S Umělou inteligencí o umělé inteligenci

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Napiš mi, prosím, text o tom, jak umělá inteligence změní svět. Text by měl porovnávat vývoj umělé inteligence, její pozitiva a negativa. Zmiň se i o jiných světových objevech - knihtisku, parním stroji, elektřině a internetu.

Od vynálezu knihtisku, parního stroje, elektřiny a internetu se svět rychle změnil, a umělá inteligence (AI) slibuje změnit ho ještě více. V posledních letech se vývoj AI rychle zrychlil, a dnes už existují stroje, které dokážou samy sebe učit a vykonávat úkoly, které dříve vyžadovaly lidskou inteligenci.

Mezi pozitiva AI patří zrychlení procesů a zvýšení jejich přesnosti. Například ve zdravotnictví mohou algoritmy pomoci s diagnostikou a léčbou, což může zachránit lidské životy. AI také může pomoci s výzkumem, zlepšováním dopravy a mnoha dalšími oblastmi.

Nicméně existují také negativa AI. Jedním z nich je ztráta pracovních míst, protože stroje mohou nahradit lidskou práci. Dalším negativem může být zneužití AI, například v oblasti kybernetického zločinu a útoků na soukromí.

Ačkoli se zdá, že AI je relativně nový objev, vývoj umělé inteligence sahá až do 50. let minulého století. V posledních letech se ale vývoj AI rychle zrychlil, a to díky rostoucím výpočetním kapacitám a vývoji nových technologií.

Z hlediska porovnání s jinými vynálezy, AI slibuje podobné změny jako knihtisk, parní stroj, elektřina a internet. Tyto vynálezy změnily svět, a AI slibuje to samé. Otázkou ale zůstává, zda bude změna pozitivní, nebo negativní. Je důležité, aby se vývoj AI řídil etickými zásadami a aby byl využíván k prospěchu lidstva.

Napiš mi, prosím, text o tom, jak umělá inteligence změní svět. Text by měl porovnávat vývoj umělé inteligence, její pozitiva a negativa. Zmiň se i o jiných světových objevech - knihtisku, parním stroji, elektřině a internetu. Jak umělá inteligence ovlivní vzdělávání, jak a kde se projevuje už dnes. Je odpor proti umělé inteligenci možný, rozumný a přínosný, je možné ji pozdržet či zastavit? Jak ji člověk může využít ke svému prospěchu a jak ji může zneužít?

Artificial Intelligence (AI) promises to change the world even more rapidly than inventions like the printing press, steam engine, electricity, and internet. AI has the ability to learn and perform tasks that previously required human intelligence. While AI has many positives, such as improving healthcare and transportation, it also has negatives, such as job loss and potential for misuse in cybercrime [1]. AI is already being integrated into various industries such as transportation, healthcare, and manufacturing, and is expected to be integrated into most human endeavors by 2030, providing new efficiencies and enhancing human capacities [2][3]. Through AI, computers are able to use their learned intelligence to make optimal decisions and discoveries in a fraction of the time it would take humans. AI tailors

learning to the individual needs of students and journalism is already benefiting from AI as well [2]. However, it is important to ensure its ethical use for the benefit of humanity, and that its potential negatives need to be managed [1][3]. The development of AI has rapidly accelerated in recent years due to technological advancements [1].

References: [1] How artificial intelligence is transforming the world [2] The Future of AI: How AI Is Changing the World | Built In [3] 3. Improvements ahead: How humans and AI might evolve ...

How artificial intelligence is transforming the world

Darrell M. West and John R. Allen Tuesday, April 24, 2018

Summary

Artificial intelligence (AI) is a wide-ranging tool that enables people to rethink how we integrate information, analyze data, and use the resulting insights to improve decision making—and already it is transforming every walk of life. In this report, Darrell West and John Allen discuss AI's application across a variety of sectors, address issues in its development, and offer recommendations for getting the most out of AI while still protecting important human values.

Most people are not very familiar with the concept of artificial intelligence (AI). As an illustration, when 1,500 senior business leaders in the United States in 2017 were asked about AI, only 17 percent said they were familiar with it.[1] A number of them were not sure what it was or how it would affect their particular companies. They understood there was considerable potential for altering business processes, but were not clear how AI could be deployed within their own organizations.

Despite its widespread lack of familiarity, AI is a technology that is transforming every walk of life. It is a wide-ranging tool that enables people to rethink how we integrate information, analyze data, and use the resulting insights to improve decisionmaking. Our hope through this comprehensive overview is to explain AI to an audience of policymakers, opinion leaders, and interested observers, and demonstrate how AI already is altering the world and raising important questions for society, the economy, and governance.

In this paper, we discuss novel applications in finance, national security, health care, criminal justice, transportation, and smart cities, and address issues such as data access problems, algorithmic bias, AI ethics and transparency, and legal liability for AI decisions. We contrast the regulatory approaches of the U.S. and European Union, and close by making a number of recommendations for getting the most out of AI while still protecting important human values.[2]

In order to maximize AI benefits, we recommend nine steps for going forward:

Encourage greater data access for researchers without compromising users' personal privacy,

invest more government funding in unclassified AI research,

promote new models of digital education and AI workforce development so employees have the skills needed in the 21st-century economy,

create a federal AI advisory committee to make policy recommendations,

engage with state and local officials so they enact effective policies,

regulate broad AI principles rather than specific algorithms,

take bias complaints seriously so AI does not replicate historic injustice, unfairness, or discrimination in data or algorithms,

maintain mechanisms for human oversight and control, and

penalize malicious AI behavior and promote cybersecurity.

I. Qualities of artificial intelligence

Although there is no uniformly agreed upon definition, AI generally is thought to refer to "machines that respond to stimulation consistent with traditional responses from humans, given the human capacity for contemplation, judgment and intention."[3] According to researchers Shubhendu and Vijay, these software systems "make decisions which normally require [a] human level of expertise"

and help people anticipate problems or deal with issues as they come up.[4] As such, they operate in an intentional, intelligent, and adaptive manner.

Intentionality

Artificial intelligence algorithms are designed to make decisions, often using real-time data. They are unlike passive machines that are capable only of mechanical or predetermined responses. Using sensors, digital data, or remote inputs, they combine information from a variety of different sources, analyze the material instantly, and act on the insights derived from those data. With massive improvements in storage systems, processing speeds, and analytic techniques, they are capable of tremendous sophistication in analysis and decisionmaking.

Intelligence

AI generally is undertaken in conjunction with machine learning and data analytics.[5] Machine learning takes data and looks for underlying trends. If it spots something that is relevant for a practical problem, software designers can take that knowledge and use it to analyze specific issues. All that is required are data that are sufficiently robust that algorithms can discern useful patterns. Data can come in the form of digital information, satellite imagery, visual information, text, or unstructured data.

Adaptability

AI systems have the ability to learn and adapt as they make decisions. In the transportation area, for example, semi-autonomous vehicles have tools that let drivers and vehicles know about upcoming congestion, potholes, highway construction, or other possible traffic impediments. Vehicles can take advantage of the experience of other vehicles on the road, without human involvement, and the entire corpus of their achieved "experience" is immediately and fully transferable to other similarly configured vehicles. Their advanced algorithms, sensors, and cameras incorporate experience in current operations, and use dashboards and visual displays to present information in real time so human drivers are able to make sense of ongoing traffic and vehicular conditions. And in the case of fully autonomous vehicles, advanced systems can completely control the car or truck, and make all the navigational decisions.

Ii. Applications in diverse sectors

AI is not a futuristic vision, but rather something that is here today and being integrated with and deployed into a variety of sectors. This includes fields such as finance, national security, health care, criminal justice, transportation, and smart cities. There are numerous examples where AI already is making an impact on the world and augmenting human capabilities in significant ways.[6]

One of the reasons for the growing role of AI is the tremendous opportunities for economic development that it presents. A project undertaken by PriceWaterhouseCoopers estimated that "artificial intelligence technologies could increase global GDP by $15.7 trillion, a full 14%, by 2030."[7] That includes advances of $7 trillion in China, $3.7 trillion in North America, $1.8 trillion in Northern Europe, $1.2 trillion for Africa and Oceania, $0.9 trillion in the rest of Asia outside of China, $0.7 trillion in Southern Europe, and $0.5 trillion in Latin America. China is making rapid strides because it has set a national goal of investing $150 billion in AI and becoming the global leader in this area by 2030.

Meanwhile, a McKinsey Global Institute study of China found that "AI-led automation can give the Chinese economy a productivity injection that would add 0.8 to 1.4 percentage points to GDP growth annually, depending on the speed of adoption."[8] Although its authors found that China currently lags the United States and the United Kingdom in AI deployment, the sheer size of its AI market gives that country tremendous opportunities for pilot testing and future development.

Finance

Investments in financial AI in the United States tripled between 2013 and 2014 to a total of $12.2 billion.[9] According to observers in that sector, "Decisions about loans are now being made by software that can take into account a variety of finely parsed data about a borrower, rather than just a credit score

and a background check."[10] In addition, there are so-called robo-advisers that "create personalized investment portfolios, obviating the need for stockbrokers and financial advisers."[11] These advances are designed to take the emotion out of investing and undertake decisions based on analytical considerations, and make these choices in a matter of minutes.

A prominent example of this is taking place in stock exchanges, where high-frequency trading by machines has replaced much of human decisionmaking. People submit buy and sell orders, and computers match them in the blink of an eye without human intervention. Machines can spot trading inefficiencies or market differentials on a very small scale and execute trades that make money according to investor instructions.[12] Powered in some places by advanced computing, these tools have much greater capacities for storing information because of their emphasis not on a zero or a one, but on "quantum bits" that can store multiple values in each location.[13] That dramatically increases storage capacity and decreases processing times.

Fraud detection represents another way AI is helpful in financial systems. It sometimes is difficult to discern fraudulent activities in large organizations, but AI can identify abnormalities, outliers, or deviant cases requiring additional investigation. That helps managers find problems early in the cycle, before they reach dangerous levels.[14]

National security

AI plays a substantial role in national defense. Through its Project Maven, the American military is deploying AI "to sift through the massive troves of data and video captured by surveillance and then alert human analysts of patterns or when there is abnormal or suspicious activity."[15] According to Deputy Secretary of Defense Patrick Shanahan, the goal of emerging technologies in this area is "to meet our warfighters' needs and to increase [the] speed and agility [of] technology development and procurement."[16]

The big data analytics associated with AI will profoundly affect intelligence analysis, as massive amounts of data are sifted in near real time—if not eventually in real time—thereby providing commanders and their staffs a level of intelligence analysis and productivity heretofore unseen. Command and control will similarly be affected as human commanders delegate certain routine, and in special circumstances, key decisions to AI platforms, reducing dramatically the time associated with the decision and subsequent action. In the end, warfare is a time competitive process, where the side able to decide the fastest and move most quickly to execution will generally prevail. Indeed, artificially intelligent intelligence systems, tied to AI-assisted command and control systems, can move decision support and decisionmaking to a speed vastly superior to the speeds of the traditional means of waging war. So fast will be this process, especially if coupled to automatic decisions to launch artificially intelligent autonomous weapons systems capable of lethal outcomes, that a new term has been coined specifically to embrace the speed at which war will be waged: hyperwar.

While the ethical and legal debate is raging over whether America will ever wage war with artificially intelligent autonomous lethal systems, the Chinese and Russians are not nearly so mired in this debate, and we should anticipate our need to defend against these systems operating at hyperwar speeds. The challenge in the West of where to position "humans in the loop" in a hyperwar scenario will ultimately dictate the West's capacity to be competitive in this new form of conflict.[17]

Just as AI will profoundly affect the speed of warfare, the proliferation of zero day or zero second cyber threats as well as polymorphic malware will challenge even the most sophisticated signature-based cyber protection. This forces significant improvement to existing cyber defenses. Increasingly, vulnerable systems are migrating, and will need to shift to a layered approach to cybersecurity with cloud-based, cognitive AI platforms. This approach moves the community toward a "thinking" defensive capability that can defend networks through constant training on known threats. This capability includes DNA-level analysis of heretofore unknown code, with the possibility of recognizing and stopping inbound malicious code by recognizing a string component of the file. This is how certain key U.S.-based systems stopped the debilitating "WannaCry" and "Petya" viruses.

Preparing for hyperwar and defending critical cyber networks must become a high priority because China, Russia, North Korea, and other countries are putting substantial resources into AI. In

2017, China's State Council issued a plan for the country to "build a domestic industry worth almost $150 billion" by 2030.[18] As an example of the possibilities, the Chinese search firm Baidu has pioneered a facial recognition application that finds missing people. In addition, cities such as Shenzhen are providing up to $1 million to support AI labs. That country hopes AI will provide security, combat terrorism, and improve speech recognition programs.[19] The dual-use nature of many AI algorithms will mean AI research focused on one sector of society can be rapidly modified for use in the security sector as well.[20]

Health care

AI tools are helping designers improve computational sophistication in health care. For example, Merantix is a German company that applies deep learning to medical issues. It has an application in medical imaging that "detects lymph nodes in the human body in Computer Tomography (CT) images."[21] According to its developers, the key is labeling the nodes and identifying small lesions or growths that could be problematic. Humans can do this, but radiologists charge $100 per hour and may be able to carefully read only four images an hour. If there were 10,000 images, the cost of this process would be $250,000, which is prohibitively expensive if done by humans.

What deep learning can do in this situation is train computers on data sets to learn what a normal-looking versus an irregular-appearing lymph node is. After doing that through imaging exercises and honing the accuracy of the labeling, radiological imaging specialists can apply this knowledge to actual patients and determine the extent to which someone is at risk of cancerous lymph nodes. Since only a few are likely to test positive, it is a matter of identifying the unhealthy versus healthy node.

AI has been applied to congestive heart failure as well, an illness that afflicts 10 percent of senior citizens and costs $35 billion each year in the United States. AI tools are helpful because they "predict in advance potential challenges ahead and allocate resources to patient education, sensing, and proactive interventions that keep patients out of the hospital."[22]

Criminal justice

AI is being deployed in the criminal justice area. The city of Chicago has developed an AI-driven "Strategic Subject List" that analyzes people who have been arrested for their risk of becoming future perpetrators. It ranks 400,000 people on a scale of 0 to 500, using items such as age, criminal activity, victimization, drug arrest records, and gang affiliation. In looking at the data, analysts found that youth is a strong predictor of violence, being a shooting victim is associated with becoming a future perpetrator, gang affiliation has little predictive value, and drug arrests are not significantly associated with future criminal activity.[23]

Judicial experts claim AI programs reduce human bias in law enforcement and leads to a fairer sentencing system. R Street Institute Associate Caleb Watney writes:

Empirically grounded questions of predictive risk analysis play to the strengths of machine learning, automated reasoning and other forms of AI. One machine-learning policy simulation concluded that such programs could be used to cut crime up to 24.8 percent with no change in jailing rates, or reduce jail populations by up to 42 percent with no increase in crime rates.[24]

However, critics worry that AI algorithms represent "a secret system to punish citizens for crimes they haven't yet committed. The risk scores have been used numerous times to guide large-scale roundups."[25] The fear is that such tools target people of color unfairly and have not helped Chicago reduce the murder wave that has plagued it in recent years.

Despite these concerns, other countries are moving ahead with rapid deployment in this area. In China, for example, companies already have "considerable resources and access to voices, faces and other biometric data in vast quantities, which would help them develop their technologies."[26] New technologies make it possible to match images and voices with other types of information, and to use AI on these combined data sets to improve law enforcement and national security. Through its "Sharp Eyes" program, Chinese law enforcement is matching video images, social media activity, online purchases, travel records, and personal identity into a "police cloud." This integrated database enables authorities to keep track of criminals, potential law-breakers, and terrorists.[27] Put differently, China has become the world's leading AI-powered surveillance state.

Transportation

Transportation represents an area where AI and machine learning are producing major innovations. Research by Cameron Kerry and Jack Karsten of the Brookings Institution has found that over $80 billion was invested in autonomous vehicle technology between August 2014 and June 2017. Those investments include applications both for autonomous driving and the core technologies vital to that sector.[28]

Autonomous vehicles—cars, trucks, buses, and drone delivery systems—use advanced technological capabilities. Those features include automated vehicle guidance and braking, lane-changing systems, the use of cameras and sensors for collision avoidance, the use of AI to analyze information in real time, and the use of high-performance computing and deep learning systems to adapt to new circumstances through detailed maps.[29]

Light detection and ranging systems (LIDARs) and AI are key to navigation and collision avoidance. LIDAR systems combine light and radar instruments. They are mounted on the top of vehicles that use imaging in a 360-degree environment from a radar and light beams to measure the speed and distance of surrounding objects. Along with sensors placed on the front, sides, and back of the vehicle, these instruments provide information that keeps fast-moving cars and trucks in their own lane, helps them avoid other vehicles, applies brakes and steering when needed, and does so instantly so as to avoid accidents.

Since these cameras and sensors compile a huge amount of information and need to process it instantly to avoid the car in the next lane, autonomous vehicles require high-performance computing, advanced algorithms, and deep learning systems to adapt to new scenarios. This means that software is the key, not the physical car or truck itself.[30] Advanced software enables cars to learn from the experiences of other vehicles on the road and adjust their guidance systems as weather, driving, or road conditions change.[31]

Ride-sharing companies are very interested in autonomous vehicles. They see advantages in terms of customer service and labor productivity. All of the major ride-sharing companies are exploring driverless cars. The surge of car-sharing and taxi services—such as Uber and Lyft in the United States, Daimler's Mytaxi and Hailo service in Great Britain, and Didi Chuxing in China—demonstrate the opportunities of this transportation option. Uber recently signed an agreement to purchase 24,000 autonomous cars from Volvo for its ride-sharing service.[32]

However, the ride-sharing firm suffered a setback in March 2018 when one of its autonomous vehicles in Arizona hit and killed a pedestrian. Uber and several auto manufacturers immediately suspended testing and launched investigations into what went wrong and how the fatality could have occurred.[33] Both industry and consumers want reassurance that the technology is safe and able to deliver on its stated promises. Unless there are persuasive answers, this accident could slow AI advancements in the transportation sector.

Smart cities

Metropolitan governments are using AI to improve urban service delivery. For example, according to Kevin Desouza, Rashmi Krishnamurthy, and Gregory Dawson:

The Cincinnati Fire Department is using data analytics to optimize medical emergency responses. The new analytics system recommends to the dispatcher an appropriate response to a medical emergency call—whether a patient can be treated on-site or needs to be taken to the hospital—by taking into account several factors, such as the type of call, location, weather, and similar calls.[34]

Since it fields 80,000 requests each year, Cincinnati officials are deploying this technology to prioritize responses and determine the best ways to handle emergencies. They see AI as a way to deal with large volumes of data and figure out efficient ways of responding to public requests. Rather than address service issues in an ad hoc manner, authorities are trying to be proactive in how they provide urban services.

Cincinnati is not alone. A number of metropolitan areas are adopting smart city applications that use AI to improve service delivery, environmental planning, resource management, energy utilization, and crime prevention, among other things. For its smart cities index, the magazine Fast Company

ranked American locales and found Seattle, Boston, San Francisco, Washington, D.C., and New York City as the top adopters. Seattle, for example, has embraced sustainability and is using AI to manage energy usage and resource management. Boston has launched a "City Hall To Go" that makes sure underserved communities receive needed public services. It also has deployed "cameras and inductive loops to manage traffic and acoustic sensors to identify gun shots." San Francisco has certified 203 buildings as meeting LEED sustainability standards.[35]

Through these and other means, metropolitan areas are leading the country in the deployment of AI solutions. Indeed, according to a National League of Cities report, 66 percent of American cities are investing in smart city technology. Among the top applications noted in the report are "smart meters for utilities, intelligent traffic signals, e-governance applications, Wi-Fi kiosks, and radio frequency identification sensors in pavement."[36]

Iii. Policy, regulatory, and ethical issues

These examples from a variety of sectors demonstrate how AI is transforming many walks of human existence. The increasing penetration of AI and autonomous devices into many aspects of life is altering basic operations and decisionmaking within organizations, and improving efficiency and response times.

At the same time, though, these developments raise important policy, regulatory, and ethical issues. For example, how should we promote data access? How do we guard against biased or unfair data used in algorithms? What types of ethical principles are introduced through software programming, and how transparent should designers be about their choices? What about questions of legal liability in cases where algorithms cause harm?[37]

Data access problems

The key to getting the most out of AI is having a "data-friendly ecosystem with unified standards and cross-platform sharing." AI depends on data that can be analyzed in real time and brought to bear on concrete problems. Having data that are "accessible for exploration" in the research community is a prerequisite for successful AI development.[38]

According to a McKinsey Global Institute study, nations that promote open data sources and data sharing are the ones most likely to see AI advances. In this regard, the United States has a substantial advantage over China. Global ratings on data openness show that U.S. ranks eighth overall in the world, compared to 93 for China.[39]

But right now, the United States does not have a coherent national data strategy. There are few protocols for promoting research access or platforms that make it possible to gain new insights from proprietary data. It is not always clear who owns data or how much belongs in the public sphere. These uncertainties limit the innovation economy and act as a drag on academic research. In the following section, we outline ways to improve data access for researchers.

Biases in data and algorithms

In some instances, certain AI systems are thought to have enabled discriminatory or biased practices.[40] For example, Airbnb has been accused of having homeowners on its platform who discriminate against racial minorities. A research project undertaken by the Harvard Business School found that "Airbnb users with distinctly African American names were roughly 16 percent less likely to be accepted as guests than those with distinctly white names."[41]

Racial issues also come up with facial recognition software. Most such systems operate by comparing a person's face to a range of faces in a large database. As pointed out by Joy Buolamwini of the Algorithmic Justice League, "If your facial recognition data contains mostly Caucasian faces, that's what your program will learn to recognize."[42] Unless the databases have access to diverse data, these programs perform poorly when attempting to recognize African-American or Asian-American features.

Many historical data sets reflect traditional values, which may or may not represent the preferences wanted in a current system. As Buolamwini notes, such an approach risks repeating inequities of the past:

The rise of automation and the increased reliance on algorithms for high-stakes decisions such as whether someone get insurance or not, your likelihood to default on a loan or somebody's risk of recidivism means this is something that needs to be addressed. Even admissions decisions are increasingly automated—what school our children go to and what opportunities they have. We don't have to bring the structural inequalities of the past into the future we create.[43]

AI ethics and transparency

Algorithms embed ethical considerations and value choices into program decisions. As such, these systems raise questions concerning the criteria used in automated decisionmaking. Some people want to have a better understanding of how algorithms function and what choices are being made.[44]

In the United States, many urban schools use algorithms for enrollment decisions based on a variety of considerations, such as parent preferences, neighborhood qualities, income level, and demographic background. According to Brookings researcher Jon Valant, the New Orleans–based Bricolage Academy "gives priority to economically disadvantaged applicants for up to 33 percent of available seats. In practice, though, most cities have opted for categories that prioritize siblings of current students, children of school employees, and families that live in school's broad geographic area."[45] Enrollment choices can be expected to be very different when considerations of this sort come into play.

Depending on how AI systems are set up, they can facilitate the redlining of mortgage applications, help people discriminate against individuals they don't like, or help screen or build rosters of individuals based on unfair criteria. The types of considerations that go into programming decisions matter a lot in terms of how the systems operate and how they affect customers.[46]

For these reasons, the EU is implementing the General Data Protection Regulation (GDPR) in May 2018. The rules specify that people have "the right to opt out of personally tailored ads" and "can contest 'legal or similarly significant' decisions made by algorithms and appeal for human intervention" in the form of an explanation of how the algorithm generated a particular outcome. Each guideline is designed to ensure the protection of personal data and provide individuals with information on how the "black box" operates.[47]

Legal liability

There are questions concerning the legal liability of AI systems. If there are harms or infractions (or fatalities in the case of driverless cars), the operators of the algorithm likely will fall under product liability rules. A body of case law has shown that the situation's facts and circumstances determine liability and influence the kind of penalties that are imposed. Those can range from civil fines to imprisonment for major harms.[48] The Uber-related fatality in Arizona will be an important test case for legal liability. The state actively recruited Uber to test its autonomous vehicles and gave the company considerable latitude in terms of road testing. It remains to be seen if there will be lawsuits in this case and who is sued: the human backup driver, the state of Arizona, the Phoenix suburb where the accident took place, Uber, software developers, or the auto manufacturer. Given the multiple people and organizations involved in the road testing, there are many legal questions to be resolved.

