

The Longest Lever:

**Is AI the Most
Transformative
Technology?**



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The Longest Lever: Is AI the Most Transformative Technology?

Moving from mystery to mastery
in an AI-powered world



*“Give me a lever long
enough and a fulcrum on
which to place it, and I shall
move the world.”*

Archimedes



AI is the Future

AI is a revolution.

AI is a threat to our jobs.

AI will boost the global economy.

AI will change the world.

All of these axioms are true.

There is a tremendous amount of excitement, debate, and hype around AI, and for good reason. When innovative minds like Stephen Hawking, Elon Musk, Ray Kurzweil, Bill Gates, and Mark Zuckerberg weigh in with strong opinions about any technology, people are bound to listen—and talk about it in the media.

So how much of AI and related technologies like machine learning (ML) and deep learning

(DL) is truly transformative, and how much is hype? As Neil Jacobstein, Singularity University Artificial Intelligence and Robotics Chair, put it: AI is not just a game-changer; it will disrupt the entire playing field.



And though it seems that every technological advance now arrives with a generous helping of hype, AI could be the rare case of an exponential technology that has the power to change the world well beyond what we can currently imagine.



“AI is perhaps the granddaddy of all exponential technologies. Surely to transform the world and the human race in ways that we can barely wrap our heads around.”

Jason Silva

Then and now: AI’s visions past are here at last (and improving fast)

While the adoption of AI has exploded across a wide range of domains over the past few years, the discipline is not new. The term Artificial Intelligence was coined in a proposal to raise funds for a 1956 conference at Dartmouth College to discuss the emerging field of “thinking machines.”

For many years, ever since that first AI gathering, researchers have explored the possibility and potential of using computers to perform cognitive tasks that once were thought to be reserved for humans. The goal of many AI researchers has been to create programs that could perform tasks most people would consider “intelligent.” Or, put another way, if an AI program could replicate the behavior of an intelligent human, that program could also be considered intelligent.



One example, in the area of conversation, is the Turing Test, named after famed mathematician and computer pioneer Alan Turing. He proposed that if a computer program could fool a set of human judges into thinking it was human, then that program

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must be intelligent. But no early AI chat programs were considered to be capable of authentic human-level dialogue. They were judged to be nothing more than a novelty—usually confined to one topic of conversation, and able to converse only a short while before their “non-humanness” was detected.

Another well-known example involves the game of chess. In the early days of AI, the consensus amongst most people (AI researchers or not) was that no chess program could ever defeat a human chess master. And for the first few decades of AI history, those naysayers were right. In both conversation and chess, two domains of human endeavor where intelligence was considered a key element, AI programs were deemed to be novices rather than experts.



But these programs kept getting better, year after year, as new AI techniques were either invented or adapted from other fields (such as mathematics or genetics). Today, the best chess programs, trained using advanced AI techniques, cannot be beaten by any human alive—and several chatbots have either passed the Turing Test (according to their



creators) or come extremely close. (Note that there is still some debate in this area—unlike in chess, Go, and other domains, where AI programs are unquestionably superior to humans.)

While the early decades of AI were marked by several up and down periods (including “AI winters” where investment waned due to dashed expectations), today’s trend is now firmly and unquestionably up. The brittleness of many early AI programs has been replaced by robust, human-surpassing abilities. Time and time again, we have seen the improvement pattern witnessed in the chess domain repeated across numerous fields: (1) early AI programs perform well in limited cases but are brittle and not up to human level; (2) the programs keep improving as AI techniques improve; (3) AI programs eventually become the best in the field, often outperforming their human counterparts.

In the six decades since its first conference, AI has progressed from novelty to novel solutions to hard problems. And the main reason AI is finally blossoming into its full potential—the key to its success—is that AI keeps improving, and improving at an ever-faster pace.

And there’s no end in sight.

Why AI? Why now?



“AI is here today; it’s not just the future of technology. It’s embedded in the fabric of your everyday life.”

Neil Jacobstein

Singularity University Chair, AI and Robotics

While many people rightly focus on the promise of AI for the future of mankind, the reality is that AI is already here, today, achieving successful results and affecting people across the globe. Recently, AI, machine learning, and deep learning applications have gained widespread attention in the media as they have begun to transform the face of major industries, including healthcare, finance, manufacturing, retail, education, and entertainment.

But why now? Why does it feel to the average citizen like AI has suddenly “come out of nowhere” to dominate field after field? If repeated improvement is

the key to AI’s success, why are so many developments happening now, and at such an accelerating rate?

