# Table of Contents

# Pros and Cons of "Artificial Intelligence" (PRO)

## Healthcare

***PRO: Improved Image Diagnostic Results***
*National Center for Biotechnology Information, July 2021*
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8285156/

The automated classification of medical images is the leading AI application today. A recent review of AI/ML-based medical devices approved in the USA and Europe from 2015–2020 found that more than half (129 (58%) devices in the USA and 126 (53%) devices in Europe) were approved or CE marked for radiological use.34 Studies have demonstrated AI's ability to meet or exceed the performance of human experts in image-based diagnoses from several medical specialties including pneumonia in radiology (a convolutional neural network trained with labelled frontal chest X-ray images outperformed radiologists in detecting pneumonia), dermatology (a convolutional neural network was trained with clinical images and was found to classify skin lesions accurately), pathology (one study trained AI algorithms with whole-slide pathology images to detect lymph node metastases of breast cancer and compared the results with those of pathologists) and cardiology (a deep learning algorithm diagnosed heart attack with a performance comparable with that of cardiologists).35–38

***PRO: Reduced Healthcare Costs***
*Health IT Analytics, September 2020*
https://healthitanalytics.com/news/artificial-intelligence-tools-could-reduce-hospital-readmissions

An artificial intelligence method could reduce 30-day hospital readmissions by an estimated 12 percent, leading to lower annual healthcare costs and improved patient care, according to a study published in PLOS One. The US spends $3 trillion annually on healthcare, researchers stated, with hospital readmissions being an important and potentially preventable source of utilization. The healthcare industry has introduced several measures to ensure readmission rates stay low for particular medical conditions, but these standards could soon extend to general surgical procedures as well.
PRO: Pushing Boundaries of Human Performance
Brookings Institute, November 2019
https://www.brookings.edu/research/risks-and-remedies-for-artificial-intelligence-in-health-care/

The flashiest use of medical AI is to do things that human providers—even excellent ones—cannot yet do. For instance, Google Health has developed a program that can predict the onset of acute kidney injury up to two days before the injury occurs; compare that to current medical practice, where the injury often isn't noticed until after it happens.[2] Such algorithms can improve care beyond the current boundaries of human performance.

***PRO: Automatic Drudgery and Medical Practice***
*Brookings Institute, November 2019*
https://www.brookings.edu/research/risks-and-remedies-for-artificial-intelligence-in-health-care/

AI can automate some of the computer tasks that take up much of medical practice today. Providers spend a tremendous amount of time dealing with electronic medical records, reading screens, and typing on keyboards, even in the exam room.[4] If AI systems can queue up the most relevant information in patient records and then distill recordings of appointments and conversations down into structured data, they could save substantial time for providers and might increase the amount of facetime between providers and patients and the quality of the medical encounter for both.
Healthcare

## Healthcare (*Continued…*)

***PRO: Better Patient and Medical Resource Management***
*Brookings Institute, November 2019*
https://www.brookings.edu/research/risks-and-remedies-for-artificial-intelligence-in-health-care/

Finally, and least visibly to the public, AI can be used to allocate resources and shape business. For instance, AI systems might predict which departments are likely to need additional short-term staffing, suggest which of two patients might benefit most from scarce medical resources, or, more controversially, identify revenue-maximizing practices.

***PRO: Chatbots can Improve Student Mental Health***
*Harvard Business Review, October 2019*
https://www.brookings.edu/research/the-role-of-ai-in-education-and-the-changing-u-s-workforce/

To reduce students' stress and improve their motivation to study, universities should also consider introducing chatbots and virtual assistants that can help them manage their mental well-being. One example of such a tool is Woebot, an AI-enabled chatbot designed to help users learn about their emotions with "intelligent mood tracking." At a time when many university health systems are stretched to capacity, and students experience dangerously long wait times for on-campus mental health counseling, chatbots could provide some immediate relief. Of course, introducing such a chatbot is not without its own inherent risks. Universities would need to exercise extreme caution in protecting students' personal data and would need some level of human oversight to monitor the advice that chatbots are giving students.

## Education

***PRO: Personalized Education for Individual Students***
*Brookings, October 2018*
https://www.brookings.edu/research/the-role-of-ai-in-education-and-the-changing-u-s-workforce/

While changes in AI and ET create challenges, these technological advancements also provide opportunities. First, innovations in artificial intelligence can provide teachers with valuable resources. Blended learning, defined as "the strategic integration of in-person learning with technology to enable real-time data use, personalized instruction, and mastery-based progression," uses emerging technology to help teachers personalize education for individual students. This approach is generally known as personalized learning. Studies have found that personalized learning is a promising approach, although implementation challenges remain. Rigorous evaluation of ongoing experimentation with blended and personalized learning will be critical to developing effective approaches to using technology in the classroom. One lesson, described in multiple analyses, is the importance of supporting teachers and educators in using technology to enhance their instruction.

***PRO: More Time for Teacher-Student Interaction***
*UNESCO, 2019*
https://unesdoc.unesco.org/ark:/48223/pf0000366994

AI can help personalise learning through various ways. AI can help create a better professional environment for teachers to work more on students with difficulties. Teachers spend plenty of time on routine and administrative tasks such as making assignments and answering frequently asked questions over and over again in school settings. A dual-teacher model entailing a teacher and a virtual teaching assistant, which can take over the teacher's routine task, frees up teachers' time, enabling them to focus on student guidance and one-to-one communication. Teachers have already started working together with AI assistants for the best outcomes for their learners.

## Education (*Continued…*)

***PRO: Personalized Learning Reduces Student Dropout***
*Harvard Business Review, October 2019*
https://www.brookings.edu/research/the-role-of-ai-in-education-and-the-changing-u-s-workforce/

With a personalized learning experience, every student would enjoy a completely unique educational approach that's fully tailored to his or her individual abilities and needs. This could directly increase students' motivation and reduce their likelihood of dropping out. It could also offer professors a better understanding of each student's learning process, which could enable them to teach more effectively. Here's what this might look like: AI-based learning systems would be able to give professors useful information about their students' learning styles, abilities, and progress, and provide suggestions for how to customize their teaching methods to students' individual needs. For example, some students might be experiencing learning difficulties or challenges that require extra attention or tutoring to keep up. Others might be advancing so rapidly that they are not being intellectually challenged and would benefit from additional study materials or assignments. In both of these hypothetical scenarios, AI learning systems would be helping students to reach their full potential, quite possibly preventing them from dropping out by identifying problems early enough to allow the appropriate corrective measures to be taken.

***PRO: Improved Assessment Methods***
*Frontiers in Education Research Journal, March 2022*
https://www.frontiersin.org/articles/10.3389/feduc.2022.755914/full

In addition, AI can also improve assessment methods in traditional classrooms by providing timely information on students' learning progress, success, or failure, through the analysis of their learning patterns based on big data (Sánchez-Prieto et al., 2020). In view of this, AI can demonstrate and present information that would not have been accessible with previous evaluation methods: AI makes it possible to identify whether a learner has reached the correct answer while also providing the teacher with that learner's process leading to the correct answer. In addition, AI can successfully identify learners' psychological states (e.g., bored, frustrated, sad) and provide support catered to each particular situation.

## Environment

***PRO: More Energy-Efficient Buildings***
*World Economic Forum, August 202*
https://www.weforum.org/agenda/2021/08/how-ai-can-fight-climate-change/

AI applications could also help design more energy-efficient buildings, improve power storage and optimise renewable energy deployment by feeding solar and wind power into the electricity grid as needed.

***PRO: Improved Household Energy Use***
*World Economic Forum, August 202*
https://www.weforum.org/agenda/2021/08/how-ai-can-fight-climate-change/

On a smaller scale, it could help households minimize their energy use - automatically switching off lights not in use or sending power from electric vehicles back into the grid to meet anticipated demand.

***PRO: Reduced Supply Chain Emission***
*Forbes, July 2022*
https://www.forbes.com/sites/markminevich/2022/07/08/how-to-fight-climate-change-using-ai/

AI can also reduce emissions by optimizing supply chains through improved demand prediction (to combat overproduction) or efficient transportation of goods (such as shortening delivery times and minimizing energy use). This can be done using data to generate models that predict demand or optimize transportation routes.