In non-transportation areas, digital platforms often have limited liability for what happens on their sites. For example, in the case of Airbnb, the firm "requires that people agree to waive their right to sue, or to join in any class-action lawsuit or class-action arbitration, to use the service." By demanding that its users sacrifice basic rights, the company limits consumer protections and therefore curtails the ability of people to fight discrimination arising from unfair algorithms.[49] But whether the principle of neutral networks holds up in many sectors is yet to be determined on a widespread basis.

Iv. Recommendations

In order to balance innovation with basic human values, we propose a number of recommendations for moving forward with AI. This includes improving data access, increasing government investment in AI, promoting AI workforce development, creating a federal advisory committee, engaging with state and local officials to ensure they enact effective policies, regulating broad objectives as opposed to specific algorithms, taking bias seriously as an AI issue, maintaining mechanisms for human control and oversight, and penalizing malicious behavior and promoting cybersecurity.

Improving data access

The United States should develop a data strategy that promotes innovation and consumer protection. Right now, there are no uniform standards in terms of data access, data sharing, or data protection. Almost all the data are proprietary in nature and not shared very broadly with the research community, and this limits innovation and system design. AI requires data to test and improve its learning capacity.[50] Without structured and unstructured data sets, it will be nearly impossible to gain the full benefits of artificial intelligence.

In general, the research community needs better access to government and business data, although with appropriate safeguards to make sure researchers do not misuse data in the way Cambridge Analytica did with Facebook information. There is a variety of ways researchers could gain data access. One is through voluntary agreements with companies holding proprietary data. Facebook, for example, recently announced a partnership with Stanford economist Raj Chetty to use its social media data to explore inequality.[51] As part of the arrangement, researchers were required to undergo background checks and could only access data from secured sites in order to protect user privacy and security.

Google long has made available search results in aggregated form for researchers and the general public. Through its "Trends" site, scholars can analyze topics such as interest in Trump, views about democracy, and perspectives on the overall economy.[52] That helps people track movements in public interest and identify topics that galvanize the general public.

Twitter makes much of its tweets available to researchers through application programming interfaces, commonly referred to as APIs. These tools help people outside the company build application software and make use of data from its social media platform. They can study patterns of social media communications and see how people are commenting on or reacting to current events.

In some sectors where there is a discernible public benefit, governments can facilitate collaboration by building infrastructure that shares data. For example, the National Cancer Institute has pioneered a data-sharing protocol where certified researchers can query health data it has using de-identified information drawn from clinical data, claims information, and drug therapies. That enables researchers to evaluate efficacy and effectiveness, and make recommendations regarding the best medical approaches, without compromising the privacy of individual patients.

There could be public-private data partnerships that combine government and business data sets to improve system performance. For example, cities could integrate information from ride-sharing services with its own material on social service locations, bus lines, mass transit, and highway congestion to improve transportation. That would help metropolitan areas deal with traffic tie-ups and assist in highway and mass transit planning.

Some combination of these approaches would improve data access for researchers, the government, and the business community, without impinging on personal privacy. As noted by Ian Buck, the vice president of NVIDIA, "Data is the fuel that drives the AI engine. The federal government has access to vast sources of information. Opening access to that data will help us get insights that will transform the U.S. economy."[53] Through its Data.gov portal, the federal government already has put over 230,000 data sets into the public domain, and this has propelled innovation and aided improvements in AI and data analytic technologies.[54] The private sector also needs to facilitate research data access so that society can achieve the full benefits of artificial intelligence.

Increase government investment in AI

According to Greg Brockman, the co-founder of OpenAI, the U.S. federal government invests only $1.1 billion in non-classified AI technology.[55] That is far lower than the amount being spent by China or other leading nations in this area of research. That shortfall is noteworthy because the economic payoffs of AI are substantial. In order to boost economic development and social innovation, federal officials need to increase investment in artificial intelligence and data analytics. Higher investment is likely to pay for itself many times over in economic and social benefits.[56]

Promote digital education and workforce development

As AI applications accelerate across many sectors, it is vital that we reimagine our educational institutions for a world where AI will be ubiquitous and students need a different kind of training than they currently receive. Right now, many students do not receive instruction in the kinds of skills that will be needed in an AI-dominated landscape. For example, there currently are shortages of data scientists, computer scientists, engineers, coders, and platform developers. These are skills that are in short supply; unless our educational system generates more people with these capabilities, it will limit AI development.

For these reasons, both state and federal governments have been investing in AI human capital. For example, in 2017, the National Science Foundation funded over 6,500 graduate students in computer-related fields and has launched several new initiatives designed to encourage data and computer science at all levels from pre-K to higher and continuing education.[57] The goal is to build a larger pipeline of AI and data analytic personnel so that the United States can reap the full advantages of the knowledge revolution.

But there also needs to be substantial changes in the process of learning itself. It is not just technical skills that are needed in an AI world but skills of critical reasoning, collaboration, design, visual display of information, and independent thinking, among others. AI will reconfigure how society and the economy operate, and there needs to be "big picture" thinking on what this will mean for ethics, governance, and societal impact. People will need the ability to think broadly about many questions and integrate knowledge from a number of different areas.

One example of new ways to prepare students for a digital future is IBM's Teacher Advisor program, utilizing Watson's free online tools to help teachers bring the latest knowledge into the classroom. They enable instructors to develop new lesson plans in STEM and non-STEM fields, find relevant instructional videos, and help students get the most out of the classroom.[58] As such, they are precursors of new educational environments that need to be created.

Create a federal AI advisory committee

Federal officials need to think about how they deal with artificial intelligence. As noted previously, there are many issues ranging from the need for improved data access to addressing issues of bias and discrimination. It is vital that these and other concerns be considered so we gain the full benefits of this emerging technology.

In order to move forward in this area, several members of Congress have introduced the "Future of Artificial Intelligence Act," a bill designed to establish broad policy and legal principles for AI. It proposes the secretary of commerce create a federal advisory committee on the development and implementation of artificial intelligence. The legislation provides a mechanism for the federal government to get advice on ways to promote a "climate of investment and innovation to ensure the global competitiveness of the United States," "optimize the development of artificial intelligence to address the potential growth, restructuring, or other changes in the United States workforce," "support the unbiased development and application of artificial intelligence," and "protect the privacy rights of individuals."[59]

Among the specific questions the committee is asked to address include the following: competitiveness, workforce impact, education, ethics training, data sharing, international cooperation, accountability, machine learning bias, rural impact, government efficiency, investment climate, job impact, bias, and consumer impact. The committee is directed to submit a report to Congress and the

administration 540 days after enactment regarding any legislative or administrative action needed on AI.

This legislation is a step in the right direction, although the field is moving so rapidly that we would recommend shortening the reporting timeline from 540 days to 180 days. Waiting nearly two years for a committee report will certainly result in missed opportunities and a lack of action on important issues. Given rapid advances in the field, having a much quicker turnaround time on the committee analysis would be quite beneficial.

Engage with state and local officials

States and localities also are taking action on AI. For example, the New York City Council unanimously passed a bill that directed the mayor to form a taskforce that would "monitor the fairness and validity of algorithms used by municipal agencies."[60] The city employs algorithms to "determine if a lower bail will be assigned to an indigent defendant, where firehouses are established, student placement for public schools, assessing teacher performance, identifying Medicaid fraud and determine where crime will happen next."[61]

According to the legislation's developers, city officials want to know how these algorithms work and make sure there is sufficient AI transparency and accountability. In addition, there is concern regarding the fairness and biases of AI algorithms, so the taskforce has been directed to analyze these issues and make recommendations regarding future usage. It is scheduled to report back to the mayor on a range of AI policy, legal, and regulatory issues by late 2019.

Some observers already are worrying that the taskforce won't go far enough in holding algorithms accountable. For example, Julia Powles of Cornell Tech and New York University argues that the bill originally required companies to make the AI source code available to the public for inspection, and that there be simulations of its decisionmaking using actual data. After criticism of those provisions, however, former Councilman James Vacca dropped the requirements in favor of a task force studying these issues. He and other city officials were concerned that publication of proprietary information on algorithms would slow innovation and make it difficult to find AI vendors who would work with the city.[62] It remains to be seen how this local task force will balance issues of innovation, privacy, and transparency.

Regulate broad objectives more than specific algorithms

The European Union has taken a restrictive stance on these issues of data collection and analysis.[63] It has rules limiting the ability of companies from collecting data on road conditions and mapping street views. Because many of these countries worry that people's personal information in unencrypted Wi-Fi networks are swept up in overall data collection, the EU has fined technology firms, demanded copies of data, and placed limits on the material collected.[64] This has made it more difficult for technology companies operating there to develop the high-definition maps required for autonomous vehicles.

The GDPR being implemented in Europe place severe restrictions on the use of artificial intelligence and machine learning. According to published guidelines, "Regulations prohibit any automated decision that 'significantly affects' EU citizens. This includes techniques that evaluates a person's 'performance at work, economic situation, health, personal preferences, interests, reliability, behavior, location, or movements.'"[65] In addition, these new rules give citizens the right to review how digital services made specific algorithmic choices affecting people.

If interpreted stringently, these rules will make it difficult for European software designers (and American designers who work with European counterparts) to incorporate artificial intelligence and high-definition mapping in autonomous vehicles. Central to navigation in these cars and trucks is tracking location and movements. Without high-definition maps containing geo-coded data and the deep learning that makes use of this information, fully autonomous driving will stagnate in Europe. Through this and other data protection actions, the European Union is putting its manufacturers and software designers at a significant disadvantage to the rest of the world.

It makes more sense to think about the broad objectives desired in AI and enact policies that advance them, as opposed to governments trying to crack open the "black boxes" and see exactly how

specific algorithms operate. Regulating individual algorithms will limit innovation and make it difficult for companies to make use of artificial intelligence.

Take biases seriously

Bias and discrimination are serious issues for AI. There already have been a number of cases of unfair treatment linked to historic data, and steps need to be undertaken to make sure that does not become prevalent in artificial intelligence. Existing statutes governing discrimination in the physical economy need to be extended to digital platforms. That will help protect consumers and build confidence in these systems as a whole.

For these advances to be widely adopted, more transparency is needed in how AI systems operate. Andrew Burt of Immuta argues, "The key problem confronting predictive analytics is really transparency. We're in a world where data science operations are taking on increasingly important tasks, and the only thing holding them back is going to be how well the data scientists who train the models can explain what it is their models are doing."[66]

Maintaining mechanisms for human oversight and control

Some individuals have argued that there needs to be avenues for humans to exercise oversight and control of AI systems. For example, Allen Institute for Artificial Intelligence CEO Oren Etzioni argues there should be rules for regulating these systems. First, he says, AI must be governed by all the laws that already have been developed for human behavior, including regulations concerning "cyberbullying, stock manipulation or terrorist threats," as well as "entrap[ping] people into committing crimes." Second, he believes that these systems should disclose they are automated systems and not human beings. Third, he states, "An A.I. system cannot retain or disclose confidential information without explicit approval from the source of that information."[67] His rationale is that these tools store so much data that people have to be cognizant of the privacy risks posed by AI.

In the same vein, the IEEE Global Initiative has ethical guidelines for AI and autonomous systems. Its experts suggest that these models be programmed with consideration for widely accepted human norms and rules for behavior. AI algorithms need to take into effect the importance of these norms, how norm conflict can be resolved, and ways these systems can be transparent about norm resolution. Software designs should be programmed for "nondeception" and "honesty," according to ethics experts. When failures occur, there must be mitigation mechanisms to deal with the consequences. In particular, AI must be sensitive to problems such as bias, discrimination, and fairness.[68]

A group of machine learning experts claim it is possible to automate ethical decisionmaking. Using the trolley problem as a moral dilemma, they ask the following question: If an autonomous car goes out of control, should it be programmed to kill its own passengers or the pedestrians who are crossing the street? They devised a "voting-based system" that asked 1.3 million people to assess alternative scenarios, summarized the overall choices, and applied the overall perspective of these individuals to a range of vehicular possibilities. That allowed them to automate ethical decisionmaking in AI algorithms, taking public preferences into account.[69] This procedure, of course, does not reduce the tragedy involved in any kind of fatality, such as seen in the Uber case, but it provides a mechanism to help AI developers incorporate ethical considerations in their planning.

Penalize malicious behavior and promote cybersecurity

As with any emerging technology, it is important to discourage malicious treatment designed to trick software or use it for undesirable ends.[70] This is especially important given the dual-use aspects of AI, where the same tool can be used for beneficial or malicious purposes. The malevolent use of AI exposes individuals and organizations to unnecessary risks and undermines the virtues of the emerging technology. This includes behaviors such as hacking, manipulating algorithms, compromising privacy and confidentiality, or stealing identities. Efforts to hijack AI in order to solicit confidential information should be seriously penalized as a way to deter such actions.[71]

In a rapidly changing world with many entities having advanced computing capabilities, there needs to be serious attention devoted to cybersecurity. Countries have to be careful to safeguard their own systems and keep other nations from damaging their security.[72] According to the U.S.

Department of Homeland Security, a major American bank receives around 11 million calls a week at its service center. In order to protect its telephony from denial of service attacks, it uses a "machine learning-based policy engine [that] blocks more than 120,000 calls per month based on voice firewall policies including harassing callers, robocalls and potential fraudulent calls."[73] This represents a way in which machine learning can help defend technology systems from malevolent attacks.

V. Conclusion

To summarize, the world is on the cusp of revolutionizing many sectors through artificial intelligence and data analytics. There already are significant deployments in finance, national security, health care, criminal justice, transportation, and smart cities that have altered decisionmaking, business models, risk mitigation, and system performance. These developments are generating substantial economic and social benefits.

Yet the manner in which AI systems unfold has major implications for society as a whole. It matters how policy issues are addressed, ethical conflicts are reconciled, legal realities are resolved, and how much transparency is required in AI and data analytic solutions.[74] Human choices about software development affect the way in which decisions are made and the manner in which they are integrated into organizational routines. Exactly how these processes are executed need to be better understood because they will have substantial impact on the general public soon, and for the foreseeable future. AI may well be a revolution in human affairs, and become the single most influential human innovation in history.

Note: We appreciate the research assistance of Grace Gilberg, Jack Karsten, Hillary Schaub, and Kristjan Tomasson on this project.

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Support for this publication was generously provided by Amazon. Brookings recognizes that the value it provides is in its absolute commitment to quality, independence, and impact. Activities supported by its donors reflect this commitment.

John R. Allen is a member of the Board of Advisors of Amida Technology and on the Board of Directors of Spark Cognition. Both companies work in fields discussed in this piece.

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The Future of AI: How Artificial Intelligence Will Change the World

Written bymike Thomas

If it feels like the future of AI is a rapidly changing landscape, that's because the present innovations in the field of artificial intelligence are accelerating at such a blazing-fast pace that it's tough to keep up.

Indeed, artificial intelligence is shaping the future of humanity across nearly every industry. It is already the main driver of emerging technologies like big data, robotics and IoT — not to mention generative AI, with tools like ChatGPT and AI art generators garnering mainstream attention — and it will continue to act as a technological innovator for the foreseeable future.

Roughly 44 percent of companies are looking to make serious investments in AI and integrate it into their businesses. And of the 9,130 patents received by IBM inventors in 2021, 2,300 were AI-related.

It seems likely that AI is going to (continue to) change the world. But how, exactly?

The evolution of ai

AI's influence on technology is due in part because of how it impacts computing. Through AI, computers have the ability to harness massive amounts of data and use their learned intelligence to make optimal decisions and discoveries in fractions of the time that it would take humans.

AI has come a long way since 1951, when the first documented success of an AI computer program was written by Christopher Strachey, whose checkers program completed a whole game on the Ferranti Mark I computer at the University of Manchester.

Since then, AI has been used to help sequence RNA for vaccines and model human speech, technologies that rely on model- and algorithm-based machine learning and increasingly focus on perception, reasoning and generalization. With innovations like these, AI has re-taken center stage like never before — and it won't cede the spotlight anytime soon.

What industries will ai change?

There's virtually no major industry that modern AI — more specifically, "narrow AI," which performs objective functions using data-trained models and often falls into the categories of deep learning or machine learning — hasn't already affected. That's especially true in the past few years, as data collection and analysis has ramped up considerably thanks to robust IoT connectivity, the proliferation of connected devices and ever-speedier computer processing.

"I think anybody making assumptions about the capabilities of intelligent software capping out at some point are mistaken," David Vandegrift, CTO and co-founder of the customer relationship management firm 4Degrees, said.

With companies spending billions of dollars on AI products and services annually, tech giants like Google, Apple, Microsoft and Amazon spending billions to create those products and services, universities making AI a more prominent part of their curricula and the U.S. Department of Defense upping its AI game, big things are bound to happen.

"Lots of industries go through this pattern of winter, winter, and then an eternal spring," former Google Brain leader and Baidu chief scientist Andrew Ng told ZDNet. "We may be in the eternal spring of AI."

Some sectors are at the start of their AI journey, others are veteran travelers. Both have a long way to go. Regardless, the impact AI is having on our present day lives is hard to ignore.

Ai in transportation

Transportation is one industry that is certainly teed up to be drastically changed by AI. Self-driving cars and AI travel planners are just a couple of facets of how we get from point A to point B that will be influenced by AI. Even though autonomous vehicles are far from perfect, they will one day ferry us from place to place.

Ai in manufacturing

Manufacturing has been benefiting from AI for years. With AI-enabled robotic arms and other manufacturing bots dating back to the 1960s and 1970s, the industry has adapted well to the powers of AI. These industrial robots typically work alongside humans to perform a limited range of tasks like assembly and stacking, and predictive analysis sensors keep equipment running smoothly.

Ai in healthcare

It may seem unlikely, but AI healthcare is already changing the way humans interact with medical providers. Thanks to its big data analysis capabilities, AI helps identify diseases more quickly and accurately, speed up and streamline drug discovery and even monitor patients through virtual nursing assistants.

Ai in education

AI in education will change the way humans of all ages learn. AI's use of machine learning, natural language processing and facial recognition help digitize textbooks, detect plagiarism and gauge the emotions of students to help determine who's struggling or bored. Both presently and in the future, AI tailors the experience of learning to student's individual needs.

Ai in media

Journalism is harnessing AI too, and will continue to benefit from it. One example can be seen in The Associated Press' use of Automated Insights, which produces thousands of earning reports stories per year. But as generative AI writing tools, such as ChatGPT, enter the market, questions about their use in journalism abound.

Ai in customer service

Most people dread getting a robo-call, but AI in customer service can provide the industry with data-driven tools that bring meaningful insights to both the customer and the provider. AI tools powering the customer service industry come in the form of chatbots and virtual assistants.

The impact of ai on society

How ai will change work

During a lecture at Northwestern University, AI expert Kai-Fu Lee championed AI technology and its forthcoming impact while also noting its side effects and limitations. Of the former, he warned:

"The bottom 90 percent, especially the bottom 50 percent of the world in terms of income or education, will be badly hurt with job displacement ... The simple question to ask is, 'How routine is a job?' And that is how likely [it is] a job will be replaced by AI, because AI can, within the routine task, learn to optimize itself. And the more quantitative, the more objective the job is—separating things into bins, washing dishes, picking fruits and answering customer service calls—those are very much scripted

tasks that are repetitive and routine in nature. In the matter of five, 10 or 15 years, they will be displaced by AI."

In the warehouses of online giant and AI powerhouse Amazon, which buzz with more than 100,000 robots, picking and packing functions are still performed by humans — but that will change.

Lee's opinion was echoed by Infosys president Mohit Joshi, who told the New York Times, "People are looking to achieve very big numbers. Earlier they had incremental, five to 10 percent goals in reducing their workforce. Now they're saying, 'Why can't we do it with one percent of the people we have?'"

On a more upbeat note, Lee stressed that today's AI is useless in two significant ways: it has no creativity and no capacity for compassion or love. Rather, it's "a tool to amplify human creativity." His solution? Those with jobs that involve repetitive or routine tasks must learn new skills so as not to be left by the wayside. Amazon even offers its employees money to train for jobs at other companies.

"One of the absolute prerequisites for AI to be successful in many [areas] is that we invest tremendously in education to retrain people for new jobs," said Klara Nahrstedt, a computer science professor at the University of Illinois at Urbana–Champaign and director of the school's Coordinated Science Laboratory.

She's concerned that's not happening widely or often enough. Marc Gyongyosi, founder of Onetrack.AI, is even more specific.

"People need to learn about programming like they learn a new language," he said. "And they need to do that as early as possible because it really is the future. In the future, if you don't know coding, you don't know programming, it's only going to get more difficult."

While many of those who are forced out of jobs by technology will find new ones, Vandegrift said, that won't happen overnight. As with America's transition from an agricultural to an industrial economy during the Industrial Revolution, which played a big role in causing the Great Depression, people eventually got back on their feet. The short-term impact, however, was massive.

"The transition between jobs going away and new ones [emerging]," Vandegrift said, "is not necessarily as painless as people like to think."

Mike Mendelson, a learner experience designer for NVIDIA, is a different kind of educator than Nahrstedt. He works with developers who want to learn more about AI and apply that knowledge to their businesses.

"If they understand what the technology is capable of and they understand the domain very well, they start to make connections and say, 'Maybe this is an AI problem, maybe that's an AI problem,'" he said. "That's more often the case than 'I have a specific problem I want to solve.'"

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Preparing for the future of ai

The possibilities of artificial general intelligence

Speaking at London's Westminster Abbey in late 2018, internationally renowned AI expert Stuart Russell joked (or not) about his "formal agreement with journalists that I won't talk to them unless they agree not to put a Terminator robot in the article."

His quip revealed an obvious contempt for Hollywood representations of far-future AI, which tend toward the overwrought and apocalyptic. What Russell referred to as "human-level AI," also known as artificial general intelligence (AGI), has long been fodder for fantasy. But the chances of its being realized anytime soon, or at all, are pretty slim.

"There are still major breakthroughs that have to happen before we reach anything that resembles human-level AI," Russell explained.

Russel also pointed out that AI is not currently equipped to fully understand language. This shows a distinct difference between humans and AI at the present moment: Humans can translate machine language and understand it, but AI can't do the same for human language. However, if we reach a point where AI is able to understand our languages, AI systems would be able to read and understand everything ever written.

"Once we have that capability, you could then query all of human knowledge and it would be able to synthesize and integrate and answer questions that no human being has ever been able to answer," Russell added, "because they haven't read and been able to put together and join the dots between things that have remained separate throughout history."

This offers us a lot to think about. On the subject of which, emulating the human brain is exceedingly difficult and yet another reason for AGI's still-hypothetical future. Longtime University of Michigan engineering and computer science professor John Laird has conducted research in the field for several decades.

"The goal has always been to try to build what we call the cognitive architecture, what we think is innate to an intelligence system," he says of work that's largely inspired by human psychology. "One of the things we know, for example, is the human brain is not really just a homogenous set of neurons. There's a real structure in terms of different components, some of which are associated with knowledge about how to do things in the world."

That's called procedural memory. Then there's knowledge based on general facts, a.k.a. semantic memory, as well as knowledge about previous experiences (or personal facts) which is called episodic memory. One of the projects at Laird's lab involves using natural language instructions to teach a robot simple games like Tic-Tac-Toe and puzzles. Those instructions typically involve a description of the goal, a rundown of legal moves and failure situations. The robot internalizes those directives and uses them to plan its actions. As ever, though, breakthroughs are slow to come — slower, anyway, than Laird and his fellow researchers would like.

"Every time we make progress," he says, "we also get a new appreciation for how hard it is."

Is agi a threat to humanity?

More than a few leading AI figures subscribe (some more hyperbolically than others) to a nightmare scenario that involves what's known as "singularity," whereby superintelligent machines take over and permanently alter human existence through enslavement or eradication.

The late theoretical physicist Stephen Hawking famously postulated that if AI itself begins designing better AI than human programmers, the result could be "machines whose intelligence exceeds ours by more than ours exceeds that of snails." Elon Musk believes and has warned that AGI is humanity's biggest existential threat. Efforts to bring it about, he has said, are like "summoning the demon." He has even expressed concern that his pal, Google co-founder Larry Page could accidentally shepherd something "evil" into existence despite his best intentions.

Even Gyongyosi rules nothing out. He's no alarmist when it comes to AI predictions, but at some point, he says, humans will no longer need to train systems; they'll learn and evolve on their own.

"I don't think the methods we use currently in these areas will lead to machines that decide to kill us," Gyongyosi said. "I think that maybe five or 10 years from now, I'll have to reevaluate that statement because we'll have different methods available and different ways to go about these things.

While murderous machines may well remain fodder for fiction, many believe they'll supplant humans in various ways.

