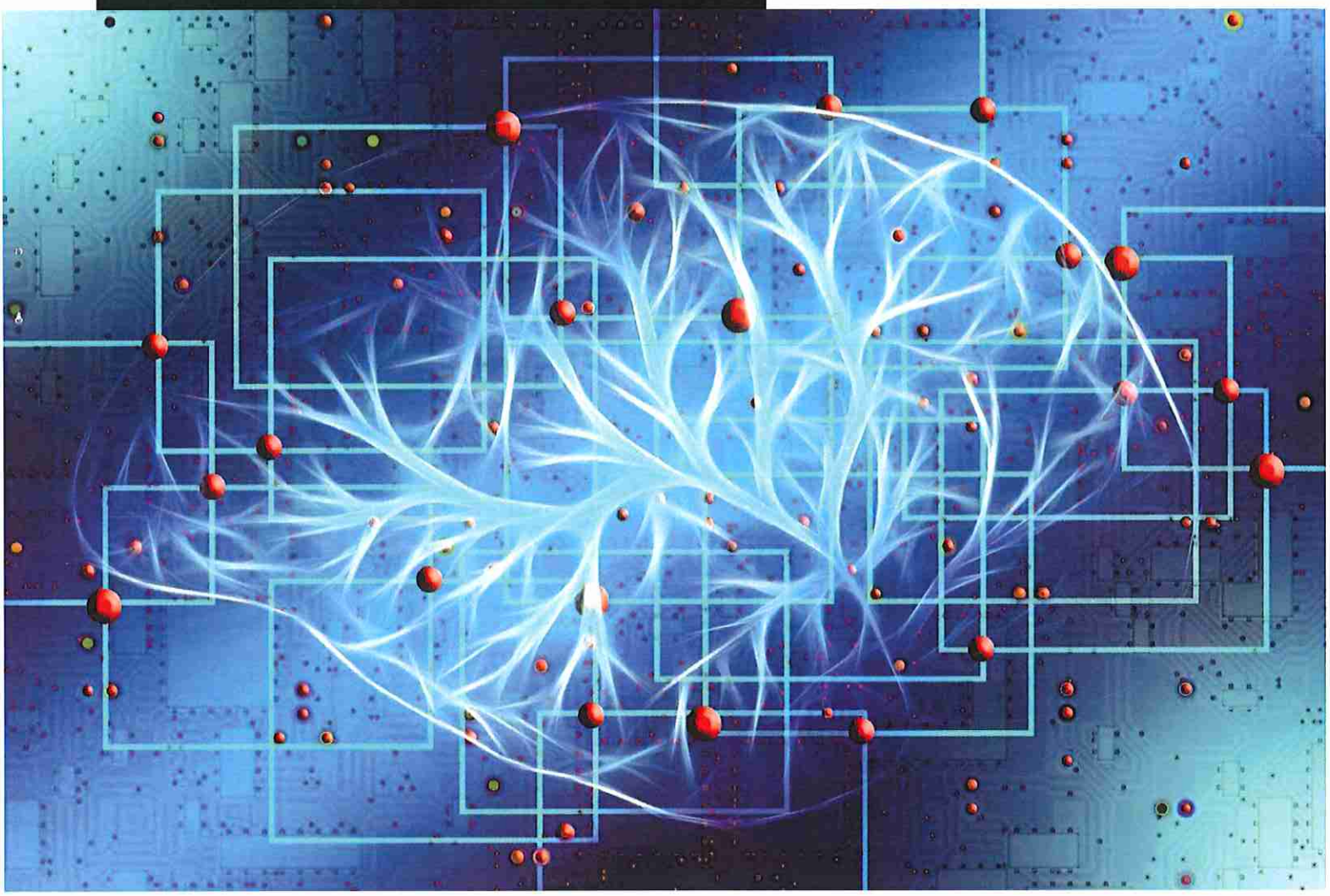
Consumer Technology Association White Paper



Use Cases in Artificial Intelligence

Understanding the Application of AI Across a Range of Industries

November 2018

Consumer Technology Association™

Produced in conjunction with cognilytica

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Executive Summary

Every few decades, a new technology paradigm emerges that changes the way that businesses, society and people interact. Just as the internet and mobile revolutions in recent decades fueled trillions of dollars of investment and productivity growth, the renaissance of artificial intelligence (AI) and related technologies is promising the same benefits across a wide range of industries and organizations.

Industries ranging from banking, hospitality, food service, recruiting and even back office operations are being impacted by a range of Machine Learning and AI technologies. These AI-enabled technologies change how businesses approach their customers, manage front and back office processes, how they recruit and hire talent and more. AI is also being applied by technology and consumer-oriented companies to develop products and services that are more intelligent, responsive and personalized to the needs of their customers and users. AI is powering the next generation of significant technology change.

This white paper is a companion to the "What is Artificial Intelligence"[1] white paper also published by the Consumer Technology Association. This white paper will quickly summarize what AI is, and then detail AI's application to a range of industries and use cases. The list of all possible uses and applications of AI is vast. This white paper is not meant to be an authoritative list of all such uses and applications of AI, but rather aims to showcase a variety of usages that are transforming different industries. Some of the use cases explored in this paper include home cybersecurity and health care to gaming, content and digital assistants.

An Overview of Artificial Intelligence

At the most abstract level, AI is ***machine behavior and function that exhibits the intelligence and behavior of humans***. This usually means the ability for machines to perceive and understand their surroundings, learn from teaching/training and its own experiences, make decisions based on reasoning and thought processes, have natural conversations and linguistic communication with humans and develop "intuition" in situations that are vague and imprecise.

Why does AI Matter?

