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Artificial Intelligence
Maximizing the Benefits

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Contents

Software advances have turned everyday things into things with extraordinary capabilities — from smart phones, to smart watches, to smart TVs, and even smart cars. Systems have learned to recognize patterns in data, make predictions based on these patterns, and use those predictions to help see and do things better. These technologies simplify daily lives and boost the ability to solve complex problems. This tremendous effect is driven by growth in the availability of massive datasets and computing power that make technologies increasingly beneficial and enable what is known as artificial intelligence (AI).

It began in the 1940s when Alan Turing made a name for himself in the field. Turing was a codebreaker during the Second World War in the UK's Bletchley Park, where he designed the Bombe machine. The Bombe machine was meant to decrypt German war messaging.[1] At Bletchley Park, Turing found the resources and enthusiasm to create a machine that could do what the human decoders were doing, but faster and more efficiently. Alan Turing's groundbreaking research and inventions laid the foundations for the field. The progress of computing power goes hand in hand with the development of artificial intelligence. Turing's Imitation Game, also known as the Turing Test, is a well-known challenge that poses a set of questions that attempts to distinguish between a human and a computer.

Turing introduced the challenge in his famous work, "Computing Machinery and Intelligence."[2]

Five decades later, IBM's Deep Blue computer used AI to beat chess grandmaster Garry Kasparov, a symbolically significant demonstration that machines were gaining ground on human intelligence. Since then, key advances have been made in developing a range of AI-based systems to serve as powerful tools of analysis and performance. AI-based technologies have become widespread, intuitive, and integral for business and consumers alike. Today's AI applications are the result of an increase in volume, variety, and velocity of data; the sophistication of algorithms that turn the data into a real-world application; and the advancements in the seamlessness of storing, accessing, and using data.

AI brings about a wealth of opportunities, and policymakers should take steps now to overcome obstacles and accelerate the benefits the technology can have on economic expansion and society. How quickly we reap these benefits, how broadly these positive effects can spread, and the direction AI takes will be shaped by leaders from government, academia, industry, and the public who all have a key stake in shaping the future of AI. These groups must come together to listen, learn, and think about their vital roles in advancing practices that empower AI to deliver its greatest positive potential. It will remain crucial to promote the responsible development and use of AI, engendering the trust necessary for adoption of a new technology and ensuring that society is prepared for the workplace of the future.

AI is giving medical science a new shot in the arm to help humans live longer, healthier lives. A new generation of AI-based tools is responsible for helping humans fly airplanes safer, identify cancers in X-rays faster, predict the weather more accurately, and navigate across town more swiftly.

This paper outlines examples of how AI-based systems are driving incredible economic progress around the world. It describes what AI is, how it works, and discusses the fundamental benefits brought on by AI. This paper also explores how advancing AI will require smarter policies to address emerging challenges.

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Artificial Intelligence:
What It Is and How It Works

AI researchers and practitioners have yet to agree on an exact taxonomy and semantics for artificial intelligence and associated technologies. AI is an umbrella term used to identify computerized systems exhibiting an unprecedented ability to accomplish rational and complex tasks.[3] The implementations of AI vary greatly, hence the difficulty of categorizing its uses and applications. AI encompasses systems with the ability to discover, process, analyze, create, and interpret data patterns from which results or decisions derive. Algorithmic models, natural language processing, deep learning, cognitive computing, machine learning models, and neural networks fall under the AI umbrella.

AI is enabling technologies to sense, remember, learn, predict, and act. Although some may think it automatically implies human-level intelligence, it more accurately implies an advanced set of tools and resources that provide more accurate answers and deliver more relevant information by augmenting and extending human potential.

Much of today's technology is geared toward enabling intelligent task-specific AI also known as narrow AI. Narrow AI refers to any system that is designed for a specific or narrow set of tasks — like playing chess or translating languages. These narrow intelligence systems do not typically have any capabilities beyond their targeted focus. For example, a computer that can drive a car is unable to screen an MRI for cancer.

There is a notable distinction between narrow AI and what is known as Artificial General Intelligence (AGI). AGI is not well-defined but refers to the idea of a future kind of AI that is able to transfer its capabilities in one domain to other domains.[4] While researchers continuously work on making computers smarter, many experts predict that AGI could be years from becoming a reality.[5]

In Healthcare, AI Is:

Speeding up the drug discovery process[a]

Enabling doctors to predict heart attacks more accurately[b]

Identifying lung cancer signals in tissue slides more accurately[c]