Oxford University's Future of Humanity Institute published the results of an AI survey. Titled "When Will AI Exceed Human Performance? Evidence from AI Experts," it contains estimates from 352 machine learning researchers about AI's evolution in years to come.

There were lots of optimists in this group. By 2026, a median number of respondents said, machines will be capable of writing school essays; by 2027 self-driving trucks will render drivers unnecessary; by 2031 AI will outperform humans in the retail sector; by 2049 AI could be the next Stephen King and by 2053 the next Charlie Teo. The slightly jarring capper: By 2137, all human jobs will be automated. But what of humans themselves? Sipping umbrella drinks served by droids, no doubt.

Diego Klabjan, a professor at Northwestern University and founding director of the school's Master of Science in Analytics program, counts himself an AGI skeptic.

"Currently, computers can handle a little more than 10,000 words," he said. "So, a few million neurons. But human brains have billions of neurons that are connected in a very intriguing and complex way, and the current state-of-the-art [technology] is just straightforward connections following very easy

patterns. So going from a few million neurons to billions of neurons with current hardware and software technologies — I don't see that happening."

How will we use agi?

Klabjan also puts little stock in extreme scenarios — the type involving, say, murderous cyborgs that turn the earth into a smoldering hellscape. He's much more concerned with machines — war robots, for instance — being fed faulty "incentives" by nefarious humans. As MIT physics professors and leading AI researcher Max Tegmark put it in a 2018 TED Talk, "The real threat from AI isn't malice, like in silly Hollywood movies, but competence — AI accomplishing goals that just aren't aligned with ours."

That's Laird's take, too: "I definitely don't see the scenario where something wakes up and decides it wants to take over the world," he said. "I think that's science fiction and not the way it's going to play out."

What Laird worries most about isn't evil AI, per se, but "evil humans using AI as a sort of false force multiplier" for things like bank robbery and credit card fraud, among many other crimes. And so, while he's often frustrated with the pace of progress, AI's slow burn may actually be a blessing.

"Time to understand what we're creating and how we're going to incorporate it into society," Laird said, "might be exactly what we need."

But no one knows for sure.

"There are several major breakthroughs that have to occur, and those could come very quickly," Russell said during his Westminster talk. Referencing the rapid transformational effect of nuclear fission (atom splitting) by British physicist Ernest Rutherford in 1917, he added, "It's very, very hard to predict when these conceptual breakthroughs are going to happen."

But whenever they do, if they do, he emphasized the importance of preparation. That means starting or continuing discussions about the ethical use of AGI and whether it should be regulated. That means working to eliminate data bias, which has a corrupting effect on algorithms and is currently a fat fly in the AI ointment. That means working to invent and augment security measures capable of keeping the technology in check. And it means having the humility to realize that just because we can doesn't mean we should.

"Most AGI researchers expect AGI within decades, and if we just bumble into this unprepared, it will probably be the biggest mistake in human history. It could enable brutal global dictatorship with unprecedented inequality, surveillance, suffering and maybe even human extinction," Tegmark said in his TED Talk. "But if we steer carefully, we could end up in a fantastic future where everybody's better off — the poor are richer, the rich are richer, everybody's healthy and free to live out their dreams."

Improvements ahead: How humans and AI might evolve together in the next decade

BY JANNA ANDERSON AND LEE RAINIE

Other questions to the experts in this canvassing invited their views on the hopeful things that will occur in the next decade and for examples of specific applications that might emerge. What will human-technology co-evolution look like by 2030? Participants in this canvassing expect the rate of change to fall in a range anywhere from incremental to extremely impactful. Generally, they expect AI to continue to be targeted toward efficiencies in workplaces and other activities, and they say it is likely to be embedded in most human endeavors.

The greatest share of participants in this canvassing said automated systems driven by artificial intelligence are already improving many dimensions of their work, play and home lives and they expect this to continue over the next decade. While they worry over the accompanying negatives of human-AI advances, they hope for broad changes for the better as networked, intelligent systems are revolutionizing everything, from the most pressing professional work to hundreds of the little "everyday" aspects of existence.

One respondent's answer covered many of the improvements experts expect as machines sit alongside humans as their assistants and enhancers. An associate professor at a major university in

Israel wrote, "In the coming 12 years AI will enable all sorts of professions to do their work more efficiently, especially those involving 'saving life': individualized medicine, policing, even warfare (where attacks will focus on disabling infrastructure and less in killing enemy combatants and civilians). In other professions, AI will enable greater individualization, e.g., education based on the needs and intellectual abilities of each pupil/student. Of course, there will be some downsides: greater unemployment in certain 'rote' jobs (e.g., transportation drivers, food service, robots and automation, etc.)."

This section begins with experts sharing mostly positive expectations for the evolution of humans and AI. It is followed by separate sections that include their thoughts about the potential for AI-human partnerships and quality of life in 2030, as well as the future of jobs, health care and education.

AI will be integrated into most aspects of life, producing new efficiencies and enhancing human capacities

Many of the leading experts extolled the positives they expect to continue to expand as AI tools evolve to do more things for more people.

Martijn van Otterlo, author of "Gatekeeping Algorithms with Human Ethical Bias" and assistant professor of artificial intelligence at Tilburg University in the Netherlands, wrote, "Even though I see many ethical issues, potential problems and especially power imbalance/misuse issues with AI (not even starting about singularity issues and out-of-control AI), I do think AI will change most lives for the better, especially looking at the short horizon of 2030 even more-so, because even bad effects of AI can be considered predominantly 'good' by the majority of people. For example, the Cambridge Analytica case has shown us the huge privacy issues of modern social networks in a market economy, but, overall, people value the extraordinary services Facebook offers to improve communication opportunities, sharing capabilities and so on."

Vint Cerf, Internet Hall of Fame member and vice president and chief internet evangelist at Google, said, "I see AI and machine learning as augmenting human cognition a la Douglas Engelbart. There will be abuses and bugs, some harmful, so we need to be thoughtful about how these technologies are implemented and used, but, on the whole, I see these as constructive."

Mícheál Ó Foghlú, engineering director and DevOps Code Pillar at Google's Munich office, said, "The trend is that AI/ML models in specific domains can out-perform human experts (e.g., certain cancer diagnoses based on image-recognition in retina scans). I think it would be fairly much the consensus that this trend would continue, and many more such systems could aid human experts to be more accurate."

Craig Mathias, principal at Farpoint Group, an advisory firm specializing in wireless networking and mobile computing, commented, "Many if not most of the large-scale technologies that we all depend upon – such as the internet itself, the power grid, and roads and highways – will simply be unable to function in the future without AI, as both solution complexity and demand continue to increase."

Matt Mason, a roboticist and the former director of the Robotics Institute at Carnegie Mellon University, wrote, "AI will present new opportunities and capabilities to improve the human experience. While it is possible for a society to behave irrationally and choose to use it to their detriment, I see no reason to think that is the more likely outcome."

Mike Osswald, vice president of experience innovation at Hanson Inc., commented, "I'm thinking of a world in which people's devices continuously assess the world around them to keep a population safer and healthier. Thinking of those living in large urban areas, with devices forming a network of AI input through sound analysis, air quality, natural events, etc., that can provide collective notifications and insight to everyone in a certain area about the concerns of environmental factors, physical health, even helping provide no quarter for bad actors through community policing."

Barry Hughes, senior scientist at the Center for International Futures at the University of Denver, commented, "I was one of the original test users of the ARPANET and now can hardly imagine living without the internet. Although AI will be disruptive through 2030 and beyond, meaning that there will be losers in the workplace and growing reasons for concern about privacy and AI/cyber-related crime, on the whole I expect that individuals and societies will make choices on use and restriction of use that

benefit us. Examples include likely self-driving vehicles at that time, when my wife's deteriorating vision and that of an increased elderly population will make it increasingly liberating. I would expect rapid growth in use for informal/non-traditional education as well as some more ambivalent growth in the formal-education sector. Big-data applications in health-related research should be increasingly productive, and health care delivery should benefit. Transparency with respect to its character and use, including its developers and their personal benefits, is especially important in limiting the inevitable abuse."

Dana Klisanin, psychologist, futurist and game designer, predicted, "People will increasingly realize the importance of interacting with each other and the natural world and they will program AI to support such goals, which will in turn support the ongoing emergence of the 'slow movement.' For example, grocery shopping and mundane chores will be allocated to AI (smart appliances), freeing up time for preparation of meals in keeping with the slow food movement. Concern for the environment will likewise encourage the growth of the slow goods/slow fashion movement. The ability to recycle, reduce, reuse will be enhanced by the use of in-home 3D printers, giving rise to a new type of 'craft' that is supported by AI. AI will support the 'cradle-to-grave' movement by making it easier for people to trace the manufacturing process from inception to final product."

Liz Rykert, president at Meta Strategies, a consultancy that works with technology and complex organizational change, responded, "The key for networked AI will be the ability to diffuse equitable responses to basic care and data collection. If bias remains in the programming it will be a big problem. I believe we will be able to develop systems that will learn from and reflect a much broader and more diverse population than the systems we have now."

Michael R. Nelson, a technology policy expert for a leading network services provider who worked as a technology policy aide in the Clinton administration, commented, "Most media reports focus on how machine learning will directly affect people (medical diagnosis, self-driving cars, etc.) but we will see big improvements in infrastructure (traffic, sewage treatment, supply chain, etc.)."

Gary Arlen, president of Arlen Communications, wrote, "After the initial frenzy recedes about specific AI applications (such as autonomous vehicles, workplace robotics, transaction processing, health diagnoses and entertainment selections), specific applications will develop – probably in areas barely being considered today. As with many new technologies, the benefits will not apply equally, potentially expanding the haves-and-have-nots dichotomy. In addition, as AI delves into new fields – including creative work such as design, music/art composition – we may see new legal challenges about illegal appropriation of intellectual property (via machine learning). However, the new legal tasks from such litigation may not need a conventional lawyer – but could be handled by AI itself. Professional health care AI poses another type of dichotomy. For patients, AI could be a bonanza, identifying ailments, often in early stages (based on early symptoms), and recommending treatments. At the same time, such automated tasks could impact employment for medical professionals. And again, there are legal challenges to be determined, such as liability in the case of a wrong action by the AI. Overall, there is no such thing as 'most people,' but many individuals and groups – especially in professional situations – WILL live better lives thanks to AI, albeit with some severe adjustment pains."

Tim Morgan, a respondent who provided no identifying details, said, "Algorithmic machine learning will be our intelligence amplifier, exhaustively exploring data and designs in ways humans alone cannot. The world was shocked when IBM's Deep Blue computer beat Garry Kasparov in 1997. What emerged later was the realization that human and AI 'centaurs' could combine to beat anyone, human or AI. The synthesis is more than the sum of the parts."

Marshall Kirkpatrick, product director of influencer marketing, responded, "If the network can be both decentralized and imbued with empathy, rather than characterized by violent exploitation, then we're safe. I expect it will land in between, hopefully leaning toward the positive. For example, I expect our understanding of self and freedom will be greatly impacted by an instrumentation of a large part of memory, through personal logs and our data exhaust being recognized as valuable just like when we shed the term 'junk DNA.' Networked AI will bring us new insights into our own lives that might seem as far-fetched today as it would have been 30 years ago to say, 'I'll tell you what music your friends are

discovering right now.' AI is most likely to augment humanity for the better, but it will take longer and not be done as well as it could be. Hopefully we'll build it in a way that will help us be comparably understanding to others."

Daniel A. Menasce, professor of computer science at George Mason University, commented, "AI and related technologies coupled with significant advances in computer power and decreasing costs will allow specialists in a variety of disciplines to perform more efficiently and will allow non-specialists to use computer systems to augment their skills. Some examples include health delivery, smart cities and smart buildings. For these applications to become reality, easy-to-use user interfaces, or better yet transparent user interfaces will have to be developed."

David Wells, chief financial officer at Netflix, responded, "Technology progression and advancement has always been met with fear and anxiety, giving way to tremendous gains for humankind as we learn to enhance the best of the changes and adapt and alter the worst. Continued networked AI will be no different but the pace of technological change has increased, which is different and requires us to more quickly adapt. This pace is different and presents challenges for some human groups and societies that we will need to acknowledge and work through to avoid marginalization and political conflict. But the gains from better education, medical care and crime reduction will be well worth the challenges."

Rik Farrow, editor of ;login: for the USENIX association, wrote, "Humans do poorly when it comes to making decisions based on facts, rather than emotional issues. Humans get distracted easily. There are certainly things that AI can do better than humans, like driving cars, handling finances, even diagnosing illnesses. Expecting human doctors to know everything about the varieties of disease and humans is silly. Let computers do what they are good at."

Steve Crocker, CEO and co-founder of Shinkuro Inc. and Internet Hall of Fame member, responded, "AI and human-machine interaction has been under vigorous development for the past 50 years. The advances have been enormous. The results are marbled through all of our products and systems. Graphics, speech [and] language understanding are now taken for granted. Encyclopedic knowledge is available at our fingertips. Instant communication with anyone, anywhere exists for about half the world at minimal cost. The effects on productivity, lifestyle and reduction of risks, both natural and man-made, have been extraordinary and will continue. As with any technology, there are opportunities for abuse, but the challenges for the next decade or so are not significantly different from the challenges mankind has faced in the past. Perhaps the largest existential threat has been the potential for nuclear holocaust. In comparison, the concerns about AI are significantly less."

James Kadtke, expert on converging technologies at the Institute for National Strategic Studies at the U.S. National Defense University, wrote, "Barring the deployment of a few different radically new technologies, such as general AI or commercial quantum computers, the internet and AI [between now and 2030] will proceed on an evolutionary trajectory. Expect internet access and sophistication to be considerably greater, but not radically different, and also expect that malicious actors using the internet will have greater sophistication and power. Whether we can control both these trends for positive outcomes is a public policy issue more than a technological one."

Tim Morgan, a respondent who provided no identifying details, said, "Human/AI collaboration over the next 12 years will improve the overall quality of life by finding new approaches to persistent problems. We will use these adaptive algorithmic tools to explore whole new domains in every industry and field of study: materials science, biotech, medicine, agriculture, engineering, energy, transportation and more. ... This goes beyond computability into human relationships. AIs are beginning to understand and speak the human language of emotion. The potential of affective computing ranges from productivity-increasing adaptive interfaces, to 'pre-crime' security monitoring of airports and other gathering places, to companion 'pets' which monitor their aging owners and interact with them in ways that improve their health and disposition. Will there be unseen dangers or consequences? Definitely. That is our pattern with our tools. We invent them, use them to improve our lives and then refine them when we find problems. AI is no different."

Ashok Goel, director of the human-centered computing Ph.D. program at Georgia Tech, wrote, "Human-AI interaction will be multimodal: We will directly converse with AIs, for example. However, much of the impact of AI will come in enhancing human-human interaction across both space (we will be networked with others) and time (we will have access to all our previously acquired knowledge). This will aid, augment and amplify individual and collective human intelligence in unprecedented and powerful ways."

David Cake, an leader with Electronic Frontiers Australia and vice-chair of the ICANN GNSO Council, wrote, "In general, machine learning and related technologies have the capacity to greatly reduce human error in many areas where it is currently very problematic and make available good, appropriately tailored advice to people to whom it is currently unavailable, in literally almost every field of human endeavour."

Fred Baker, an independent networking technologies consultant, longtime leader in the Internet Engineering Task Force and engineering fellow with Cisco, commented, "In my opinion, developments have not been 'out of control,' in the sense that the creation of Terminator's Skynet or the HAL 9000 computer might depict them. Rather, we have learned to automate processes in which neural networks have been able to follow data to its conclusion (which we call 'big data') unaided and uncontaminated by human intuition, and sometimes the results have surprised us. These remain, and in my opinion will remain, to be interpreted by human beings and used for our purposes."

Bob Frankston, software innovation pioneer and technologist based in North America, wrote, "It could go either way. AI could be a bureaucratic straitjacket and tool of surveillance. I'm betting that machine learning will be like the X-ray in giving us the ability to see new wholes and gain insights."

Perry Hewitt, a marketing, content and technology executive, wrote, "Today, voice-activated technologies are an untamed beast in our homes. Some 16% of Americans have a smart speaker, and yet they are relatively dumb devices: They misinterpret questions, offer generic answers and, to the consternation of some, are turning our kids into a**holes. I am bullish on human-machine interactions developing a better understanding of and improving our daily routines. I think in particular of the working parent, often although certainly not exclusively a woman, who carries so much information in their head. What if a human-machine collaboration could stock the house with essentials, schedule the pre-camp pediatrician appointments and prompt drivers for the alternate-side parking/street cleaning rules. The ability for narrow AI to assimilate new information (the bus is supposed to come at 7:10 but a month into the school year is known to actually come at 7:16) could keep a family connected and informed with the right data, and reduce the mental load of household management."

John McNutt, a professor in the school of public policy and administration at the University of Delaware, responded, "Throwing out technology because there is a potential downside is not how human progress takes place. In public service, a turbulent environment has created a situation where knowledge overload can seriously degrade our ability to do the things that are essential to implement policies and serve the public good. AI can be the difference between a public service that works well and one that creates more problems than it solves."

Randy Marchany, chief information security officer at Virginia Tech and director of Virginia Tech's IT Security Laboratory, said, "AI-human interaction in 2030 will be in its 'infancy' stage. AI will need to go to 'school' in a manner similar to humans. They will amass large amounts of data collected by various sources but need 'ethics' training to make good decisions. Just as kids are taught a wide variety of info and some sort of ethics (religion, social manners, etc.), AI will need similar training. Will AI get the proper training? Who decides the training content?"

Robert Stratton, cybersecurity expert, said, "While there is widespread acknowledgement in a variety of disciplines of the potential benefits of machine learning and artificial intelligence technologies, progress has been tempered by their misapplication. Part of data science is knowing the right tool for a particular job. As more-rigorous practitioners begin to gain comfort and apply these tools to other corpora it's reasonable to expect some significant gains in efficiency, insight or profitability in many fields. This may not be visible to consumers except through increased product choice, but it may include everything from drug discovery to driving."

A data analyst for an organization developing marketing solutions said, "Assuming that policies are in place to prevent the abuse of AI and programs are in place to find new jobs for those who would be career-displaced, there is a lot of potential in AI integration. By 2030, most AI will be used for marketing purposes and be more annoying to people than anything else as they are bombarded with personalized ads and recommendations. The rest of AI usage will be its integration into more tedious and repetitive tasks across career fields. Implementing AI in this fashion will open up more time for humans to focus on long-term and in-depth tasks that will allow further and greater societal progression. For example, AI can be trained to identify and codify qualitative information from surveys, reviews, articles, etc., far faster and in greater quantities than even a team of humans can. By having AI perform these tasks, analysts can spend more time parsing the data for trends and information that can then be used to make more-informed decisions faster and allow for speedier turn-around times. Minor product faults can be addressed before they become widespread, scientists can generate semiannual reports on environmental changes rather than annual or biannual."

Helena Draganik, a professor at the University of Gdańsk in Poland, responded, "AI will not change humans. It will change the relations between them because it can serve as an interpreter of communication. It will change our habits (as an intermediation technology). AI will be a great commodity. It will help in cases of health problems (diseases). It will also generate a great 'data industry' (big data) market and a lack of anonymity and privacy. Humanity will more and more depend on energy/electricity. These factors will create new social, cultural, security and political problems."

There are those who think there won't be much change by 2030.

Christine Boese, digital strategies professional, commented, "I believe it is as William Gibson postulated, 'The future is already here, it just not very evenly distributed.' What I know from my work in user-experience design and in exposure to many different Fortune 500 IT departments working in big data and analytics is that the promise and potential of AI and machine learning is VASTLY overstated. There has been so little investment in basic infrastructure, entire chunks of our systems won't even be interoperable. The AI and machine learning code will be there, in a pocket here, a pocket there, but system-wide, it is unlikely to be operating reliably as part of the background radiation against which many of us play and work online."

An anonymous respondent wrote, "While various deployments of new data science and computation will help firms cut costs, reduce fraud and support decision-making that involves access to more information than an individual can manage, organisations, professions, markets and regulators (public and private) usually take many more than 12 years to adapt effectively to a constantly changing set of technologies and practices. This generally causes a decline in service quality, insecurity over jobs and investments, new monopoly businesses distorting markets and social values, etc. For example, many organisations will be under pressure to buy and implement new services, but unable to access reliable market information on how to do this, leading to bad investments, distractions from core business, and labour and customer disputes."

Mario Morino, chairman of the Morino Institute and co-founder of Venture Philanthropy Partners, commented, "While I believe AI/ML will bring enormous benefits, it may take us several decades to navigate through the disruption and transition they will introduce on multiple levels."

Daniel Berninger, an internet pioneer who led the first VoIP deployments at Verizon, HP and NASA, currently founder at Voice Communication Exchange Committee (VCXC), said, "The luminaries claiming artificial intelligence will surpass human intelligence and promoting robot reverence imagine exponentially improving computation pushes machine self-actualization from science fiction into reality. The immense valuations awarded Google, Facebook, Amazon, Tesla, et al., rely on this machine-dominance hype to sell infinite scaling. As with all hype, pretending reality does not exist does not make reality go away. Moore's Law does not concede the future to machines, because human domination of the planet does not owe to computation. Any road map granting machines self-determination includes 'miracle' as one of the steps. You cannot turn a piece of wood into a real boy. AI merely 'models' human activity. No amount of improvement in the development of these models turns the 'model' into the 'thing.' Robot reverence attempts plausibility by collapsing the breadth of

human potential and capacities. It operates via 'denialism' with advocates disavowing the importance of anything they cannot model. In particular, super AI requires pretending human will and consciousness do not exist. Human beings remain the source of all intent and the judge of all outcomes. Machines provide mere facilitation and mere efficiency in the journey from intent to outcome. The dehumanizing nature of automation and the diseconomy of scale of human intelligence is already causing headaches that reveal another AI Winter arriving well before 2030."

Paul Kainen, futurist and director of the Lab for Visual Mathematics at Georgetown University, commented, "Quantum cat here: I expect complex superposition of strong positive, negative and null as typical impact for AI. For the grandkids' sake, we must be positive!"

The following one-liners from anonymous respondents also tie into AI in 2030:

An Internet Hall of Fame member wrote, "You'll talk to your digital assistant in a normal voice and it will just be there – it will often anticipate your needs, so you may only need to talk to it to correct or update it."

The director of a cognitive research group at one of the world's top AI and large-scale computing companies predicted that by 2030, "Smartphone-equivalent devices will support true natural-language dialog with episodic memory of past interactions. Apps will become low-cost digital workers with basic commonsense reasoning."

An anonymous Internet Hall of Fame member said, "The equivalent of the 'Star Trek' universal translator will become practical, enabling travelers to better interact with people in countries they visit, facilitate online discussions across language barriers, etc."

An Internet of Things researcher commented, "We need to balance between human emotions and machine intelligence – can machines be emotional? – that's the frontier we have to conquer."

An anonymous respondent wrote, "2030 is still quite possibly before the advent of human-level AI. During this phase AI is still mostly augmenting human efforts – increasingly ubiquitous, optimizing the systems that surround us and being replaced when their optimization criteria are not quite perfect – rather than pursuing those goals programmed into them, whether we find the realization of those goals desirable or not."

A research scientist who works for Google said, "Things will be better, although many people are deeply worried about the effects of AI."

An ARPANET and internet pioneer wrote, "The kind of AI we are currently able to build as good for data analysis but far, far away from 'human' levels of performance; the next 20 years won't change this, but we will have valuable tools to help analyze and control our world."

An artificial intelligence researcher working for one of the world's most powerful technology companies wrote, "AI will enhance our vision and hearing capabilities, remove language barriers, reduce time to find information we care about and help in automating mundane activities."

A manager with a major digital innovation company said, "Couple the information storage with the ever-increasing ability to rapidly search and analyze that data, and the benefits to augmenting human intelligence with this processed data will open up new avenues of technology and research throughout society."

Other anonymous respondents commented:

"AI will help people to manage the increasingly complex world we are forced to navigate. It will empower individuals to not be overwhelmed."

"AI will reduce human error in many contexts: driving, workplace, medicine and more."

"In teaching it will enhance knowledge about student progress and how to meet individual needs; it will offer guidance options based on the unique preferences of students that can guide learning and career goals."

"2030 is only 12 years from now, so I expect that systems like Alexa and Siri will be more helpful but still of only medium utility."

"AI will be a useful tool; I am quite a ways away from fearing SkyNet and the rise of the machines."

"AI will produce major benefits in the next 10 years, but ultimately the question is one of politics: Will the world somehow manage to listen to the economists, even when their findings are uncomfortable?"