It is becoming clear that people are ever-more demanding of their interactions with devices and systems. People often obtain greater satisfaction from the convenience of automated self-service systems than they do in dealing with the inevitable shortcomings of human-to-human interaction. People also want instant access to information, goods delivered to them at their whim and transportation to destinations with minimal hassle. Just as importantly, businesses have the never-ending desire to increase productivity, provide greater levels of service and satisfaction to their customers and improve their interactions with all their stakeholders. Businesses want to be able to identify people and objects in their ever-growing piles of data. All

these factors are driving individuals and organizations to demand more from machines and systems regarding what they want from interactions with other humans and organizations – automation combined with intelligence. This is driving the need for and adoption of AI and other forms of more intelligent systems.

Narrow AI vs. General AI

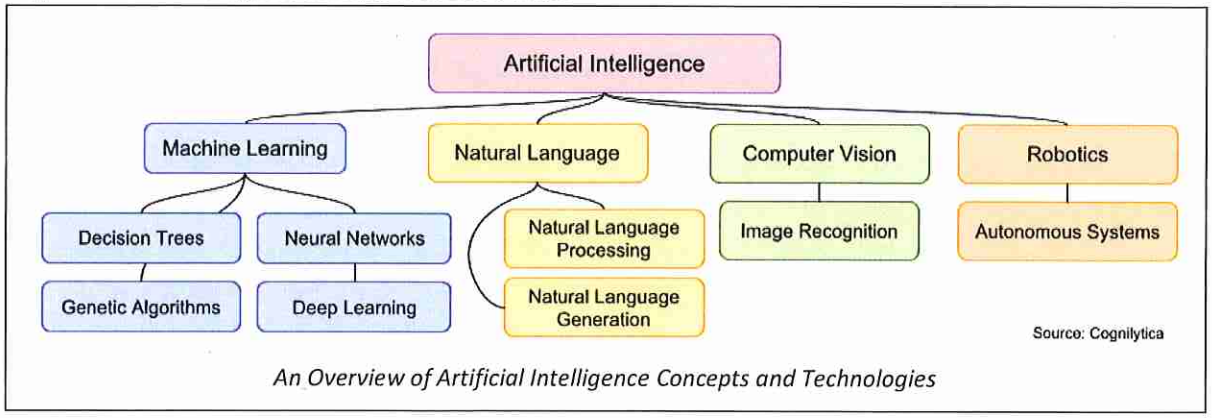
AI has a broad spectrum of ability. The more an AI system approaches the abilities of a human, with all the intelligence, emotion, broad applicability of knowledge, then the "stronger" it is. On one end of this spectrum is Artificial General Intelligence (AGI), or the development of machine intelligence so strong and general purpose that it can tackle any task and handle any problem with the cognitive capabilities and mental dexterity of humans. Overall, intelligent systems can generalize knowledge from one domain to another, make plans in the future based on knowledge and experiences and adapt to change as it happens in the ecosystem. Currently, there has not been anything built that is close to the capabilities of AGI systems.

On the other hand, the more specific to a particular application a particular AI system is, the more "narrow" it is. Narrow AI systems do not aim to solve the problem of AGI but rather use bits and pieces of AI technology to solve specific problems. Narrow AI systems are applied to a specific task, and the intelligence is not meant (or able) to be applied to other tasks. Examples include image recognition, conversational technology, predictive analytics, recommendation engines and profiling systems and self-driving vehicles. Since we have not yet achieved AGI, it follows then that all current practical implementations of AI are considered Narrow AI.

The Artificial Intelligence Ecosystem

Human intelligence comes from a combination of many discrete skills that together form a whole intelligent being. Likewise, the field of AI encapsulates many overlapping concepts that contribute to increasing intelligence of the systems in which they are applied. AI systems need to be able to learn, just like their human counterparts. The ability to learn is called ***Machine Learning (ML)***, of which the application of ***Neural Networks*** and ***Deep Learning*** is one approach. AI systems need to be able to perceive their environments, which is known as ***Computer Vision***, interact with the environment through ***robotics and autonomous systems***, and interact with humans in their ***natural language***. The below chart identifies some of the most important concepts and terms in AI:

Figure 1: Artificial Intelligence Concepts and Related Terms



An Overview of Artificial Intelligence Concepts and Technologies

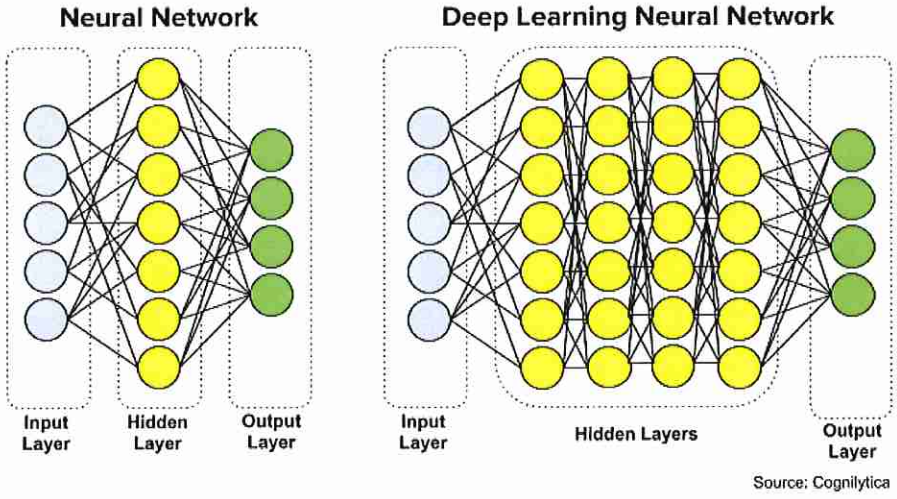
Refer to the *"What is Artificial Intelligence"* white paper, which provides additional information on the above terms and their relation to AI, as well as the glossary at the end of this white paper for further high-level definitions.

Neural Networks & Deep Learning: Simulating the Way the Brain Works

Our brains are remarkable biological machines that containing billions of neurons with intricate interconnections that provide all our capabilities for sensing our environment, learning from experience, and interacting and making sense of the world around us. AI researchers sought to replicate the complicated structure of the brain by creating artificial Neural Networks as a way to simulate how the brain works. With Neural Networks, ML is structured as a set of artificial neurons that are connected together and that take input information, analyze it, and produce an output. Over time these networks quickly learn patterns through supervised learning approaches.