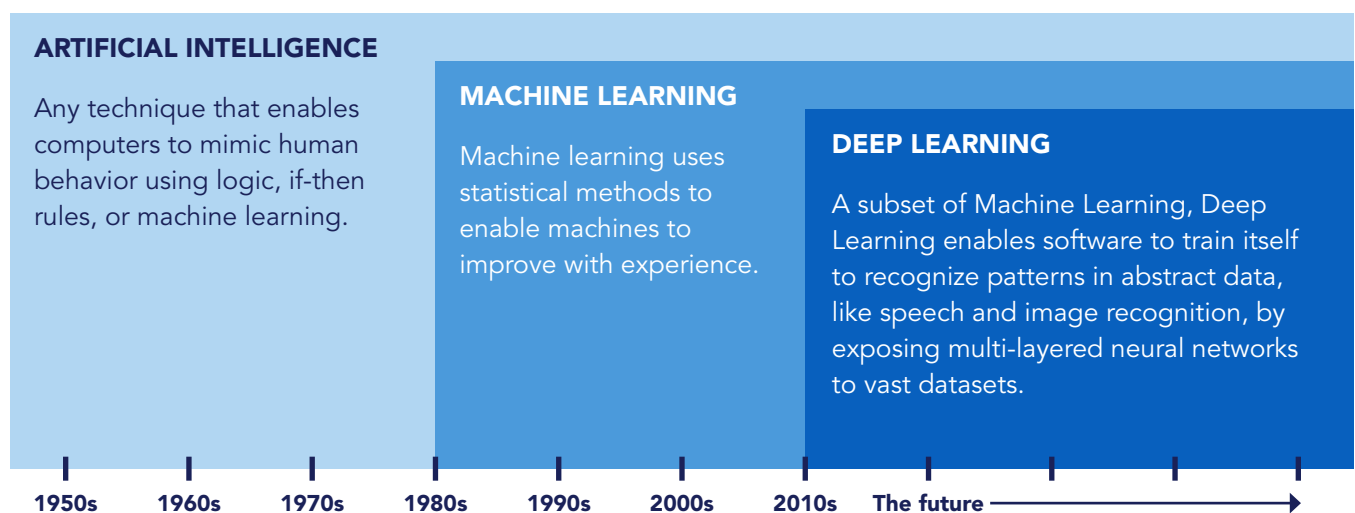Identifying autism in babies earlier and with greater accuracy[d]

Analyzing DNA to predict and diagnose genetic diseases[e]

Technical Approaches in Artificial Intelligence

Since the start of research on AI, numerous breakthroughs have unlocked successively bigger opportunities to solve problems. Algorithms are the recipes or commands that have propelled these opportunities. An **algorithm** is a set of sequential steps and directions that turn data inputs, referred to as "training data," into desired outputs.[6] In computer science, algorithmic approaches are used to arrive at results faster and more efficiently.

Algorithms are informed by the developers' choice in data sets, general knowledge, perception, and end goal. Algorithms are trained to derive certain results or achieve certain tasks, and in turn they vary in complexity. Some algorithms become more complex on their own when they "learn." Learning algorithms learn from the datasets and instructions to recognize patterns. Learning allows algorithms to optimize results and delivery.[7]

Figure 1: Timeline of AI Development

ARTIFICIAL INTELLIGENCE

Any technique that enables computers to mimic human behavior using logic, if-then rules, or machine learning.

MACHINE LEARNING

Machine learning uses statistical methods to enable machines to improve with experience.

DEEP LEARNING

A subset of Machine Learning, Deep Learning enables software to train itself to recognize patterns in abstract data, like speech and image recognition, by exposing multi-layered neural networks to vast datasets.

1950s 1960s 1970s 1980s 1990s 2000s 2010s The future →

Since the early 1950s, subsequent breakthroughs in artificial intelligence have created new subsets — machine learning and deep learning — that have in turn helped unlock even larger opportunities to solve bigger problems.

In Agriculture, AI Is:

Making farmers more productive[f]

Creating smarter tractors[g]

Allowing crop yields to be more predictable[h]

Killing weeds more accurately[i]

Making weather more predictable[j]

Many algorithms are considered company trade secrets because they are indeed the "secret sauce" behind the world's most useful services and products. Sophisticated algorithms, datasets that have grown in volume, velocity, and veracity, and the optimization of information processing have enabled the integration of AI into useful technologies and applications (see Figure 1).

Machine Learning

Machine learning involves systems that learn by taking advantage of statistical methods that allow improvement with experience. These systems are "trained," often with human input using large amounts of data. Machine learning models rely on algorithms in order to learn how to respond to a given set of data. Over time these systems develop a model based on past patterns in data that informs how they make predictions when fed new datasets (see Figure 2).