"I strongly believe that an increasing use of numerical control will improve the lives of people in general."

"AI will help us navigate choices, find safer routes and avenues for work and play, and help make our choices and work more consistent."

"Many factors will be at work to increase or decrease human welfare, and it will be difficult to separate them."

AI will optimize and augment people's lives

The hopeful experts in this sample generally expect that AI will work to optimize, augment and improve human activities and experiences. They say it will save time and it will save lives via health advances and the reduction of risks and of poverty. They hope it will spur innovation and broaden opportunities, increase the value of human-to-human experiences, augment humans and increase individuals' overall satisfaction with life.

Clay Shirky, writer and consultant on the social and economic effects of internet technologies and vice president at New York University, said, "All previous forms of labor-saving devices, from the level to the computer, have correlated with increased health and lifespan in the places that have adopted them."

Jamais Cascio, research fellow at the Institute for the Future, wrote, "Although I do believe that in 2030 AI will have made our lives better, I suspect that popular media of the time will justifiably highlight the large-scale problems: displaced workers, embedded bias and human systems being too deferential to machine systems. But AI is more than robot soldiers, autonomous cars or digital assistants with quirky 'personalities.' Most of the AI we will encounter in 2030 will be in-the-walls, behind-the-scenes systems built to adapt workspaces, living spaces and the urban environment to better suit our needs. Medical AI will keep track of medication and alert us to early signs of health problems. Environmental AI will monitor air quality, heat index and other indicators relevant to our day's tasks. Our visual and audio surroundings may be altered or filtered to improve our moods, better our focus or otherwise alter our subconscious perceptions of the world. Most of this AI will be functionally invisible to us, as long as it's working properly. The explicit human-machine interface will be with a supervisor system that coordinates all of the sub-AI – and undoubtedly there will be a lively business in creating supervisor systems with quirky personalities."

Mike Meyer, chief information officer at Honolulu Community College, wrote, "Social organizations will be increasingly administered by AI/ML systems to ensure equity and consistency in provisioning of services to the population. The steady removal of human emotion-driven discrimination will rebalance social organizations creating true equitable opportunity to all people for the first time in human history. People will be part of these systems as censors, in the old imperial Chinese model, providing human emotional intelligence where that is needed to smooth social management. All aspects of human existence will be affected by the integration of AI into human societies. Historically this type of base paradigmatic change is both difficult and unstoppable. The results will be primarily positive but will produce problems both in the process of change and in totally new types of problems that will result from the ways that people do adapt the new technology-based processes."

Mark Crowley, an assistant professor, expert in machine learning and core member of the Institute for Complexity and Innovation at the University of Waterloo in Ontario, Canada, wrote, "While driving home on a long commute from work the human will be reading a book in the heads-up screen of the windshield. The car will be driving autonomously on the highway for the moment. The driver will have an idea to note down and add to a particular document; all this will be done via voice. In the middle of this a complicated traffic arrangement will be seen approaching via other networked cars. The AI will politely interrupt the driver, put away the heads-up display and warn the driver they may need to take over in the next 10 seconds or so. The conversation will be flawless and

natural, like Jarvis in 'Avengers,' even charming. But it will be tasks-focused to the car, personal events, notes and news."

Theodore Gordon, futurist, management consultant and co-founder of the Millennium Project, commented, "There will be ups and downs, surely, but the net is, I believe, good. The most encouraging uses of AI will be in early warning of terror activities, incipient diseases and environmental threats and in improvements in decision-making."

Yvette Wohn, director of the Social Interaction Lab and expert on human-computer interaction at the New Jersey Institute of Technology, said, "One area in which artificial intelligence will become more sophisticated will be in its ability to enrich the quality of life so that the current age of workaholism will transition into a society where leisure, the arts, entertainment and culture are able to enhance the well-being of society in developed countries and solve issues of water production, food growth/distribution and basic health provision in developing countries."

Ken Goldberg, distinguished chair in engineering, director of AUTOLAB's and CITRIS' "people and robots" initiative, and founding member of the Berkeley Artificial Intelligence Research Lab at the University of California, Berkeley, said, "As in the past 50+ years, AI will be combined with IA (intelligence augmentation) to enhance humans' ability to work. One example might be an AI-based 'Devil's Advocate' that would challenge my decisions with insightful questions (as long as I can turn it off periodically)."

Rich Ling, a professor of media technology at Nanyang Technological University, responded, "The ability to address complex issues and to better respond to and facilitate the needs of people will be the dominant result of AI."

An anonymous respondent wrote, "There will be an explosive increase in the number of autonomous cognitive agents (e.g., robots), and humans will interact more and more with them, being unaware, most of the time, if it is interactivity with a robot or with another human. This will increase the number of personal assistants and the level of service."

Fred Davis, mentor at Runway Incubator in San Francisco, responded, "As daily a user of the Google Assistant on my phone and both Google Home and Alexa, I feel like AI has already been delivering significant benefits to my daily life for a few years. My wife and I take having an always-on omnipresent assistant on hand for granted at this point. Google Home's ability to tell us apart and even respond with different voices is a major step forward in making computers people-literate, rather than the other way around. There's always a concern about privacy, but so far it hasn't caused us any problems. Obviously, this could change and instead of a helpful friend I might look at these assistants as creepy strangers. Maintaining strict privacy and security controls is essential for these types of services."

Andrew Tutt, an expert in law and author of "An FDA for Algorithms," which called for "critical thought about how best to prevent, deter and compensate for the harms that they cause," said, "AI will be absolutely pervasive and absolutely seamless in its integration with everyday life. It will simply become accepted that AI are responsible for ever-more-complex and ever-more-human tasks. By 2030, it will be accepted that when you wish to hail a taxi the taxi will have no driver – it will be an autonomously driven vehicle. Robots will be responsible for more-dynamic and complex roles in manufacturing plants and warehouses. Digital assistants will play an important and interactive role in everyday interactions ranging from buying a cup of coffee to booking a salon appointment. It will no longer be unexpected to call a restaurant to book a reservation, for example, and speak to a 'digital' assistant who will pencil you in. These interactions will be incremental but become increasingly common and increasingly normal. My hope is that the increasing integration of AI into everyday life will vastly increase the amount of time that people can devote to tasks they find meaningful."

L. Schomaker, professor at the University of Groningen and scientific director of the Artificial Intelligence and Cognitive Engineering (ALICE) research institute, said, "In the 1990s, you went to a PC on a desktop in a room in your house. In the 2010s you picked a phone from your pocket and switched it on. By 2030 you will be online 24/7 via miniature devices such as in-ear continuous support, advice and communications."

Michael Wollowski, associate professor of computer science and software engineering at Rose-Hulman Institute of Technology and expert in the Internet of Things, diagrammatic systems, and artificial intelligence, wrote, "Assuming that industry and government are interested in letting the consumer choose and influence the future, there will be many fantastic advances of AI. I believe that AI and the Internet of Things will bring about a situation in which technology will be our guardian angel. For example, self-driving cars will let us drive faster than we ever drove before, but they will only let us do things that they can control. Since computers have much better reaction time than people, it will be quite amazing. Similarly, AI and the Internet of Things will let us conduct out lives to the fullest while ensuring that we live healthy lives. Again, it is like having a guardian angel that lets us do things, knowing they can save us from stupidity."

Steve King, partner at Emergent Research, said, "2030 is less than 12 years away. So ... the most likely scenario is AI will have a modest impact on the lives of most humans over this time frame. Having said that, we think the use of AI systems will continue to expand, with the greatest growth coming from systems that augment and complement human capabilities and decision-making. This is not to say there won't be negative impacts from the use of AI. Jobs will be replaced, and certain industries will be disrupted. Even scarier, there are many ways AI can be weaponized. But like most technological advancements, we think the overall impact of AI will be additive – at least over the next decade or so."

Vassilis Galanos, a Ph.D. student and teaching assistant actively researching future human-machine symbiosis at the University of Edinburgh, commented, "2030 is not that far away, so there is no room for extremely utopian/dystopian hopes and fears. ... Given that AI is already used in everyday life (social-media algorithms, suggestions, smartphones, digital assistants, health care and more), it is quite probable that humans will live in a harmonious co-existence with AI as much as they do now – to a certain extent – with computer and internet technologies."

Charlie Firestone, communications and society program executive director and vice president at the Aspen Institute, commented, "I remain optimistic that AI will be a tool that humans will use, far more widely than today, to enhance quality of life such as medical remedies, education and the environment. For example, the AI will help us to conserve energy in homes and in transportation by identifying exact times and temperatures we need, identifying sources of energy that will be the cheapest and the most efficient. There certainly are dire scenarios, particularly in the use of AI for surveillance, a likely occurrence by 2030. I am hopeful that AI and other technologies will identify new areas of employment as it eliminates many jobs."

Pedro U. Lima, an associate professor of computer science at Instituto Superior Técnico in Lisbon, Portugal, said, "Overall, I see AI-based technology relieving us from repetitive and/or heavy and/or dangerous tasks, opening new challenges for our activities. I envisage autonomous mobile robots networked with a myriad of other smart devices, helping nurses and doctors at hospitals in daily activities, working as a 'third hand' and (physical and emotional) support to patients. I see something similar happening in factories, where networked robot systems will help workers on their tasks, relieving them from heavy duties."

John Laird, a professor of computer science and engineering at the University of Michigan, responded, "There will be a continual off-loading of mundane intellectual and physical tasks on to AI and robotic systems. In addition to helping with everyday activities, it will significantly help the mentally and physically impaired and disabled. There will also be improvements in customized/individualized education and training of humans, and conversely, the customization of AI systems by everyday users. We will be transitioning from current programming practices to user customization. Automated driving will be a reality, eliminating many deaths but also having significant societal changes."

Steven Polunsky, director of the Alabama Transportation Policy Research Center at the University of Alabama, wrote, "AI will allow public transportation systems to better serve existing customers by adjusting routes, travel times and stops to optimize service. New customers will also see advantages. Smart transportation systems will allow public transit to network with traffic signals and providers of 'last-mile' trips to minimize traffic disruption and inform decision making about modal (rail, bus, mobility-on-demand) planning and purchasing."

Sanjiv Das, a professor of data science and finance at Santa Clara University, responded, "AI will enhance search to create interactive reasoning and analytical systems. Search engines today do not know 'why' we want some information and hence cannot reason about it. They also do not interact with us to help with analysis. An AI system that collects information based on knowing why it is needed and then asks more questions to refine its search would be clearly available well before 2030. These 'search-thinking bots' will also write up analyses based on parameters elicited from conversation and imbue these analyses with different political (left/right) and linguistic (aggressive/mild) slants, chosen by the human, using advances in language generation, which are already well under way. These 'intellectual' agents will become companions, helping us make sense of our information overload. I often collect files of material on my cloud drive that I found interesting or needed to read later, and these agents would be able to summarize and engage me in a discussion of these materials, very much like an intellectual companion. It is unclear to me if I would need just one such agent, though it seems likely that different agents with diverse personalities may be more interesting! As always, we should worry what the availability of such agents might mean for normal human social interaction, but I can also see many advantages in freeing up time for socializing with other humans as well as enriched interactions, based on knowledge and science, assisted by our new intellectual companions."

Lawrence Roberts, designer and manager of ARPANET, the precursor to the internet and Internet Hall of Fame member, commented, "AI voice recognition, or text, with strong context understanding and response will allow vastly better access to website, program documentation, voice call answering, and all such interactions will greatly relieve user frustration with getting information. It will mostly provide service where no or little human support is being replaced as it is not available today in large part. For example, finding and/or doing a new or unused function of the program or website one is using. Visual, 3D-space-recognition AI to support better-than-human robot activity including vehicles, security surveillance, health scans and much more."

Christopher Yoo, a professor of law, communication and computer and information science at the University of Pennsylvania Law School, responded, "AI is good at carrying out tasks that follow repetitive patterns. In fact, AI is better than humans. Shifting these functions to machines will improve performance. It will also allow people to shift their efforts to high-value-added and more-rewarding directions, an increasingly critical consideration in developing world countries where population is declining. Research on human-computer interaction (HCI) also reveals that AI-driven pattern recognition will play a critical role in expanding humans' ability to extend the benefits of computerization. HCI once held that our ability to gain the benefit from computers would be limited by the total amount of time people can spend sitting in front of a screen and inputting characters through a keyboard. The advent of AI-driven HCI will allow that to expand further and will reduce the amount of customization that people will have to program in by hand. At the same time, AI is merely a tool. All tools have their limits and can be misused. Even when humans are making the decisions instead of machines, blindly following the results of a protocol without exercising any judgment, can have disastrous results. Future applications of AI will thus likely involve both humans and machines if they are to fulfill their potential."

Joseph Konstan, distinguished professor of computer science specializing in human-computer interaction and AI at the University of Minnesota, predicted, "Widespread deployment of AI has immense potential to help in key areas that affect a large portion of the world's population, including agriculture, transportation (more efficiently getting food to people) and energy. Even as soon as 2030, I expect we'll see substantial benefits for many who are today disadvantaged, including the elderly and physically handicapped (who will have greater choices for mobility and support) and those in the poorest part of the world."

The future of work: Some predict new work will emerge or solutions will be found, while others have

deep concerns about massive job losses and an unraveling society

A number of expert insights on this topic were shared earlier in this report. These additional observations add to the discussion of hopes and concerns about the future of human jobs. This segment starts with comments from those who are hopeful that the job situation and related social issues will turn out well. It is followed by statements from those who are pessimistic.

Respondents who were positive about the future of AI and work

Bob Metcalfe, Internet Hall of Fame member, co-inventor of Ethernet, founder of 3Com and now professor of innovation and entrepreneurship at the University of Texas at Austin, said, "Pessimists are often right, but they never get anything done. All technologies come with problems, sure, but ... generally, they get solved. The hardest problem I see is the evolution of work. Hard to figure out. Forty percent of us used to know how to milk cows, but now less than 1% do. We all used to tell elevator operators which floor we wanted, and now we press buttons. Most of us now drive cars and trucks and trains, but that's on the verge of being over. AIs are most likely not going to kill jobs. They will handle parts of jobs, enhancing the productivity of their humans."

Stowe Boyd, founder and managing director at Work Futures, said, "There is a high possibility that unchecked expansion of AI could rapidly lead to widespread unemployment. My bet is that governments will step in to regulate the spread of AI, to slow the impacts of this phenomenon as a result of unrest by the mid 2020s. That regulation might include, for example, not allowing AIs to serve as managers of people in the workplace, but only to augment the work of people on a task or process level. So, we might see high degrees of automation in warehouses, but a human being would be 'in charge' in some sense. Likewise, fully autonomous freighters might be blocked by regulations."

An anonymous respondent wrote, "Repeatedly throughout history people have worried that new technologies would eliminate jobs. This has never happened, so I'm very skeptical it will this time. Having said that, there will be major short-term disruptions in the labor market and smart governments should begin to plan for this by considering changes to unemployment insurance, universal basic income, health insurance, etc. This is particularly the case in America, where so many benefits are tied to employment. I would say there is almost zero chance that the U.S. government will actually do this, so there will be a lot of pain and misery in the short and medium term, but I do think ultimately machines and humans will peacefully coexist. Also, I think a lot of the projections on the use of AI are ridiculous. Regardless of the existence of the technology, cross-state shipping is not going to be taken over by automated trucks any time soon because of legal and ethical issues that have not been worked out."

Steven Miller, vice provost and professor of information systems at Singapore Management University, said, "It helps to have a sense of the history of technological change over the past few hundred years (even longer). Undoubtedly, new ways of using machines and new machine capabilities will be used to create economic activities and services that were either a) not previously possible, or b) previously too scarce and expensive, and now can be plentiful and inexpensive. This will create a lot of new activities and opportunities. At the same time, we know some existing tasks and jobs with a high proportion of those tasks will be increasingly automated. So we will simultaneously have both new opportunity creation as well as technological displacement. Even so, the long-term track record shows that human societies keep finding ways of creating more and more economically viable jobs. Cognitive automation will obviously enhance the realms of automation, but even with tremendous progress in this technology, there are and will continue to be limits. Humans have remarkable capabilities to deal with and adapt to change, so I do not see the 'end of human work.' The ways people and machines combine together will change – and there will be many new types of human-machine symbiosis. Those who understand this and learn to benefit from it will proposer."

Henry E. Brady, dean of the Goldman School of Public Policy at the University of California, Berkeley, wrote, "AI can replace people in jobs that require sophisticated and accurate pattern matching – driving, diagnoses based upon medical imaging, proofreading and other areas. There is also the fact that in the past technological change has mostly led to new kinds of jobs rather than the net elimination of jobs. Furthermore, I also believe that there may be limits to what AI can do. It is very good at pattern matching, but human intelligence goes far beyond pattern matching and it is not clear that computers will be able to compete with humans beyond pattern matching. It also seems clear that even the best algorithms will require constant human attention to update, check and revise them."

Geoff Livingston, author and futurist, commented, "The term AI misleads people. What we should call the trend is machine learning or algorithms. 'Weak' AI as it is called – today's AI – reduces repetitive tasks that most people find mundane. This in turn produces an opportunity to escape the trap of the proletariat, being forced into monotonous labor to earn a living. Instead of thinking of the 'Terminator,' we should view the current trend as an opportunity to seek out and embrace the tasks that we truly love, including more creative pursuits. If we embrace the inevitable evolution of technology to replace redundant tasks, we can encourage today's youth to pursue more creative and strategic pursuits. Further, today's workers can learn how to manage machine learning or embrace training to pursue new careers that they may enjoy more. My fear is that many will simply reject change and blame technology, as has often been done. One could argue much of today's populist uprising we are experiencing globally finds its roots in the current displacements caused by machine learning as typified by smart manufacturing. If so, the movement forward will be troublesome, rife with dark bends and turns that we may regret as cultures and countries."

Marek Havrda, director at NEOPAS and strategic adviser for the GoodAI project, a private research and development company based in Prague that focuses on the development of artificial general intelligence and AI applications, explained the issue from his point of view, "The development and implementation of artificial intelligence has brought about questions of the impact it will have on employment. Machines are beginning to fill jobs that have been traditionally reserved for humans, such as driving a car or prescribing medical treatment. How these trends may unfold is a crucial question. We may expect the emergence of 'super-labour,' a labour defined by super-high-added-value of human activity due to augmentation by AI. Apart from the ability to deploy AI, super-labour will be characterised by creativity and the ability to co-direct and supervise safe exploration of business opportunities together with perseverance in attaining defined goals. An example may be that by using various online, AI gig workers (and maybe several human gig workers), while leveraging AI to its maximum potential ... at all aspects from product design to marketing and after-sales care, three people could create a new service and ensure its smooth delivery for which a medium-size company would be needed today. We can expect growing inequalities between those who have access and are able to use technology and those who do not. However, it seems more important how big a slice of the AI co-generated 'pie' is accessible to all citizens in absolute terms (e.g., having enough to finance public service and other public spending) which would make everyone better off than in pre-AI age, than the relative inequalities."

Yoram Kalman, an associate professor at the Open University of Israel and member of The Center for Internet Research at the University of Haifa, wrote, "In essence, technologies that empower people also improve their lives. I see that progress in the area of human-machine collaboration empowers people by improving their ability to communicate and to learn, and thus my optimism. I do not fear that these technologies will take the place of people, since history shows that again and again people used technologies to augment their abilities and to be more fulfilled. Although in the past, too, it seemed as if these technologies would leave people unemployed and useless, human ingenuity and the human spirit always found new challenges that could best be tackled by humans."

Thomas H. Davenport, distinguished professor of information technology and management at Babson College and fellow of the MIT Initiative on the Digital Economy, responded, "So far, most implementations of AI have resulted in some form of augmentation, not automation. Surveys of managers suggest that relatively few have automation-based job loss as the goal of their AI initiatives. So

while I am sure there will be some marginal job loss, I expect that AI will free up workers to be more creative and to do more unstructured work."

Yvette Wohn, director of the Social Interaction Lab and expert on human-computer interaction at the New Jersey Institute of Technology, commented, "Artificial intelligence will be naturally integrated into our everyday lives. Even though people are concerned about computers replacing the jobs of humans the best-case scenario is that technology will be augmenting human capabilities and performing functions that humans do not like to do. Smart farms and connected distribution systems will hopefully eliminate urban food deserts and enable food production in areas not suited for agriculture. Artificial intelligence will also become better at connecting people and provide immediate support to people who are in crisis situations."

A principal architect for a major global technology company responded, "AI is a prerequisite to achieving a post-scarcity world, in which people can devote their lives to intellectual pursuits and leisure rather than to labor. The first step will be to reduce the amount of labor required for production of human necessities. Reducing tedium will require changes to the social fabric and economic relationships between people as the demand for labor shrinks below the supply, but if these challenges can be met then everyone will be better off."

Tom Hood, an expert in corporate accounting and finance, said, "By 2030, AI will stand for Augmented Intelligence and will play an ever-increasing role in working side-by-side with humans in all sectors to add its advanced and massive cognitive and learning capabilities to critical human domains like medicine, law, accounting, engineering and technology. Imagine a personal bot powered by artificial intelligence working by your side (in your laptop or smartphone) making recommendations on key topics by providing up-to-the-minute research or key pattern recognition and analysis of your organization's data? One example is a CPA in tax given a complex global tax situation amid constantly changing tax laws in all jurisdictions who would be able to research and provide guidance on the most complex global issues in seconds. It is my hope for the future of artificial intelligence in 2030 that we will be augmenting our intelligence with these 'machines.'"

A professor of computer science expert in systems who works at a major U.S. technological university wrote, "By 2030, we should expect advances in AI, networking and other technologies enabled by AI and networks, e.g., the growing areas of persuasive and motivational technologies, to improve the workplace in many ways beyond replacing humans with robots."

The following one-liners from anonymous respondents express a bright future for human jobs:

"History of technology shows that the number of new roles and jobs created will likely exceed the number of roles and jobs that are destroyed."

"AI will not be competing with humanity but augmenting it for the better."

"We make a mistake when we look for direct impact without considering the larger picture – we worry about a worker displaced by a machine rather than focus on broader opportunities for a better-trained and healthier workforce where geography or income no longer determine access not just to information but to relevant and appropriate information paths."

"AI can significantly improve usability and thus access to the benefits of technology. Many powerful technical tools today require detailed expertise, and AI can bring more of those to a larger swath of the population."

Respondents who have fears about AI's impact on work

A section earlier in this report shared a number of key experts' concerns about the potential negative impact of AI on the socioeconomic future if steps are not taken soon to begin to adjust to a future with far fewer jobs for humans. Many additional respondents to this canvassing shared fears about this.

Wout de Natris, an internet cybercrime and security consultant based in Rotterdam, Netherlands, wrote, "Hope: Advancement in health care, education, decision-making, availability of information, higher standards in ICT-security, global cooperation on these issues, etc. Fear: Huge segments of society, especially the middle classes who carry society in most ways, e.g., through taxes, savings and

purchases, will be rendered jobless through endless economic cuts by industry, followed by governments due to lower tax income. Hence all of society suffers. Can governments and industry refrain from an overkill of surveillance? Otherwise privacy values keep declining, leading to a lower quality of life."

Jonathan Taplin, director emeritus at the University of Southern California's Annenberg Innovation Lab, wrote, "My fear is that the current political class is completely unprepared for the disruptions that AI and robotics applied at scale will bring to our economy. While techno-utopians point to universal basic income as a possible solution to wide-scale unemployment, there is no indication that anyone in politics has an appetite for such a solution. And because I believe that meaningful work is essential to human dignity, I'm not sure that universal basic income would be helpful in the first place."

Alex Halavais, an associate professor of social technologies at Arizona State University, wrote, "AI is likely to rapidly displace many workers over the next 10 years, and so there will be some potentially significant negative effects at the social and economic level in the short run."

Uta Russmann, professor in the department of communication at FHWien der WKW University of Applied Sciences for Management & Communication, said, "Many people will not be benefitting from this development, as robots will do their jobs. Blue-collar workers, people working in supermarkets stacking shelves, etc., will not be needed less, but the job market will not offer them any other possibilities. The gap between rich and poor will increase as the need for highly skilled and very well-paid people increases and the need for less skilled workers will decrease tremendously."

Ross Stapleton-Gray, principal at Stapleton-Gray and Associates, an information technology and policy consulting firm, commented, "Human-machine interaction could be for good or for ill. It will be hugely influenced by decisions on social priorities. We may be at a tipping point in recognizing that social inequities need to be addressed, so, say, a decreased need for human labor due to AI will result in more time for leisure, education, etc., instead of increasing wealth inequity."