## Environment (*Continued…*)

***PRO: Long-term Hazard Prediction and Prevention***
*Forbes, July 2022*
https://www.forbes.com/sites/markminevich/2022/07/08/how-to-fight-climate-change-using-ai/

In addition to forecasting long-term trends, AI can also help us build early warning systems that can provide timely alerts about upcoming events. For example, by analyzing data from weather stations, satellite images and sensor networks, AI can help us identify conditions conducive to extreme weather events such as hurricanes, floods and wildfires. These early warning systems can allow us to take action to mitigate the impacts of these events before they occur. For example, according to a World Economic Forum Report on How AI can help the world fight wildfires, AI can help prevent wildfires by utilizing data sources like satellite images, real-time weather data, and social media posts to developing better fire detection and fire spread algorithms. A smart framework integrating all of these systems is necessary to build a dynamic wildfire risk map with an interactive fire spread simulation

***PRO: Better Understanding of Earth's Climate***
*Frontiers in Environmental Science Research Journal, January 2023*
https://www.frontiersin.org/research-topics/52976/ai-and-data-analytics-for-climate-data-management

The goal of using AI and data analytics for climate data management is to use the advanced analytical and processing capabilities of these technologies to improve our understanding of the Earth's climate and to develop more effective strategies for addressing the challenges posed by climate change. The scope of AI and data analytics for climate data management is broad, covering a wide range of applications and areas of study. Some examples of the scope include:

***PRO: Better Climate Predictive modeling***
*Frontiers in Environmental Science Research Journal, January 2023*
https://www.frontiersin.org/research-topics/52976/ai-and-data-analytics-for-climate-data-management

Predictive modeling: Using machine learning algorithms to predict weather patterns and natural disasters, which can help with disaster preparedness and response. This can include predicting the likelihood of heat waves, droughts, floods, hurricanes, and other extreme weather events.

***PRO: Better Climate Data Interpretation***
*Fronters in Environmental Science Research Journal, January 2023*
https://www.frontiersin.org/research-topics/52976/ai-and-data-analytics-for-climate-data-management

Data interpretation: Using AI to process and interpret large amounts of satellite data, which can provide valuable information on climate change and its impacts. This can include analyzing data on sea level rise, changes in vegetation, and changes in ice cover.

***PRO: Better Monitoring and reduction of greenhouse gas emissions***
*Frontiers in Environmental Science Research Journal, January 2023*
https://www.frontiersin.org/research-topics/52976/ai-and-data-analytics-for-climate-data-management

Monitoring and reduction of greenhouse gas emissions: Developing more efficient methods for monitoring and reducing greenhouse gas emissions. This can include using AI to optimize energy use in buildings, transportation, and other sectors, and to develop more efficient methods for capturing and storing carbon dioxide.

***PRO: Better Climate Adaptation***
*Frontiers in Environmental Science Research Journal, January 2023*
https://www.frontiersin.org/research-topics/52976/ai-and-data-analytics-for-climate-data-management

Climate adaptation: Developing strategies to help communities, businesses, and governments adapt to the impacts of climate change. This can include using AI to identify vulnerable areas and to develop plans for protecting infrastructure and communities from the effects of climate change.

## Environment (*Continued…*)

***PRO: Better Climate mitigation***
*Frontiers in Environmental Science Research Journal, January 2023*
https://www.frontiersin.org/research-topics/52976/ai-and-data-analytics-for-climate-data-management

Climate mitigation: Developing strategies to reduce greenhouse gas emissions and slow the pace of climate change. This can include using AI to identify and evaluate potential mitigation options, such as carbon capture and storage, renewable energy, and energy efficiency.

***PRO: Better Climate research***
*Frontiers in Environmental Science Research Journal, January 2023*
https://www.frontiersin.org/research-topics/52976/ai-and-data-analytics-for-climate-data-management

Climate research: Using AI techniques to improve the understanding of the Earth's climate, including the study of ocean currents, atmospheric circulation, and regional climate variability.

## Transportation

***PRO: Better Performing Autonomous Vehicles***
*Brookings Institution, April 2018*
https://www.brookings.edu/research/how-artificial-intelligence-is-transforming-the-world/

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]

***PRO: Safer and Cleaner Transport System***
*Mathematical and Computational Applications Research Journal, September 2022*
https://www.mdpi.com/2297-8747/27/5/77/pdf

Analyzing traffic patterns to decrease road accidents and optimizing sailing routes to cut emissions are two examples of how artificial intelligence (AI) opens up the choices for making transportation safer, more dependable, more efficient, and cleaner [6]. This technology helps in the obtaining of pertinent information on their effects and of new measures to illustrate this procedure and validate the benefits of new technologies in transportation [7].

***PRO: Better Logistical Efficiency***
*International Finance Corporation, November 2019*
https://www.ifc.org/wps/wcm/connect/7c21eaf5-7d18-43b7-bce1-864e3e42de2b/EMCompass-Note-75-AI-making-transport-safer-in-Emerging-Markets.pdf?MOD=AJPERES&CVID=mV7VCeN

Developing countries often rank low on the LPI because logistics expenditures as a percentage of GDP are usually higher, partly due to a lack of efficiency caused by inadequate infrastructure and poor customs procedures. Whereas developed countries usually spend between 6 and 8 percent of GDP on logistics, these costs can range from 15 to 25 percent in some developing countries.15 AI can help optimize movements in order to maximize efficiency. In particular, the field of e-logistics—in which Internet-related technologies are applied to the supply and demand chain— also incorporates AI in several ways, such as matching shippers with delivery service providers.

## Transportation (*Continued…*)

***PRO: Increased Reliability and Predictability***
*International Finance Corporation, November 2019*
https://www.ifc.org/wps/wcm/connect/7c21eaf5-7d18-43b7-bce1-864e3e42de2b/EMCompass-Note-75-AI-making-transport-safer-in-Emerging-Markets.pdf?MOD=AJPERES&CVID=mV7VCeN

As an enabler of the movement of people and goods, transport is dependent on consistent performance and the ability to forecast arrival and departure times. In public transport, providing timely and accurate transit travel time information can attract ridership and increase satisfaction of transit users.13 The World Bank's Logistics Performance Index (LPI) includes timeliness as one of its six dimensions of trade to develop an indicator for a country's supply chain management. Uncertain and unreliable infrastructure, as well as congestion, have an impact on reliability and predictability. Urban mobility solution providers, such as Uber and Lyft, use AI in multiple ways to provide reliable pickup and drop-off times for their routes, and such technologies can be harnessed to improve the quality of public transport solutions globally. One example is Via, which is licensing its technology to the New York City Department of Education to design smart bus routes and provide transparency on pickups and drop-offs.14

## Finance

***PRO: Better Trading Decision-Making***
*Brookings Institution, April 2018*
https://www.brookings.edu/research/how-artificial-intelligence-is-transforming-the-world/

A prominent example of this is taking place in stock exchanges, where high-frequency trading by machines has replaced much of human decision-making. 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.

***PRO: Fraud Detection and Prevention***
*Brookings Institution, April 2018*
https://www.brookings.edu/research/how-artificial-intelligence-is-transforming-the-world/

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]

***PRO: Improved Profits from Cost Savings***
*Brookings Institution, January 2019*
https://www.brookings.edu/research/how-artificial-intelligence-affects-financial-consumers/

With traditional banks vying to maintain market share and maximize shareholder values, it's safe to say that the gold rush toward AI will only intensify. According to Autonomous Next's 2018 Machine Intelligence forecast, banks, insurance companies, and investment management firms are poised to save more than $1.0 trillion by 2030 if they incorporate systematic investment in AI technologies into their business models. Banks are expected to reap the lion's share of these savings.

## Finance (*Continued…*)

***PRO: Increased Financial Protection for Consumers***
*Brookings Institution, January 2019*
https://www.brookings.edu/research/how-artificial-intelligence-affects-financial-consumers/

Consumer financial protection in the age of AI provides an opportunity to engage non-public agents in the business of protecting consumers from financial harm. A primary objective of consumer financial protection is to make financial services and markets fairer for all consumers. AI can contribute to this goal by expanding access to safer and more effective financial products and services that allow consumers to build wealth and access credit.