Although the possibility of an AI-powered world has been explored since the 1950s, such a vision was not practical with the technology of the day. But in recent years, several trends have converged to put AI development and adoption on the fast track:

- The cost of computer processing power has fallen dramatically, and a new generation of even more powerful chips is on the way.
- The cost of cloud access, data storage, and processing has also fallen, as the availability of data has soared.
- Neuroscience and computer science are complementary fields that have grown in parallel, and in recent years, AI advances have often been informed by our dramatically improved understanding of the human brain.

It may seem remarkable how quickly AI and related technologies are changing the way we live our professional and personal lives. But as our skills in learning and applying AI grow and enable us to build more (and more powerful) applications, that rate of change will only accelerate.



We have (exponential) lift-off

The point at which an exponential trend becomes noticeable is sometimes called the “Knee of the Curve,” and that’s where AI is now. Today’s explosion of interest and investment in AI applications seems to point to that period of rapidly accelerating growth.

While AI’s recent triumphs in a variety of different fields have been impressive, they will almost certainly pale in comparison to what is coming in the future, as new AI breakthroughs are likely to arrive even faster and be more disruptive than we imagine. Humans are famously bad at predicting the future of technologies, according to Dr. Peter H. Diamandis, Co-founder and Chairman of Singularity University. He says that we tend to overestimate technology’s abilities in the near-term, and massively underestimate what it can do in the long term. If that rule of thumb holds true with AI, we are all in for an exciting ride in the next few years.



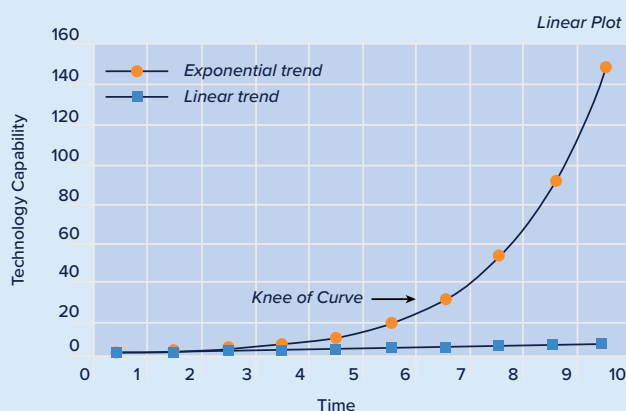
Show me the money: the potential economic impact of AI

*With automation, there will come abundance.
Almost everything will get very cheap.*

Elon Musk

It’s clear that these large organizations are not just talking—they are investing heavily in AI and related technologies to power their future.

Linear vs. Exponential Growth



“By 2020, machine learning/AI will move forward 10x.”

Peter H. Diamandis, MD

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Here are just a few of the AI-driven economic changes we can expect to see in the years ahead:

The AI market, valued at \$16.06 billion in 2017, is expected to grow to \$190.61 billion by 2025, at a compound annual growth rate of 36.62%.

[source](#)

By 2030, global GDP could rise as much as 14% thanks to AI, equivalent to injecting another \$15.7 trillion into the world economy. North America and China should experience the most significant economic gains due to AI (China: up to 26% potential GDP boost by 2030; North America: possible 14% GDP boost).

[source](#)

Mind-bending spending trend: IDC projects considerable growth in AI/ML spending, from \$12 billion (2017) to \$57.6 billion (2021)—nearly a fivefold increase.

[source](#)

According to Forrester, companies using AI, big data, and IoT to discover new advantageous business insights “will steal \$1.2 trillion per annum from their less-informed peers by 2020.”

[source](#)

AI could double annual economic growth rates by 2035.

[source](#)

AI has the potential to boost rates of profitability by an average of 38% and could lead to an economic boost of \$14 trillion by 2035.

[source](#)



“I set a date for the Singularity—representing a profound and disruptive transformation in human capability—as 2045.”

Dr. Ray Kurzweil

*Co-Founder and Chancellor,
Singularity University*

Imagining the AI Future

Exponential technologies are those which are rapidly accelerating and shaping major industries and all aspects of our lives. They include augmented reality (AR), virtual reality (VR), data science, digital biology and biotech, medicine, nanotech and digital fabrication, networks and computing systems, robotics, and robocars.

So what’s so special about AI? There are several reasons why AI is a topic that seems to fuel popular imagination and passionate debate that reaches far beyond the technical arena.

