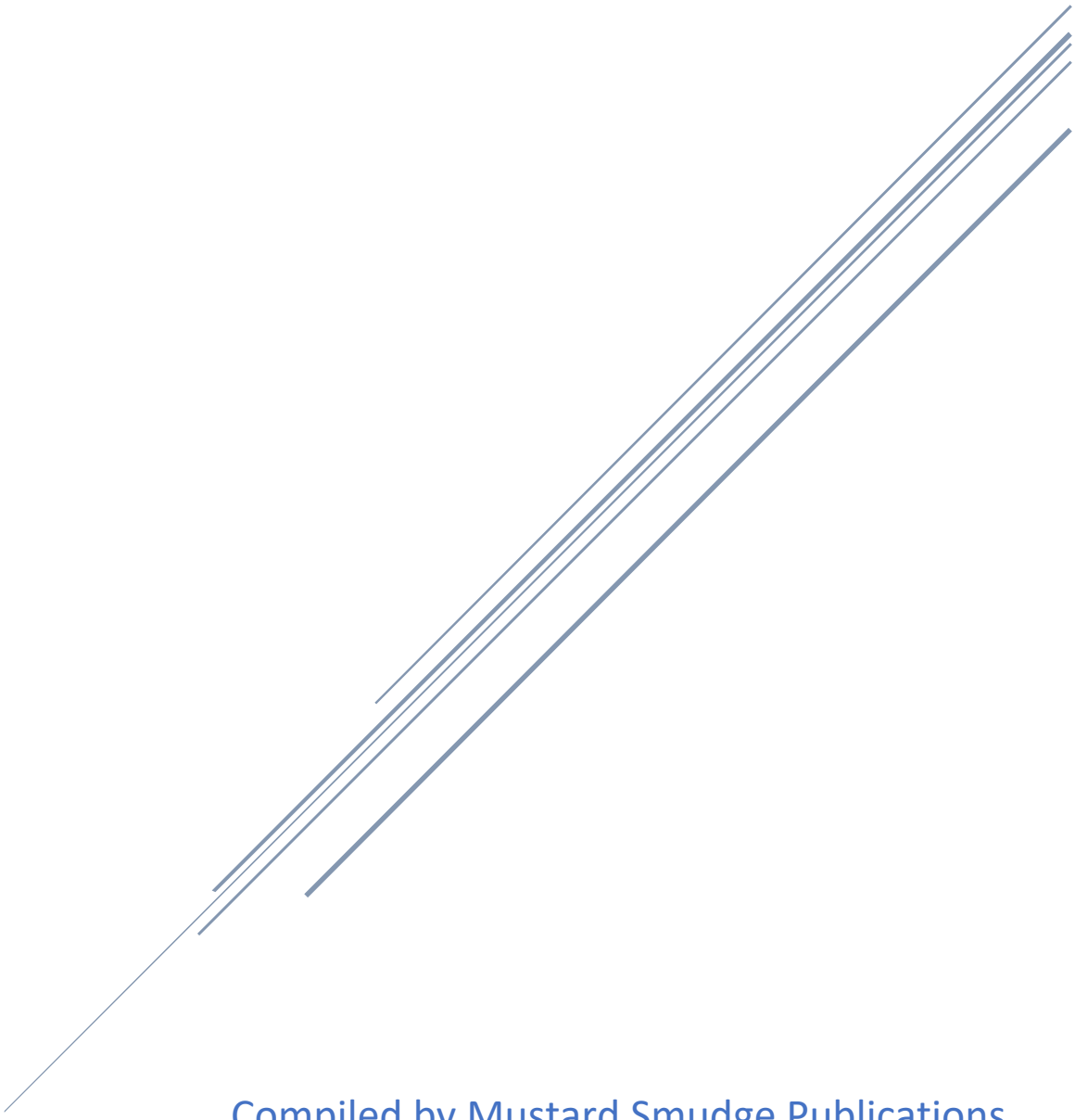
NATURALLY ARTIFICIAL INTELLIGENCE



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Naturally Artificial Intelligence