Neural Networks were previously hard to manage and scale. However, with the creation of Deep Learning, combined with huge datasets (aka "big data") and ever faster computer processors, we have a way to handle many layers of artificial neurons for more complicated learning. Deep Learning consists of many interconnected layers of neurons (see Figure 2) that provide increasingly more capabilities for handling greater levels of intelligence.

Figure 2: Neural Networks and Deep Learning



Neural Networks & Deep Learning

Deep Learning is being applied successfully in a wide range of situations, such as natural language processing, Computer Vision, machine translation, bioinformatics, gaming, and many other applications where classification, pattern matching, and the use of this automatically tuned deep neural network approach works well. While Machine Learning approaches today still have a ways to go before coming close to being as good as our brains, they are quickly

getting better and achieving things we never thought were possible before – self-driving cars, recognizing faces, beating world masters at Chess and Go, and talking to you.

Augmented intelligence

While AI technologies can fill many gaps and show promise in a lot of areas, for the most part, these technologies are not complete or flawless enough to fully perform many tasks currently done by humans.

That doesn't mean AI is not applicable for these organizations. Businesses and agencies can realize significant benefits by enhancing the capabilities of their existing staff and leveraging AI as a "force multiplier" that enables them to do more with their existing resources. This is the key idea behind the concept of Augmented Intelligence. In much the same way that robotics engineers have created exoskeletons that empower humans to perform activities that were previously impossible or required great effort or fatigue, so too can Augmented Intelligence systems provide assistance that can enable humans to perform information tasks that were previously impossible, too difficult, or required significant amounts of time and effort.

One of the most effective ways to achieve early ROI with AI is to adopt technology that provides intelligent assistance to humans in their daily tasks, rather than replacing them with automated alternatives. For example, in many situations, it's impossible for a human to process all the data that's available to them. Individuals in any data processing, analytics, management, or information centric job can gain superhuman powers with an AI-enabled assistant that can help them find, aggregate, and analyze a wider range of information than they would be capable of doing on their own. Through AI and Machine Learning companies are able to best match the caller with an available agent based on a number of factors including customer data, demographic data, and previous interactions leading to more positive and successful connections.

Security Applications and Use Cases of AI

One of the biggest challenges with the widespread use of networks, computers and interconnected systems is their increasing vulnerability to attack. Consumers want the benefit of systems that can instantly access the almost limitless resources available online from anywhere they can get a network connection. However, consumers also want to prevent others from inappropriately accessing, compromising or damaging those systems.
Crime, and cybercrime specifically, is a very human activity, calling up the worst in human creativity for selfish or harmful ends. Fortunately, AI systems can provide solutions to help stem the tide of cybersecurity threats. By powering technology systems with cognitive capabilities, advanced pattern matching, and big data-powered analytics, technology firms and end users have a chance to fight back against the increasing wave of security threats.

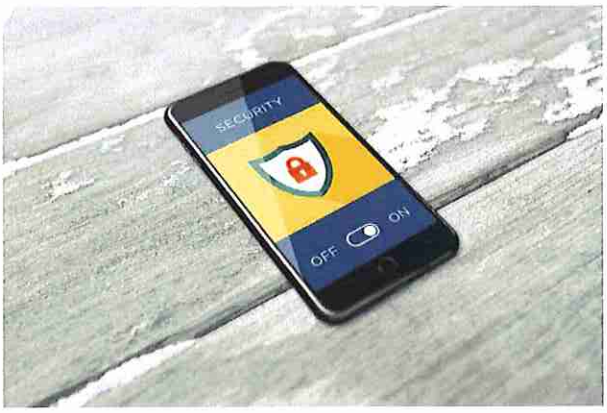
Use Case: Using AI to Combat Evolving Cybersecurity Threats

Cyberthreats and attacks are increasingly becoming more sophisticated. A report on malicious AI, "The Malicious Use of Artificial Intelligence: Forecasting, Prevention, and Mitigation,"[2] produced by a group of 26 experts from 14 different academic, governmental and industry organizations, warns of three major categories of AI-driven threats gaining traction: automated bots, convincing fake media and threat detection avoidance. Phishing attacks, digital impersonation of others, synthetic images produced by AI that are indistinguishable from real images and automated hacking threats are emerging on the scene, powered by AI advances. AI systems are also learning how to thwart cybersecurity countermeasures.

To combat these new threats, there's a new wave of technologies emerging that use AI to thwart these AI-enabled attacks. In addition, human-assisted AI systems learn to watch for patterns and detect outlier behaviors in real-time to thwart attacks such as account takeover, data exfiltration and malware. AI technologies are able to always keep a watchful eye and better detect and stop threats before they happen.

Use Case: AI in Home Cybersecurity

A mere two decades ago, very few homes had a single device permanently connected to the internet. Now homes are teeming with dozens of devices ranging from smart thermostats and lights, to security cameras, home entertainment systems, and computers, phones, tablets and much more. Each of these connected devices provides great value and entertainment to users, but also creates a wide array of "threat vectors" that those with malicious intent can use to attack unwary targets.



Technology companies are arming themselves with the power of cognitive solutions, using AI to help detect, thwart and prevent attacks on vulnerable systems. AI is good at spotting patterns in data. By training AI systems on vast catalogues of malicious programs as well as the normal patterns of behavior, machine language-enhanced systems can spot abnormal behavior that doesn't fit the accepted usage patterns or fits the patterns of already-profiled malware. These AI systems can then be enabled to deny access, require additional verification, or otherwise protect the system from continued attack.

Similarly, consumer technology vendors are realizing there's strength in numbers. As these devices become increasingly interconnected, threats detected at one device in the network can notify and inform all the connected devices, providing instant response to cyberattacks. AI systems help identify the sources of these attacks, determine which systems might be the most vulnerable, and identify how to best prevent the spread of malicious threats. In effect, these AI systems are acting like 24/7 network and administrative operations, keeping a constant watch on systems and responding to threats as they happen, without requiring human intervention.