***PRO: Increased Financial Accessibility***
*Brookings Institution, January 2019*
https://www.brookings.edu/research/how-artificial-intelligence-affects-financial-consumers/

Reducing systematic financial invisibility is one way AI can extend financial access. Financial exclusion remains a significant barrier to economic mobility for millions. Per Consumer Financial Protection Bureau (CFPB) estimates, approximately 15 percent of rural consumers aged 25 and older are likely to be credit invisible. Results from FDIC's 2017 household banking survey reveal the growing challenge of connecting with rural consumers, who are less likely to use mobile banking and often rely disproportionately on rapidly sunsetting bank teller relationships to navigate their deposit accounts.

***PRO: Improved Financial Regulation for Crime Prevention***
*Brookings Institution, May 2022*
https://www.brookings.edu/research/the-case-for-placing-ai-at-the-heart-of-digitally-robust-financial-regulation/

The second example comes from the rapid flight of millions of refugees attracting human traffickers to the country's borders seeking to ensnare desperate women and children and sell them into slavery for work and sex. Banks are required by law to maintain anti-money laundering (AML) systems to detect and report money movement that may indicate human trafficking and other crimes, but these systems are mostly analog and notoriously ineffective. The United Nations' Office on Drugs and Crime estimates that less than 1% of financial crime is caught. AI-powered compliance systems would have a far better chance of flagging the criminal rings targeting Ukraine. If such systems had been in effect in recent years, moreover, the human trafficking trade might not be flourishing. As it stands today, an estimated 40 million people are being held captive in modern human slavery, and one in four of them is a child.

## Manufacturing

***PRO: Increased Gross Value Addition***
*Purdue University, May 2021*
https://pcrd.purdue.edu/wp-content/uploads/2021/06/RPI-102-Artificial-Intelligence-2021.pdf

Accenture's research has shown that AI could add an additional U.S. $3.8 trillion GVA (Gross Value Added) in 2035 to the manufacturing sector—an increase of almost 45 percent compared with business-as-usual. Despite this economic impact potential, the MAPI study found from their nationwide survey that only 5% of its members have mapped where AI opportunities exist and subsequently developed a clear strategy to generate the data that AI requires. On the other hand, some 56% of its members have stated they have no AI data plan in place. The report concluded that significant technical and workforce barriers remain regarding AI, including interoperability between equipment and a lack of employees with needed AI-skills. Regarding AI adoption among Indiana manufacturers, a survey conducted by Conexus Indiana found that a little less than one-fifth are planning to implement AI by the year 2025.3

## Manufacturing (*Continued…*)

***PRO: Faster Product Development***
*TechTarget, January 2023*
https://www.techtarget.com/searcherp/feature/10-AI-use-cases-in-manufacturing

Some manufacturers are turning to AI systems to assist in faster product development, as is the case with drug makers. AI can analyze data from experimentation or manufacturing processes. Manufacturers can use insights gained from the data analysis to reduce the time it takes to create pharmaceuticals, lower costs and streamline replication methods.

***PRO: Improved Supply Chain Management Saves Costs***
*TechTarget, January 2023*
https://www.techtarget.com/searcherp/feature/10-AI-use-cases-in-manufacturing

One strong AI in manufacturing use case is supply chain management. Large manufacturers typically have supply chains with millions of orders, purchases, materials or ingredients to process. Handling these processes manually is a significant drain on people's time and resources and more companies have begun augmenting their supply chain processes with AI.
For example, a car manufacturer may receive nuts and bolts from two separate suppliers. If one supplier accidentally delivers a faulty batch of nuts and bolts, the car manufacturer will need to know which vehicles were made with those specific nuts and bolts. An AI system can help track which vehicles were made with the defective nuts and bolts, making it easier for manufacturers to recall them from the dealerships.

***PRO: Improved Inventory Management Reduces Bottlenecks***
*TechTarget, January 2023*
https://www.techtarget.com/searcherp/feature/10-AI-use-cases-in-manufacturing

Some manufacturing companies are relying on AI systems to better manage their inventory needs.
AI systems can keep track of supplies and send alerts when they need to be replenished. Manufacturers can even program AI to identify industry supply chain bottlenecks.
For example, a pharmaceutical company may use an ingredient that has a short shelf-life. AI systems can predict whether that ingredient will arrive on time or, if it's running late, how the delay will affect production.

***PRO: Higher Safety and Lower Costs (ex. through predictive maintenance)***
*TechTarget, January 2023*
https://www.techtarget.com/searcherp/feature/10-AI-use-cases-in-manufacturing

Manufacturing plants, railroads and other heavy equipment users are increasingly turning to AI-based Predictive maintenance (PdM) to anticipate servicing needs.
If equipment isn't maintained in a timely manner, companies risk losing valuable time and money. On the one hand, they waste money and resources if they perform machine maintenance too early. On the other, waiting too long can cause the machine extensive wear and tear. The latter can also expose workers to safety hazards. PdM systems can also help companies predict what replacement parts will be needed and when.

## Entertainment

***PRO: Fair, Improved Online Gaming Experience***
*The Jerusalem Post, November 2022*
https://www.jpost.com/special-content/how-can-artificial-intelligence-transform-the-entertainment-industry-723616

In the online casino industry, AI is being used to create realistic and fair gaming experiences by using algorithms that can mimic human behavior. This ensures that the games are as fair as possible and that players have a realistic chance of winning.

## Entertainment (*Continued…*)

***PRO: Improved Content Recommendations***
*Forbes, December 2022*
https://www.forbes.com/sites/joshwilson/2022/12/06/artificial-intelligence-machine-learning-and-the-future-of-entertainment/?sh=adef2546de44

Since the dawn of cinema and TV a winning formula for content has been hard to come by. With every entity consistently struggling to recognize what their viewers actually want and what will be a hit. Even throwing top-of-the-line A-list actors and a $200 million budget has not always been a formula for success and is synonymous with a big risk and a lot of pressure for investors, platforms, and studios. The advent of AI and machine learning is set to change the guessing game that the media and entertainment industry have grown scarily accustomed to with - a lot of the time - hundreds of millions of dollars on the line.

***PRO: Improved Analytics for Personalized Content***
*The Jerusalem Post, November 2022*
https://www.jpost.com/special-content/how-can-artificial-intelligence-transform-the-entertainment-industry-723616

One of the most exciting potential applications of AI in the entertainment industry is its ability to create personalized experiences for users. AI can analyze a user's preferences and behavior patterns to recommend similar content that they might enjoy. This could make it easier for users to discover new and interesting content, as well as help content creators, target their audience more effectively.

***PRO: Enhanced or New Entertainment Content***
*Grand View Research, Accessed: February 2022*
https://www.grandviewresearch.com/industry-analysis/artificial-intelligence-ai-media-entertainment-market-report

The service segment dominated the artificial intelligence in media & entertainment market in 2021 with a revenue share of 59.2%. The rising applications of computer-generated graphics and visual effects in commercial advertisements and movies are anticipated to influence market growth positively. Furthermore, continuing technological progressions in AI-based technologies enable the advancement of engaging content with the incorporation of advanced visual effect structures. The service segment is projected to witness the fastest growth on account of the lack of trained professionals in virtual production and VFX technology, film studios or moviemakers often hire qualified agencies and their services to implement VFX in their video productions.

***PRO: More Interactive Entertainment***
*The Jerusalem Post, November 2022*
https://www.jpost.com/special-content/how-can-artificial-intelligence-transform-the-entertainment-industry-723616

Enhanced experiences: AI can be used to create more immersive and interactive experiences for users. For example, AI-powered chatbots can provide engaging conversations with users who are playing online casino real money, and AI-based recommendations can help users discover new content that they'll love.
Social Welfare

## Societal Welfare

***PRO: Economic Empowerment of Vulnerable Populations***
*McKinsey & Company, November 2018*
https://www.mckinsey.com/featured-insights/artificial-intelligence/applying-artificial-intelligence-for-social-good

With an emphasis on currently vulnerable populations, these domains involve opening access to economic resources and opportunities, including jobs, the development of skills, and market information. For example, AI can be used to detect plant damage early through low-altitude sensors, including smartphones and drones, to improve yields for small farms.