Introduction

Our understanding of artificial intelligence (AI) continuously changes as technology advances. New breakthroughs and applications in AI lead to a deeper understanding of what it means to be intelligent, both in machines and humans. What does AI mean to us today? According to IBM, AI is technology that enables computers and machines to simulate human learning, comprehension, problem solving, decision making, creativity and autonomy. The incremental changes to our understanding of what can be accomplished with machine simulations have advanced at an increasingly rapid pace over the last few decades, but it has a long history of advancements over the centuries.

The automatons of the 12th – 17th centuries were primarily powered by springs or hanging weights with a sophisticated system of cams and levers. They would not be considered AI technology but could mimic certain human and animal movements. Leonardo DaVinci's design and probable construction of a mechanical knight had an external crank that worked a series of pulleys and cables that allowed it to imitate human movements. The automatons of this time period were primarily used for entertainment purposes, but they did contribute to the mindset and technological groundwork that would later fuel the Industrial Revolution.

The 18th and 19th centuries saw the development of machinery on an industrial scale, such as the knitting machines used in the woolen mills of Great Britain. As an issue that would reverberate down to our current times, workers there naturally worried about being displaced by increasingly efficient machines. Large protest movements, such as that of the Luddites, highlighted the conflict between human skill and ingenuity versus machine mimicry. Ironically, the Luddites themselves were willing to accept the new technology, but were opposed to the fraudulent and deceitful manner in which they were used to get around standard labor practices. They wanted machines that made high-quality goods and that would be run by workers who had gone through an apprenticeship and were paid decent wages. They were standing up against technologies that put money or convenience above other human values.

The early 20th century saw the word "robot" introduced into normal conversation from the Czech word "robota", meaning forced labor. The Czechoslovakian writer Karl Capek first used the term in his play about robots that were used as slaves who later revolted and annihilated the human race. A few years later, a Japanese inventor, Makoto Nishimura, set out to build a different kind of robot, or as he called it, an "artificial human". His invention would celebrate nature and humanity, and rather than a slave, it

would be a friend, and even an inspirational model for society. The completed artificial human could change its facial expression and move its head and hands via an air pressure mechanism, and could write words on paper with the pen in its hand.

In the 1950's technology pioneers like Alan Turing and John McCarthy worked on machine intelligence, and the term "artificial intelligence" came into our normal lexicon. In the 1960's robots were first used in the automobile industry to perform welding operations on cars, and by the end of the next decade the first autonomous vehicle to successfully navigate an obstacle course came into being. The 2000's saw rovers on Mars, Apple's Siri employ speech recognition, and Open AI using deep learning to create code and other writing tasks. The pace of technological advancement had picked up.

Status of AI in 2025

The field of AI is currently experiencing rapid growth and is being adopted by a growing number of sectors of our society. Today, the most advanced AI systems, which are still classified as "Narrow AI" incorporate "deep learning" processes that give them the ability to identify relationships and respond to queries that arise in scenarios in which the needed computational algorithm cannot be specified in advance (see previous section for a more detailed explanation of deep learning AI). Implementation of existing AI include the following:

- Healthcare**:** AI is being used for disease diagnosis, personalized medicine, drug discovery, and robotic surgery
- Finance: AI is used for fraud detection, risk management, personalized financial services, and algorithmic trading
- Manufacturing**:** AI powers robots for automation, quality control, predictive maintenance, and supply chain optimization
- Retail**:** AI is used for personalized shopping experiences, targeted marketing, and inventory management

Generative AI is a type of artificial intelligence that focuses on creating new content, like text, images, video, or music, based on existing data. It learns patterns from large datasets and then uses those patterns to generate novel content in a variety of formats.