To train a computer to become a master chess player, a computer might start with a massive training database of all possible moves in all possible chess games. It then assigns each sequence of moves in a game a value of win or lose. By evaluating millions of these games and identifying the moves that most

Figure 2: How Machine Learning Validates Predictions

5
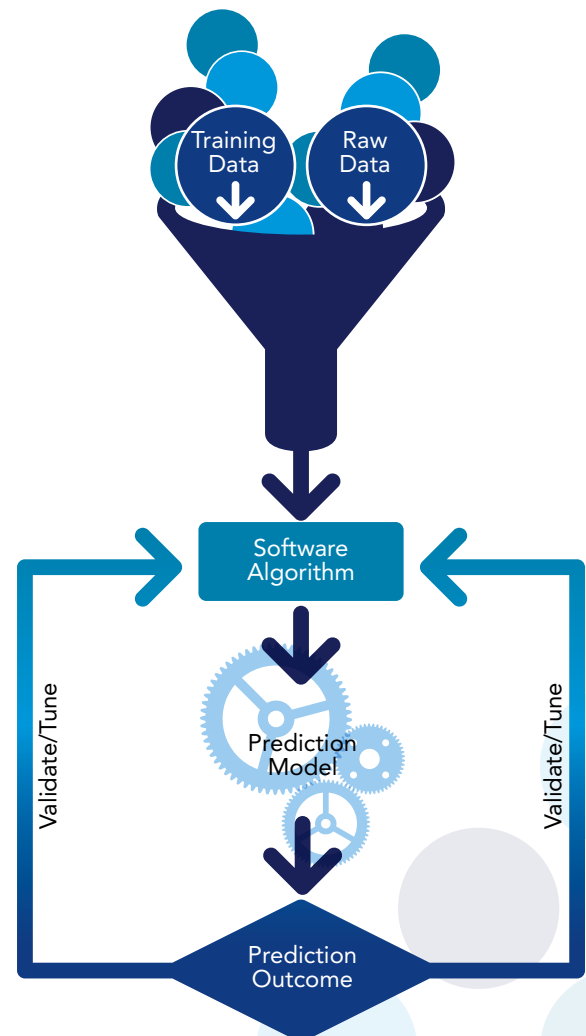
AI IN ACTION

In Finance, AI Is:

Preventing billions in credit card fraud by predicting fraudulent transactions[k]

Making deposits easier by merely taking a picture of a check[l]

Detecting and fighting financial fraud[m]

Helping retailers keep track of their inventory[n]

Speeding up insurance claim processing[o]

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frequently lead to a win, it can statistically predict which moves are the most likely to lead to a win. This ability to use machine learning to predict outcomes based on training data has proved to be especially helpful in areas like detecting credit card fraud or predicting the new products and services consumers might like.

Deep Learning

As AI researchers sought better ways to help computers learn how to perform targeted tasks, they developed what is called deep network learning — which has proved to be especially capable at learning to perform even more complex tasks like image and voice recognition. Deep learning systems take advantage of huge data sets, like a large collection of photos, and run them through a multi-level web of artificial neurons called a "neural network" because it emulates the way neurons in our brain work. It is called "deep" because these systems break down the problem into many neuron-sized chunks, and automatically generate multiple layers of abstractions of the data to identify patterns (see Figure 3).

For example, the first layer in a neural network might classify individual pixels in a picture, then layer by layer it works to identify edges, contours, features, and then combinations of features. Each time the set of data that is being used to train the system is run through the neurons, they pick up new details about the photos, until after many successive cycles, they have learned a great deal about them. Ultimately the system can make a prediction of how likely a picture might be to contain, for example, a cat. For targeted tasks, like face recognition, neural networks have shown they can achieve greater than 99 percent accuracy at distinguishing one person from another.[8] The more data of the same type there is, the better the accuracy of the output.

Automation

Automation enables systems, processes, and tools to operate automatically or with minimum human intervention.[9] Most of the AI-based systems deployed today can accomplish these functions by aggregating and analyzing data to streamline decisions and processes.