## Societal Welfare (*Continued…*)

***PRO: Improved Public Service Delivery***
*Brookings Institution, February 2022*
https://www.brookings.edu/blog/future-development/2022/02/23/ai-for-social-protection-mind-the-people/

Advocates argue that AI could radically improve the efficiency and quality of public service delivery in education, health care, social protection, and other sectors (Bullock 2019; Samoili and others 2020; de Sousa 2019; World Bank 2020). In social protection, AI could be used to assess eligibility and needs, make enrollment decisions, provide benefits, and monitor and manage benefit delivery (ADB 2020). Given these benefits and the fact that AI technology is readily available and relatively inexpensive, why has AI not been widely used in social protection?

***PRO: Improved Equality and Inclusion***
*McKinsey & Company, November 2018*
https://www.mckinsey.com/featured-insights/artificial-intelligence/applying-artificial-intelligence-for-social-good

Addressing challenges to equality, inclusion, and self-determination (such as reducing or eliminating bias based on race, sexual orientation, religion, citizenship, and disabilities) are issues in this domain. One use case, based on work by Affectiva, which was spun out of the MIT Media Lab, and Autism Glass, a Stanford research project, involves using AI to automate the recognition of emotions and to provide social cues to help individuals along the autism spectrum interact in social environments.

***PRO: Better Health and Hunger Management***
*McKinsey & Company, November 2018*
https://www.mckinsey.com/featured-insights/artificial-intelligence/applying-artificial-intelligence-for-social-good

This domain addresses health and hunger challenges, including early-stage diagnosis and optimized food distribution. Researchers at the University of Heidelberg and Stanford University have created a disease-detection AI system—using the visual diagnosis of natural images, such as images of skin lesions to determine if they are cancerous—that outperformed professional dermatologists. AI-enabled wearable devices can already detect people with potential early signs of diabetes with 85 percent accuracy by analyzing heart-rate sensor data. These devices, if sufficiently affordable, could help more than 400 million people around the world afflicted by the disease.

***PRO: Improved Crisis Response and Management***
*McKinsey & Company, November 2018*
https://www.mckinsey.com/featured-insights/artificial-intelligence/applying-artificial-intelligence-for-social-good

These are specific crisis-related challenges, such as responses to natural and human-made disasters in search and rescue missions, as well as the outbreak of disease. Examples include using AI on satellite data to map and predict the progression of wildfires and thereby optimize the response of firefighters. Drones with AI capabilities can also be used to find missing persons in wilderness areas.

## Cybersecurity

***PRO: Quicker Threat Response***
*IBM, Accessed: February 2023*
https://www.ibm.com/security/artificial-intelligence

As cyberattacks grow in volume and complexity, artificial intelligence (AI) is helping under-resourced security operations analysts stay ahead of threats. Curating threat intelligence from millions of research papers, blogs and news stories, AI technologies like machine learning and natural language processing provide rapid insights to cut through the noise of daily alerts, drastically reducing response times. Watch the video to see how AI helps analysts connect the dots between threats.

## Cybersecurity (*Continued…*)

***PRO: New Threat Detection***
*IEEE Computer Society, Accessed: February 2023*
https://www.computer.org/publications/tech-news/trends/the-use-of-artificial-intelligence-in-cybersecurity

AI can be used to spot cyber threats and possibly malicious activities. Traditional software systems simply cannot keep pace with the sheer number of new malware created every week, so this is an area AI can really help with. By using sophisticated algorithms, AI systems are being trained to detect malware, run pattern recognition, and detect even the minutest behaviors of malware or ransomware attacks before it enters the system.

***PRO: Breach Risk Prediction***
*IEEE Computer Society, Accessed: February 2023*
https://www.computer.org/publications/tech-news/trends/the-use-of-artificial-intelligence-in-cybersecurity

AI systems help determine the IT asset inventory which is an accurate and detailed record of all devices, users, and applications with different levels of access to various systems.
Now, considering the asset inventory and threat exposure (as discussed above), AI-based systems can predict how and where you are most likely to be compromised so that you can plan and allocate resources towards areas of most vulnerabilities.
Prescriptive insights from AI-based analysis enables you to configure and improve controls and processes to reinforce your cyber resilience

***PRO: Automated Attack Response***
*CNBC, September 2022*
https://www.cnbc.com/2022/09/13/ai-has-bigger-role-in-cybersecurity-but-hackers-may-benefit-the-most.html

In general, AI is used to help detect attacks more accurately and then prioritize responses based on real world risk, Driver said. And it allows automated or semi-automated responses to attacks, and finally provides more accurate modelling to predict future attacks. “All of this doesn’t necessarily remove the analysts from the loop, but it does make the analysts’ job more agile and more accurate when facing cyber threats,” Driver said.

## Agriculture

***PRO: Improved Pest Management***
*Forbes, February 2021*
https://www.forbes.com/sites/louiscolumbus/2021/02/17/10-ways-ai-has-the-potential-to-improve-agriculture-in-2021/

The UN, international agencies and large-scale agricultural operations are pioneering drone data combined with in-ground sensors to improve pest management. Using infrared camera data from drones combined with sensors on fields that can monitor plants' relative health levels, agricultural teams using AI can predict and identify pest infestations before they occur. An example of this is how the UN is using working in conjunction with PwC to evaluate data palm orchards in Asia for potential pest infestations, as is shown in the image below.

***PRO: Improved Livestock Health and Production Management***
*Forbes, February 2021*
https://www.forbes.com/sites/louiscolumbus/2021/02/17/10-ways-ai-has-the-potential-to-improve-agriculture-in-2021/

Monitoring livestock’s health, including vital signs, daily activity levels and food intake, ensures their health is one of the fastest-growing aspects of AI and machine learning in agriculture. Understanding how every type of livestock reacts to diet and boarding conditions is invaluable in understanding how they can be best treated for the long-term. Using AI and machine learning to understand what keeps daily cows contended and happy, producing more milk is essential. For many farms who rely on cows and livestock, this area opens up entirely new insights into how farms can be more profitable.

## Agriculture (*Continued…*)

***PRO: Improved Yields, Reduced Operating Costs***
*Forbes, February 2021*
https://www.forbes.com/sites/louiscolumbus/2021/02/17/10-ways-ai-has-the-potential-to-improve-agriculture-in-2021/

Today, there's a shortage of agricultural workers, making AI and machine learning-based smart tractors, agribots and robotics a viable option for many remote agricultural operations that struggle to find workers. Large-scale agricultural businesses can't find enough employees and turn to robotics for hundreds of acres of crops while also providing an element of security around the perimeter of remote locations. Programming self-propelled robotics machinery to distribute fertilizer on each row of crops helps keep operating costs down and further improve field yields. Agriculture robots' sophistication has grown quickly, an example of which is shown in the dashboard of the VineScout robot in use.

***PRO: Better Solutions Through Data Analytics***
*Science Direct, April 2020*
https://www.sciencedirect.com/science/article/pii/S258972172030012X

Panpatte (2018) said that artificial intelligence makes it possible for farmers to assemble large amount of data from government as well as public websites, analyze all of it and provide farmers with solutions to many ambiguous issues as well as it provides us with a smarter way of irrigation which results in higher yield to the farmers. Due to artificial intelligence, farming will be found to be a mix of technological as well as biological skills in the near future which will not only serve as a better outcome in the matter of quality for all the farmers but also minimize their losses and workloads. UN states that, by 2050, 2/3rd of world's population will be living in urban areas which arises a need to lessen the burden on the farmers. AI in agriculture can be applied which would automate several processes, reduce risks and provide farmers with a comparatively easy and efficient farming.

***PRO: More Efficient Autonomous Farm Operations***
*Science Direct, April 2020*
https://www.sciencedirect.com/science/article/pii/S258972172030012X

Robotics and Autonomous Systems (RAS) are introduced in large sectors of the economy with relatively low productivity such as Agri-Food. According to UK-RAS White papers (2018) the UK Agri-Food chain, from primary farming through to retail, generates over £108bn p.a., and with 3.7 m employees in a truly international industry yielding £20bn of exports in 2016. Robotics has played a substantial role in the agricultural production and management. The researchers have now started emphasizing on technologies to design autonomous agricultural tools as the conventional farming machineries lacked in efficiency (Dursun and Ozden, 2011). The main purpose of coming up with this technology is to replace human labor and produce effective benefits on small as well as large scale productions (Manivannan and Priyadharshini, 2016). In this sector, the room for robotic technologies has amplified productivity immensely (Pedersen et al., 2008). The robots are performing various agricultural operations autonomously such as weeding, irrigation, guarding the farms for delivering effective reports, ensuring that the adverse environmental conditions do not affect the production, increase precision, and manage individual plants in various unfamiliar ways.