AI-powered robots: from helpful to homicidal

Portrayals of robots in popular culture usually show self-aware machines with capabilities that rival or exceed their human counterparts. And when one considers what a vast increase in intelligence might eventually entail, two scenarios typically come to mind: increased empathy or unstoppable evil. Thus, we have seen both of these qualities depicted in numerous examples of the “super-intelligent machine.”

A wide range of robots, from helpful (Star Wars) to homicidal (Terminator), provides a number of scenarios for us to ponder in considering the future of AI. Killer robots have become familiar sci-fi movie tropes, but they echo real fears that AI poses a threat to our livelihoods and safety. And when someone of Elon Musk’s stature tweets that “with artificial intelligence, we are summoning the demon,” people pay attention.



AI awareness and acceptance: rapid changes in our home and work lives

Helpful and entertaining applications of AI, such as Siri, Cortana, and Alexa, have quickly found wide consumer acceptance. At the same time, AI-powered machines that have very publicly outperformed humans in *Jeopardy!*, chess, and Go have provided

what some consider to be a troubling view of the AI revolution.

What these examples have in common is that they are changing the public’s perception of AI, even if it’s just their awareness of it. AI used to be confined to the ivory towers of research labs. Now, more people know about AI and have witnessed its many capabilities firsthand—whether it is performed by a device in their pocket, or by a machine on TV displaying feats of previously-unimagined smarts.

In short, AI awareness, acceptance, and debate is at an all-time high. And that’s a good thing.

The Singularity is nearing: AI building AI

Question: what is the slowest step (or weakest link) in the task of building AI systems? If you answered, “the human who is building the AI,” you might be right.

One of the most significant steps in AI’s evolution will come when **AI begins building better versions of itself**. It makes logical sense: if AI is about mastering a difficult task that is typically performed by intelligent humans, what better example of such a task than building AI systems?

Once perfected, “AI built by AI” should be a more efficient process, resulting in ever faster and smarter programs. And there is another upside: automating the development of new AI programs is one strategy companies might use to deal with the current shortage of AI designers, programmers, and engineers.

Expert Views of the AI Future: Utopian, Dystopian, and Irreverent

First, no one is going to accidentally build a robot that wants to rule the world ... Creating a robot that can suddenly take over is like someone accidentally building a 747 jetliner.

Michio Kaku

Success in creating AI would be the biggest event in human history. Unfortunately, it might also be the last unless we learn how to avoid the risks.

Stephen Hawking



Artificial intelligence will reach human levels by around 2029. Follow that out further to, say, 2045; we will have multiplied the intelligence, the human biological machine intelligence of our civilization a billion-fold.

Ray Kurzweil

In the future, artificial intelligence is going to feel less artificial and more intelligent.

Dharmesh Shah

There is just a huge amount of unwarranted hype around AI right now. I am definitely not worried about the AI apocalypse.

Google AI chief John Giannandrea

The development of full artificial intelligence could spell the end of the human race.

Stephen Hawking

I definitely fall into the camp of thinking of AI as augmenting human capability and capacity.

Satya Nadella

AI will probably most likely lead to the end of the world, but in the meantime, there will be some great companies.

Sam Altman

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I believe this artificial intelligence is going to be our partner. If we misuse it, it will be a risk. If we use it right, it can be our partner.

Masayoshi Son

By far, the greatest danger of artificial intelligence is that people conclude too early that they understand it.

Eliezer Yudkowsky



If you could train an AI to be a Buddhist, it would probably be pretty good.

Reid Hoffman

People are spending way too much time thinking about climate change, way too little thinking about AI.

Peter Thiel

Over the next 20 years, AI will help drive massive financial expansion (through solving myriad societal problems) rather than presaging the end of the middle class.

Malcolm Frank

It's not artificial intelligence I'm worried about; it's human stupidity.

Neil Jacobstein

A survey of 1,000 organizations that have deployed AI-based systems shows that they have created more new jobs, not fewer. Additionally, two-thirds of survey respondents said there has been no reduction in overall jobs due to AI.

CapGemini

AI Will Put 10 Million Jobs At High Risk—More Than Were Eliminated By The Great Recession

CB Insights

AI, Machine Learning, and Deep Learning

Understanding how machines learn also gives insight into how humans learn since we are basically just biological machines.