In Cybersecurity, AI Is:
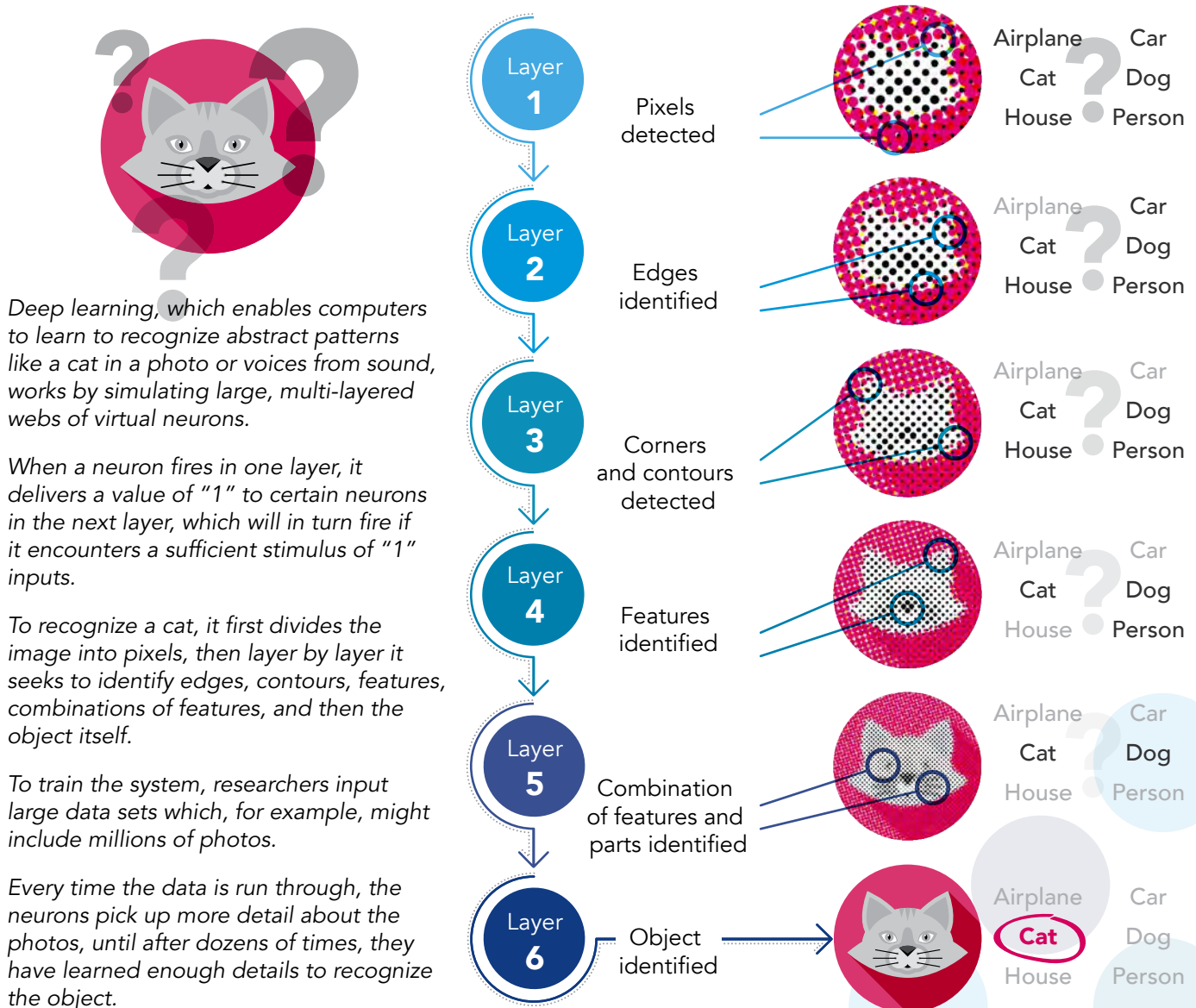
Improving cyber threat detection[p]

Warding off hackers[q]

Automating cyber defenses[r]

Analyzing malicious behavior patterns[s]

Detecting malware in real-time[t]

Figure 3: How Deep Neural Networks Make Decisions From Experience

Deep learning, which enables computers to learn to recognize abstract patterns like a cat in a photo or voices from sound, works by simulating large, multi-layered webs of virtual neurons.

When a neuron fires in one layer, it delivers a value of "1" to certain neurons in the next layer, which will in turn fire if it encounters a sufficient stimulus of "1" inputs.

To recognize a cat, it first divides the image into pixels, then layer by layer it seeks to identify edges, contours, features, combinations of features, and then the object itself.

To train the system, researchers input large data sets which, for example, might include millions of photos.

Every time the data is run through, the neurons pick up more detail about the photos, until after dozens of times, they have learned enough details to recognize the object.

Layer 1 — Pixels detected

Layer 2 — Edges identified

Layer 3 — Corners and contours detected

Layer 4 — Features identified

Layer 5 — Combination of features and parts identified

Layer 6 — Object identified

Airplane Car Cat Dog House Person

Cat

7

In Transportation, AI Is:

Creating smarter traffic lights that reduce time at red lights by 40 percent[u]

Using autonomous boats to monitor fish stock and gather environmental data[v]

Cutting train delays[w]

Enabling smarter ridesharing to reduce congestion[x]

Making air travel safer[y]

AI Solutions for Business: Case Studies

AI-based tools and technologies are enabling business processes that are faster, seamless, and more efficient. The number of business applications AI-based tools enable is unprecedented. Each year, more and more business sectors continue to reap the benefits of these technologies. Below are a few use cases of business solutions powered by AI.