AI systems are also being used to categorize attacks based on threat level and adapt over time. Instead of dealing with yesterday's attacks, AI-enabled systems are analyzing the ways these threats are accessing systems and even proactively probing their own systems to detect future potential threat vectors. AI-powered Natural Language Processing is also being used to monitor email and websites for spam and phishing attacks. With the ability to read and understand content, AI-powered systems can understand whether the content conforms to acceptable usage patterns or is an attempt to gain unauthorized access.

Use Case: AI in Fraud Detection

In addition to technology threats, AI is helping with aspects of financial and business fraud. Fraud and financial crimes are extremely common in most enterprises, from seemingly smaller issues of unearned time and benefits to much larger cases of embezzlement. According to the Association of Certified Fraud Examiners' (ACFE) Report to the Nations on Occupational Fraud and Abuse[3], on average, a company loses 5% of its revenues to fraud each year, with the median loss at $140,000 per year and over 20% of companies reporting losses of $1 million or more. To make matters worse, most companies didn't detect the fraud until at least 18 months after it was first perpetrated, with smaller organizations taking the longest and having the smallest financial cushion to deal with the impact.

The primary way fraud is currently detected is through tips from other employees, and not through any examination or audit of financial data. Companies don't have the human resources or data to audit all the various systems they operate. Companies, using human intervention, are forced to either spot check reports on an occasional basis, work on an honor system with their employees and management, or depend on whistleblowers to get the attention of auditors. All these current methods require an intense amount of human labor to physically check every report, every receipt, and every line item. Clearly, the costs to do that sort of intense auditing would not result in a positive ROI for most enterprises. As a result, they usually accept fraud as a "cost of doing business". However, what if a reliable, automated and intelligent way to audit and enforce compliance with all expense reports could be introduced? Then fraud could be reduced, efficiency increased, and compliance enforced without losing money in the process.

The key to keeping a lid on this fraud is to identify the fraud before it takes too much of a bite out of the company's bottom line. To do this, companies need to put processes and controls in place that automatically audit, monitor, and accept or reject transactions that don't fit an acceptable pattern. The ability of AI systems to detect patterns and deviations from patterns make them well-suited for fraud detection. AI and Machine Learning are helping companies keep a lid on fraud without imposing significant requirements on the business in terms of time and resources.

With the evolution of the capabilities of Machine Learning-enabled AI systems, it is now possible to thwart more fraudulent activities, replacing many human tasks with automated

ones, and augmenting the other tasks so that humans can be significantly more effective at their jobs. With AI, companies are now able to audit 100% of expense reports with very little human effort. AI systems can automatically scan receipts and other expense documentation and automatically classify and identify valid data to different spending categories. The system can then automatically check and verify that the classification of expense fits with the submitted report. Then, using advanced pattern matching, these systems check to see if the submitted expenses match patterns that the system has learned are typical for the company, for the role of the employee and for the expected behavior patterns of that user. Additionally, these AI-enabled systems cross-check and verify individual pieces of data to see if the information is valid and is what would be expected. Because of AI, companies are now able to save up to tens of thousands of dollars every year by catching faulty expense reports. One company, Mortenson Construction, was able to successfully audit over 3,000 expense reports with the help of AI auditing software and recoup T&E spend for the company.[4]

In many ways, the AI-enabled systems are acting as automated, intelligent virtual assistants, providing the sort of capabilities that would otherwise require a significant amount of human power to accomplish. Indeed, there is no real way to get the assured level of auditing and compliance desired by finance professionals without the use of AI and Machine Learning. AI enables the ability to enforce 100% compliance and 100% audit of expense reports and submitted documentation, rather than just occasional or partial auditing.

Digital Assistants

One of the most popular uses of AI is in providing always-available assistance to our daily tasks, from simple queries about facts to scheduling meetings and playing music. AI is enabling and empowering a new range of digital assistants with the power of cognitive technology.

Use Case: Voice Assistants

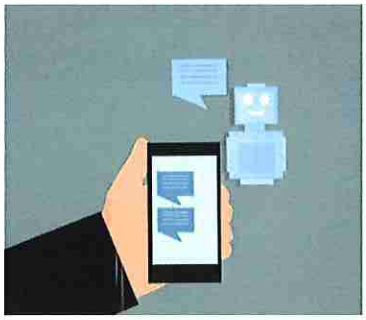
Voice assistants are voice-based conversational interfaces paired with intelligent cloud-based back-ends that give users the ability to interact with natural language and accomplish a range of tasks. These conversational interface-based devices are quickly gaining popularity with devices and technology like Amazon Alexa, Apple Siri, Google Home, Microsoft Cortana, Samsung Bixby [trademarks of their respective companies] and an increasing number of new entrants into a space. These devices, which some refer to as "smart speakers" do more than simply provide voice controls for music.

These devices combine Natural Language Processing and Natural Language Generation capabilities with back-end AI-powered intelligence. These systems are enabling a wide range of capabilities from interaction with news and weather information, to helping with homework and information queries, to controlling home automation devices. In a recent demo of this technology these intelligent voice assistants even acted on behalf of users to have

complete conversations with businesses to book appointments and other activities. Indeed, these are your real-life, AI-powered virtual assistants.

Soon, intelligent assistants will be everywhere. We'll be interacting with them daily in both our personal and professional lives. We'll be chatting with assistants in our homes and interacting with other people's and business' conversational agents. In a future where everyone will have a personal electronic virtual assistant, we'll have them do everything from messaging friends when planning a birthday party, to scheduling all the logistics for that party, to dealing with inbound calls from late attendees who are lost or can't make it. In the future, we'll be dependent on these intelligent assistants for keeping our lives in order, just as we are now dependent on our GPS systems to keep us from getting lost and our mobile phones for keeping us always connected.