# Disadvantages of "Artificial Intelligence" (CON)

## Job Displacement

***CON: Automation Replace Human Workers***
*University of St. Thomas, November 2020*
https://news.stthomas.edu/artificial-intelligence-and-its-impact-on-jobs/

"Computers, intelligent machines and robots seem like the workforce of the future. And as more and more jobs are replaced by technology, people will have less work to do and ultimately will be sustained by payments from the government," predicts Elon Musk, the cofounder and CEO of Tesla. This is a scary proposition in some sense, in that what will we do if all the work is done by AI or robots? Isn't life tough enough? Don't we have enough economic disparity and can barely make ends meet today? To add insult to injury, many of the analyses seem to center on displacing the low wage workers. As if they didn't have enough disadvantages already, their entire economic class will be wiped out is the feeling we get from the news cycle. This is evidenced by robotic warehouses and chatbots or automated customer service and we can really feel the changes all around us.

***CON: Wider Range of Automation***
*Brookings Institution, January 2022*
https://www.brookings.edu/blog/up-front/2022/01/19/understanding-the-impact-of-automation-on-workers-jobs-and-wages/

The "new automation" of the next few decades—with much more advanced robotics and artificial intelligence (AI)—will widen the range of tasks and jobs that machines can perform, and have the potential to cause much more worker displacement and inequality than older generations of automation. This can potentially affect college graduates and professionals much more than in the past. Indeed, the new automation will eliminate millions of jobs for vehicle drivers and retail workers, as well as those for health care workers, lawyers, accountants, finance specialists, and many other professionals.

***CON: Better AI Routine Task Performance***
*Forbes, October 2018*
https://www.forbes.com/sites/quora/2018/10/09/how-artificial-intelligence-job-displacement-will-affect-the-worldwide-economy/?sh=130ab28d1f52

As outlined in my new book AI Superpowers, 40-50% of our jobs will be technically and economically doable by AI and automation over the next 15 years. AI can optimize within a single domain by "watching and learning" from many actual examples. So AI certainly cannot do most things that we humans can do. Disruption will hit the industry in areas with the largest number of routine jobs – manufacturing, call centers, banks, retail, etc. It will also cause existing players to compete on their speed of automation. Those who automate faster will be economically advantaged and may win over outsized profits. There will also be disruptions in certain markets (such as loans by apps rather than banks, news edited by personalized AI rather than editors, robot fast food restaurants rather than human-serviced ones).

## Skills Gap

***CON: Worker Training in AI Skills***
*Financial Times and IBM, Accessed: February 2023*
https://www.ft.com/partnercontent/ibm/closing-the-ai-skills-gap.html

After all, new technologies usually create new jobs. Also, the main value of AI is to augment human work and reduce drudgery, rather than make employees redundant. There is no quick and easy solution to the AI skills gap, but by following a three-pronged approach – training staff in data and AI skills, infusing AI technologies to automate mundane tasks, freeing up human workers to upskill and using AI to streamline hiring – companies will be doing much to close the talent shortage.

## Skills Gap (*Continued…*)

***CON: Retraining for New Skills and Jobs***
*University of St. Thomas, November 2020*
https://news.stthomas.edu/artificial-intelligence-and-its-impact-on-jobs/

Bloomberg reports that "more than 120 million workers globally will need retraining in the next three years due to artificial intelligence's impact on jobs, according to an IBM survey." That report and interpretations of it seem to suggest that adoption of AI may result in massive job losses and requires massive retraining. This paints a doomsday scenario, creates uncertainty and worry. The interpretation is AI equals job loss; we would argue that the interpretation should be interpreted as AI and technology advancements will require job retraining and job reskilling. The reports also seem to suggest that our educational system is preparing for jobs of today, when we see that the jobs of the future will be quite different, with different resources and tools at our disposal. This further creates panic in that we see nothing but chaos and the inability to control our destiny for ourselves and our children.

***CON: Limited Skills Slows AI Adoption***
*Forbes, May 2022*
https://www.forbes.com/sites/joemckendrick/2022/05/14/paradox-artificial-intelligence-helps-solve-but-suffers-from-skills-shortages/?sh=4421c2275003

At the same time, the greatest barrier to adoption remains limited AI skills, expertise, or knowledge (34%). Such skills need to include being able to explain how AI arrived at a decision remains critical for businesses. A majority of IT professionals in 2021 and 2022 say being able to explain how their AI arrived at a decision is important to their business. Lack of skills and training to develop and manage trustworthy AI (63%) and AI governance and management tools that do not work across all data environments (60%) are the largest barriers companies face in developing AI that is explainable and trustworthy.

## Wealth / Income Inequality

***CON: Displacement of Low Wage Workers***
*University of St. Thomas, November 2020*
https://news.stthomas.edu/artificial-intelligence-and-its-impact-on-jobs/

"Computers, intelligent machines and robots seem like the workforce of the future. And as more and more jobs are replaced by technology, people will have less work to do and ultimately will be sustained by payments from the government," predicts Elon Musk, the cofounder and CEO of Tesla. This is a scary proposition in some sense, in that what will we do if all the work is done by AI or robots? Isn't life tough enough? Don't we have enough economic disparity and can barely make ends meet today? To add insult to injury, many of the analyses seem to center on displacing the low wage workers. As if they didn't have enough disadvantages already, their entire economic class will be wiped out is the feeling we get from the news cycle. This is evidenced by robotic warehouses and chatbots or automated customer service and we can really feel the changes all around us.

***CON: More Impact on Poor Economies***
*International Monetary Fund, December 2020*
https://www.imf.org/en/Blogs/Articles/2020/12/02/blog-how-artificial-intelligence-could-widen-the-gap-between-rich-and-poor-nations

Our recent staff research finds that new technology risks widening the gap between rich and poor countries by shifting more investment to advanced economies where automation is already established. This could in turn have negative consequences for jobs in developing countries by threatening to replace rather than complement their growing labor force, which has traditionally provided an advantage to less developed economies. To prevent this growing divergence, policymakers in developing economies will need to take actions to raise productivity and improve skills among workers.

## Wealth / Income Inequality (*Continued…*)

***CON: Larger Income Variations***
*Forbes, June 2021*
https://www.forbes.com/sites/jackkelly/2021/06/18/artificial-intelligence-has-caused--50-to-70-decrease-in-wages-creating-income-inequality-and-threatening-millions-of-jobs/?sh=91bf63510091

Artificial intelligence, robotics and new sophisticated technologies have caused a wide chasm in wealth and income inequality. It looks like this issue will accelerate. For now, college-educated, white-collar professionals have largely been spared the fate of degreeless workers. People with a postgraduate degree saw their salaries rise, while "low-education workers declined significantly." According to the study, "The real earnings of men without a high-school degree are now 15% lower than they were in 1980."

***CON: Varied Gender and Racial Impact***
*Brookings Institution, November 2019*
https://www.brookings.edu/research/what-jobs-are-affected-by-ai-better-paid-better-educated-workers-face-the-most-exposure/

Men, prime-age workers, and white and Asian American workers may be the most affected by AI. Men, who are overrepresented in both analytic-technical and professional roles (as well as production), work in occupations with much higher AI exposure scores. Meanwhile, women's heavy involvement in "interpersonal" education, health care support, and personal care services appears to shelter them. This both tracks with and accentuates the finding from our earlier automation analysis.

## Bias and Discrimination

***CON: Biased Hiring Decisions (Ex. Due to Biased Training Data)***
*Harvard Business Review, October 2019*
https://hbr.org/2019/10/what-do-we-do-about-the-biases-in-ai

Bias can creep into algorithms in several ways. AI systems learn to make decisions based on training data, which can include biased human decisions or reflect historical or social inequities, even if sensitive variables such as gender, race, or sexual orientation are removed. Amazon stopped using a hiring algorithm after finding it favored applicants based on words like "executed" or "captured" that were more commonly found on men's resumes, for example. Another source of bias is flawed data sampling, in which groups are over- or underrepresented in the training data. For example, Joy Buolamwini at MIT working with Timnit Gebru found that facial analysis technologies had higher error rates for minorities and particularly minority women, potentially due to unrepresentative training data.