Content Marketing

Using data insights to personalize content and tailor it to the needs of specific audiences has become an easier process with the integration of AI. AI uses aggregate data points to design and develop content that is unique and relevant. Leveraging the full power of AI has enabled businesses to market their content more strategically. Adobe is an AI solution provider that integrates data science and algorithmic optimization capabilities into its Marketing Cloud and personalization engine, Adobe Target.[10]

Adobe's AI platform, Adobe Sensei, powers this capability by allowing customers to insert their own data models into Adobe Target and receive recommendations and automated deliveries of personalized suggestions. The platform enables businesses to use the new-found insight to determine the best experience for consumers, predict products or services consumers might seek next, and target their advertising in a more precise manner.

Banking

Banking is an industry that consistently uses AI's assistive traits to enhance customer experience and protection of assets. Banks leverage AI-based tools to create and deliver more efficient processes and services. AI can be used to monitor global activity and link malicious actors that banking institutions may have in common. This helps banks reduce false positives in sanction-screening.

AI can also help predict credit risk, monitor for online fraud, and forecast economic occurrences that can affect consumers and business. AI business solution provider, Microsoft Azure Machine Learning (AzureML), for example, developed an online fraud detection model to help identify and address fraud early on. The company also developed a forecasting model using a linear regression algorithm to create a predictive model of Microsoft stock (MSFT).[11]

In Energy, AI Is:

Enabling smarter thermostats that save energy[z]

Advancing ultra-accurate demand prediction that helps us better manage the grid[aa]

Reducing energy and improving the environment[bb]

Transforming the electric grid to reduce energy and improve the environment[cc]

Improving solar energy forecasts by 30 percent to improve our ability to use renewable energy[dd]

Manufacturing

Manufacturing is one of the most common displays of how AI and automation can improve operations and expand creation. Manufacturing and industrial operations rely on several applications of AI, including automation, neural networks, and machine learning. Siemens PLM is an example of a company that is harnessing AI to connect industrial facilities while leveraging the power of automation, Internet of Things (IoT), and analytics.[12]

With its industrial operating system, Mindsphere, Siemens PLM enables applications that develop data analytics and insights on product performance. Cloud-based applications on MindSphere like Product Intelligence, allow users to get unified and comprehensive data insights on product and supply chain performance. Additionally, Siemens PLM integrates predictive analytics in its industrial operating system to identify any anomalies in facilities or automation systems.

Health

The healthcare industry is one where the benefits of AI-enabled technologies can have an incredibly profound effect. From healthcare providers to patients to organizational management, the list of AI-powered solutions in healthcare is always growing. One pioneer in the field of offering AI solutions in healthcare is IBM and its Watson Health solutions.[13]

To help doctors, IBM Watson Health has created IBM Watson for Genomics, a system that interprets genetic test results faster and more accurately. Watson for Genomics uses analytics to research data and existing medical research and find content relevant to specific genomic sequences. For healthcare teams, IBM Watson Care Manager uses analytics to consolidate data, connect stakeholders, and automate management workflows.[14]

Human Capital Management

AI applications in the realm of business operations and employee management have streamlined existing processes and provided employers with a better grasp of employee experience. Workday is one example of a financial and human capital management company that has been infusing its services with AI to help businesses succeed.

Workday describes a framework for their customers to navigate various AI applications.[15] The company leverages automated and natural language processing technologies to enhance employer-employee communication and handle repetitive menial tasks. Other AI applications in this realm include incorporating intelligent predictions to inform decision-making and developing personalized recommendations for professional development and performance.

AI IN ACTION

In Entertainment, AI Is:

Generating special effects that make movies more exciting, lovable, and believable[ee]

Enabling online streaming services to recommend movies you will enjoy[ff]

Creating entirely new forms of art[gg]

Transforming memories into art by giving a photo an artistic look[hh]

Transforming heavily pixelated or blurry photos into a clear image[ii]

Design and Engineering

In the field of design, AI is making groundbreaking contributions to the practice of generative design. Generative design aims to replicate the natural process of design by allowing designers to input design parameters into a generative design system.[16] The system leverages sophisticated algorithms and cloud computing power to deliver numerous design options. This approach saves time and resources, boosts creativity, and leads to novel geometry and fabrication.

Autodesk, a design and engineering software company, provides AI-powered generative design software for its customers.[17] Airbus used Autodesk generative design software to create a new cabin partition that is stronger yet lighter than its predecessor; Hack Rod used generative design to assist in the creation of an incredible race car chassis; and Nike used Autodesk software to design shoes used by Olympic athletes.