Use Case: Intelligent Chatbots



Humans were born to talk and communicate. Much of the brain is devoted to generating, sensing, processing and understanding speech and communications in their various forms. When humans were building our first civilizations we were also creating and expanding spoken and written forms of communication. We didn't start communication with swipes and types, in fact for most of human history we did not have technology, so it's no surprise that what we want from our interactions with machines is what we want from interactions with people: natural conversation.

At its simplest core, a chatbot is a software application or computer program that accepts input in the form of written or spoken text in a natural language and provides as output text in written or spoken form also in a natural language. Unlike other programs, the whole "trick" of a chatbot is to make it seem as if you're conversing with a real human being. Chatbots have been around for a long time, but AI is increasingly empowering these systems to provide greater interaction, more natural human conversation, and more intelligence than ever before.

Chatbots are best suited for applications where back-and-forth interaction with humans is required. Such scenarios include customer support and customer service, information acquisition (especially over the phone), interaction with devices where physical input is not possible or convenient such as when driving or in the kitchen when your hands are not free, or a new class of intelligent personal assistants where hands-free interaction is preferred.

There are many possible applications for Chatbots. The most immediate use of Chatbots with high ROI for the business is in customer service and support. Chatbots are being integrated into customer support to answer customer questions, help guide complicated transactions, and answer questions regarding orders, shipping, returns and other matters. This frees up call center operations to deal with more complex customer or order related issues.

Chatbots are also being used to engage customers using ***conversational commerce***. Leveraging messaging platforms such as SMS, Facebook Messenger, Slack, Kik, and embedded web technologies, conversational bots are interacting with customers to place orders in the form of

a conversation rather than clicking a website or using a mobile app. The pervasiveness of Chatbots and voice assistants are making it so that ordering something is now just a matter of uttering a phrase like "reorder toilet paper." It's possible to go from urgent situation to problem resolved quickly by uttering that phrase. Many companies have taken notice and are building bots to help customers make better decisions when there are complex choices among products, and to have ongoing engagements with customers before, during, and after their purchases. This can lead to greater customer satisfaction for retailers and manufacturers leading to increased sales through upselling and cross-selling.

Financial services industries are also finding use for Chatbots, using them to power so-called ***robo-advisor*** platforms in which AI-enabled systems combined with personalized information can provide more direct guidance on matters of personal finance. Chatbots are used to interact with customers on the platforms they prefer while keeping them up to date with notifications or alerts.

Use Case: Natural Language Processing & Understanding

In addition to Chatbots, there are a number of ways AI and Natural Language Processing can be applied. One way is sentiment analysis. Sentiment analysis is usually driven by algorithms and is used around voice of the customer materials to determine customer feelings. Natural Language Processing technology can analyze a variety of things such as reviews and survey responses, online and social media and can monitor and review conversations to find patterns in these customer interactions. In customer service and call center applications, sentiment analysis is a valuable tool that is used for monitoring opinions, emotions and interactions. Companies can analyze customer feedback allowing them to discover trending topics, identify top complaints and track critical trends over time. AI technologies allow companies to track feedback far faster than they could with humans monitoring the systems and extract information in specific languages without large amounts of work and training.

Natural Language Processing can also be used internally at organizations for things such as document sharing. Natural Language Processing allows different individuals and departments to receive tailored text. For example, executives might want to receive the full report, but HR may only care about certain aspects. It can also help with internal routing of tickets or support communication. Every message and request that is received can be reviewed and routed to the correct parties. Natural Language Processing can also be used in ecommerce applications to help with descriptions and search features. Natural Language Processing system need to be trained to understand the context of a word in a sentence so when a customer types "soccer shoes" in a search, they don't also get soccer balls or other types of shoes.

As an example of this Natural Language Processing capability, Volumation, an Austin, Texas based startup leverages an AI-based technology to "Humanize the Digital World". Using an array of cameras paired with AI-driven software process, the system captures 3D video of real people, places, and objects at multiple angles. The AI system finds points of interest in each image, matches them between the group of images and makes an estimation as to their place in 3d space. This provides an AI-enhanced augmented reality (AR) system that can map real

objects to a virtual environment, producing a volumetric, 4-Dimensional video of the experience that can be played back on many different platforms.

AI Use Cases in Health, Fitness and Wellness

AI systems are helping in significant ways to monitor and improve people's health and well-being. They are being used to detect and monitor for potentially dangerous conditions and provide personalized approaches to the delivery of healthcare. AI is enabling a future in which we have around-the-clock access to high-quality healthcare, delivered with automated assistants that know more about us than our doctors do.

Use Case: AI in Preventative Analytics

AI combined with big data and analytics is helping detect and prevent illness before it happens. Doctors and health practitioners are increasingly using tools that can mine patient data and combine that with Machine Learning to identify patterns that could indicate potential health issues. In fact, clinical trials and research are showing that AI systems are just as helpful, or even more so, than traditional medical practices in detecting early signs of illnesses such as diabetes, Alzheimer's and other potential health issues and illnesses.[5] Many hospitals and health care practitioners are implementing something called the AI-enabled Early Warning System (EWS) that aims to "reduce in-hospital mortality and prevent unplanned transfers to the intensive care unit (ICU)".[6] These AI systems keep an always-on watch over patients in the hospital and can detect even the slightest of issues that can lead to serious problems.

For example, CarePredict, an AI-driven digital health company that has developed an integrated solution consisting of a wearable device, smart remote sensors, and a Deep Learning platform to provide insights around seniors' health. The wearable collects data autonomously that today is normally only observable by a human. Machine Learning and unique kinematics algorithms are used to quantify activities performed by the human body such as drinking, eating, sleeping, walking, grooming, etc. These unique and rich data sets are used to train the Deep Learning neural nets to surface insights like self-neglect due to depression, unusual toileting patterns due to a urinary tract infection, or increased fall risk due to malnutrition, lack of rest, and dehydration. These insights are generated without any self-reporting by the senior. The power of these unique data sets coupled with AI essentially provides a 24/7 net of continuous observation for the senior -- giving caregivers unparalleled insight into the evolving health of the senior -- so that proactive measures can be taken to avert a more serious health issue.