Aneesh Aneesh, author of "Global Labor: Algocratic Modes of Organization" and professor at the University of Wisconsin, Milwaukee, responded, "Just as automation left large groups of working people behind even as the United States got wealthier as a country, it is quite likely that AI systems will automate the service sector in a similar way. Unless the welfare state returns with a vengeance, it is difficult to see the increased aggregate wealth resulting in any meaningful gains for the bottom half of society."

Alper Dincel of T.C. Istanbul Kultur University in Turkey, wrote, "Unqualified people won't find jobs, as machines and programs take over easy work in the near future. Machines will also solve performance problems. There is no bright future for most people if we don't start to try finding solutions."

Jason Abbott, professor and director at the Center for Asian Democracy at University of Louisville, said, "AI is likely to create significant challenges to the labor force as previously skilled (semi-skilled) jobs are replaced by AI – everything from AI in trucks and distribution to airlines, logistics and even medical records and diagnoses."

Kenneth R. Fleischmann, an associate professor at the University of Texas at Austin's School of Information, responded, "In corporate settings, I worry that AI will be used to replace human workers to a disproportionate extent, such that the net economic benefit of AI is positive, but that economic benefit is not distributed equally among individuals, with a smaller number of wealthy individuals worldwide prospering, and a larger number of less wealthy individuals worldwide suffering from fewer opportunities for gainful employment."

Gerry Ellis, founder and digital usability and accessibility consultant at Feel The BenefIT, responded, "Technology has always been far more quickly developed and adopted in the richer parts of the world than in the poorer regions where new technology is generally not affordable. AI cannot be taken as a stand-alone technology but in conjunction with other converging technologies like augmented reality, robotics, virtual reality, the Internet of Things, big data analysis, etc. It is estimated that around 80% of jobs that will be done in 2030 do not exist yet. One of the reasons why unskilled and particularly

repetitive jobs migrate to poor countries is because of cheap labour costs, but AI combined with robotics will begin to do many of these jobs. For all of these reasons combined, the large proportion of the earth's population that lives in the under-developed and developing world is likely to be left behind by technological developments. Unless the needs of people with disabilities are taken into account when designing AI related technologies, the same is true for them (or I should say 'us,' as I am blind)."

Karen Oates, director of workforce development and financial stability for La Casa de Esperanza, commented, "Ongoing increases in the use of AI will not benefit the working poor and low-to-middle-income people. Having worked with these populations for 10 years I've already observed many of these people losing employment when robots and self-operating forklifts are implemented. Although there are opportunities to program and maintain these machines, realistically people who have the requisite knowledge and education will fill those roles. The majority of employers will be unwilling to invest the resources to train employees unless there is an economic incentive from the government to do so. Many lower-wage workers won't have the confidence to return to school to develop new knowledge/skills when they were unsuccessful in the past. As the use of AI increases, low-wage workers will lose the small niche they hold in our economy."

Peggy Lahammer, director of health/life sciences at Robins Kaplan LLP and legal market analyst, commented, "Jobs will continue to change and as many disappear new ones will be created. These changes will have an impact on society as many people are left without the necessary skills."

A European computer science professor expert in machine learning commented, "The social sorting systems introduced by AI will most likely define and further entrench the existing world order of the haves and the have-nots, making social mobility more difficult and precarious given the unpredictability of AI-driven judgements of fit. The interesting problem to solve will be the fact that initial designs of AI will come with built-in imaginaries of what 'good' or 'correct' constitutes. The level of flexibility designed in to allow for changes in normative perceptions and judgements will be key to ensuring that AI driven-systems support rather than obstruct productive social change."

Stephen McDowell, a professor of communication at Florida State University and expert in new media and internet governance, commented, "Much of our daily lives is made up of routines and habits that we repeat, and AI could assist in these practices. However, just because some things we do are repetitive does not mean they are insignificant. We draw a lot of meaning from things we do on a daily, weekly or annual basis, whether by ourselves or with others. Cultural practices such as cooking, shopping, cleaning, coordinating and telling stories are crucial parts of building our families and larger communities. Similarly, at work, some of the routines are predictable, but are also how we gain a sense of mastery and expertise in a specific domain. In both these examples, we will have to think about how we define knowledge, expertise, collaboration, and growth and development."

David Sarokin, author of "Missed Information: Better Information for Building a Wealthier, More Sustainable Future," commented, "My biggest concern is that our educational system will not keep up with the demands of our modern times. It is doing a poor job of providing the foundations to our students. As more and more jobs are usurped by AI-endowed machines – everything from assembling cars to flipping burgers – those entering the workplace will need a level of technical sophistication that few graduates possess these days."

Justin Amyx, a technician with Comcast, said, "My worry is automation. Automation occurs usually with mundane tasks that fill low-paying, blue-collar-and-under jobs. Those jobs will disappear – lawn maintenance, truck drivers and fast food, to name a few. Those un-skilled or low-skilled workers will be jobless. Unless we have training programs to take care of worker displacement there will be issues."

The future of health care: Great expectations for many lives saved, extended and improved, mixed

with worries about data abuses and a divide between 'the haves and have-nots'

Many of these experts have high hopes for continued incremental advances across all aspects of health care and life extension. They predict a rise in access to various tools, including digital agents that can perform rudimentary exams with no need to visit a clinic, a reduction in medical errors and better, faster recognition of risks and solutions. They also worry over the potential for a widening health care divide between those who can afford cutting-edge tools and treatments and those less privileged. They also express concerns about the potential for data abuses such as the denial of insurance or coverage or benefits for select people or procedures.

Leonard Kleinrock, Internet Hall of Fame member and co-director of the first host-to-host online connection and professor of computer science at the University of California, Los Angeles, predicted, "As AI and machine learning improve, we will see highly customized interactions between humans and their health care needs. This mass customization will enable each human to have her medical history, DNA profile, drug allergies, genetic makeup, etc., always available to any caregiver/medical professional that they engage with, and this will be readily accessible to the individual as well. Their care will be tailored to their specific needs and the very latest advances will be able to be provided rapidly after the advances are established. The rapid provision of the best medical treatment will provide great benefits. In hospital settings, such customized information will dramatically reduce the occurrence of medical injuries and deaths due to medical errors. My hope and expectation is that intelligent agents will be able to assess the likely risks and the benefits that ensue from proposed treatments and procedures, far better than is done now by human evaluators, such humans, even experts, typically being poor decision makers in the face of uncertainty. But to bring this about, there will need to be carefully conducted tests and experimentation to assess the quality of the outcomes of AI-based decision making in this field. However, as with any 'optimized' system, one must continually be aware of the fragility of optimized systems when they are applied beyond the confines of their range of applicability."

Kenneth Grady, futurist, founding author of the Algorithmic Society blog and adjunct and advisor at the Michigan State University College of Law, responded, "In the next dozen years, AI will still be moving through a phase where it will augment what humans can do. It will help us sift through, organize and even evaluate the mountains of data we create each day. For example, doctors today still work with siloed data. Each patient's vital signs, medicines, dosage rates, test results and side effects remain trapped in isolated systems. Doctors must evaluate this data without the benefit of knowing how it compares to the thousands of other patients around the country (or world) with similar problems. They struggle to turn the data into effective treatments by reading research articles and mentally comparing them to each patient's data. As it evolves, AI will improve the process. Instead of episodic studies, doctors will have near-real-time access to information showing the effects of treatment regimes. Benefits and risks of drug interactions will be identified faster. Novel treatments will become evident more quickly. Doctors will still manage the last mile, interpreting the analysis generated through AI. This human in the loop approach will remain critical during this phase. As powerful as AI will become, it still will not match humans on understanding how to integrate treatment with values. When will a family sacrifice effectiveness of treatment to prolong quality of life? When two life-threatening illnesses compete, which will the patient want treated first? This will be an important learning phase, as humans understand the limits of AI."

Charles Zheng, a researcher into machine learning and AI with the National Institute of Mental Health, commented, "In the year 2030, I expect AI will be more powerful than they currently are, but not yet at human level for most tasks. A patient checking into a hospital will be directed to the correct desk by a robot. The receptionist will be aided by software that listens to their conversation with the patient and automatically populates the information fields without needing the receptionist to type the information. Another program cross-references the database in the cloud to check for errors. The patient's medical images would first be automatically labeled by a computer program before being sent to a radiologist."

A professor of computer science expert in systems who works at a major U.S. technological university wrote, "By 2030 … physiological monitoring devices (e.g., lower heartbeats and decreasing blood sugar levels) could indicate lower levels of physical alertness. Smart apps could detect those decaying physical conditions (at an individual level) and suggest improvements to the user (e.g., taking a coffee break with a snack). Granted, there may be large-scale problems caused by AI and robots, e.g., massive unemployment, but the recent trends seem to indicate small improvements such as health monitor apps outlined above, would be more easily developed and deployed successfully."

Kenneth Cukier, author and senior editor at The Economist, commented, "AI will be making more decisions in life, and some people will be uneasy with that. But these are decisions that are more effectively done by machines, such as assessing insurance risk, the propensity to repay a loan or to survive a disease. A good example is health care: Algorithms, not doctors, will be diagnosing many diseases, even if human doctors are still 'in the loop.' The benefit is that healthcare can reach down to populations that are today underserved: the poor and rural worldwide."

Gabor Melli, senior director of engineering for AI and machine learning for Sony PlayStation, responded, "My hope is that by 2030 most of humanity will have ready access to health care and education through digital agents."

Kate Eddens, research scientist at the Indiana University Network Science Institute, responded, "There is an opportunity for AI to enhance human ability to gain critical information in decision-making, particularly in the world of health care. There are so many moving parts and components to understanding health care needs and deciding how to proceed in treatment and prevention. With AI, we can program algorithms to help refine those decision-making processes, but only when we train the AI tools on human thinking, a tremendous amount of real data and actual circumstances and experiences. There are some contexts in which human bias and emotion can be detrimental to decision-making. For example, breast cancer is over-diagnosed and over-treated. While mammography guidelines have changed to try to reflect this reality, strong human emotion powered by anecdotal experience leaves some practitioners unwilling to change their recommendations based on evidence and advocacy groups reluctant to change their stance based on public outcry. Perhaps there is an opportunity for AI to calculate a more specific risk for each individual person, allowing for a tailored experience amid the broader guidelines. If screening guidelines change to 'recommended based on individual risk,' it lessens the burden on both the care provider and the individual. People still have to make their own decisions, but they may be able to do so with more information and a greater understanding of their own risk and reward. This is such a low-tech and simple example of AI, but one in which AI can – importantly – supplement human decision-making without replacing it."

Angelique Hedberg, senior corporate strategy analyst at RTI International, said, "The greatest advancements and achievements will be in health – physical, mental and environmental. The improvements will have positive trickle-down impacts on education, work, gender equality and reduced inequality. AI will redefine our understanding of health care, optimizing existing processes while simultaneously redefining how we answer questions about what it means to be healthy, bringing care earlier in the cycle due to advances in diagnostics and assessment, i.e. in the future preventative care identifies and initiates treatment for illness before symptoms present. The advances will not be constrained to humans; they will include animals and the built environment. This will happen across the disease spectrum. Advanced 'omics' will empower better decisions. There will be a push and a pull by the market and individuals. This is a global story, with fragmented and discontinuous moves being played out over the next decade as we witness wildly different experiments in health across the globe. This future is full of hope for individuals and communities. My greatest hope is for disabled individuals and those currently living with disabilities. I'm excited for communities and interpersonal connections as the work in this future will allow for and increase the value of the human-to-human experiences. Progress is often only seen in retrospect; I hope the speed of exponential change allows everyone to enjoy the benefits of these collaborations."

An anonymous respondent wrote, "In health care, I hope AI will improve the diagnostics and reduce the number of errors. Doctors cannot recall all the possibilities; they have problems correlating

all the symptoms and recognizing the patterns. I hope that in the future patients will be interviewed by computers, which will correlate the described symptoms with results of tests. I hope that with the further development of AI and cognitive computing there will be fewer errors in reports of medical imaging and diagnosis."

Eduardo Vendrell, a computer science professor at the Polytechnic University of Valencia in Spain, responded, "In the field of health, many solutions will appear that will allow us to anticipate current problems and discover other risk situations more efficiently. The use of personal gadgets and other domestic devices will allow interacting directly with professionals and institutions in any situation of danger or deterioration of our health."

Monica Murero, director of the E-Life International Institute and associate professor in sociology of new technology at the University of Naples Federico II in Italy, commented, "In health care, I foresee positive outcomes in terms of reducing human mistakes, that are currently still creating several failures. Also, I foresee an increased development of mobile (remote) 24/7 health care services and personalized medicine thanks to AI and human-machine collaboration applied to the field."

Uta Russmann, professor in the department of communication at FHWien der WKW University of Applied Sciences for Management & Communication, said, "Life expectancy is increasing (globally) and human-machine/AI collaboration will help older people to manage their life on their own by taking care of them, helping them in the household (taking down the garbage, cleaning up, etc.) as well as keeping them company – just like cats and dogs do, but it will be a much more 'advanced' interaction."

Lindsey Andersen, an activist at the intersection of human rights and technology for Freedom House and Internews, now doing graduate research at Princeton University, commented, "AI will augment human intelligence. In health care, for example, it will help doctors more accurately diagnose and treat disease and continually monitor high-risk patients through internet-connected medical devices. It will bring health care to places with a shortage of doctors, allowing health care workers to diagnose and treat disease anywhere in the world and to prevent disease outbreaks before they start."

An anonymous respondent said, "The most important place where AI will make a difference is in health care of the elderly. Personal assistants are already capable of many important tasks to help make sure older adults stay in their home. But adding to that emotion detection, more in-depth health monitoring and AI-based diagnostics will surely enhance the power of these tools."

Denis Parra, assistant professor of computer science in the school of engineering at the Pontifical Catholic University of Chile Chile, commented, "I live in a developing country. Whilst there are potential negative aspects of AI (loss of jobs), for people with disabilities AI technology could improve their lives. I imagine people entering a government office or health facility where people with eye- or ear-related disabilities could effortlessly interact to state their necessities and resolve their information needs."

Timothy Leffel, research scientist, National Opinion Research Center (NORC) at the University of Chicago, said, "Formulaic transactions and interactions are particularly ripe for automation. This can be good in cases where human error can cause problems, e.g., for well-understood diagnostic medical testing."

Jean-Daniel Fekete, researcher in human-computer interaction at INRIA in France, said, "Humans and machines will integrate more, improving health through monitoring and easing via machine control. Personal data will then become even more revealing and intrusive and should be kept under personal control."

Joe Whittaker, a former professor of sciences and associate director of the NASA GESTAR program, now associate provost at Jackson State University, responded, "My hope is that AI/human-machine interface will become commonplace especially in the academic research and health care arena. I envision significant advances in brain-machine interface to facilitate mitigation of physical and mental challenges. Similar uses in robotics should also be used to assist the elderly."

James Gannon, global head of eCompliance for emerging technology, cloud and cybersecurity at Novartis, responded, "AI will increase the speed and availability to develop drugs and therapies for

orphan indications. AI will assist in general lifestyle and health care management for the average person."

Jay Sanders, president and CEO of the Global Telemedicine Group, responded, "AI will bring collective expertise to the decision point, and in health care, bringing collective expertise to the bedside will save many lives now lost by individual medical errors."

Geoff Arnold, CTO for the Verizon Smart Communities organization, said, "One of the most important trends over the next 12 years is the aging population and the high costs of providing them with care and mobility. AI will provide better data-driven diagnoses of medical and cognitive issues and it will facilitate affordable AV-based paratransit for the less mobile. It will support, not replace, human care-givers."

John Lazzaro, retired professor of electrical engineering and computer science, University of California, Berkeley, commented, "When I visit my primary care physician today, she spends a fair amount time typing into an EMS application as she's talking to me. In this sense, the computer has already arrived in the clinic. An AI system that frees her from this clerical task – that can listen and watch and distill the doctor-patient interaction into actionable data – would be an improvement. A more-advanced AI system would be able to form a 'second opinion' based on this data as the appointment unfolds, discreetly advising the doctor via a wearable. The end goal is a reduction in the number of 'false starts' in-patient diagnosis. If you've read Lisa Sander's columns in the New York Times, where she traces the arc of difficult diagnoses, you understand the real clinical problem that this system addresses."

Steve Farnsworth, chief marketing officer at Demand Marketing, commented, "Machine learning and AI offer tools to turn that into actionable data. One project using machine learning and big data already was able to predict SIDS correctly 94% of the time. Imagine AI looking at diagnostics, tests and successful treatments of millions of medical cases. We would instantly have a deluge of new cures and know the most effective treatment options using only the data, medicines and therapies we have now. The jump in quality health care alone for humans is staggering. This is only one application for AI."

Daniel Siewiorek, a professor with the Human-Computer Interaction Institute at Carnegie Mellon University, predicted, "AI will enable systems to perform labor-intensive activities where there are labor shortages. For example, consider recovery from an injury. There is a shortage of physical therapists to monitor and correct exercises. AI would enable a virtual coach to monitor, correct and encourage a patient. Virtual coaches could take on the persona of a human companion or a pet, allowing the aging population to live independently."

Joly MacFie, president of the Internet Society, New York chapter, commented, "AI will have many benefits for people with disabilities and health issues. Much of the aging baby boomer generation will be in this category."

The overall hopes for the future of health care are tempered by concerns that there will continue to be inequities in access to the best care and worries that private health data may be used to limit people's options.

Craig Burdett, a respondent who provided no identifying details, wrote, "While most AI will probably be a positive benefit, the possible darker side of AI could lead to a loss of agency for some. For example, in a health care setting an increasing use of AI could allow wealthier patients access to significantly-more-advanced diagnosis agents. When coupled with a supportive care team, these patients could receive better treatment and a greater range of treatment options. Conversely, less-affluent patients may be relegated to automated diagnoses and treatment plants with little opportunity for interaction to explore alternative treatments. AI could, effectively, manage long-term health care costs by offering lesser treatment (and sub-optimal recovery rates) to individuals perceived to have a lower status. Consider two patients with diabetes. One patient, upon diagnosis, modifies their eating and exercise patterns (borne out by embedded diagnostic tools) and would benefit from more advanced treatment. The second patient fails to modify their behaviour resulting in substantial ongoing treatment that could be avoided by simple lifestyle choices. An AI could subjectively evaluate that the patient has

little interest in their own health and withhold more expensive treatment options leading to a shorter lifespan and an overall cost saving."

Sumandra Majee, an architect at F5 Networks Inc., said, "AI, deep learning, etc., will become more a part of daily life in advanced countries. This will potentially widen the gap between technology-savvy people and economically well-to-do folks and the folks with limited access to technology. However, I am hopeful that in the field of healthcare, especially when it comes to diagnosis, AI will significantly augment the field, allowing doctors to do a far better job. Many of the routines aspects of checkups can be done via technology. There is no reason an expert human has to be involved in basic A/B testing to reach a conclusion. Machines can be implemented for those tasks and human doctors should only do the critical parts. I do see AI playing a negative role in education, where students may not often actually do the hard work of learning through experience. It might actually make the overall population dumber."

Timothy Graham, a postdoctoral research fellow in sociology and computer science at Australian National University, commented, "In health care, we see current systems already under heavy criticism (e.g., the My Health Record system in Australia, or the NHS Digital program), because they are nudging citizens into using the system through an 'opt-out' mechanism and there are concerns that those who do not opt out may be profiled, targeted and/or denied access to services based on their own data."

Valarie Bell, a computational social scientist at the University of North Texas, commented, "Let's say medical diagnosis is taken over by machines, computers and robotics – how will stressful prognoses be communicated? Will a hologram or a computer deliver 'the bad news' instead of a physician? Given the health care industry's inherent profit motives it would be easy for them to justify how much cheaper it would be to simply have devices diagnose, prescribe treatment and do patient care, without concern for the importance of human touch and interactions. Thus, we may devolve into a health care system where the rich actually get a human doctor while everyone else, or at least the poor and uninsured, get the robot."

The following one-liners from anonymous respondents also tie into the future of health care:

"People could use a virtual doctor for information and first-level response; so much time could be saved!"

"The merging of data science and AI could benefit strategic planning of the future research and development efforts that should be undertaken by humanity."

"I see economic efficiencies and advances in preventive medicine and treatment of disease, however, I do think there will be plenty of adverse consequences."

"Data can reduce errors – for instance, in clearly taking into account the side effects of a medicine or use of multiple medications."

"Human-machine/AI collaboration will reduce barriers to proper medical treatment through better recordkeeping and preventative measures."

"AI can take over many of the administrative tasks current doctors must do, allowing them more time with patients."

The future of education: High hopes for advances in adaptive and individualized learning, but some doubt that there will be any significant progress and worry over digital divide

Over the past few decades, experts and amateurs alike have predicted the internet would have large-scale impacts on education. Many of these hopes have not lived up to the hype. Some respondents to this canvassing said the advent of AI could foster those changes. They expect to see more options for affordable adaptive and individualized learning solutions, including digital agents or "AI assistants" that work to enhance student-teacher interactions and effectiveness.

Barry Chudakov, founder and principal of Sertain Research and author of "Metalifestream," commented, "In the learning environment, AI has the potential to finally demolish the retain-to-know learning (and regurgitate) model. Knowing is no longer retaining – machine intelligence does that; it is making significant connections. Connect and assimilate becomes the new learning model."

Lou Gross, professor of mathematical ecology and expert in grid computing, spatial optimization and modeling of ecological systems at the University of Tennessee, Knoxville, said, "I see AI as assisting

in individualized instruction and training in ways that are currently unavailable or too expensive. There are hosts of school systems around the world that have some technology but are using it in very constrained ways. AI use will provide better adaptive learning and help achieve a teacher's goal of personalizing education based on each student's progress."

Guy Levi, chief innovation officer for the Center for Educational Technology, based in Israel, wrote, "In the field of education AI will promote personalization, which almost by definition promotes motivation. The ability to move learning forward all the time by a personal AI assistant, which opens the learning to new paths, is a game changer. The AI assistants will also communicate with one another and will orchestrate teamwork and collaboration. The AI assistants will also be able to manage diverse methods of learning, such as productive failure, teach-back and other innovating pedagogies."

Micah Altman, a senior fellow at the Brookings Institution and head scientist in the program on information science at MIT Libraries, wrote, "These technologies will help to adapt learning (and other environments) to the needs of each individual by translating language, aiding memory and providing us feedback on our own emotional and cognitive state and on the environment. We all need adaptation; each of us, practically every day, is at times tired, distracted, fuzzy-headed or nervous, which limits how we learn, how we understand and how we interact with others. AI has the potential to assist us to engage with the world better – even when conditions are not ideal – and to better understand ourselves."

Shigeki Goto, Asia-Pacific internet pioneer, Internet Hall of Fame member and a professor of computer science at Waseda University, commented, "AI is already applied to personalized medicine for an individual patient. Similarly, it will be applied to learning or education to realize 'personalized learning' or tailored education. We need to collect data which covers both of successful learning and failure experiences, because machine learning requires positive and negative data."

Andreas Kirsch, fellow at Newspeak House, formerly with Google and DeepMind in Zurich and London, wrote, "Higher education outside of normal academia will benefit further from AI progress and empower more people with access to knowledge and information. For example, question-and-answer systems will improve. Tech similar to Google Translate and WaveNet will lower the barrier of knowledge acquisition for non-English speakers. At the same time, child labor will be reduced because robots will be able to perform the tasks far cheaper and faster, forcing governments in Asia to find real solutions."

Kristin Jenkins, executive director of BioQUEST Curriculum Consortium, said, "One of the benefits of this technology is the potential to have really effective, responsive education resources. We know that students benefit from immediate feedback and the opportunity to practice applying new information repeatedly to enhance mastery. AI systems are perfect for analyzing students' progress, providing more practice where needed and moving on to new material when students are ready. This allows time with instructors to focus on more-complex learning, including 21st-century skills."

Mike Meyer, chief information officer at Honolulu Community College, commented, "Adult education availability and relevance will undergo a major transformation. Community colleges will become more directly community centers for both occupational training and greatly expanded optional liberal arts, art, crafts and hobbies. Classes will, by 2030, be predominantly augmented-reality-based, with a full mix of physical and virtual students in classes presented in virtual classrooms by national and international universities and organizations. The driving need will be expansion of knowledge for personal interest and enjoyment as universal basic income or equity will replace the automated tasks that had provided subsistence jobs in the old system."