Mark Jackson

Singularity University

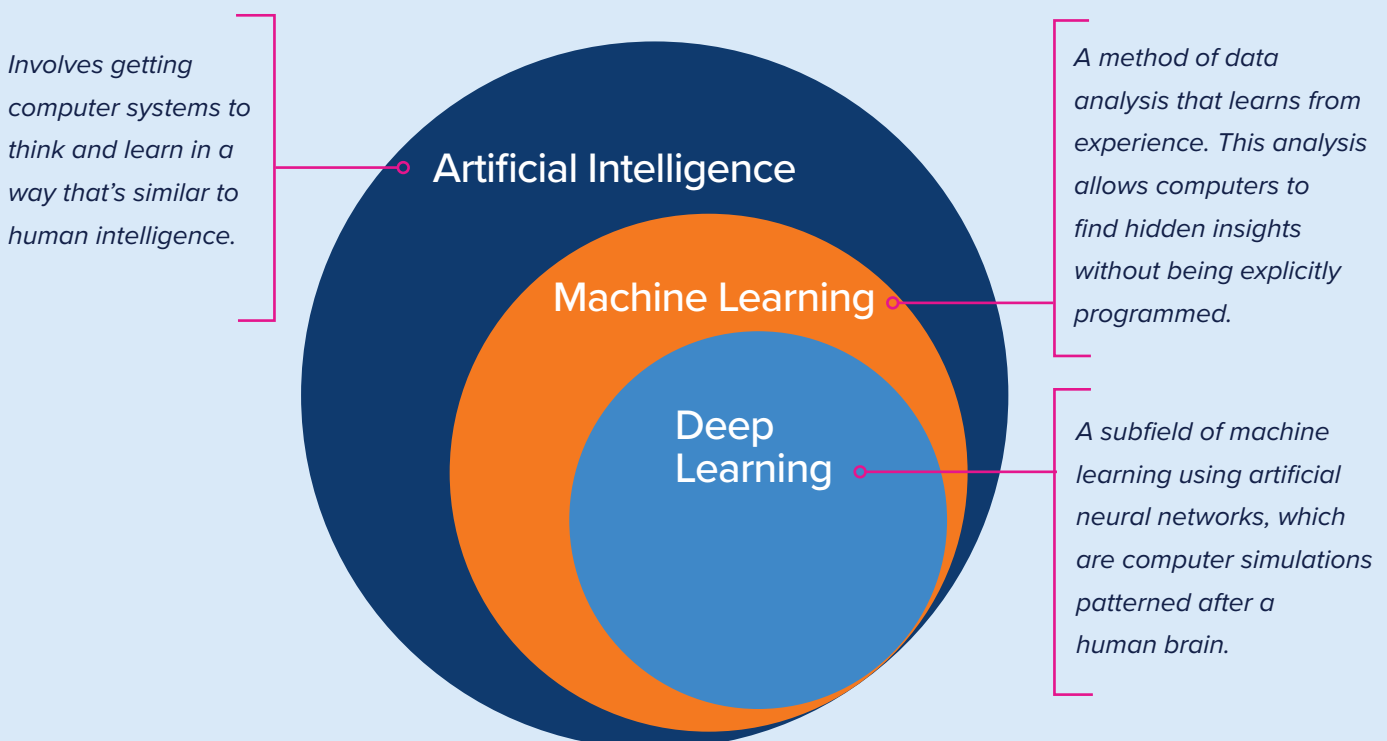
Artificial Intelligence (AI) is an “umbrella term” for a broad field of sciences involved in developing computer systems that think and learn in a way that’s similar to human intelligence.

AI applications are often divided into two groups: Narrow AI (or Weak AI)—applications that perform specific tasks such as playing chess, and General AI (also known as

Strong AI, Artificial General Intelligence, or AGI)—programs that can achieve more generalized goals or handle a variety of tasks that cut across multiple domains, such as understanding language, context, and emotions as humans do.

Machine Learning (ML) is a method of data analysis that learns from experience, enabling computers to find hidden insights without being explicitly programmed. ML programs analyze data and learn from it to make decisions and predictions, and includes both supervised (manual entry of data and solutions) and unsupervised learning.

Deep Learning (DL) is a subfield of machine learning that uses artificial neural networks, which are computer simulations patterned after a human brain.



The World's Leading Companies Lead with AI


Just a few years ago, AI wasn't on the radar screen for most enterprise companies. Today, marquee brands such as Amazon, Apple, Facebook, GE, IBM, Microsoft, and Sony are building their futures on a foundation of AI talent and culture. Google, in particular, declared its intention in May 2017 to switch from a "mobile-first" strategy to follow an "AI-first" strategy. The company aims to shift its focus from "searching and organizing the world's information to AI and machine learning," according to Google CEO Sundar Pichai.