AI-enabled systems are also helping with diagnosing illnesses. Computer Vision systems based on AI can look at radiology images and lab results and are able to detect differences between healthy and cancerous tissues. These systems can then improve radiation treatments and increase accuracy by personalizing treatments. Combined with the new wave of intelligent

electronic health records, these extra pairs of eyes are helping assist in diagnostics, clinical decisions and personalized treatment suggestions.

Diving Deeper with Deep Learning in Healthcare Applications

Deep Learning networks are increasingly being used in a multitude of healthcare applications, from imaging diagnostics on the frontline to clinical decision making, and Augmented Intelligence approaches to medical diagnoses. The use of different types of Deep Learning approaches is giving machines the ability to process images, video, and audio, as well as make insightful predictions on behavioral and biological data.[21]

These Deep Learning Neural Networks have successfully been used to improve medical image analysis, with studies showing that these systems can identify cancer up to 50% faster and with performance on par with leading radiologists and dermatologists.[7] These algorithms can potentially save our health care system billions of dollars annually, by providing a preliminary diagnosis before a patient sees a specialist or visits an emergency room. Another recent study showed that a Deep Learning system that analyzed medical radiology images could detect at least fifty eye diseases as accurately as a doctor. This software was issued the first FDA permit for an AI diagnostic system.[8]

AI tools are also helping with public health issues such as epidemics and outbreak detection by monitoring emerging diseases and providing outbreak reports in real-time allowing for faster reaction time in treatment and quarantining sick patients. Individual doctors and health institutions are unable to monitor all sources of medical data and to identify a high priority potential epidemic, but AI systems can keep constant watch on health reports and spot patterns where they might exist.[22]

1se Case: AI in Consumer-Focused Healthcare

The combination of AI, personal wearable devices and big data is ushering in a new era of immediate, highly-personalized healthcare that's tailored not only to each individual person, but also to the daily changes in the way patients work, live, sleep, act, eat and play. These AI systems are being used to both detect and help prevent illness and reduce or eliminate unhealthy habits.

AI-enabled Chatbots are increasingly providing immediate medical advice, recommending treatments for urgent care situations based on access to both a vast library of knowledge as well as knowledge about the user. For example, Alder Hey Children's Hospital in the UK is using AI to help answer a variety of questions for young patients and their families before their hospital stay.[9] By using cognitive technologies the hospital is able to provide more personalized information to each patient, improve patient/staff interaction and extend the care before and after the patient visit.

In addition, many AI-enabled apps are using the combination of Internet of Things (IoT) devices and wearables to tailor this medical guidance based on what is already known about the user.

Increasing use of wearables is further enhancing the ability to provide on-demand, effective, personalized treatment by using AI-enabled pattern matching that can extract valuable insight from biorhythms such as heart rate, sleeping patterns, activity and daily food consumption. This is the ultimate form of personalized medicine that combines the latest in technology to provide access to healthcare advice when it is not otherwise available. The Cleveland Clinic has enabled doctors and nurses to use technology to become proactive and intervene with patients before situations get too serious. For example, using historical data collected from ICU patients, they have been able to make predictions about whether current patients will need vasopressors to prevent the occurrence of cardiac failure.[10]

In many parts of the world adequate medical care is not available. And even when it is available, it might not be immediate or cost effective to get treatment. AI is further pushing the boundaries of what is possible with telemedicine. AI technology is enabling new levels of self-service healthcare through intelligent assistants that provide personalized care, which can be escalated to human healthcare providers if needed. By using a smartphone, tablet or computer, patients are able to connect with virtual health assistants, and through conversational interaction, the patient can get advice that is most appropriate to their situation and symptoms and provide self-care options or easily find in-network treatment options. The use of AI in this way is leading to continued improvements in quality of care, health outcomes and patient satisfaction, while also helping to reduce the cost of care.

Babylon Health, based in the United Kingdom, built an application that allows users to track their health and to consult an AI-powered chatbot. This chatbot asks the patient a series of questions, and based on the responses, makes a recommendation to determine if the patient should see a medical professional or if this is something that can be self-treated by the patient. The Babylon system learns from the patients and refines its performance over time. The patient's symptoms are stored in the application regardless of the determination and used to assist with diagnosis. In 2016 an informal comparison was made of Babylon's ability to triage patients in comparison with a reference doctor and nurse. This study showed that Babylon had a 92% accuracy rate, whereas the doctor showed only 82% accuracy, and the nurse at 77%.

Improving Health Care Operations

AI and Machine Learning technologies are making a big impact in the healthcare back office and helping to minimize or eliminate time-consuming non-patient-care activities. AI-enabled systems are bringing efficiencies to the back office helping to spot billing errors, identify fraud, eliminating errors and speeding up processes that previously required time-intensive manual review. Auditing of invoices through AI can help spot coding errors, identify suspect charges, false claims and other anomalies with greater accuracy and speed than humans.

By training Machine Learning algorithms on historical claims data, these systems are able to learn and recognize medical terms and billing codes. The algorithms can then make sure new incoming claims are filed correctly, speeding up payment and reducing errors. Furthermore, healthcare providers are using AI systems to spot billing fraud and abuse before claims are paid.

By analyzing large amounts of historical claims, systems can learn what looks normal and more quickly spot anomalies, flagging potentially fraudulent reports in near real-time.

Enhancing the Pharmaceutical Industry

The pharmaceutical industry has seen great advancements with AI including help with drug discovery, drug manufacturing, and clinical trials, among other pharmaceutical operations. AI technologies are able to better identify candidates for clinical trials by using a much wider range of data genetic information, social media platforms and even doctor visits. This allows for more targeted, quicker and less expensive trials overall.