Jennifer Groff, co-founder of the Center for Curriculum Redesign, an international non-governmental organization dedicated to redesigning education for the 21st century, wrote, "The impact on learning and learning environments has the potential to be one of the most positive future outcomes. Learning is largely intangible and invisible, making it a 'black box' – and our tools to capture and support learning to this point have been archaic. Think large-scale assessment. Learners need tools that help them understand where they are in a learning pathway, how they learn best, what they need next and so on. We're only just beginning to use technology to better answer these questions. AI has the potential to help us better understand learning, gain insights into learners at scale and, ultimately, build better

learning tools and systems for them. But as a large social system, it is also prey to the complications of poor public policy that ultimately warps and diminishes AI's potential positive impact."

Norton Gusky, an education-technology consultant, wrote, "By 2030 most learners will have personal profiles that will tap into AI/machine learning. Learning will happen everywhere and at any time. There will be appropriate filters that will limit the influence of AI, but ethical considerations will also be an issue."

Cliff Zukin, professor of public policy and political science at Rutgers University's School of Planning and Public Policy and the Eagleton Institute of Politics, said, "It takes 'information' out of the category of a commodity, and more information makes for better decisions and is democratizing. Education, to me, has always been the status leveler, correcting, to some extent, for birth luck and social mobility. This will be like Asimov's 'Foundation,' where everyone is plugged into the data-sphere. There is a dark side (later) but overall a positive."

However, some expect that there will be a continuing digital divide in education, with the privileged having more access to advanced tools and more capacity for using them well, while the less-privileged lag behind.

Henning Schulzrinne, co-chair of the Internet Technical Committee of the IEEE Communications Society, professor at Columbia University and Internet Hall of Fame member, said, "Human-mediated education will become a luxury good. Some high school- and college-level teaching will be conducted partially by video and AI-graded assignments, using similar platforms to the MOOC [massive open online courses] models today, with no human involvement, to deal with increasing costs for education ('robo-TA')."

Joe Whittaker, a former professor of sciences and associate director of the NASA GESTAR program, now associate provost at Jackson State University, responded, "Huge segments of society will be left behind or excluded completely from the benefits of digital advances – many persons in underserved communities as well as others who are socio-economically challenged. This is due to the fact that these persons will be under-prepared generally, with little or no digital training or knowledge base. They rarely have access to the relatively ubiquitous internet, except when at school or in the workplace. Clearly, the children of these persons will be greatly disadvantaged."

Some witnesses of technology's evolution over the past few decades feel that its most-positive potential has been disappointingly delayed. After witnessing the slower-than-expected progress of tech's impact on public education since the 1990s, they are less hopeful than others.

Ed Lyell, longtime educational technologies expert and professor at Adams State University, said education has been held back to this point by the tyranny of the status quo. He wrote, "By 2030, lifelong learning will become more widespread for all ages. The tools already exist, including Khan Academy and YouTube. We don't have to know as much, just how to find information when we want it. We will have on-demand, 24/7 'schooling.' This will make going to sit-down classroom schools more and more a hindrance to our learning. The biggest negative will be from those protecting current, status-quo education including teachers/faculty, school boards and college administrators. They are protecting their paycheck- or ego-based role. They will need training, counseling and help to embrace the existing and forthcoming change as good for all learners. Part of the problem now is that they do not want to acknowledge the reality of how current schools are today. Some do a good job, yet these are mostly serving already smarter, higher-income communities. Parents fight to have their children have a school like they experienced, forgetting how inefficient and often useless it was. AI can help customize curricula to each learner and guide/monitor their journey through multiple learning activities, including some existing schools, on-the-job learning, competency-based learning, internships and such. You can already learn much more, and more efficiently, using online resources than almost all of the classes I took in my public schooling and college, all the way through getting a Ph.D."

A consultant and analyst also said that advances in education have been held back by entrenched interests in legacy education systems, writing, "The use of technology in education is minimal today due to the existence and persistence of the classroom-in-a-school model. As we have seen over the last 30 years, the application of artificial intelligence in the field of man/machine interface has grown in many

unexpected directions. Who would have thought back in the late 1970s that the breadth of today's online (i.e., internet) capabilities could emerged? I believe we are just seeing the beginning of the benefits of the man/machine interface for mankind. The institutionalized education model must be eliminated to allow education of each and every individual to grow. The human brain can be 'educated' 24 hours a day by intelligent 'educators' who may not even be human in the future. Access to information is no longer a barrier as it was 50 years ago. The next step now is to remove the barrier of structured human delivery of learning in the classroom."

Brock Hinzmann, a partner in the Business Futures Network who worked for 40 years as a futures researcher at SRI International, was hopeful in his comments but also issued a serious warning. He wrote: "Most of the improvements in the technologies we call AI will involve machine learning from big data to improve the efficiency of systems, which will improve the economy and wealth. It will improve emotion and intention recognition, augment human senses and improve overall satisfaction in human-computer interfaces. There will also be abuses in monitoring personal data and emotions and in controlling human behavior, which we need to recognize early and thwart. Intelligent machines will recognize patterns that lead to equipment failures or flaws in final products and be able to correct a condition or shut down and pinpoint the problem. Autonomous vehicles will be able to analyze data from other vehicles and sensors in the roads or on the people nearby to recognize changing conditions and avoid accidents. In education and training, AI learning systems will recognize learning preferences, styles and progress of individuals and help direct them toward a personally satisfying outcome.

"However, governments or religious organizations may monitor emotions and activities using AI to direct them to 'feel' a certain way, to monitor them and to punish them if their emotional responses at work, in education or in public do not conform to some norm. Education could become indoctrination; democracy could become autocracy or theocracy."

Next: About this canvassing of experts

Jak se dá umělá inteligence používat v běžném životě, je vhodná pro každého?

Umělá inteligence může být využita v mnoha různých oblastech, včetně vzdělávání, zdravotnictví, průmyslu a obchodě. [1] V oblasti vzdělávání může umělá inteligence pomoci studentům učit se efektivněji a pomoci učitelům vylepšit svou výuku, například pomocí funkce Presenter Coach v PowerPointu. [3] Nicméně, ne každý potřebuje používat umělou inteligenci v běžném životě a není vhodná pro každého účel. [1] Je důležité si uvědomit, že umělá inteligence není zamýšlena nahradit lidské zaměstnance, ale spíše jim pomoci v jejich práci. [1]

References: [1] Umělá inteligence (AI): 10 tipů, jak využít ChatGPT [2] Umělá inteligence: jaké jsou výhody a nevýhody | Zpravodajství [3] Odborný článek: Jak umělá inteligence usnadňuje učení?

Ušetří vám práci a vyrazí dech. 10 tipů, jak zapřáhnout umělou inteligenci

PAVEL KASÍK

Generování textů, oprava nefunkčního kódu, psaní e-mailů nebo překvapivě dobré fotomontáže. Podívejte se, jak si můžete každý den usnadnit svou práci pomocí nástrojů na bázi neuronových sítí. Vše v češtině a obvykle zcela zdarma.

Článek

Služba ChatGPT získala 100 milionů aktivních uživatelů už za dva měsíce od svého uvedení. Velká část samozřejmě budou lidé, kteří si s konverzačním nástrojem zkusí popovídat nebo otestují, v čem se chová jinak, než člověk. To může být samozřejmě zábavné, ale ukazuje to jen malou část možností, kterou tento nástroj nabízí.

Sestavili jsme proto několik ukázek, které názorně demonstrují, jak lze ChatGPT a další podobné nástroje využít v každodenní praxi. Napřed ale malé varování.

Chatgpt si vymýšlí a kecá

Nástroj ChatGPT je založený na velkém jazykovém modelu (LLM). Je vytrénovaný na velkém množství textů z internetu. Umí tak, slovo po slově, generovat důvěryhodně vypadající text.

Ale to neznamená, že jde o výsledky odpovídající realitě. ChatGPT si vymýšlí, fabuluje a sebejistě vám bude tvrdit naprosté nesmysly. Není to „chyba“, vyplývá to z principu, na kterém služba funguje.

Na to je třeba pamatovat, když uvažujete o použití k něčemu jinému než pro vlastní pobavení. Veškerý výstup z nástrojů založených na LLM berte vždy maximálně jako nápad či návrh, nikoli jako bernou minci. Vygenerovaná fakta ověřujte, než je někde použijete.

Tak, to bychom měli z krku, a pojďme se podívat, k čemu se dají služby typu ChatGPT reálně využít. Nový chat zahájíte na adrese chat.openai.com (nutná registrace).

1. Generování nápadů, obsahová inspirace

Jedním z typických využití velkého jazykového modelu je tvorba v zásadě neomezeného množství nápadů na prakticky libovolné téma. Ne všechny vygenerované nápady vám budou užitečné, ale skoro vždy ve výsledcích najdete něco, co by vás samotné nenapadlo.

Příklad: „Vytvoř tabulku s deseti rozmatinými příklady, jak lze ChatGPT použít v každodenním životě pro zvýšení osobní i pracovní produktivity. Vždy uveď: číslo, využití, příklad zadání.“

Osvědčilo se mi požadovat od ChatGPT výsledek ve formě tabulky. Nejenže to zvyšuje přehlednost, ale často to vede k užitečnějším výsledkům. Rigidní forma tabulky nejspíše udržuje kontext a nedává tolik příležitostí utéct od tématu k obecným frázím.

Pomocí tlačítek můžete nechat vygenerovat novou odpověď, nebo upravit a přepsat zadání. Důležité je, že prvním dotazem interakce nemusí skončit. Naopak, pro nejlepší výsledky je vhodné postupně upřesňovat své požadavky. Klidně napište „Libí se mi ten osmý tip, chtěl bych víc podobných tipů.“

2. Psaní e-mailů dle zadání

E-mailová komunikace má jistá specifika. Obvykle se očekává nějaký zdvořilostní úvod, závěr a nějaké ty fráze, které se starají o to, aby text nezněl neurvale nebo primitivně. A zatímco některé e-maily určitě budu vždy chtít psát sám, u jiných mi nedělá problém nechat si text vygenerovat.

Začnu novou konverzaci, a hned od začátku nastavím tón: „Buď můj asistent, který mi pomáhá psát zdvořilé e-maily.“ Osvědčilo se mi, že než se vrhnu do generování, zeptám se ChatGPT, co pro mne v této roli bude potřebovat.

Příklad: „Napiš e-mail řediteli hotelu U Staré Stodoly. Byl jsem tam ubytován 21. až 25. června 2022 a po celou dobu nešla klimatizace. Protože to byly opravdu horké dny, bylo to nepříjemné. Napiš, aby navrhl, jak problém vyřešit a kompenzovat.“

Neznamená to, že musíte e-mail použít přesně tak, jak vám jej ChatGPT vyplivnul. Můžete v konverzaci pokračovat a přidat další dotazy nebo požadavky. Třeba v tomto (zcela smyšleném) případě bych chtěl, aby mail obsahoval zmínku konkrétního návrhu kompenzace.

Zejména pokud je pro vás psaní formálních textů utrpením, může vám tento nástroj ušetřit čas i nervy. Pro někoho je ostatně jednodušší upravovat již vygenerovaný text, než zírat na prázdnou obrazovku.

Konverzaci si můžete uložit, a v případě, že dostanete na mail odpověď, můžete ji vložit do již nastartované konverzace a zachovat tak kontext. To je další velká výhoda nástroje ChatGPT: můžete se vracet k již vygenerovaným textům a navázat na ně.

3. Rada s problémy v excelu

Pro někoho může být překvapivé, co všechno ChatGPT „zvládá“. Řadě lidí se osvědčil třeba jako technický poradce s řešením problémů v tabulkovém procesoru. Už jenom taková maličkost, jako je tvorba ukázkových dat, je díky nástroji hračkou.

Řekněme ale, že jsou to reálná data, a my s nimi máme nějak pracovat. A narazili jsme na problém: stáří auta je uvedeno textem (7 let, 4 roky apod.), my ale potřebujeme číslo.

Příklad: „V Excelu mám v buňce E2 hodnoty jako 17 let nebo 4 roky. Jakým vzorcem z toho dostanu jen číslo? Mám anglický Excel.“

Nezapomeňte, že si můžete nechat vygenerovat odpovědí více. ChatGPT pokaždé nabídl trochu jiné řešení, z toho některá byla nefunkční a jiná zase naprosto hloupá. Proto je potřeba funkčnost ověřit a nespoléhat na ChatGPT. Pamatujme, že ChatGPT „neví“, co je to Excel, nemá aplikaci před sebou, prostě jen generuje důvěryhodně znějící radu.

ChatGPT zdaleka není vševědoucí. Bude vám často radit špatně, nebo budou vygenerované formulky nepoužitelné pro vaši situaci. Není to „expert na Excel“, ale obecný jazykový model. Časem se ale naučíte, jak dotazy pokládat tak, aby vám odpovědi byly užitečné. Velkou výhodou je, že můžete požádat o to, aby vám ChatGPT vysvětlil, jak výsledek funguje.

Možnost získat „přednášku na míru“ je vhodná zejména tehdy, kdy používáte nějaký vzorec, kterému nerozumíte. Namísto toho, abyste slepě důvěřovali vygenerované odpovědi, se tak můžete něco nového naučit.

4. Vysvětlování pojmů v kontextu

Už jsme se naučili, že jazykovým modelům bychom neměli bezhlavě důvěřovat. To ale neznamená, že si od nich nemůžeme nechat poradit. Mým oblíbeným příkladem je generování vysvětlení na míru cílovému publiku.

Příklad: „Buď můj učitel fyziky. Když led taje, mění se jeho objem?“

„Vymysli experiment, který by to názorně demonstroval. Cílem je ukázat princip hustoty vody a ledu dětem.“

Často je právě vymýšlení vhodných a pochopitelných příkladů složité právě pro lidi, kteří dané problematice rozumí. Proto může být užitečné hledat inspiraci právě u chatbota, který umí „nasimulovat“ různé stupně porozumění.

Příklad: „Vysvětli, jak se při bouřce tvoří blesky. Vytvoř tabulku, kde bude vysvětlení „pro 1. stupeň ZŠ“, „pro 2. stupeň ZŠ“, „pro maturanty“ a „doktorand fyziky“. Sloupce: Pro koho, Vysvětlení principu tvorby blesku. U pokročilejších vysvětlení uveď i zajímavosti, které u jednodušších vysvětlení chybí.“

Generátor se také hodí pro vytváření různých pohledů na věc. Řekněme, že chci posoudit výhody a nevýhody nějakého nápadu.

Příklad: „Buď můj odborný poradce pro otázky ekonomie. Vyjmenuj hlavní výhody a nevýhody progresivního zdanění. Výsledky prezentuj ve formě odrážek. Uveď známé zastánce a odpůrce progresivního zdanění v historii.“

Podobných odrážek vypočítávajících klady a zápory jsou ostatně plné i klasické powerpointové prezentace. I s jejich tvorbou vám může ChatGPT pomoci. Brzy se ostatně zřejmě dočkáme i integrace tohoto nástroje přímo do PowerPointu.

5. Generování a ladění zdrojového kódu

Že se velkým jazykovým modelům celkem daří psaní „obecných okecávek“ asi nikoho moc nepřekvapilo. Řada programátorů je ale zaskočena tím, jak moc nástroj ChatGPT dokáže pomoci při generování funkčního kódu v různých programovacích jazycích.

Příklad: „Buď můj programátor a lektor programování. Potřebuji funkci, která z řetězce 17.12.2022 udělá 17. prosince roku 2022. Používám JavaScript.“

Opět platí již zmíněné varování: jazykový model „neví“, co dělá. Bez uzardění vám tedy vygeneruje řešení, které je zcela nefunkční. Proto berte kód od ChatGPT jen jako návrh, na kterém budete dále stavět.

Osvědčilo se mi požadovat po ChatGPT, aby svůj kód vysvětlil. Výsledky jsou pak nejen přehlednější, ale také se u toho můžete naučit něco nového.

Pro pokročilé programátory to možná bude spíše frustrující zážitek. Naprosté začátečníky to zase může odradit od toho, aby se zlepšovali. Myslím si ale, že lze najít řadu příkladů, kdy je generování nějaké funkce nebo části programu opravdu užitečné a šetří čas. Na podobném principu fungují i nástroje jako TabNine Copilot, které jsou integrované přímo do vývojářského prostředí. U ChatGPT je ale výhoda, že si o výsledcích můžete „popovídat“ nebo postupným upřesňováním požadavků dosáhnout lepšího kódu.

6. Vytváření souhrnů

Jednou ze silných stránek velkých jazykových modelů je tvorba stručných souhrnů. Nemusíte se totiž bát, že by si ChatGPT tolik vymýšlel. Poskytnete mu text a on vám vrátí jeho shrnutí.

Příklad: „Buď můj asistent. Toto je článek o skenování mobilem. (Shift + Enter pro nový řádek, Ctrl + V pro vložení článku, Shift + Enter pro nový řádek) Vytvoř mi stručné shrnutí toho nejdůležitějšího v článku.“

K textu navíc můžete psát doplňující otázky.

Pozor jen na jedno nepříjemné omezení. Paměť v rámci konkrétní konverzace je omezená na asi tři tisíce slov. Pokud tedy vložíte příliš dlouhý článek, stane se vám, že ChatGPT zapomene, o čem jsme se bavili na začátku.

Přestože občas někdo tvrdí něco jiného, ChatGPT nemá přístup k internetu. Nemůžete tedy vložit odkaz na článek a chtít jeho souhrn. Bohužel se ale ochotný model snaží vyhovět i přes svou neschopnost číst obsah stránky, a tak si souhrn jednoduše vycucá z prstu na základě adresy článku.

Někdy to působí tak důvěryhodně, že mají lidé dojem, že skutečně článek četl. Stačí ale zadat adresu, ze které není zjevné, o co se jedná, a bude každému jasné, že si odpovědi ChatGPT vymýšlí.

Užitečná rozšíření pro chatgpt

Pokud s ChatGPT pracujete často, budou se vám možná hodit tato rozšíření.

ChatGPT Prompt Genius (Chrome)– do levého menu vám přidá možnost exportovat odpovědi ve formátu PDF nebo PNG, umožní také vytvářet vlastní seznam šablon otázek.

WebChatGPT (Chrome) – vloží do ChatGPT možnost využití aktuálních informací z internetu. Do vaší otázky přidá informace z vyhledávače. Výsledky jsou někdy překvapivě dobré, umí pracovat se zdroji. Ale nečekejte zázraky, stále je to starý známý kecálista ChatGPT.

GPT for Sheets (Google Sheets) – jednoduchá integrace ChatGPT do Google Sheets nabízí zajímavé možnosti pro tvorbu tabulek. ChatGPT pak můžete volat jako funkci a vytvářet tak přehledné tabulky s překvapivou rychlostí.

7. Nekonečné množství variant

Často potřebujeme vymyslet několik alternativ nějakého textu, třeba abychom klientovi nabídli různé možnosti, nebo abychom vyzkoušeli různé verze reklamy a zjistili, která funguje nejlépe.
Příklad: „Buď můj reklamní poradce. Vygeneruj mi prosím deset variant této reklamy ve stejném formátu: Titulek: Umělá inteligence přímo pro vás, Text: Chatovací nástroj ChatGPT vám vygeneruje odpovědi na otázky nebo pomůže programovat. Vyzkoušejte zdarma. Vygeneruj tabulku se sloupci Titulek reklamy, Text reklamy."

A pak můžete pokračovat. Můžete zadání upřesnit, nebo prostě požádat o další a další variace.

I průměrný marketér by zřejmě vygeneroval lepší reklamy. Ale rozhodně ne za deset sekund, což je čas, který k tomu potřeboval ChatGPT. Navíc se generátor nevyčerpá a neunaví, můžete jej o různé varianty téhož žádat až do soudného dne.

Nebo do výpadku služby, ke kterým dochází poměrně často. Jindy se zase stane, že odpověď v půlce skončí. Pak nezbývá než generovat znovu.

7. Pokročilé fotomontáže díky ai

Odpočineme si na chvíli od textového ChatGPT a připomeneme si nástroje pro generování obrazů. V předchozím návodu jsme ukázali, jak pomocí Stable Diffusion a Midjourney vytvářet obrazy na prakticky libovolné téma.

https://www.seznamzpravy.cz/clanek/tech-technologie-navody-usetri-vam-praci-a-vyrazi-dech-10-tipu-jak-zaprahnout-umelou-inteligenci-227059

Umělá inteligence: rizika i příležitosti

Společnost

Umělá inteligence se dostává do všech aspektů našeho života. V čem spočívají rizika a jaké jsou naopak příležitosti?

Umělá inteligence se stává součástí našeho každodenního života, proto je nezbytné stanovit pravidla. Parlament chce určit rámec, který lidem umožní využívat jejích výhod a současně minimalizovat rizika.

Růst a prosperita Evropy jsou úzce spjaty s tím, jak budeme využívat data a s nimi související technologie. Umělá inteligence může v našich životech znamenat výraznou změnu, ať už k lepšímu či horšímu. Evropský parlament proto založil zvláštní výbor pro zkoumání jejích dopadů a vyzval, aby pravidla pro umělou inteligenci byla zaměřená především na člověka a byla připravená na různé budoucí scénáře. Níže jsou nastíněny některé z hlavních příležitostí a hrozeb spojených s budoucím využíváním umělé inteligence (anglicky artificial intelligence – AI).

Přečtěte si více o tom, co umělá inteligence je a jak ji využíváme.

Výhody umělé inteligence

Země Evropské unie jsou v digitálním průmyslu a v digitalizaci podnikání silnými hráči. Vzhledem k existenci vysoce kvalitní digitální infrastruktury a regulačního rámce, který chrání soukromí a svobodu projevu, by se EU mohla v datové ekonomii a jejím využívání stát celosvětovým lídrem.

Přínosy v běžném životě

AI nám může zlepšit zdravotní péči, může přinést bezpečnější auta a další dopravní prostředky a v neposlední řadě i levnější produkty s delší životností a služby přizpůsobené lidem na míru. Usnadnit může i přístup k informacím, vzdělání a odborné přípravě – právě toto hledisko se dostalo do popředí zejména s přechodem na distanční způsoby výuky během pandemie Covid-19. Vzhledem k tomu, že roboti mohou být využíváni pro nebezpečné práce, dokáže umělá inteligence zároveň zvýšit bezpečnost na pracovišti a nabídnout nové pracovní příležitosti v rostoucím a vyvíjejícím se odvětví průmyslu řízeném pomocí AI.

Příležitosti umělé inteligence pro podniky

V podnicích umožňuje AI vývoj nové generace produktů a služeb, a to i v těch odvětvích, ve kterých mají evropské společnosti již nyní silné postavení: zelená a oběhová ekonomika, strojírenství, zemědělství, zdravotní péče, móda, cestovní ruch. Umělá inteligence pomůže s optimalizací a plynulostí prodeje, může zlepšit údržbu strojů, zvýšit výkon a kvalitu produkce, úroveň služeb pro zákazníky a rovněž ušetří energii.

Příležitosti AI ve veřejných službách

Umělá inteligence využívaná ve veřejných službách může snížit náklady a nabídnout nové možnosti ve veřejné dopravě, vzdělávání, energetice a při nakládání s odpady a zároveň zlepšit

udržitelnost produktů. Právě proto by mohla mimo jiné přispět k naplnění cílů Zelené dohody pro Evropu.

Prevence dezinformací

Řízení založené na datech, prevence dezinformací a kybernetických útoků a zajištění přístupu ke kvalitním informacím: z těchto důvodů může AI účinně posílit demokracii. Zároveň lze jejím prostřednictvím podpořit diverzitu a otevřenost, a to například zmírněním předsudků při přijímání nových zaměstnanců skrze využívání primárně analytických dat.

Umělá inteligence, bezpečnost a ochrana

Lze předpokládat, že AI bude stále častěji využívána i pro prevenci kriminality a v systému trestního soudnictví. Masivní soubory dat dokáže umělá inteligence zpracovat rychleji, rizika útěku vězňů hodnotí přesněji a dokáže předvídat a předcházet nejen trestné činnosti, ale i teroristickým útokům. Online platformy ji v současné době využívají hlavně pro detekci nezákonného a nevhodného online chování.

V oblasti vojenství by mohla být umělá inteligence využita k obranným a útočným strategiím proti hackování a phishingu (technika pro získávání citlivých údajů v elektronické komunikaci) či k cílení na klíčové systémy v kybernetické válce.

Hrozby a výzvy spojené s umělou inteligencí

Zvyšující se závislost na systémech umělé inteligence nicméně představuje určitá rizika.