Relationship Management

Relationship management is the lifeblood of big and small businesses across many sectors. Engaging current and potential clients to provide effective services and products has shifted from being nice-to-have to must-have. The goal of relationship management is to build strong working relationships that ensure business prosperity. A pioneer in the practice is Salesforce. The company has taken its already successful approach and infused it with AI capabilities that take relationship management to the next level.

Salesforce calls its AI platform Einstein. The platform learns from existing customer data to deliver insights, predictions, and personalized recommendations.[18] Customers of Salesforce CRM platform are unique in their needs and uses; Einstein takes this individuality to create tailored experiences. For Room & Board, a furniture retailer, Salesforce Einstein combines online reviews and sales to target highly personalized recommendations in customer emails. Room & Board reported 150 percent higher conversion rate for customers engaged with this type of predictive content.

In Education, AI Is:

Helping teachers customize instruction to every student's needs[jj]

Improving outcomes by customizing learning content to the learner[kk]

Identifying at-risk students, and boosting graduation rates[ll]

Making study time more efficient[mm]

Enabling crowdsourced tutoring[nn]

AI Industry Demand and Adoption: Facts and Figures

Although the concept of AI has been around for more than 60 years, only recently have breakthroughs allowed AI-enabled tools to become so widespread.

In business, AI-enabled systems and resources are not one-size fits all. They are customized solutions to unique sector needs and wants. From finance to transportation, the business applications of AI are wide and varied. AI-driven technologies are so popular with consumers that an estimated four billion AI enabled devices are already in consumer's hands.[19]

- By 2019, analysts predict artificial intelligence will be incorporated into 75 percent of all commercial apps,[20] and the number of devices we use that incorporate AI will grow from four to seven billion devices by 2020.[21]

- According to Gartner, by 2021, 40 percent of new enterprise applications implemented will include AI-based technologies. [22]

- A 2017 PwC report on global impact and adoption of AI found that AI is certainly increasing competitive advantage for business.

- 72 percent of business decisionmakers believe that AI will be the business advantage of the future.

- 70 percent of business executives are optimistic about AI's potential to enable proactive approaches.

- 59 percent of business executives believe AI will improve big data analytics.

In Manufacturing, AI Is:

Enabling designers to explore every possible alternative design[oo]

Enabling generative design technologies to design airplane parts that are both stronger and lighter[pp]

Detecting manufacturing defects and automating quality control[qq]

Optimizing assembly lines[rr]

Preventing breakdowns before they happen[ss]

Driving Growth in the Economy With AI

AI is one of the most dynamic technological drivers of economic growth, and could be a game-changer for the global economy.

AI Is a Trillion-Dollar Economic Accelerator

Economists predict that AI has the potential to dramatically accelerate economic growth in new and dynamic ways — doubling annual economic growth rates by 2035.[23] AI has the potential to contribute up to an additional $15.7 trillion to the global economy by 2030 (with a GDP that would be 14 percent higher) — more than the current output of China and India combined.[24] One of the keys to this growth comes from the fact that AI will help people make more efficient use of their time — boosting labor productivity by up to 40 percent. As a result, every country would benefit in huge ways (see Figure 4.)[25]

But These Economic Gains Are Not Assured

Although many are optimistic about the long-term effect of AI on the economy, some prominent economists worry that US economic opportunities could be cut short because of delayed deployment of the technology and miss out on vast economic gains caused misplaced fears about the technology. They warn that the US will need to strategically harness AI to help spur greater productivity gains and to better compete globally.[26] Recognizing AI's potential to grow economies and solve problems, other countries are already making strategic investments in AI. The benefits from future technology growth will be concentrated in the countries that lead the way in this revolution.

In Government, AI Is:

Reading handwritten addresses to route 25 billion letters faster, saving hundreds of millions of dollars[tt]

Advancing cybersecurity improvements by developing a "cyber-immune" system[uu]

Protecting wildlife from illegal poaching by outsmarting the poachers[vv]

Predicting the paths of planet-killing asteroids[ww]

Translating government documents into multiple languages for better access[xx]