***CON: Biased Criminal Profiling***
*Harvard Business Review, October 2019*
https://hbr.org/2019/10/what-do-we-do-about-the-biases-in-ai

Thirty years later, algorithms have grown considerably more complex, but we continue to face the same challenge. AI can help identify and reduce the impact of human biases, but it can also make the problem worse by baking in and deploying biases at scale in sensitive application areas. For example, as the investigative news site ProPublica has found, a criminal justice algorithm used in Broward Country, Florida, mislabeled African-American defendants as "high risk" at nearly twice the rate it mislabeled white defendants. Other research has found that training natural language processing models on news articles can lead them to exhibit gender stereotypes.

## Bias & Discrimination (*Continued…*)

***CON: Promotes Ageism Through Age Discrimination***
*The Conversation, January 2022*
https://theconversation.com/artificial-intelligence-can-discriminate-on-the-basis-of-race-and-gender-and-also-age-173617

AI is trained by data, and the absence of older adults could reproduce or even amplify the above ageist assumptions in its output. Many AI technologies are focused on a stereotypical image of an older adult in poor health — a narrow segment of the population that ignores healthy aging. This creates a negative feedback loop that not only discourages older adults from using AI, but also results in further data loss from these demographics that would improve AI accuracy.

***CON: Divergent Facial Recognition Accuracy***
*Harvard University, October 2020*
https://sitn.hms.harvard.edu/flash/2020/racial-discrimination-in-face-recognition-technology/

Face recognition algorithms boast high classification accuracy (over 90%), but these outcomes are not universal. A growing body of research exposes divergent error rates across demographic groups, with the poorest accuracy consistently found in subjects who are female, Black, and 18-30 years old. In the landmark 2018 “Gender Shades” project, an intersectional approach was applied to appraise three gender classification algorithms, including those developed by IBM and Microsoft. Subjects were grouped into four categories: darker-skinned females, darker-skinned males, lighter-skinned females, and lighter-skinned males. All three algorithms performed the worst on darker-skinned females, with error rates up to 34% higher than for lighter-skinned males (Figure 1). Independent assessment by the National Institute of Standards and Technology (NIST) has confirmed these studies, finding that face recognition technologies across 189 algorithms are least accurate on women of color.

## Privacy and Security

***CON: Non-consented Use of Photo Data***
*Harvard University, October 2020*
https://sitn.hms.harvard.edu/flash/2020/racial-discrimination-in-face-recognition-technology/

Police use face recognition to compare suspects’ photos to mugshots and driver’s license images; it is estimated that almost half of American adults – over 117 million people, as of 2016 – have photos within a facial recognition network used by law enforcement. This participation occurs without consent, or even awareness, and is bolstered by a lack of legislative oversight. More disturbingly, however, the current implementation of these technologies involves significant racial bias, particularly against Black Americans. Even if accurate, face recognition empowers a law enforcement system with a long history of racist and anti-activist surveillance and can widen pre-existing inequalities.

***CON: Face Surveillance Threatens Freedom (Ex. Expression and Association)***
*Harvard University, October 2020*
https://sitn.hms.harvard.edu/flash/2020/racial-discrimination-in-face-recognition-technology/

But how specifically do unjust applications of face recognition and surveillance harm Black Americans? As stated by the Algorithmic Justice League, “face surveillance threatens rights including privacy, freedom of expression, freedom of association and due process.” Surveillance is linked to behavioral changes including self-censorship and avoiding activism for fear of retribution; for example, face recognition was employed to monitor and identify Black Lives Matter protestors. The FBI has a long history of surveilling prominent Black activists and leaders to track and suppress their efforts. Additionally, continual surveillance induces fear and psychological harm, rendering subjects vulnerable to targeted abuses, as well as physical harm, by expanding systems of government oversight used to deny access to healthcare and welfare. In a criminal justice setting, face recognition technologies that are inherently biased in their accuracy can misidentify suspects, incarcerating innocent Black Americans.

## Privacy & Security (*Continued…*)

***CON: Heightened and Divergent Privacy Concerns***
*World Economic Forum, March 2022*
https://www.weforum.org/agenda/2022/03/designing-artificial-intelligence-for-privacy/

Data privacy is often linked with artificial intelligence (AI) models based on consumer data. Understandably, users are wary about automated technologies that obtain and use their data, which may include sensitive information. As AI models depend on data quality to deliver salient results, their continued existence hinges on privacy protection being integral to their design.

***CON: Massive Data Collection for AI Training***
*World Economic Forum, March 2022*
https://www.weforum.org/agenda/2022/03/designing-artificial-intelligence-for-privacy/

There are many popular online services and products that rely on large datasets to teach and improve their AI algorithms. Some of the data in those datasets might be considered private even by the least privacy-conscious users. Streams of data from networks, social media pages, mobile phones, and other devices contribute to the volume of information that businesses use to train machine learning systems. Thanks to overreaching personal data use and mismanagement by some companies, privacy protection is becoming a public policy issue around the world.

## Unintended Consequences

***CON: Biased Decision-Making***
*Psychology Today, November 2022*
https://www.psychologytoday.com/us/blog/hovercraft-full-eels/202211/ai-and-unintended-consequences-human-decision-making

Both examples highlight the potential for unintended consequences when AI tools end up becoming the default decision-maker. Shacklett (2020) argued that most companies don't want to allow AI to make the actual decision. The problem, though, is that when such systems offer a straightforward recommendation (like a risk score or a suggested action), it becomes very easy for humans to simply develop a bias (i.e., a tendency) to accept the recommendation without any critical assessment of whether it's an appropriate recommendation.

***CON: Reinforcement Learning Agent***
*Harvard Business Review, May 2021*
https://hbr.org/2021/05/5-rules-to-manage-ais-unintended-consequences

Social media firms claim they're just trying to build communities and connect the world and that they need ad revenues to remain free. But nothing is really free. For them, more views mean more money and so they've optimized their algorithms to maximize engagement. Views are the algorithms' "reward function" — the more views the algorithms can attract to the platform the better. When an algorithm promotes a given post and sees an upsurge of views, it will double down on the strategy, selectively timing, targeting and pushing posts in ways that it has found will stimulate further sharing, a process called reinforcement learning. It doesn't take an AI expert to see where this leads: provocative posts that evoke strong emotions will get more views and so the algorithm will favor them, leading to ever-increasing revenues for the platform. But social platforms aren't the only ones who use reinforcement learning AI. As companies adopt it, leaders should look to social media companies' problems to understand how it can lead to unintended consequences — and try to avoid making predictable mistakes.

## Unintended Consequences (*Continued…*)

***CON: Unintended Reliance of AI***
*Psychology Today, November 2022*
https://www.psychologytoday.com/us/blog/hovercraft-full-eels/202211/ai-and-unintended-consequences-human-decision-making

When using GPS, we allocate our attentional resources to following its directions, which adversely affects our ability to follow the steps needed to create a mental map. There also seems to be little incentive to create such a map since the resources required to follow the AI-driven GPS are usually lower than those required for mental mapping. Therefore, people often default to the use of GPS instead of the alternative.

***CON: New Forms of AV Accidents***
*Brookings Institution, June 2021*
https://www.brookings.edu/research/autonomous-vehicles-as-a-killer-app-for-ai/

AVs will likely be safer than human-driven cars, in large part through reducing human error which the National Highway Traffic Safety Association (NHTSA) estimates accounts for 94 percent of crashes. While widespread adoption of AVs should ultimately result in safer roads, there have been several high profile accidents involving AVs, such as a Waymo van that crashed into a car in Arizona. Perhaps as a result of some of these high-profile accidents, consumer demand for AVs seems to be relatively low. According to a 2021 survey by the American Automobile Association, only 14 percent of drivers report that they would trust riding in a vehicle that drives itself, a response similar to the 2020 survey. It is possible, however, that consumer attitudes will change once Level 4 and 5 vehicles become commercially available.

## Lack of Regulation and Oversight

***CON: Super-Intelligent AI Could Outperform Humans***
*Brookings Institution, April 2015*
https://www.brookings.edu/blog/techtank/2015/04/14/understanding-artificial-intelligence/

Recent press has even highlighted the risks associated with AI becoming “super-intelligent”: not just equaling or outperforming humans in certain fields, but leaving humans in AI’s intellectual dust across every domain. In this scenario, our ability to contribute becomes virtually insignificant in all but the most artisanal of sectors. While this seems like the worst-case scenario, it’s not. If AI has goals different from ours, it may view humanity as a problem to be solved on the path to an optimal world, creating a doomsday scenario.