AI algorithms are helping better understand, identify, and treat diseases. The MIT Clinical Machine Learning Group is developing algorithms to better understand disease progression and to facilitate new treatment strategies.[5] AI systems are also being used to help with drug manufacturing. By analyzing data, AI systems can help reduce drug production costs as well as help identify and find ways to repurpose existing drugs to help treat diseases it was not initially intended for.

AI in the Content Industry

AI is already being applied to the creation and management of content in a wide range of industries, from gaming to journalism to video editing. Is this white paper written by an AI system? Perhaps in a few years it might be hard to tell. AI systems combine the power of Machine Learning with Natural Language Processing and generation to create content and experiences that are every bit as realistic as those created by their human counterparts.

Use Case: AI in Gaming

AI has had a long and rich history with games of all sorts. Some of the first AI researchers developed algorithms to teach systems how to play chess and checkers. An AI system famously defeated chess grandmaster Garry Kasparov in 1997, and recent AI advancements have been proven in gaming environments.[11] AlphaGo beat the best human Go player in 2016[12], and other AI systems have played, and beat, human players in games like DoTA.[13] Certainly, AI systems are proving to be quick learners of games and fierce opponents. However, this is just one way in which AI is being applied to gaming.

In order to enhance player interaction and game experience gaming companies are making increased use of Chatbots in video games. These human-like bots and avatars are interacting with players to create a rich conversational environment that poses additional challenges and opportunities for the players. In addition, AI systems are being used to improve visuals and game features. For example, many game creators are using AI to improve the way game characters move and express themselves and create a vast and diverse play area filled with lifelike creatures. These AI-powered characters can develop throughout the game, showing signs of learning with the potential to develop their own personalities

AI is also being used to increase personalization of game play. The use of big data and Machine Learning by game creators is leading to systems that over time learn how players play and what their specific preferences and interests are to make the game reactive to individual players. These same AI systems are also being used to test games and make sure that there are no loopholes or game situations that are undesirable. Indeed, AI is now not just another player in the game experience, but an active participant.

Use Case: AI in Content Management

With the power of Natural Language Generation and Machine Learning, AI is being increasingly used to generate content and create everything from weather reports and sports recaps to journalistic pieces. Already, many financial reports, press releases, business market industry coverage, and other general information written in human consumable format is being generated by AI systems. The Washington Post reported that its own AI bot, Heliograf, published 850 stories with little human oversight in 2017.[14] Most of the stories covered local politics and sports events, but that is significant, given that journalistic organizations are steadily downsizing in the face of relentless market forces. In general, AI systems are well suited to generating human readable content that originates from quantitative information or from databases. Since humans aren't great at reading tables of data, having a machine summarize that information in natural language format is a good application of AI technology.

In addition, these AI systems are doing more than just generating the news. In some cases, they are also reading the news. Reuters, for example, is using AI to scour twitter feeds to find breaking news before it becomes headlines.[15] This information is being passed to journalists to determine if there is something newsworthy to cover, and if so, the first articles may then be generated through AI systems.

AI is also helping with content management and media workflow. News organizations, such as The New York Times, are using AI-based technology that augments the activities of journalists to provide additional research, content suggestions, relevant content links, additional insight, and quotes reducing the time it takes to write and research articles.[16] These AI systems act as an intelligent content search tool that can further enhance the ability of journalists to cover stories with greater accuracy and connect the dots between different stories.

Furthermore, AI is helping to battle the recent scourge of misinformation, "fake news", and bot-generated content. AI systems use Machine Learning to identify patterns of real human behavior in content reading and commenting versus patterns of machine-generated or enhanced flow. The systems can detect word patterns that may indicate misleading content or comments that are meant to misinform. These submitted comments and content are flagged for human inspection or held in moderation. In addition, these systems are increasingly being

used to also monitor human activity. Machine Learning-based systems do a good job keeping an eye on the tone of language, use of words and other content that might fit into undesirable patterns.

Use Case: AI in Video Editing and Manipulation

AI is providing value for more than just written content -- it's also helping with images and video. Through the use of Computer Vision and Machine Learning, AI systems are able to view thousands of hours of video content and distill that content into the most impactful and relevant parts. For example, AI is being used to automatically create highlight reels for sports and entertainment related video content. AI systems are also providing Augmented Intelligence to help video editors by suggesting different styles or edits based on mood or composition.[17]

AI systems are also enabling users to search through thousands of hours of content to find individual items of interest. One of the primary ways in which Machine Learning has been successfully applied is to the field of image recognition and classification. In particular, Deep Learning approaches to AI have drastically simplified the process of identifying objects within an image or video content. As a result, the use of Machine Learning for image recognition has enabled a wide range of applications such as facial recognition to better text and image identification to other applications. These AI systems can extract and identify objects and content within large volumes of data. Combining this capability with Natural Language Processing provides companies the ability to use natural language search to identify objects with large quantities of video data.

AI systems are also increasingly being used to generate video content. Retailers, news outlets and other content creators are using AI-powered video engines to automatically create video clips and montages for different use cases. For example, ecommerce vendors such as Amazon and Alibaba generate short-form videos about their products to help create interest and generate sales. Alibaba's Aliwood editor uses text and images from the product page to create a 20-second video complete with background music all generated by AI in less than a minute.[18]

Additionally, AI-powered systems are also being used to alter and make changes to videos. Using three-dimensional face mesh mapping and Machine Learning, AI systems are able to find and match the poses of real-world subjects and morph those images into that of other subjects. This means you can make someone appear to do or say something that they have not done or said in real life. The use of AI in this way poses some significant ethical challenges, but on a technical level, it's already possible.

Additional Applications of AI

Use Case: AI in Self-Driving Vehicles

Self-driving vehicles are incorporating AI to help them learn how to navigate the nation's roadways. In the initial phase of deployment vehicles are traveling the roadways and learning from their experiences, guided by human teachers. Eventually, using Deep Learning techniques, these vehicles will recognize what to do on their own.