- Content Creation: AI tools are being used to generate articles, social media posts, marketing materials, and even creative works of art
- Personalization: AI helps tailor content and experiences to individual user preferences in areas like online shopping and entertainment

- Enhanced Search and Information Retrieval: AI is improving search engines and enabling more efficient access to information

There are significant limitations to the continual advancement of AI technology which include the looming scarcity of additional large datasets which are needed to “train” AI models, and the ability of the existing electric power grid to supply sufficient electricity for powering and cooling the computers running the advanced AI software. Generative AI models in use today learn from existing large datasets and are unable to generate truly novel ideas or solutions if they lack information about new scenarios or concepts. In essence, generative AI can't create something entirely new if it doesn't have the necessary information or training data to do so. Its ability to generate new content is limited by the existing data it has been trained on.

Into the Weeds With AI

If you would like to get a better understanding of how AI works you can read the following which is still a summary for beginners. If getting a little deeper into the artificial weeds is not your thing, well, skip this section and proceed to the next section and no one will be the wiser. Except you. You won’t be the wiser that is.

Developing AI processes includes formulating advanced algorithms and models to perform human tasks, like recognizing speech or images and making decisions. This requires machine learning and neural networks, as well as more complicated concepts like deep learning and natural language processing. It has the potential to make our lives easier and better by doing things like automating routine tasks, powering virtual assistants, generating transcripts, and providing content from processors like ChatGPT or Google Gemini.

AI can be broadly classified into three major groups which include “Narrow AI”, “General AI (AGI)”, and “Superintelligence (ASI)”. Within these three broad classifications there are different types of AI processes that need to be in place to make them function as intended.

Narrow AI, which is in use today, utilizes reactive and limited memory processes in performing specific tasks. Reactive AI focuses on immediate responses and the concept of memory doesn’t come into play. For example, Spotify uses reactive AI models to understand what the user is currently listening to (music, podcasts, books) and provides recommendations based on that input. If the user requests a different genre of music for instance, the reactive AI will come up with new recommendations for a playlist based on the current selection and not past music requests. Limited memory

AI can look at past data to make informed decisions and create a short-term memory, although it isn't retained indefinitely. It can analyze patterns to make decisions, but they also require continuous training and new data to learn and improve. For example, generative AI tools like ChatGPT and conversational AI tools like Alexa use limited memory AI. Limited memory AI requires neural networks, deep learning and natural language processing (NLP) to work.

AGI or General Intelligence is what data scientists at large tech companies are working towards today, but have not yet achieved. Hypothetically, AGI will possess human-level understanding and reasoning, with complex problem-solving abilities. General AI would also take situational context into account and adapt its course of action. AGI will require the use of theory of mind and possibly self-awareness AI to function correctly. Theory of mind AI will be designed to understand human emotions, thoughts and interactions. Self-awareness AI will understand its own existence and identity, but also possess the ability to comprehend its own thoughts and emotions, similar to human self-awareness.

ASI or superintelligence would surpass human capabilities. Future predictions all seem to suggest that a super AI would potentially change every industry with its ability to outperform humans in every field. However, for this to be successfully implemented, strict governmental laws, ethical considerations and human autonomy needs to be considered and rules established. That's because any breakthroughs in this type of technology can lead to exponentially dire consequences.

The limited memory AI utilized for generative AI applications today requires deep learning processes to function correctly. Modeled loosely on the human brain, limited memory involves setting up a neural network consisting of thousands or even millions of simple processing nodes that are densely interconnected into layers. An individual node might be connected to several nodes in the layer beneath it, from which it receives data, and several nodes in the layer above it, to which it sends data. Each incoming connection to a node will be assigned a factor known as a "weight". During active processing, each incoming data value (a number) will be multiplied by the weight factor and these values will then be summed to produce an overall node output value. This output value is compared to an established threshold value and either "passed" to the next downstream node(s) or "failed" and subsequently used to fine-tune the overall model.