Just as Bill Gates famously transformed Microsoft in 1995 to take advantage of what he termed the "Internet tidal wave," many of today's most innovative companies are now gearing up to surf the tidal wave of AI. Examples of how organizations can put AI work to drive added value are listed in the graphic below.

And it's not just industry giants who seek to become players in the AI space. In October 2017, there were 3,488 AI startups listed on AngelList, along with 2,559 investors and 2,238 jobs. As of October 2019, those AngelList numbers have grown to 7,144 AI startups, 2,884 AI angel investors, and 4,364 startup jobs in AI.

As shown by the infographic on page 14, AI startups are emerging to challenge established players in a wide range of fields, including:

- Business Intelligence
- Productivity
- Customer Relationship Management
- Human Resources
- Sales and Marketing
- Finance
- Operations
- Digital Commerce
- Data Science
- Engineering
- Security and Risk
- Manufacturing



Expanding the range of the possible: AI's added value

- Augments human skills
- Improves prediction accuracy
- Accelerates process timing
- Solves complex problems quickly
- Improves product and service quality
- Increases productivity
- Decreases total product and service costs
- Manages corporate task and domain knowledge

SOURCE: NEIL JACOBSTEIN

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AI startups are emerging to challenge established players in a wide range of fields.

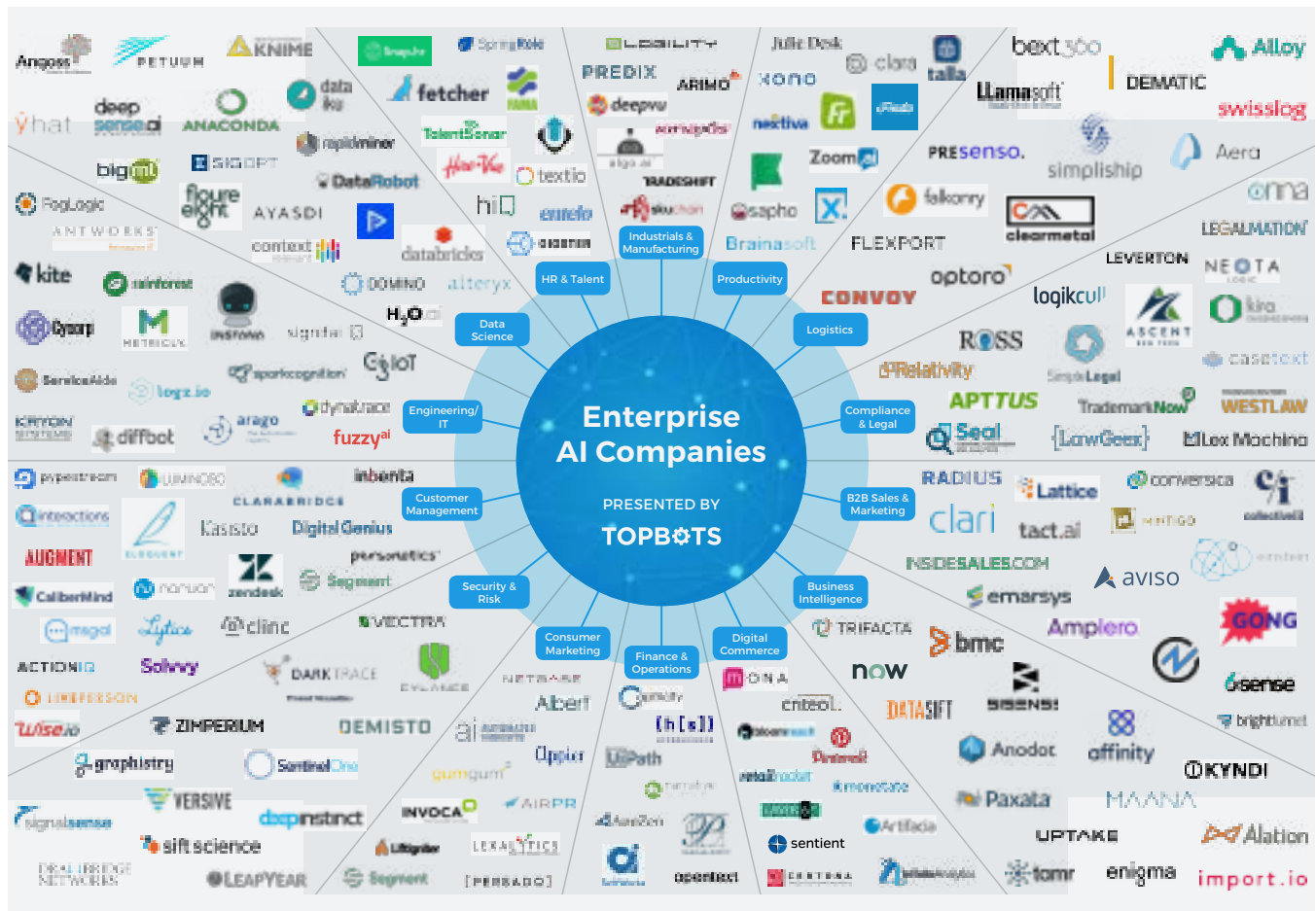


IMAGE CREDIT: TOPBOTS.COM

Amplifying and Augmenting Human Intelligence

We're rapidly heading towards what I call a "Meta-Intelligence," a future in which we are all highly connected—brain-to-brain via the cloud—sharing thoughts, knowledge, and actions.

Peter H. Diamandis, MD

Executive Founder and Director,
Singularity University

Perhaps the most transformative aspect of AI is its promise to usher in an entirely new relationship between humans and machines. In movies, a high-stakes human-vs-robot struggle for power and survival is great for dramatic tension. But the reality may be a little more nuanced as humans evolve alongside robots—and particularly as humans and robots merge.

Cyborgs—human beings whose bodies are enhanced with artificial parts such as robotic limbs, wearable hardware, or implantable devices—have been standard fare in sci-fi

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and fantasy for years. And though **Blade Runner-style cyborgs** won't be here soon, humans who are enhanced or augmented by computer implants or mechanical devices are becoming increasingly common.



Diamandis says that today's extraordinary rate of exponential growth may do much more than disrupt industries. It may give birth to a new species, reinventing humanity over the next 30 years.

It may sound far out, but Diamandis is not the only one thinking along the lines of amplifying and augmenting human intelligence with AI. Tesla and SpaceX founder Elon Musk recently announced he is backing a new venture called Neuralink, which also aims to redefine the future of humanity. Neuralink reportedly seeks to link the human brain with cloud computing by creating micro-devices that can be surgically implanted into the brain. In addition to helping people with brain injuries and diseases, this technology might also be used in the future to deliver extra cognitive capabilities to help humans keep pace with rapidly evolving AI.