One example of the strategy for rolling out AI on the nation's roadways is Drive.ai, which plans to deploy self-driving vehicles in three phases.[19] During the first phase each vehicle will have a safety driver in it, a person who can immediately take over control of the vehicle if it encounters problems. Once the AI systems in the vehicle have been trained well enough the safety driver will no longer be necessary, and it will be time to move on to phase two. In phase two each vehicle will have a chaperone, a person who will sit in a passenger seat and be able to assist other passengers and monitor operations, but who will not be expected to take control of the vehicle in a split second. Finally, after passengers have become comfortable riding in a vehicle that is driving itself, it will be time for phase three, in which there will be no driver and no chaperone in the vehicle, only the passengers who have summoned it for a ride.

Learning will be an ongoing process for AI-powered driverless vehicles, even after we are comfortable riding in them without human chaperones. The Drive.ai system will include monitoring by a remote operator. Should the vehicle encounter an unfamiliar situation it will come to a stop and seek guidance from the remote operator. Each remote operator will be able to monitor multiple vehicles at once, and each interaction with a remote operator will be a learning experience for the AI system in the vehicle. Once the vehicle has learned what to do in a previously unfamiliar situation it will be able to navigate future similar situations on its own.

Use Case: AI Helping with Law Enforcement

AI technologies are being used to help law enforcement in a variety of ways. Facial recognition technologies are increasingly being used in public places like airports or stadiums or where large crowds are gathered such as festivals or marathons. This technology has been able to help catch criminals, identity missing individuals or those suspected of human trafficking operations.

In addition, many non-profit organizations and agencies are understaffed and struggle to keep up with their current workload and the volume of tips that come in. AI technologies have been able to augment staff, automate processes and help sort through the mounds of data and leads received. In 2017, Intel partnered with the non-profit National Center for Missing and Exploited Children (NCMEC)[20] to help the organization sort through the millions of tips they receive, help categorize, classify and prioritize inbound tips as well as automate manual work. This has led to a substantial increase in efficiency and increase the number of valid tips that law enforcement could process.

Non-violent crimes such as stolen and counterfeit goods, financial crimes, petty theft and other crimes of opportunity also fall on law enforcement to investigate. These crimes impact quality of life, but many resource strapped departments don't have the manpower or expertise to efficiently investigate and prosecute these crimes. Luxury goods like purses and accessories are frequently counterfeit and AI technologies help make it easier for law enforcement to spot and identify fakes. AI-enabled systems can take and process photographs of the item, run the images though algorithms and quickly and accurately detect if the item is real.

Summary

AI is applicable to a wide range of industries and use cases, and this white paper has shown just a slice of the possibilities. This paper explored use cases across a wide range of industries such as home cybersecurity, healthcare, gaming, content and digital assistants. Even beyond all these use cases, AI technologies are impacting a wide range of industries ranging from banking, hospitality, food service, recruiting, energy, retail and beyond. AI is transforming many industries, products, services, and organizations, changing the way businesses interact and the way products and services are delivered. Increasingly technology and consumer-oriented companies are developing products and services that are more intelligent, responsive, and personalized to the needs of their customers, clients and users. AI is powering the next generation of significant technology change and we're just scratching the surface of its capabilities.

Call for Community Engagement

CTA is working with consumer technology industry experts, legislators and regulators to help ensure that we all can maximize the opportunities presented by AI. Here are some opportunities for you to get involved.

Consumer Technology Association

CTA AI Working Group

CTA's AI Working Group aims to help grow acceptance and adoption of AI technology by guiding CTA activities related to AI including market research, policy positions, and promotion of AI technology at CES®. To get involved please contact Melissa Matalon at mmatalon@cta.tech.

CTA AI Advisory Group

CTA's AI Advisory Group aims to help grow acceptance and adoption of AI technology by studying AI technical issues and, when needed, developing industry consensus related to these issues. To get involved please contact Kerrianne Haresign at kharesign@cta.tech.

CTA 21st Century Workforce Council

Engage with CTA's newest member council – the 21st Century Workforce Council to stay abreast of how the consumer tech industry is addressing the nation's skills gap and preparing current and future worker to perform high-skilled jobs. https://cta.tech/Membership/Member-Groups/21st-Century-Workforce-Council.aspx

Glossary

Artificial Intelligence (AI) - While there is no single definition, it is commonly accepted that AI is machine behavior and function that exhibits the intelligence and behavior of humans.

Artificial General Intelligence (AGI) - "Strong" or "General" AI is the pursuit of AI capabilities that can handle any cognitive situation, much as humans can.

Augmented Intelligence - Augmented intelligence systems seek to augment or enhance human labor with AI capabilities, rather than replacing humans.

Autonomous Vehicle (AV) - Cars, trucks, planes, ships, and other moving vehicles that operate on their own, such as driving, steering, and braking, without human intervention.

Chatbot - Interfaces to computers and systems with voice or text interaction that use the "natural" conversational language of humans.

Cobot (Collaborative Robot)- Robotic systems that operate in close proximity to, and in conjunction with humans in their activities.

Computer Vision - Computer technology that can intelligently process, understand, detect, and identify images and video.

Deep Learning - An advanced form of neural network Machine Learning that utilizes big data to generate impressive results.

Explainable AI (XAI) - An approach to AI that provides explanations and reasoning behind AI decision-making.

Intelligent Process Automation - The use of AI and Machine Learning to make business processes more intelligent.

Machine Learning - Algorithms, tools, and techniques that give computers the ability to learn from experience and data.

"Narrow" AI - The use of AI for individual tasks rather than the creation of general AI capabilities.

Natural Language Processing (NLP) - Technology that is capable of understanding written or spoken human conversation.

Natural Language Generation (NLG) - Technology that produces conversational text or speech understandable by humans.

Neural Network - A form of Machine Learning that emulates how the brain works by reinforcing connections between inputs, intermediate learning layers, and the output of what is learned.

Sources & Endnotes

End Notes:

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