When a neural network is being trained, all of its weights and thresholds are initially set to random values. Training data is fed to the bottom input layer and it passes through the succeeding layers, getting multiplied and added together in complex ways, until it finally arrives, radically transformed, at the output layer. During training, the weights and

thresholds are continually adjusted until training data with the same labels consistently yield similar outputs.

Large Language Models (LLMs) are also utilized in certain generative AGI models. LLMs are advanced AI systems that learn to understand and generate human language by analyzing massive amounts of text data. They use a type of neural network called a transformer model, which allows them to process entire sequences of text in parallel and capture the relationships between words and phrases. This enables them to generate coherent, contextually relevant text, translate languages, and answer questions.

There are five basic steps that define how AI works once the algorithms and networks have been developed. How to develop these algorithms and networks is way beyond the basics presented here and for those of you wishing a more advanced understanding on how to do this we salute you and wish you safe travels. The five steps include data collection, data processing, outcome predictions, adjustments, and assessments.

- *Data collection* - This step involves inputting large data sets from various sources in the form of text, audio, videos, etc. The digital data values would be input to the bottom layer of a neural network for example
- *Data processing* - Once data is input, the raw data is transformed into a usable format for analysis and model training. This step includes tasks like cleaning, transforming, and preparing the data to make it suitable for machine learning algorithms. Data is classified as “pass” or “fail” at each node when a neural network is utilized
- *Outcome predictions* - After the processing step, calculations are performed on the “passed” output data to predict likely outcomes, such as determining customer behavior and market trends. Using advanced forecasting models, AI estimates future outcomes based on the patterns and trends identified by the data
- *Adjustments* - When “failed” data does not match existing patterns, new patterns are generated with the data and adjustments are made to the existing algorithms and models to accept the new patterns. Incorporating new data and adapting models provide relevancy in an ever-changing environment. New calculations can then be performed with the data based on the new algorithms to predict new outcomes
- *Assessments* - The final step involves evaluating an AI system's performance, accuracy, and potential impact, as well as identifying and mitigating risks. This step is crucial for ensuring the AI system functions as intended, adheres to ethical guidelines, and aligns with organizational goals

Artificial Intelligence (AI) v Intelligence Augmentation (IA)

AI (Artificial Intelligence) focuses on replicating or surpassing human intelligence, while IA (Intelligence Augmentation) focuses on enhancing human capabilities through technology. IA is a form of AI that works alongside humans, providing assistance and tools to improve decision-making and efficiency. We've been using IA tools and devices now for several years with technologies like Alexa language processing to answer questions, GPS systems to guide drivers, and Roomba vacuum robots that learn our floorplans and take care of cleaning our floors and rugs.

While AI is being seen as a replacement for human intelligence, it is important to note that current AI lacks creativity. AI can perform tasks based on algorithms and data, but it cannot think outside the limitations of its programming, with a dependence on human prompt and direction. Human ingenuity is essential for innovation and creativity, which AI cannot fully replace. As such, AI and IA are transforming the future of work that will depend on human-machine collaboration, where AI and IA are used as complements, not substitutes.

Events that occurred in the recent past exemplify the relationship between AI and IA. In 2016 a computer named AlphaGo made headlines by defeating the Korean world champion at the ancient, popular strategy game Go. AlphaGo was the artificial intelligence, developed by Google, and the win for AI technology generated comparisons to IBM's Deep Blue defeat of the reigning chess champion in 1997. The game of Go was thought to be a more complex and demanding challenge than chess for measuring the advancement of AI technology. Much agonizing about the threat of AI to human existence followed AlphaGo's victory, not unlike what's happening right now over ChatGPT and similar technology. But there was an interesting outcome to the match.