But wait ... there's swarm.

A company called UNANIMOUS A.I. has launched what it calls Swarm Artificial Intelligence. This software platform is designed to amplify human intelligence, empowering groups to harness their collective knowledge, wisdom, and intuition. The system is designed to improve the predictive power and decision-making skills of groups, and it has enabled ordinary fans to predict the outcomes of events ranging from the World Series to the Academy Awards to the Kentucky Derby—all with astonishing accuracy. Swarm AI offers humans an opportunity to amplify their collective intelligence, not replace it—and it may be the key to keeping humanity human, says Louis Rosenberg, the company's founder and CEO. (Assuming, of course, that people swarm up to the idea.)

From mystery to mastery

As transformational technologies like AI cut a wide swath of disruption across every industry, business leaders face extraordinary pressures to grow today's business while simultaneously taking steps to ensure future success. Imagine:

- Seeing how exponential technologies, digital trends, new business models, and unpredictable consumers will impact your industry
- Knowing which business you should be in over the next five, ten, or twenty years
- Understanding the leadership skills necessary to drive massive positive change
- Understanding what to do today to evolve your strategy and adapt your organization to prevent disruption and ensure success.

Enter Singularity University

At Singularity University, we're laying the groundwork for exponential change.

With our learning and innovation platform, proven tools and methods, and global network of world-class Faculty and experts, Singularity University helps transform companies of all sizes into nimble organizations that can get out in front of market disruptions and achieve exceptional business results.

To learn more about how Singularity University can help your company and leadership team be exponential, explore our suite of powerful enterprise solutions at su.org/enterprise designed to uplevel your leadership, innovation, and strategy. Learn how we can help you see the future more clearly to uncover and respond to new opportunities and empower your leaders to thrive amid uncertainty and disruption.

Our enterprise solutions can help you advance your innovation capabilities from any starting point. If you and your core leadership team want to learn how exponential technologies and an exponential mindset can help transform your organization, apply to our popular **Executive Program**. Our **Exponential Innovation Program** will help you map out a successful innovation journey using the latest innovation tools and methodologies and organizational models. And our **Online Courses** (also available for organizations) will help you see beyond disruption to opportunity, adopt a mindset for a better future, and learn to design for scalable impact.