Nedostatečné využívání a nadužívání AI

Za hlavní hrozbu je považováno především nedostatečné využívání umělé inteligence: promarněné příležitosti mohou pro EU znamenat špatnou implementaci zásadních programů, jako je například Zelená dohoda pro Evropu, ale i ztrátu konkurenční výhod oproti jiným regionům a hospodářskou stagnaci. Nedostatečné využití AI může pramenit z obecné nedůvěry veřejnosti a podniků v umělou inteligenci, ale i z nevyhovující infrastruktury, nízkých investic či fragmentace digitálních trhů (a to vzhledem ke skutečnosti, že proces učení umělé inteligence je závislý na datech).

Podobně problematické však může být nadužívání AI. Příkladem je investování do aplikací, které se ukázaly být nepoužitelnými, nebo použití umělé inteligence tam, kde není vhodná – například k vysvětlování složitých a značně komplexních společenských jevů.

Odpovědnost: Kdo nese vinu za škody způsobené AI?

Důležité je určit, kdo je zodpovědný za škodu způsobenou zařízením nebo službou ovládanou umělou inteligencí. Pokud kupříkladu dojde k nehodě automobilu řízeného AI, hradí škody majitel, výrobce automobilu nebo programátor?

Pokud by byl producent zbaven odpovědnosti, neexistoval by žádný podnět k poskytování kvalitního produktu a služby, což by mohlo zásadně poškodit důvěru lidí v technologie. Na stranu druhou, i samotné regulace mohou být příliš striktní a potlačovat inovativní růst.

Hrozby AI pro základní práva a demokracii

Výsledky produkované umělou inteligencí závisí na tom, jak je navržena a jaká data používá. Jak návrh samotný, tak i data mohou být záměrně či neúmyslně ovlivněny. Některé klíčové aspekty určitého problému například nemusí být vůbec do algoritmu zakomponovány nebo mohou být naprogramovány tak, že reflektují a replikují strukturální předsudky. Zároveň s tím by použití čísel k

reprezentaci a vyjádření komplexní sociální reality mohlo způsobit, že se umělá inteligence bude jevit jako faktická a přesná, i když tomu tak ve skutečnosti není. Tento fenomén je označován jako tzv. „mathwashing“ (z anglického „math“ = matematika a „washing“ = mytí).

V případě nesprávného provedení by tak umělá inteligence mohla činit negativně zaujatá rozhodnutí ovlivněná etnickým původem, pohlavím či věkem a zpochybnit objektivnost procesů při najímání či propouštění zaměstnanců, při nabízení půjček, či dokonce v trestním řízení.

AI by mohla vážně ovlivnit právo na soukromí a ochranu údajů – může být například využita v zařízeních pro rozpoznávání tváří, pro online sledování a profilování jednotlivců. Umělá inteligence navíc umožňuje slučování poskytnutých informací, čímž vytváří nová data – tato skutečnost může mnohdy vést k neočekávaným výsledkům.

V umělé inteligenci lze navíc spatřovat potenciální hrozbu i pro demokracii. Již v minulosti jí bylo přisuzováno vytváření tzv. komnat ozvěn založených na zobrazování obsahu, který koresponduje s přechozím online chováním dané osoby. AI tak nevytváří dostatečný prostor pro pluralistickou, rovnoměrně přístupnou a inkluzivní veřejnou debatu. Může být dokonce využita k vytváření falešných, leč extrémně realistických videí, audio nahrávek a obrázků, též známých jako tzv. „deepfakes“. Ty mohou představovat značná finanční rizika, poškozovat dobré jméno a zpochybnit rozhodování. To vše může následně vést k rozdělení a polarizaci veřejné sféry a k ovlivňování samotných voleb.

AI by mohla svou roli sehrát i při upírání svobody shromažďování a protestů, neboť ji lze využít k sledování a profilování jedinců spojených s určitým přesvědčením nebo činy.

Dopad umělé inteligence na pracovní místa

Očekává se, že využívání AI na pracovišti povede k rušení velkého počtu pracovních míst. Ačkoliv se zároveň předpokládá, že umělá inteligence vytvoří nová a lepší pracovní místa, skutečností je, že vzdělání a odborný výcvik budou hrát klíčovou roli při prevenci dlouhodobé nezaměstnanosti a při zajišťování kvalifikovaných pracovníků.

Hospodářská soutěž a konkurenceschopnost

Shromažďování informací může mimo jiné vést k narušení hospodářské soutěže – aktéři s větším množstvím informací mohou nad svými oponenty získat výhodu a konkurenci účinně eliminovat.

Bezpečnostní rizika

Veškeré způsoby využití umělé inteligence, které jsou v přímém fyzickém kontaktu s lidmi nebo přímo integrované do lidského těla, mohou představovat bezpečnostní rizika. Existuje možnost chybného návrhu, zneužití či hacknutí. Nedostatečná regulace při používání AI ve zbraních může vést ke ztrátě kontroly nad nebezpečnými zbraněmi.

Otázka transparentnosti

Riziko spočívá také v nerovnováze v přístupu k informacím. Na základě chování lidí v online prostředí a díky dalším datům může bez vědomí dotčených osob dojít například k cílenému přizpůsobování politických kampaní člověku na míru či předvídání toho, kolik je daná osoba u online prodejce ochotna utratit. Dalším problémem transparentnosti je skutečnost, že ne vždy je lidem jasné, zda interagují s umělou inteligencí či reálnou osobou.

Přečtěte si více o tom, jak chtějí europoslanci utvářet legislativu v oblasti dat, aby podpořili inovace a zajistili bezpečnost.

Odkazy

Evropská komise: Bílá kniha o umělé inteligenci - evropský přístup k excelenci a důvěře

Studie Think tanku EP: Artificial intelligence: How does it work, why does it matter, and what can we do about it? (anglicky)

Artificial intelligence: how does it work, why does it matter and what can we do about it?

Think Tank Evropského parlamentu: Opportunities of artificial intelligence (anglicky)

Council of Europe study: algorithms and human rights

Artificial intelligence: legal and ethical reflections

Odkaz: 20200918STO87404

Jak umělá inteligence usnadňuje učení?

AUTOR
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Anotace

Příspěvek se věnuje tomu, jak nyní (a v blízké budoucnosti) může umělá inteligence měnit edukační procesy a pomoci s učením se. Zaměříme se jak na praktické příklady, tak na to, jaký vliv to může mít na vnímání učitelské profesní identity.

Když se mluví o umělé inteligenci a vzdělávání, můžeme se setkat s celou řadou mýtů. Ten první se týká představy, že jde o technologie, jejichž cílem je nahradit běžné učitele, což má za následek ztrátu osobního kontaktu a sociálního rozměru učení. Tento mýtus těsně souvisí s tím, o čem se v jiných souvislostech hovoří již dlouho, totiž s mimořádně nízkou kredibilitou profesní identity učitele. Druhý mýtus je ten, že umělá inteligence je všude kolem nás a nemá smysl se jí tedy nějak speciálně didakticky věnovat. Třetí mýtus pak spočívá v tom, že je nutné výuku umělé inteligence zavést do školního kurikula, protože jen schopnost s ní pracovat na úrovni základního programování dá žákům možnost nadvlády nad ní.

Všechny tři mýty obsahují určitou dávku pravdu, je možné říct, že vždy přinášejí něco pozitivního a užitečného. Ale současně v sobě vždy obsahují jistou přepjatost, která dle našeho soudu není zcela nutná. To, čemu bychom se chtěli věnovat v tomto článku, je ukázka několika zajímavých oblastí, ve kterých umělá inteligence přímo pomáhá ve výuce (nebo v nejbližší době bude), a zamyšlení se nad tím, co takové systémy vlastně přinášejí a jak je z hlediska pedagogiky vhodné o nich vlastně přemýšlet.

Domníváme se, že umělá inteligence není konkurencí k učitelské profesi, ale něčím, co může významně žákům pomoci v tom, aby se skutečně efektivně učili. Mimo řady benefitů, o kterých budeme ještě mluvit, totiž řeší jeden z velkých problémů školství obecně – příliš velikého množství studentů, kteří připadají na jednoho vyučujícího. Systémy s AI obecně umožňují tento problém částečně kompenzovat, což dává učiteli reálnou možnost kvalitně vyučovat a pracovat se skupinou, zatímco mnoho individualizovaných aktivit je možné určitým způsobem delegovat právě na umělou inteligenci.

Co je to umělá inteligence?

Říci v jedné či dvou větách, co je to umělá inteligence (AI), není snadné. Jde o poměrně široké spektrum technologických postupů, které umožňují algoritmům deduktivním způsobem řešit problémy, jejichž přesné zadání v sobě nemají implementováno. K tomu, aby AI mohla vykonávat svůj účel, je nutné, aby trénovala s nějakým, poměrně velkým množstvím dat. Dnes asi nejpopulárnějším způsobem, jak umělou inteligenci implementovat, je využít umělé neuronové sítě, která je inspirovaná lidským mozkem a standardně umožňuje provádět klasifikaci objektů, často podle předem ne zcela jasného klíče.

To, co je důležité, je, že umělá inteligence nepracuje s žádnými dopředu danými postupy, ale snaží se o hledání vlastního řešení. Tím se liší od tradičních modelů deterministických algoritmů. V případě umělé inteligence tedy řešení není možné dopředu odhadnout. Pokud bychom si chtěli návrh nějaké neuronové sítě vyzkoušet, pak velice doporučujeme TensorFlow, což je prostředí pro

návrh AI od Google, které je nyní otevřené a existuje k němu nepřeberné množství návodů a postupů, jak s ním pracovat, nebo co jeho prostřednictvím lze vytvořit.

Tradičně se můžeme setkat s pojetím umělé inteligence, které se říká všeobecná, což je taková, která by se měla mít schopnost naučit čemukoli a byla by podobně univerzální jako lidská mysl. Jde ale spíše o teoretický koncept s omezenou aplikovatelností a mnohem častěji se pracuje s menšími, úzce specializovanými systémy, které umí řešit své poměrně malé a úzce zadané úkoly, jako je vyhledávání, práce s dialogem, analýza obrazu atp.

Pokud by někoho zajímaly podrobnější příklady, velice doporučujeme sledovat Google a jeho AI skupinu, kde najdete nejen jednotlivé nástroje, ale také velké množství popularizačních, ale současně nesmírně aktuálních textů. Cognitive Services od Microsoftu jsou praktičtější, ale také hodně zajímavé. Obecně je možné říci, že umělá inteligence je v současnosti trend, který se uplatňuje téměř všude, a pokud se podíváme například na sezam TOP 200 nástrojů pro vzdělávání, tak téměř všechny s umělou inteligencí nějakým způsobem pracují.

Poslední pojem, který bychom měli objasnit, je rozdíl mezi AI a strojovým učením. Říká se vtip, že umělá inteligence je to, co je napsané v PowerPointu a strojové učení to, co je napsané v Pythonu. Jde vlastně o silně synonymní pojmy, mezi kterými není nutné v našem kontextu příliš rozlišovat.

Nyní se pokusíme upozornit na některé konkrétní aplikace umělé inteligence, které se mohou zajímavým způsobem uplatňovat ve vzdělávání. Ve svém výběru budeme záměrně pracovat s nástroji, které mohou být navázané na konkrétní oborové didaktiky.

Presenter coach v powerpointu

Zcela nová funkce, která bude brzy dostupná v online verzi PowerPointu (do instalované se dostane později) se jmenuje Presenter Coach. Uživatel díky ní může přednášet svoji prezentaci (v angličtině) a systém mu hlídá srozumitelnost, tempo mluvy nebo to, zda nepoužívá vycpávková slova nebo jen nečte informace ze slidů. Jde tedy o nástroj, který má vést k rozvoji prezentačních dovedností v angličtině při použití PowerPointu. Jestliže se dnes hovoří o tom, jaký význam mají prezentační dovednosti, pak je jednoznačně možné říci, že takové systémy mohou jejich výuku výrazně zefektivnit. Učitel se může soustředit na jisté uvedení do problematiky a poté dávat podstatně efektivnější zpětnou vazbu, protože žáci budou moci základní trénink a nejčastější chyby vyřešit prostřednictvím funkce Presenter Coach.

Na tomto příkladu je současně pěkně vidět, že nejde o systém, který nahradí učitele, nebo který sám o sobě naučí někoho prezentovat, ale umožní postupovat mnohem rychleji, cíleněji a individualizovaněji s tím, že učitel může ve výuce využít mnohem více své odbornosti, protože se může věnovat například rétorickým figurám či lexiku a obsahu presentace místo běžného opravování chyb. Navíc takových, které musí každý žák „nadřít“ sám, což je v běžném způsobu organizace výuky nesmírně náročné.

Grammarly

Grammarly je jednou z nejpopulárnějších aplikací, které pracují s výukou angličtiny. Tvůrci ji doporučují jak pro rodilé mluvčí, tak také pro ty, co se anglicky učí. Funguje jako doplněk do prohlížeče, případně jako samostatná webová aplikace. Pokud člověk začne psát jakýkoliv anglický text, tento nástroj mu začne kontrolovat pravopis a upozorňovat ho na chyby, kterých se v textu dopouští. Například, že mu chybí člen, opakují se mu slova, určitá věc se má říci frází anebo že užívá pasivní tvar, což je v češtině docela běžná, ale angličtina to v oblibě úplně nemá.

Cílem aplikace je tedy vést každého uživatele, aby anglicky psal a současně snadno mohl vidět, co má špatně. Systém chybu jen podtrhne, a pokud člověk nechce poradit, může zkusit daný

gramatický problém vyřešit sám. Obecně platí, že pokud člověk sám píše něco, co ho zajímá – od blogu, po tweety, a má k dispozici systém, který ho opravuje jak v oblasti gramatiky, tak stylisticky může dělat poměrně rychlé a velké pokroky. Současně jde o snahu o posílení všudypřítomného učení – Grammmarly se integruje do Google Docs, mailu nebo kamkoli jinam.

Učitel má pak možnost se svými žáky pracovat na tom, aby se v psaní zlepšovali, anebo věnovat více času například konverzaci. Grammarly samozřejmě není jediným nebo samostatně funkčním systémem, ale může s procesem učení hodně pomoci, pokud se podaří v žácích vybudovat psaní a studijní návyky, kterých je možné využít.

Bohužel, více chyb ve stylistice umí opravovat jen placená verze.

Codeacademy

Pokud se chce člověk naučit základy kódování, tedy osvojit si nějakým programovací jazyka a dokázat v něm napsat jednoduchý program, pak zřejmě není moc lepších variant než využít Codeacademy. Tento nástroj umožňuje v jednotlivých lekcích postupovat tak, že zadává jednoduché úlohy, které postupně vyhodnocuje. Není potřeba nic kompilovat a systém umí s procesem učení kódování pohodlně poradit. Naopak hromadné učení kódování ve třídě jsou – asi pro každého kdo to kdy zkoušel – nesmírně náročné. Každý žák je jinak rychlý, má jiný postup a nedaří se mu jiné věci. Tento nástroj umožňuje, aby každý pracovat svým tempem a učitel se věnoval těm, co mají někde problém, a výuce programování jako určitému stylu myšlení. Především v začátcích je to velice praktické.

Ze všech uvedených nástrojů je Codeacademy s umělou inteligencí spojený zřejmě nejméně. Současně je v něm možné se ale naučit spoustu zajímavých věcí, které k pochopení umělé inteligence budou směřovat.

Umíme česky, mat-mat, slepé mapy

Tři zmíněné projekty mají společného jmenovatele, totiž tým z Fakulty informatiky Masarykovy univerzity, který se zaměřuje na adaptivní učení. Ve zkratce řečeno všechny tři se snaží zadávat žákům úkoly, které jsou poměrně náročně klasifikovány podle toho, jakým způsobem je plní ostatní. Systém tak umí odhadnout (a nutno říci, že v mnoha případech mnohem lépe než učitel), jaká je třída úloh, se kterými bude mít student určitý problém, a podle toho mu nabídnout takové, na kterých se může efektivně učit.

Žáci tak například mohou pracovat na stejné úrovni obtížnosti, ale každý plní jiné úkoly podle toho, co mu zrovna jde či nejde. Takový model je v běžném offline pojetí výuky velice obtížně použitelný, ale nesmírně efektivní. Pokud tedy chceme zařídit, že se žáci například procvičí ve sčítání, mohou užít mat-mat, protože tento systém generování a adaptací příkladů umí velice dobře.

Všechny systémy jsou zajímavé v oblasti práce s chybou, která je vnímaná jako základní deskriptor pro další učení. Současně ale v žádném případě nevylučují z edukačního procesu učitele. Ten se ale může věnovat buď individuálním intervencím, nebo třeba výkladu jevů, které si žáci sami osvojují. Anebo mu zůstane dostatek prostoru na formativní hodnocení, což je něco, co zatím AI umí poměrně málo, a současně platí, že od člověka (učitele) má velkou váhu.

Závěrem

Všechny výše uvedené nástroje je možné poměrně snadno implementovat do školního i mimoškolního vzdělávání. Současně ukazují, jakým směrem se může spojení umělé inteligence a vzdělávání posouvat. Zatímco ještě před několika málo lety bylo v módě hovořit o tom, jak budou

roboti brát práci lidem, dnes se mnohem více hovoří o tom, že bychom měli uvažovat o budování hybridních systémů, ve kterých bude na určitém úkolu spolupracovat více lidí spolu se systémy umělé inteligence. Myslíme si, že například oblast vzdělávání integrující jak učitele, tak také třeba knihovníky nebo odborníky na technologie spolu s moderními nástroji využívající AI, může být velice pěkným příkladem toho, kam je možné proces učení posunout.

Domníváme se, že se nám podařilo poměrně přesvědčivě na několika málo ilustrativních příkladech ukázat, co všechno je možné díky AI ve vzdělávání efektivněji řešit a jaké nové možnosti vzdělávání, ale i práce pedagoga takové nástroje nabízí. Jistě, jedním z velkých problémů současného vzdělávání je přetížení kurikula, které bude muset být určitým způsobem redukováno, ale není jedním z problémů i to, že některé činnosti vykonáváme zásadně neefektivně? Podobně je velkým hendikepem malá profesní sebedůvěra učitelů. Ale nemohou technologie pomoci ukázat jejich opravdovou kvalitu a dát jim prostor více času věnovat těm věcem, ve kterých jsou opravdu dobří – náročnému učení druhých, formativnímu hodnocení, facilitaci týmů, které řeší určité projekty atp.? Technologie jistě nejsou něčím, co by fungovalo samo o sobě, nebo bylo vždy lepší než „klasické způsoby“, ale jistě jsou dobrým prostředkem pro zlepšení některých jasně existujících problémů.

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Nahradí umělá inteligence učitele? Dokáže reagovat na emoce žáků, na neverbální vyjadřování, na gesta?

Umělá inteligence (UI) nemůže nahradit lidské učitele, protože vzdělávání je vztahem jedna na jednoho a mnoha na jednoho, který zahrnuje empatii, emoce a lidské spojení [1]. UI může poskytovat personalizované vzdělávání pro každého studenta a objektivní zpětnou vazbu, ale nikdy nemůže nahradit teplo, kreativitu a spojení, které vycházejí z lidské interakce při výuce [2]. Učitelé pomáhají studentům uvědomit si jejich jedinečnost, rozvíjet dovednosti řešení problémů, podporovat lásku k učení a poskytovat cenné lekce z osobního života [1]. UI může potenciálně pomoci při rozvoji učitelů a zavádění nových výukových metod, ale nikdy je nemůže nahradit [2]. Vzdělávání je vzájemně podporující ekosystém, kde se učení děje od různých lidí v různých formách [1]. UI může být užitečná jako pomůcka pro učitele, ale učitelé zůstanou klíčovými prvky vzdělávacího procesu.

References: [1] Why Artificial Intelligence Will Never Replace Teachers [2] AI In Education: Can AI Replace Teachers In Schools? [3] Will AI Replace Teachers?

Why artificial intelligence will never replace teachers

A recent feature on Forbes talked about how artificial intelligence or AI can never replace humans by outlining the fact that it is a technology that is here to make you more valuable. While there have been consistent debates in the online fraternity regarding the extent to which AI can disrupt the employment world as we know it, the results point in the same direction.

There are still decades to be covered, as far as the complete takeover of basic human jobs is considered. This is because humans are strides ahead of AI and ML when it comes to emotional perceptions, and understanding of different figures of speech, such as sarcasm, humor, sadness, etc.

And, even if AI and ML-powered robots can understand the overall tone of speech, they lack the empathy and distinctly human touch when it comes to relationships, and impeccable grasp over the sentiments.

This is one crucial basis that makes it impossible for AI to replace humans as teachers!

Here, we explore the subject matter at length and discuss various characteristics that make humans better than AI when it comes to teaching.

Let us begin by exploring the essence of teaching.

Humans as teachers: the entire essence

Teaching is a one-on-one and many-to-one relationship that works in many unique ways. Not only does a teacher impart worldly knowledge to the students, but they also learn from them. Teachers and students form a symbiotic and synergistic ecosystem that helps in the mutual enhancement of knowledge (various flavors).

Further, what makes humanized teaching so special, is the fact that teaching happens outside the classrooms as well. It happens throughout life, and that too in various forms, such as visual learning, learning by listening, by doing things, life experiences, etc. Also, learning varies from one person to another depending on their perceptions, abilities, and preferences.

Humans as teachers have three distinct characteristics that add to the entire essence of teaching, and we discuss them below.

1. Teaching is about relationships

An AI might be able to replicate some aspects of a teacher-student relationship. Still, it will never fully replicate the warmth, empathy, and connection that comes from real human interaction.

2. Teachers are constantly evolving

They are always learning new things and experimenting with new methods in the classroom. No machine could ever duplicate the nimbleness and creativity of a good teacher.

3. Teaching is about human connection

One of the most powerful aspects of teaching is the relationship between teacher and student. This connection is what helps students learn, grow, and feel supported in their education. An AI can never replace that.

Now that we have established the premise, let us move on to discuss the pointers to support it and help you understand why AI can never replace human teachers.

Artificial intelligence vs human teachers: can ai replace teachers?

Through this blog, we aim to help understand the role of teachers, and how an AI could potentially assist them in their teaching. We also hope to answer any questions or concerns readers might have about AI and its impact on education.

The fear that artificial intelligence will one day replace teachers is understandable but unfounded. There are several reasons why AI will never be able to completely replace a human teacher.

We also hope that you will also agree on how AI could play an important part in revolutionizing today's teaching methods.

1. Teachers Play a Vital Role in the Education

Teachers help students realize their uniqueness, which helps to encourage creativity and develop problem-solving skills. They help foster a love of learning and provide support and guidance as students grow and develop. They are also responsible for preparing students to enter the future workforce or pursue further education based on their interests.

On the other hand, AI has already started to play a role in the education sector by helping to personalize learning for each student. It can also provide students with objective and responsive feedback on their work, which helps them to improve their learning skills.

However, an AI has its limitations in interpreting and responding to the non-verbal cues that teachers often use in the classroom. There are other essential aspects of teaching that AI will never be able to replicate. Teachers also provide valuable life skills lessons, such as dealing with disappointment or failure.

Teachers are constantly evolving, learning new things, and experimenting with new methods in the classroom. An AI might be used to assist in teacher development by giving feedback based on previously fed criteria and proposing new teaching methods.

2. Institutional Learning Is a Mutually Supportive Ecosystem

When we talk about teaching, we must understand and accept one fact – teaching is not a one-person job. As mentioned earlier, teaching and learning come in various forms, from various people, and in various flavors.

When students go to a school, they learn and perceive from the actions of others as well – their peers, teachers (that might not even teach their class), the staff members, and the overall educational infrastructure an institution offers.

Let us try to understand this with the help of an example.

Kyle is a pre-schooler who is home-schooled with state-of-the-art AI teaching solutions. He has access to some of the most awesome educational materials and is going well. Seeing his performance in various online tests and assessments, his parents think about continuing homeschooling without the aid of a teacher.

Now, after 3 or 4 years, they think it's time for him to learn in the real-life education system. Kyle goes to the school and witnesses a whole new world out there. There are many things to remember, such as names of his peers, teachers, departments, routes to different sections of his school, rules, etc.

Now, his learning is not only about the books, numbers, or rules of grammar. He is learning sports, teamwork, respecting the space, privacy, and opinions of other people around him. He is now realizing that learning and education are so much more than simply completing sheets after sheets of work and interactive activities.

This is just a small glimpse of how institutional learning can contribute to the wiring of our brains and

As AI alone cannot equip the students with such a comprehensive and holistic ecosystem on its own, it can never completely replace humanized teaching.