Figure 4: AI Could Double Economic Growth
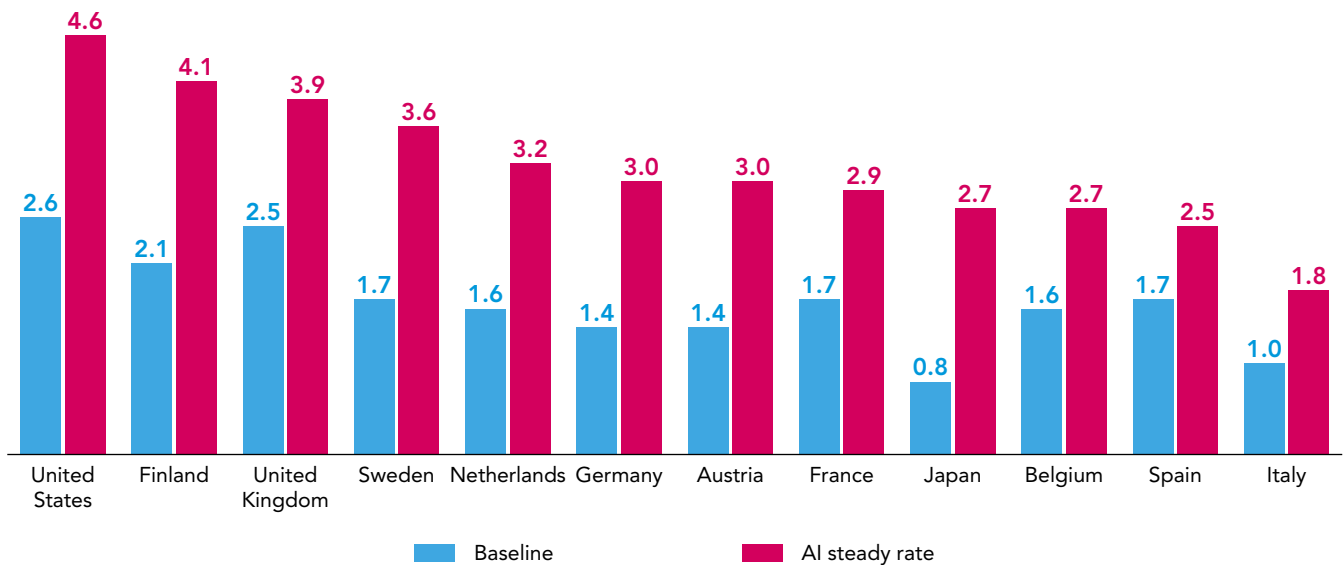
Annual growth rates in 2035 of gross value added (a close approximation of GDP), comparing baseline growth in 2035 to an artificial intelligence scenario where AI has been absorbed into the economy.

Source: Accenture and Frontier Economics

The Ethical and Legal Implications of AI

Excitement about AI has been tempered by concerns about potential downsides. Some are concerned that AI is poised to automate large classes of jobs and put huge numbers of people out of work. Others worry that if AI is used in high-stakes decision-making that biases contained deep within data sets and algorithmic models could unfairly bias the decisions with life-altering results. Some have already identified age, sex, and race biases in algorithms — for example in systems used to rank teachers, and in a gender-biased model used for natural language processing.[27] Others wonder how autonomous systems like self-driving cars would make ethical decisions and believe it is important that AI decision-making can be made transparent.

These are important questions. As AI advances, it is critically important to proactively address the influence that AI could have on people and society in both the short and long run. Through vital interdisciplinary research, it is possible to get ahead of many potential issues and to develop assessments, guidance, rules, and best practices for maximizing positive opportunities from AI. There is a broad range of important work to help AI become a tool for societal good, develop best practices, and tackle transparency and ethical issues. Some of the promising work involves principles of failsafe design, analysis of the influence of automation on the workforce, and development of ways to ensure that datasets do not amplify or encode systemic bias.[28] In addition, scientists are also advancing some promising technologies for complex systems to help advance safer and smarter systems by incorporating goals and motivations more directly from humans.[29]

There are also many efforts focused just on ways to better explain how AI may have reached a decision, including a major effort by DARPA focused solely on advancing explainable artificial intelligence.[30] These systems could help us understand why a self-driving car swerved off the road after perceiving a certain object, or to investigate if an image classification algorithm was trained to be biased.

To get at these and other issues, the Partnership on AI, a group of AI leaders and public interest advocates have come together to start the process of formulating best practices on AI technologies: to improve the public's understanding of AI; to create a dialog on the ethical, social, economic, and legal implications of AI; and to help ensure that AI technologies benefit and empower as many people as possible.[31]

Likewise, many governments also are examining these issues. For example, a federal strategy for advancing AI research in the United States is focused on answering many of these key questions — including major topics around addressing the ethical, legal, and societal implications of AI; ensuring safety and security of AI systems; and measuring and evaluating AI technologies through standards and benchmarks.[32]

As AI advances, it is critically important to proactively address the influence that AI could have on people and society in both the short and long run.

Recommendations for Continued Innovation in AI

To unlock the vast societal benefits and economic growth brought on by AI-based systems, stakeholders need to nurture future innovation by:

➲ **Addressing the ethical, social, economic, and legal implications of AI.** As the development of AI-based systems continues to grow, industry, government, and public interest leaders must continue to consider and address future ethical issues. Stakeholders must work together to advance critical solutions, engage and educate the public about the technology, and develop best practices for developers to minimize negative implications of the technology.