***CON: Super-Intelligent AI Could be Uncontrollable***
*Brookings Institution, April 2015*
https://www.brookings.edu/blog/techtank/2015/04/14/understanding-artificial-intelligence/

While building an all-powerful AI seems avoidable, some AI philosophers predict that once human-level AI exists, its ability to self-improve will rapidly cascade into super-intelligent AI if unchecked. Given the advantages it would by definition have over us, a malevolent, superhuman AI would be a hard thing to reign in. The consequence is that we may have only one chance to design AI to be “human-friendly”. A reliable solution to this “control problem” is arguably one of the biggest unsolved AI problems today.

***CON: Difficulty Assessing Compliance in AI Development***
*Brookings Institution, April 2015*
https://www.brookings.edu/blog/techtank/2015/04/14/understanding-artificial-intelligence/

At a high level, regulation includes governmental rules or directives that restrict how entities can legally operate. This policy lever works best in sectors where the relevant actors are known – or at least identifiable – and their operations sufficiently understandable such that compliance can be evaluated. AI development appears to be one of the sectors most resistant to this type of regulation: its actors are almost indistinguishable from other tech companies, seemingly requiring only computers, electricity, engineers and caffeine to forge ahead.

## Lack of Regulation & Oversight (*Continued…*)

***CON: Possibility of Secret AI Projects***
*Brookings Institution, April 2015*
https://www.brookings.edu/blog/techtank/2015/04/14/understanding-artificial-intelligence/

A secret or concealed AI project would be an easy thing to imagine. In fact, dozens probably exist today, whether bootstrapped or funded by public or private financiers. US investors have backed companies operating in regulatory gray zones before, and locating overseas outside US jurisdiction would hardly discourage foreign sources of capital. When there is both a moral and financial argument for pushing the envelope, it's only a matter of time. The rising on-demand, distributed economy offers many examples.

***CON: Higher Risk of Discrimination (Ex. Absence of Transparency and Oversight)***
*Brookings Institution, June 2020*
https://www.brookings.edu/research/understanding-risk-assessment-instruments-in-criminal-justice/

Even still, a lack of evidence does not guarantee that discrimination is absent, and these claims should be taken seriously. One of the most concerning possible sources of bias can come from the historical outcomes that an RAI learns to predict. If these outcomes are the product of unfair practices, it is possible that any derivative model will learn to replicate them, rather than predict the true underlying risk for misconduct. For example, though race groups have been estimated to consume marijuana at roughly equal rates, Black Americans have historically been convicted for marijuana possession at higher rates.[19] A model that learns to predict convictions for marijuana possession from these historical records would unfairly rate Black Americans as higher risk, even though true underlying rates of use are the same across race groups. Careful selection of outcomes which reflect true underlying crime rates may avoid this issue. For example, a model that predicts convictions for violent crime is less likely to be biased, because convictions for violent crime appear to mirror true underlying rates of victimization.[20]

## Dependence on AI

***CON: Over-reliance on Machine Capabilities (Ex. May Cause Avoidable Accidents)***
*European Parliament Research Service, March 2020*
https://www.europarl.europa.eu/RegData/etudes/STUD/2020/634452/EPRS_STU(2020)634452_EN.pdf

In May 2016, 40-year-old Joshua Brown died when his Tesla Model S collided with a truck while Autopilot was engaged in Florida, USA. An investigation by the National Highways and Transport Safety Agency found that the driver, and not Tesla, were at fault (Gibbs, 2016). However, the National Highway Traffic Safety Administration later determined that both Autopilot and over-reliance by the motorist on Tesla's driving aids were to blame (Felton, 2017). In March 2018, Wei Huang was killed when his Tesla Model X crashed into a highway safety barrier in California, USA. According to Tesla, the severity of the accident was 'unprecedented'. The National Transportation Safety Board later published a report attributing the crash to an Autopilot navigation mistake. Tesla is now being sued by the victim's family (O'Kane, 2018).

***CON: Risk of Delusional Social Competence***
*European Parliament Research Service, March 2020*
https://www.europarl.europa.eu/RegData/etudes/STUD/2020/634452/EPRS_STU(2020)634452_EN.pdf

Enjoying a friendship or relationship with a companion robot may involve mistaking, at a conscious or unconscious level, the robot for a real person. To benefit from the relationship, a person would have to 'systematically delude themselves regarding the real nature of their relation with the [AI]' (Sparrow, 2002). According to Sparrow, indulging in such 'sentimentality of a morally deplorable sort' violates a duty that we have to ourselves to apprehend the world accurately. Vulnerable people would be especially at risk of falling prey to this deception (Sparrow and Sparrow, 2006).

## Dependence on AI (*Continued…*)

***CON: Risk of Emotional Manipulation (Ex. harmful to children)***
*European Parliament Research Service, March 2020*
https://www.europarl.europa.eu/RegData/etudes/STUD/2020/634452/EPRS_STU(2020)634452_EN.pdf

Affective AI is also open to the possibility of deceiving and coercing its users – researchers have defined the act of AI subtly modifying behaviour as 'nudging', when an AI emotionally manipulates and influences its user through the affective system. While this may be useful in some ways – drug dependency, healthy eating – it could also trigger behaviours that worsen human health. Systematic analyses must examine the ethics of affective design prior to deployment; users must be educated on how to recognise and distinguish between nudges; users must have an opt-in system for autonomous nudging systems; and vulnerable populations that cannot give informed consent, such as children, must be subject to additional protection. In general, stakeholders must discuss the question of whether or not the nudging design pathway for AI, which lends itself well to selfish or detrimental uses, is an ethical one to pursue (IEEE, 2019).

***CON: Reduced Physician Agency in Medicine***
*Springer, Journal of Bioethical Inquiry, January 2021*
https://link.springer.com/article/10.1007/s11673-020-10080-1

Medicine's "most cherished and defining values including care for the individual and meaningful physician–patient interactions" may be compromised by adherence to neoliberal principles of "efficiency, calculability, predictability and control" enabled by AI (Dorsey and Ritzer 2016, 15). Managerial control of physician agency may be achieved by soft or hard-stop guidelines, decision tools, the specification of tasks to be completed, tests that are mandated or impermissible, and the implementation of treatment pathways by non-human automated means in EMRs.

## Cost and Accessibility

***CON: Lack of Local Talent***
*Springer Research Journal, January 2023*
https://link.springer.com/chapter/10.1007/978-3-031-08215-3_3

While the technology ecosystem within Africa has grown significantly, there is still a large gap between the pace of software development and AI development within the continent. Fortunately, the interest of outside entities like Google, Microsoft and IBM has led to the establishment of AI research labs on the continent and the local startup ecosystem has also begun to grow. Something we find extremely promising is the emergence of local AI practitioners and research groups that have formed to address local problems in agriculture, healthcare, education and more. Initiatives, such as Bhala, a smart keyboard that is the first mobile application to support spell-checking Ndebele, Shona, Swati, Swahili, Xhosa, and Zulu, is an example of home-grown technology that meets the needs of local populations and fills a gap overlooked by larger players in this spaceFootnote7. A subsequent section in this chapter (survey of the landscape of AI in the continent) provides a deeper look into the current state of artificial intelligence within the African continent. We analyse over 100 startups and organisations dedicated to providing AI products, services and education and note trends that show great promise or bring cause for concern.

***CON: Expensive and Rare AI Experts***
*McKinsey & Company, November 2018*
https://www.mckinsey.com/featured-insights/artificial-intelligence/ai-adoption-advances-but-foundational-barriers-remain

And while several of the barriers to AI adoption that we asked about are much less pressing for digitized companies (only 27 percent cite a lack of AI strategy, compared with 46 percent of all others), respondents at these companies are just as likely as their peers to say it's hard to find the right talent for AI. In fact, talent is the biggest challenge for the most digitized organizations, cited by 41 percent of those respondents.