3. AI Cannot Provide the Holistic Emotional Connect

This connection is what helps students learn, grow, and feel supported in their education. AI can never replace the emotional support that teachers provide. Teachers are lifelong learners who continue to learn and grow throughout their careers. They are constantly adapting to new situations and the needs of their students.

AI can't provide the same level of support that teachers can. In addition, teachers are passionate about education and helping students learn. They don't just see it as a job — they see it as a calling; they see it as their purpose. And that's something that AI will never be able to understand.

Teachers understand that to transfer the knowledge they want to impart to students, they must create a conducive environment for limitless learning.

4. Teachers Can Adapt and Change Their Teaching Methods

Teachers can adapt and change their teaching methods to meet the needs of an individual student. They understand that one student is different from another. One understands a subject better than the other and has its own ways of absorbing knowledge.

Teachers can provide a personalized learning experience depending on each student's capacity and find a way for them to excel in a subject. Teachers are also able to connect with their students on a personal level, which helps them learn and blossom.

Teachers provide essential life skills to their students, such as working collaboratively and thinking critically. They help to instill values in their students and prepare them for the future.

While we have been discussing the things AI cannot impart as a teacher, let us move on to find how technology can help students and teachers enjoy an enhanced learning experience.

Artificial intelligence – an enabler that augments teaching and learning

While AI can't provide a holistic learning experience, teachers can definitely enhance the quality of education with its functionalities. For example, an AI-based educational software can help identify areas where a student is struggling and needs help. These solutions can answer a teachers' doubts when it comes to choosing the most effective teaching plans or strategies.

Currently, AI is finding application in multiple other areas of education, such as evaluation, teaching with different approaches, testing, personalized learning, virtual learning, etc.

One such example is PrepAI, which helps teachers in generating fair, bias-free, and unique questions in various formats and from multiple sources. The software helps teachers create MCQs, fill-ups, descriptive questions, and true/false questions of easy, medium and hard difficulty, in an effortless manner.

Such smart and powerful solutions can definitely help both teachers and students in identifying and filling the gaps in learning. While AI can't fully replace teachers, it may be the catalyst for a new era in which both teachers and machines collaborate to create a beneficial learning environment that benefits students in every way.

So, would AI replace teachers – NO. But it will definitely disrupt the education and learning sectors and would emerge as one of the best enablers for augmented learning and teaching.

A recent feature on Forbes talked about how artificial intelligence or AI can never replace humans by outlining the fact that it is a technology that is here to make you more valuable. While there

have been consistent debates in the online fraternity regarding the extent to which AI can disrupt the employment world as we know it, the results point in the same direction.

There are still decades to be covered, as far as the complete takeover of basic human jobs is considered. This is because humans are strides ahead of AI and ML when it comes to emotional perceptions, and understanding of different figures of speech, such as sarcasm, humor, sadness, etc.

And, even if AI and ML-powered robots can understand the overall tone of speech, they lack the empathy and distinctly human touch when it comes to relationships, and impeccable grasp over the sentiments.

This is one crucial basis that makes it impossible for AI to replace humans as teachers!

Here, we explore the subject matter at length and discuss various characteristics that make humans better than AI when it comes to teaching.

Let us begin by exploring the essence of teaching.

Humans as teachers: the entire essence

Teaching is a one-on-one and many-to-one relationship that works in many unique ways. Not only does a teacher impart worldly knowledge to the students, but they also learn from them. Teachers and students form a symbiotic and synergistic ecosystem that helps in the mutual enhancement of knowledge (various flavors).

Further, what makes humanized teaching so special, is the fact that teaching happens outside the classrooms as well. It happens throughout life, and that too in various forms, such as visual learning, learning by listening, by doing things, life experiences, etc. Also, learning varies from one person to another depending on their perceptions, abilities, and preferences.

This is why humanized learning differs from controlled, or uncontrolled learning models in ML and AI systems because learning in humans is unique for every single individual.

Humans as teachers have three distinct characteristics that add to the entire essence of teaching, and we discuss them below.

1. Teaching is about relationships

An AI might be able to replicate some aspects of a teacher-student relationship. Still, it will never fully replicate the warmth, empathy, and connection that comes from real human interaction.

2. Teachers are constantly evolving

They are always learning new things and experimenting with new methods in the classroom. No machine could ever duplicate the nimbleness and creativity of a good teacher.

3. Teaching is about human connection

One of the most powerful aspects of teaching is the relationship between teacher and student. This connection is what helps students learn, grow, and feel supported in their education. An AI can never replace that.

Now that we have established the premise, let us move on to discuss the pointers to support it and help you understand why AI can never replace human teachers.

Artificial intelligence vs human teachers: can ai replace teachers?

Through this blog, we aim to help understand the role of teachers, and how an AI could potentially assist them in their teaching. We also hope to answer any questions or concerns readers might have about AI and its impact on education.

The fear that artificial intelligence will one day replace teachers is understandable but unfounded. There are several reasons why AI will never be able to completely replace a human teacher.

4 Basic Forms of AI

We also hope that you will also agree on how AI could play an important part in revolutionizing today's teaching methods.

1. Teachers Play a Vital Role in the Education

Teachers help students realize their uniqueness, which helps to encourage creativity and develop problem-solving skills. They help foster a love of learning and provide support and guidance as students grow and develop. They are also responsible for preparing students to enter the future workforce or pursue further education based on their interests.

On the other hand, AI has already started to play a role in the education sector by helping to personalize learning for each student. It can also provide students with objective and responsive feedback on their work, which helps them to improve their learning skills.

6 Types of Learning

However, an AI has its limitations in interpreting and responding to the non-verbal cues that teachers often use in the classroom. There are other essential aspects of teaching that AI will never be able to replicate. Teachers also provide valuable life skills lessons, such as dealing with disappointment or failure.

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Arya Bharti

Driven by passion and an unrelenting urge to learn, Arya Bharti has a keen interest in evolving and innovative business technology and solutions that empower businesses and people alike. You can connect with Arya on LinkedIn and Facebook.

Can ai replace teachers in schools?

By Tetiana Paratsii
June 24, 2021
9 minutes to read

Summary: What will happen if tomorrow artificial intelligence replaces teachers at school? Such a future is possible today when AI technologies have taken a big step forward. But artificial intelligence still has to learn from humans, and its functionality is limited.

Ai is changing the education industry

We asked the experts what they think about AI in educational processes:

Peter luntz, ils international language school milan

The way we learn and communicate in the 21st century has changed. Digital competencies have become the norm in many life and work settings.

Looking back, we see that writing implements, the printing press, computers, and the telephone revolutionized how we communicate and how we learn. Tools often start as a way to accomplish a task, but then they can create a new way of communicating once they establish a point of no return. So teaching methods that do not take digital learning into account will risk becoming obsolete. They may even alienate students, especially younger learners, who come into educational settings with a new set of expectations.

Technology shaping the modern classroom

Technology must give added value, otherwise, it is just smoke and mirrors. It is always a means to an end, not the end itself. Technology can cater for different learning styles. Providing information in various formats allows students who are visual, auditory, experiential, or reflective to interact with resources at their own pace. Blended learning approaches allow students to have a group classroom moment and individual moments online or on electronic resources that allow for increased individualization of the learning experience.

Using technology to improve communication in the classroom

Technological innovations like online learning platforms allow certain communications to happen outside the classroom (asynchronous communication). This has the advantage of permitting student-teacher and student-student exchanges that would be impossible in the classroom. This could allow teachers to extend the discussion beyond the time constraints of the classroom. It also allows students who are less likely to speak up in the classroom the chance to speak out online.

Diana Wilson, profile Sports LLC Phoenix AZ

I do not think that AI will ever replace good teachers, but it will become a great teacher's aid, enabling teachers to do better what they do best. As machine learning advances, human contact and the approval or the real people in one’s life will be even more important. As human contact becomes more rare, students will not care what artificial intelligence thinks of them.

AI may become a fantastic babysitter!

We live in a wired world now. We switched to AI automated ultra-high-definition tracking cameras to live stream sports. If we were not there recording games, someone else would be trying to film their athlete's game on their cellphone instead of enjoying the game.

Education and sports go hand in hand. AI will change the classroom for the better. In athletics, automation and an algorithm that can distinguish between a baseball and a bird were a breakthrough in sports videography for us. Now we can schedule our cameras from one centralized studio to control various venues around the state and eventually anywhere in the world to turn on automatically, track the action, zoom in and pull back just as if there were a skilled and smooth camera operator manning the helm.

Joel mcleod, Stadivm

Integrating AI into the classroom is already being done today, with providers like Microsoft EDU releasing apps like Presentation Translator, which creates real-time subtitles of what the teacher is saying in multiple languages.

Mostly, education systems worldwide have an established curriculum that teachers repeat year after year to different cohorts. With AI to augment the roles teachers have, a wider variety of material could be covered more easily without the need for teachers to complete additional research.

If an artificial intelligence system took over the role of teaching students completely, we would likely see a continuous analysis of student performance data, which could then adapt the curriculum each year taught to students.

Because of the significantly larger capacity of an AI system to research, process, and teach different information, the AI super teacher could likely optimize how to find and present information to lead to the highest grades amongst students.

Dariya bogretsova, leobit

Due to the evolution in technology, manual working things are now replaced by automated machines. This makes our work easier and less time-consuming. People are trying to adopt new things. Recently, AI is a trend. AI is used in different fields like data science, cybersecurity, medical, stock market, eCommerce. Even in the education sector, smart learning classes have been introduced, which is basically digital education. Some say that teachers cannot be replaced by AI as teachers help students better understand subjects. But if AI replaces teachers, the cost of teachers will be cut down (i.e., you don't need to pay any pension or salary). By seeing both the pros and cons, it is not all about gaining knowledge, understanding of students is also important, which only teachers can do.

Kentaro toyama, university of michigan

In the short and medium terms, no. AI for personalized instruction has been worked on since at least the 1960s when Patrick Suppes at Stanford proposed that computers would excel at customized instruction. An early success was Carnegie Mellon's Geometry Tutor project which led to Cognitive Tutor, one of the more celebrated AI systems for math instruction. But rigorous studies of such systems fail to show consistent advantages over good human teachers.

AI fails to be a super teacher because the crux in education is *student motivation* to do what are years of mental calisthenics. That motivation comes from social interaction that no current or near-future technology can deliver. Human super teachers are adept at a range of motivational tactics—from encouraging to inspiring to rewarding to scolding—that students take seriously. Even young kids quickly realize that a computer is a computer, that its rewards and penalties can be ignored with no social consequences.

In the long term, it's hard to say. If AI—and more robotics—reaches a point where we have emotional responses to robots similar to how we interact with other people, then a humanoid robot

might act like a good teacher. If that happens, then robots could potentially be super teachers. But that's a long way off.

Michael russell, ratchet straps usa (bellville)

AI can become a super teacher at schools through the vast knowledge that is already available through a simple Google search to find the best ways to teach others through visuals. As machine learning becomes more and more rapid with vast amounts of knowledge, I believe we will see an impact inside of our schools first hand with simplifying content and using AI to judge what methods students learn best and comprehend material best with.

The ability to use an algorithm based on Method A vs Method B of teaching students based on prior learning patterns could greatly shape almost any student into a smarter learner with minimal effort required. This can be done through image testing, video learning, or even plain content learning techniques to determine what works best for the students.

Kathryn starke, urban literacy consultant, author, founder of creative minds publications, llc

AI a super teacher? As a former elementary school teacher and urban literacy specialist, I have watched trends in education change, specifically in teaching, reading instruction, and using educational technological applications. While an abundance of technology is added to the elementary school curriculum, they are not all effective. Many teachers are so overwhelmed with the mandate to use tech in every lesson that the actual teaching of the lesson is often a second thought.

Children are now coming to kindergarten knowing how to use an iPad and laptop but unable to use a pair of scissors or correctly hold a pencil. A balance should be created between using technology, collaboration, real books, and hands-on learning in the classroom. There is a role for AI in the education sector that has not been thoroughly explored. AI can help teachers save time, provide children with differentiated instruction, and communicate with parents in real-time.

The possibilities are endless, but the reality in education is that nothing is more important than the classroom teacher. A super teacher is a person with degrees and expertise in education with the passion, empathy, and creativity to understand the importance of building relationships and reaching every child. However, the capabilities of AI can help a teacher become a super teacher for our children.

Blair heckel, data science dojo redmond, wa

Computer-based learning entails gaining knowledge via reading or videos. For AI to become a super teacher, it must develop cognitive and linguistic abilities to connect and adapt to the learner's needs. Compare this with the simplistic ability of AI to identify a weak area in a human student through practice exercises.

Regular research is being conducted in the space of building linguistic ability in AI and building AI based on an understanding of the human brain. Based on these advances, AI will likely soon become an all-encompassing (in terms of breadth and depth of knowledge) and cognitive super teacher.

Tom Chivers, proprivacy

AI teachers have the potential to teach 24 hours a day, so they can educate students in various time zones. Because AI will never tire, it will never make errors or fail to express a point coherently.

The ability for students to constantly communicate with AI and ask questions—even when they leave the classroom and go home—will give rise to constant one-on-one teaching. This level of teaching stands to revolutionize education and could lead to massively improved results.

A lack of personal emotions will allow AI to teach without prejudice, meaning that all students receive the same level of care and attention. However, there is a danger that the data used to develop

AI could re-express prejudices within human inputs. Thus, development will need to be handled correctly for AI teachers to function without error.

A lack of emotional understanding could be a drawback if an AI teacher cannot read a student's inability to process information, leading to frustration, sadness, and other normal human emotions. However, as time passes AI will likely become better at reading human emotions to provide teaching and emotional support when needed.

Jon hayes, authority hacker

AI cannot replace teachers at schools. However, there are some ways AI could support the teacher's work and help them do a better job.

The idea of AI replacing teachers may sound appealing on some levels because teachers are humans, they get tired, they are expensive and in increasingly short supply, while robots do not require pay, bonuses, rewards, health insurance, etc. But in reality, this is not as easy as one may think. Education is not just about acquiring knowledge; it is about interactions and shaping young minds. I probably agree with robots knowing absolutely everything, they might give arguments and help you in problem-solving, but they will not be able to bring real human interaction. While teachers can explain to you, again and again, they will try to convey the topic to everyone and can't leave until they give a satisfactory answer. They will come up with different case studies, lifetime experiences, and invent stories to show the application of the topic. Teachers inspire students to think and innovate things, find out solutions to problems, something AI cannot do.

AI has come a long way; there's no denying it. And it's being used more and more in the educational sector. It's true that AI won't have to take breaks and will always be receptive to questions.

The problem is that when we look at what humans offer that AI can't, we see things that AI simply can't provide. It's that elusive human element. That quality makes adults continue to talk about their favorite teachers decades after they've left the class. AI will not ever be able to capture that element.

Will ai replace teachers?

BY MATTHEW LYNCH
JULY 22, 2021
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Through the years, robots have taken over many jobs. First, they replaced horses and wagons and horses and plows, then they started to replace people. A few examples of artificial intelligence (AI)s replacing humans are:

Mobile check deposits;
The Scan and Go at Walmart;
The AI Autopilot in commercial flights;
Spam filters;
Lyft, Ubber, and other ridesharing apps;
Plagiarism checkers;
Spam filters;
And there are so many more!

So, here's the real question that has been plaguing the education world—the hot debate, if you will. "Will AI replace teachers?"

What is ai in teaching?

China is letting AI in the classroom for several reasons. The biggest use for AI in Chinese classrooms is in the form of facial recognition technology. The school systems there use AI as a teacher's assistant, per se, to "take attendance". This technology is also capable of handling new school enrollments.

China is also looking at using AI to analyze teachers as they teach the children and monitor their and their students' performance.

What about in America? How is AI used in teaching here?

If you've ever heard of, seen, or used a diagnostic test for placing a student in a curriculum or for tailoring a curriculum to meet a student's need, then you've encountered AI in education. And if you're familiar with this form of AI in the classroom, you probably already know how much AI can improve student outcomes.

What is an ai teacher?

The AI teacher, otherwise known as the mechanical teacher, is exactly what it sounds like. It's a computer or machine that can teach a student according to the level it's programmed to teach.

So why do we need a human teacher?

While the thought of an infallible computer teaching your child might seem promising, an AI cannot adapt its teaching to its student mid-lesson or read its student's emotions, as a human teacher can. It cannot further simplify problems that students are having problems with unless it's programmed to do so. It also cannot inspire its students as a human teacher can.

The biggest benefit of the human teacher is that she gives her students that human connection that they need. She also enhances their development of social skills.

Will ai replace teachers?

There are some who believe that teachers will be completely replaced by robots by the year 2027. One reason for this is that there is a demand for teachers today that is not being met.

Additionally, human teachers do carry with them some disadvantages. Some teachers are selfish. Others can be complacent or of poor character. Some can have a compromising character or not be as knowledgeable about particular subjects as they should be. These flaws can be corrected, though, through management and proper monitoring.

However, if you ask anyone the top qualities of a good teacher, an AI cannot meet these standards.

Here are a few:
Friendly attitude;
Listening skills;
Respectful attitude;
Strong work ethic;
Patient;
Discipline Skills; and,
Adept at creating a kid-friendly environment.

Conclusion

AI cannot replace teachers. They cannot give a child what they need. Students need the love, transaction, student-teacher rapport, and collaboration that an AI cannot provide.

However, this does not mean that the AI is not necessary. AI is wonderful in a classroom! It makes the human teacher's job easier and helps her to be more efficient. This added efficiency allows her the time she needs to work more one-on-one with her students to provide more adaptability and understanding for them. Adaptability and further understanding, of course, are two other things that an AI teacher would struggle to provide.

Ondřej Šteffl: Umělá inteligence změní svět, i ten váš

Je možné, že umělá inteligence úplně změní svět, že změní, jak budeme přemýšlet, řešit problémy, komunikovat, po čem toužit, jaké práce vykonávat, že změní, jak se budeme cítit, a možná změní i to, co znamená být člověkem. Nevíme, zda se to stane, ale možné to je. Někteří si dokonce myslí, že umělá inteligence by mohla tento svět zničit. Nevíme, zda se to stane, ale možné to je. Rostoucí nejistota je příznakem dnešní doby. Ale i kdyby měl nastat konec světa, nebude to hned. Proto není od věci se zamyslet, co vlastně umělá inteligence umí a zda ji nepodceňujeme.

Víc, než si myslíme

Umělá inteligence je kolem nás už dlouho, máme ji v mobilu, je na Facebooku, v Googlu, v autě i v ledničce. Situace se změnila 30. listopadu 2022 zpřístupněním velkého jazykového modelu pro širokou veřejnost - chatGPT 3.5. Dnes však máme již verzi 4.0 a co tu bude za půl roku, těžko odhadnout. Zatím je vše v plenkách. I když konkurence mezi Googlem a Microsoftem a také Anthropic tlačí vývoj neuvěřitelně rychle dopředu. V plenkách jsme o všem především my lidé. Nevíme, co od AI čekat, teprve se učíme s ní komunikovat. Jen postupně zjišťujeme, co všechno už umí a kde (zatím!) selhává. Kdosi to trefně přirovnal k situaci, jako by se lidstvo setkalo s mimozemšťanem, který je navíc měsíc co měsíc chytřejší.

Od počítačů čekáme, že fungují podle algoritmů, předvídatelně a přesně. Když na mobilu stisknete R, napíše R. A byli bychom překvapeni, kdyby napsal W. Jenže jazykové modely se chovají

jinak, mnohem více jako člověk než jako počítač. Stejně jako my dělají chyby, někdy si dokonce vymýšlí, a své výmysly obhajují, někdy si dají říct, jindy ne. Ale protože takové chování od počítače či mobilu nečekáme, chyby nás překvapují a přeceňujeme jejich význam. Chyb i podivného chování ovšem bude rychle ubývat.

To kde počítače teď užíváme, nás mate i v tom, co čekáme, že velké jazykové modely umí. Například neumí dobře počítat. Ještě v polovině března si neporadili s úlohou: Kolika způsoby lze rozměnit deset korun, když mám k dispozici korunové, dvoukorunové a pětikorunové mince? Zato jsou výborné jinde, kde to nečekáme, třeba v rozpoznávání emocí a práci s nimi. Navíc AI se už umí naučit mluvit vaším hlasem, vaší intonací s hlasem vyjadřovat emoce. Psychoterapeuti (někteří) si všimli, že už teď část jejich práce AI zastane překvapivě dobře. Zkazí-li vám kolega v práci něčím náladu, vcelku slušně vás navede, jak se s tím vyrovnat. Nejspíš by dokázal i dobře moderovat konflikty, ale zatím mu neumíme předat podrobnosti situace. Byli jsme zvyklí, že my se ptáme a počítač odpovídá. GPT se umí ptát skvěle, ale musíte to po něm chtít.

Někteří hledají útěchu v tom, že velké jazykové modely jsou vlastně pouhým vylepšením toho, co nám v mobilu nabízí další slovo, ano jsou. Stejně tak je ovšem lidský mozek pouhým vylepšením mozku myši. GPT-4 náhle umí věci, které ani jeho tvůrci nečekali - "vykazuje pozoruhodné schopnosti v různých oblastech a úlohách, včetně abstrakce, chápání, vidění, kódování, medicíny, práva, porozumění lidem a jejich chování, motivům a emocím", píše se v expertním zhodnocení modelu a dále "vykazuje emergentní chování a schopnosti, jejichž zdroje a mechanismy jsou v tuto chvíli ještě neznámé".

Reagujeme jako na jiné neštěstí - první fází je popírání

Lidé jsou zaskočeni, AI umí věci, které jsme nečekali, a mnohdy je umí lépe a vždy rychleji než my. Mnohá povolání jsou přímo ohrožena. Právníci, marketéři, copywriteri, redaktoři, překladatelé, každý, kdo pracuje se slovy a symboly, tedy i programátoři a grafici, a například také učitelé, kouči, psychoterapeuti, nejrůznější poradci a jistě další, o kterých to třeba zatím ani netušíme. Už teď je jasné, že mnozí lidé budou nahrazeni v tom, na co jsou nejvíc pyšní, AI bude umět rychleji, efektivně a často i lépe to, co se oni léta učili, co třeba i dovedli k dokonalosti. Příchod AI ohrožuje jejich sebepojetí, jejich identitu. A to je pro každého velká nebo dokonce ta největší ztráta. Negativní dopady umělé inteligence na lidstvo nemusí spočívat v tom, že nám začne škodit či nás likvidovat, ale prostě kvůli její převaze ztratíme smysl svého bytí.

Lidé, kteří se cítí ohroženi, pak reagují stejně jako na jiné neštěstí. Podle modelu Kübler-Rossové je v takové situaci první reakcí popírání, a to je přesně to, co nyní tak často vidíme. Spousta lidí se soustřeďuje na to, aby prokázala, co všechno velké jazykové modely neumí, že jsou pouhým pravděpodobnostním strojem na odhadování následujícího slova, jaké dělá chyby. A hlavně se snaží přesvědčit sami sebe i ostatní, že jsou lepší a nenahraditelní. Přitom je ovšem jasné, že většina shledaných nedostatků bude dříve či později, a spíše dříve, odstraněna. Všechny dnešní závěry nad GPT-4 jsou pořád mudrování nad Flyerem bratří Wrightů, ale většina z nás se dožije Concordu nebo programu Apollo, píše David Kyjovský.

Tandem: člověk + AI

AI je tady a její vývoj se nedá zastavit, mj. i proto, že má vojenské užití. Rusko ani Čína by naše evropská omezení těžko respektovaly. Vývoj je navíc tak rychlý, že bude těžké ho byť jen regulovat. Nemá smysl před AI utíkat, není kam. Místo abychom hledali chyby a co neumí, bude lépe hledat to, co umí lépe než my, a učit se to využívat.

Průmyslová revoluce vedla k tomu, že lidem pomáhají stroje. Po nástupu počítačů si kancelářskou práci bez nich neumíme představit. Automatizace pojí lidi a roboty. Od AI revoluce lze čekat to samé. Lidé a AI budou společně tvořit a pracovat. Budoucnost, alespoň ta nejbližší, patří tandemům AI plus člověk, který s ní dokáže maximálně efektivně spolupracovat.

Můj obor je školství a vzdělávání. Ptal se mě novinář, zda je AI pro školy ohrožení či výzva. Ohrožení je to především pro ty, kteří to jako ohrožení vnímají. Určitě to je výzva, větší než byl covid. Ale především je to povinnost - povinnost žáky a studenty učit, jak AI efektivně využívat. A to platí všude, nejen ve školství. Nemyslete si, že zrovna vás se to netýká.

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