➲ **Accelerating the scientific breakthroughs that fuel greater opportunity.** Since its inception, public and private investment in R&D has played a vital role in fostering technological development. For example, in 2015 the federal government invested more than $1 billion into AI research.[33] R&D is not only needed to advance AI technologies and tools, but continued research is also necessary at the intersection of AI, law, policy, psychology, sociology, and ethics to better understand societal consequences of AI.

➲ **Focusing on the importance of computer science education.** AI will lead to an increase in new industries, companies, and jobs; it is also likely to require new skills and change the

industries where the jobs are located.[34] To ensure we can become a nation of learners, it is vital for policymakers to focus on advancing early child education, K–12 education, higher education, alternatives to traditional education, transitional safety net programs, and on workers whose jobs might be affected by any form of automation to help prepare them for the next set of jobs that will inevitably become available.

➲ **Closing a looming talent gap by ensuring more people can become data scientists and programmers.** There is a projected shortage of people with the skills necessary to deploy and advance AI technologies. Although demand for data scientists is growing at about 12 percent a year, by 2024 it means the US alone could be short as many as 250,000 data scientists.[35] By 2020, the US Bureau of Labor Statistics predicts that there will be 1.4 million computing jobs but just 400,000 computer science students with the skills to apply for those jobs.[36] This growing gap could impede the development of the AI applications necessary to solve some of our biggest societal challenges, and it underscores the importance of efforts to fill these well-paying jobs.

To unlock the vast societal benefits and economic growth brought on by AI-based systems, stakeholders need to nurture future innovation.

⊃ **Instilling trust in AI-based systems.** To ensure broad adoption of beneficial AI-based systems, developers, researchers, and practitioners should have privacy and security considerations as a primary consideration. Privacy and security considerations should be baked into AI tools and systems before deployment.

⊃ **Expanding accessibility and usability of large datasets.** Our ability to solve complex problems is tied to the quality and availability of relevant data. If AI is an engine for expanding societal opportunities, then data is the fuel. By increasing the availability of data, including government data, that could be used to train and test AI systems, leaders could greatly expand AI enabled solutions. Governments should take steps to make more of their own data available in machine readable formats to improve access to trainable data, while also fostering data-friendly policies that enable innovation in the way data is used.

⊃ **Promoting the adoption of cloud computing.** The cloud is essential to scale intelligent opportunities everywhere because it increases available computing power, expands the ability to work with increasingly large datasets, and enables ordinary things to gain extraordinary intelligence and makes them accessible at planetary scale. As a start, governments should encourage and enable broad cloud adoption, and then harness AI opportunities to enhance the way they deliver citizen services, improve security, and solve major societal problems. At a time when cross-border Internet traffic has been increasing by more than 50 percent since 2005,[37] enabling data to flow freely across borders has become an essential enabler for solving critical societal challenges and enabling future opportunities.

We are at the beginning of a new era in AI that is being applied in thousands of innovative ways to help us improve our lives, grow the economy, and help solve problems in ways that were simply never possible before. To ensure that AI can deliver its greatest positive potential, industry, government, academics, and public interest leaders must all work together to advance practices that enable us as a society to take full advantage of emerging artificial intelligence technologies. Never before have AI-enabled opportunities been so vast and thoughtful policy so vital.

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[bb] By infusing the electric grid with software and sensors, and enabling it to connect to circuit breakers, meters, and appliances, the smart grid is poised to change the way electricity is generated, distributed, managed, and consumed — providing up to $2 trillion in customer benefits over the next 20 years. Siemens software is helping advance this future through more capable grid technologies that infuse the grid with decentralized intelligence to maximize autonomy. This software not only provides communities an easy on-ramp for reaping the benefits of the smartgrid, it's also giving communities a reliable and cost-effective way to boost their energy resiliency. See *Intelligence Replaces — Making Power Grids Ready for the Future,* available at http://w3.siemens.com/smartgrid/global/en/projects/Pages/Intelligence-replaces-copper.aspx.

[cc] By infusing the electric grid with software and sensors, and enabling it to connect to circuit breakers, meters, and appliances, the smart grid is poised to change the way electricity is generated, distributed, managed, and consumed — providing up to $2 trillion in customer benefits over the next 20 years. Siemens software is helping advance this future through more capable grid technologies that infuse the grid with decentralized intelligence to maximize autonomy. This software not only provides communities an easy on-ramp for reaping the benefits of the smartgrid, it's also giving communities a reliable and cost effective way to boost their energy resiliency. http://w3.siemens.com/smartgrid/global/en/projects/Pages/Intelligence-replaces-copper.aspx

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