## Cost and Accessibility (*Continued…*)

***CON: High Implementation Costs***
*IMB, May 2022*
https://www.ibm.com/downloads/cas/GVAGA3JP

Except for COVID-19, the factors driving—and hindering–AI adoption have been extremely consistent across all three editions of the IBM Global AI Adoption Index. Limited skills, high prices, and difficulty scaling or tackling complex projects have remained the key contributing factors to limited AI adoption. As these issues all negatively impact more than a quarter of businesses today, they remain a huge hurdle to widespread adoption.

***CON: Varied Policies and Contexts***
*Brookings Institution, June 2022*
https://www.brookings.edu/techstream/overcoming-the-barriers-to-technology-adoption-on-african-farms/

Other perhaps more important obstacles to technology diffusion are agricultural policies and contexts that make technological adoption unappealing for farmers. Producers adopt new technologies when they solve a current, urgent production problem at an affordable cost. However, context-specific constraints lead many producers to conclude that the risks inherent in the new technology outweigh the benefits. These constraints include the cost of the technology, a lack of information on how to use the technology, poor access to markets, or expensive or lacking complementary inputs (such as energy, water, or transportation). According to recent surveys of the state of agricultural technology adoption in Africa, context-specific constraints have hindered the adoption of existing technology (such as fertilizer and hybrid seeds) and will probably limit the adoption of 4IR technology on the farm in the near future.

## Ethical Considerations

***CON: Lack of Universal Understanding of Ethics***
*Pew Research Center, June 2021*
https://www.pewresearch.org/internet/2021/06/16/1-worries-about-developments-in-ai/

It would be quite difficult – some might say impossible – to design broadly adopted ethical AI systems. A share of the experts responding noted that ethics are hard to define, implement and enforce. They said context matters when it comes to ethical considerations. Any attempt to fashion ethical rules generates countless varying scenarios in which applications of those rules can be messy. The nature and relative power of the actors in any given scenario also matter. Social standards and norms evolve and can become wholly different as cultures change. Few people have much education or training in ethics. Additionally, good and bad actors exploit loopholes and gray areas where ethical rules aren't crisp, so workarounds, patches or other remedies are often created with varying levels of success.

***CON: Threat of  Diverse Black-box Systems***
*Pew Research Center, June 2021*
https://www.pewresearch.org/internet/2021/06/16/1-worries-about-developments-in-ai/

A portion of these experts infused their answers with questions that amount to this overarching question: How can ethical standards be defined and applied for a global, cross-cultural, ever-evolving, ever-expanding universe of diverse black-box systems in which bad actors and misinformation thrive?
A selection of respondents' comments on this broad topic is organized over the next 20 pages under these subheadings: 1) It can be hard to agree as to what constitutes ethical behavior. 2) Humans are the problem: Whose ethics? Who decides? Who cares? Who enforces? 3) Like all tools, AI can be used for good or ill, which makes standards-setting a challenge. 4) Further AI evolution itself raises questions and complications.

## Ethical Considerations (*Continued…*)

***CON: Difficulties Discerning AI Decision-making Basis***
*Pew Research Center, June 2021*
https://www.pewresearch.org/internet/2021/06/16/1-worries-about-developments-in-ai/

Some respondents noted that, even if workable ethics requirements might be established, they could not be applied or governed because most AI design is proprietary, hidden and complex. How can harmful AI "outcomes" be diagnosed and addressed if the basis for AI "decisions" cannot be discerned? Some of these experts also note that existing AI systems and databases are often used to build new AI applications. That means the biases and ethically troubling aspects of current systems are being designed into the new systems. They say diagnosing and unwinding the pre-existing problems may be difficult if not impossible to achieve.

***CON: Risk of Political Manipulation***
*European Parliament Research Service, March 2020*
https://www.europarl.europa.eu/RegData/etudes/STUD/2020/634452/EPRS_STU(2020)634452_EN.pdf

AI has important repercussions for democracy, and people's right to a private life and dignity. For instance, if AI can be used to determine people's political beliefs, then individuals in our society might become susceptible to manipulation. Political strategists could use this information to identify which voters are likely to be persuaded to change party affiliation, or to increase or decrease their probability of turning out to vote, and then to apply resources to persuade them to do so. Such a strategy has been alleged to have significantly affected the outcomes of recent elections in the UK and USA (Cadwalladr, 2017a; b).

***CON: Risk of Market Manipulations***
*European Parliament Research Service, March 2020*
https://www.europarl.europa.eu/RegData/etudes/STUD/2020/634452/EPRS_STU(2020)634452_EN.pdf

King et al. (2019) discuss several ways in which autonomous financial agents could commit financial crimes, including market manipulation, which is defined as 'actions and/or trades by market participants that attempt to influence market pricing artificially' (Spatt, 2014).
Simulations of markets comprising artificial trading agents have shown that, through reinforcement learning, an AI can learn the technique of order-book spoofing, which involves placing orders with no intention of ever executing them in order to manipulate honest participants in the marketplace (Lin, 2017).

## Autonomous Weapons Systems

***CON: Risk of Ethical Malpractices***
*European Parliament Research Service, March 2020*
https://www.europarl.europa.eu/RegData/etudes/STUD/2020/634452/EPRS_STU(2020)634452_EN.pdf

AI also poses a threat in the form of autonomous weapons systems (AWS). As these are designed to cause physical harm, they raise numerous ethical quandaries. The IEEE (2019) lays out a number of recommendations to ensure that AWS are subject to meaningful human control: they suggest audit trails to guarantee accountability and control; adaptive learning systems that can explain their reasoning in a transparent, understandable way; that human operators of autonomous systems are identifiable, held responsible, and aware of the implications of their work; that autonomous behaviour is predictable; and that professional codes of ethics are developed to address the development of autonomous systems – especially those intended to cause harm. The pursuit of AWS may lead to an international arms race and geopolitical stability; as such, the IEEE recommend that systems designed to act outside the boundaries of human control or judgement are unethical and violate fundamental human rights and legal accountability for weapons use.

## Autonomous Weapon Systems (*Continued…*)

***CON: Risk of Misidentification***
*European Parliament Research Service, March 2020*
https://www.europarl.europa.eu/RegData/etudes/STUD/2020/634452/EPRS_STU(2020)634452_EN.pdf

The human can identify misbehaviour by an otherwise autonomous system, and take corrective action. For instance, a credit scoring system may misclassify an adult as ineligible for credit because their age was incorrectly input—something a human may spot from the applicant's photograph. Similarly, a computer vision system on a weaponised drone may mis-identify a civilian as a combatant, and the human operator—it is hoped—would override the system.

***CON: Risk of AI-Inspired Arms Race***
*European Parliament Research Service, March 2020*
https://www.europarl.europa.eu/RegData/etudes/STUD/2020/634452/EPRS_STU(2020)634452_EN.pdf

As automatic and autonomous systems have become more capable, militaries have become more willing to delegate authority to them. This is likely to continue with the widespread adoption of AI, leading to an AI inspired arms-race. The Russian Military Industrial Committee has already approved an aggressive plan whereby 30% of Russian combat power will consist of entirely remote-controlled and autonomous robotic platforms by 2030. Other countries are likely to set similar goals. While the United States Department of Defense has enacted restrictions on the use of autonomous and semiautonomous systems wielding lethal force, other countries and non-state actors may not exercise such self-restraint.

***CON: Risk of Higher Targeted Assassinations***
*European Parliament Research Service, March 2020*
https://www.europarl.europa.eu/RegData/etudes/STUD/2020/634452/EPRS_STU(2020)634452_EN.pdf

Widespread availability of low-cost, highly-capable, lethal, and autonomous robots could make targeted assassination more widespread and more difficult to attribute. Automatic sniping robots could assassinate targets from afar.

***CON: Risk of Higher Suicidal Bombing Rates***
*European Parliament Research Service, March 2020*
https://www.europarl.europa.eu/RegData/etudes/STUD/2020/634452/EPRS_STU(2020)634452_EN.pdf

As commercial robotic and autonomous vehicle technologies become widespread, some groups will leverage this to make more advanced Improvised Explosive Devices (IEDs). Currently, the technological capability to rapidly deliver explosives to a precise target from many miles away is restricted to powerful nation states. However, if long distance package delivery by drone becomes a reality, the cost of precisely delivering explosives from afar would fall from millions of dollars to thousands or even hundreds. Similarly, self-driving cars could make suicide car bombs more frequent and devastating since they no longer require a suicidal driver.