Human Go players gained access to data detailing the moves made by the AI system and, in a very humanlike way, developed new strategies that led to better-quality decisions in their game play. This also happened earlier with chess players after IBM's computer beat the reigning world chess champion. A follow up match between the IBM computer versus a human provided with the IBM computer ended in a win for the human/computer team. Similarly, the AlphaGo with human support is likely to win. The human team member provides a crucial advantage by offering diverse perspectives, and creative insights that can complement the AI's analytical strengths. It's possible that

rather than viewing AI as a threat to human intelligence, if used in the right way it can be a valuable tool that can enhance human abilities.

Socio-Economic Impact

For millennia, waves of technological change have been perceived as a double-edged sword for the economy and labor market, increasing output and wealth but potentially reducing pay and job opportunities for typical workers. This was true during the industrial revolution, and if left to the whims of an unregulated market it can have dire impacts to large sectors of society. But fears of large-scale impacts to employment by the introduction of AI so far have not come true. Earlier predictions, such as a 2013 study from the University of Oxford speculated that nearly 47% of US jobs could be automated by AI over the following two decades. This prediction seems to have been wildly exaggerated with experts now agreeing that often AI can serve as a tool to enhance worker efficiency rather than significantly disrupting employment rates.

AI's socioeconomic impact is multifaceted, encompassing both opportunities and challenges. It can boost economic growth, enhance productivity, and create new industries, but also lead to job displacement, increased inequality, and societal disruptions. According to the Congressional Budget Office, only 5 percent of businesses in the United States currently rely on AI to produce goods and services. For many businesses, customizing AI to their specific needs is costly, and it is unclear when those costs might fall. As a result, the use of AI is concentrated among larger, and younger, businesses in a few sectors of the economy—although that could change over time as profitable use of the technology becomes less dependent on a business's size.

The economic impacts of new technology, both short-term and long-term, will be felt differently by various sectors of society. To pick one example, just a few years ago it seemed like self-driving vehicles were on the verge of taking over the transportation sector which would produce a mass displacement of folks who drive vehicles for a living. That prediction of a takeover by AI has not come to fruition because technological and regulatory hurdles have not been adequately addressed, but it's unknown how this may play out in the future.

Currently, based on population, trucking is the largest single occupation that AI could replace in the near future. There are approximately 3.5 million people that drive vehicles for their livelihood, and the elimination of those jobs would directly impact the lives of those drivers. The transition to a largely AI-operated trucking industry is likely to come in stages as the technology develops, and there are any number of scenarios possible depending on what seems feasible and profitable. While some driving jobs

may decrease, new roles will emerge in fleet management, logistics planning, and AI system maintenance. The question then becomes at what scale will the economy be able to absorb a displaced workforce assuming some will be reskilled for new roles? Policy makers don't really know the answers at this point but ethical planning is required now to adequately address potential impacts in the future.

Other sectors of the economy that AI implementation could have the biggest impact on will include customer service, computer programming, research analysts, paralegals, and factory/warehouse workers. Computer programming tasks can be automated to some extent with AI, though more complex tasks still require a human touch. Automation can provide data collection, document review and preliminary analysis for research and legal work. Already, AI-driven robots are increasingly taking over repetitive tasks in factories and warehouses. Professions less likely to be impacted by AI include those of an inherent human-centric nature such as teaching, nursing, therapist, and creative artists.

Economists have historically viewed technology as increasing total economic value, while acknowledging that such growth can create winners and losers. But it's also conceivable that some new technologies, including AI, might end up simply resizing the slices of the economic pie where businesses simply redistribute gains to their owners. That situation would parallel developments over recent decades like tax cuts and deregulation, which have had a small positive effect on economic growth but have asymmetrically benefited those with greater wealth. In such a case, AI could have a big impact on the labor market and economy without registering any impact on productivity growth. No evidence of such a trend is yet apparent, but it may become so in the future and is worth watching closely.

AI has frequently been cited for the potential of producing rising inequality or stagnant wage growth, both in the United States and beyond. The *Journal of Economic Literature* includes studies which suggest skill-biased technological change in the past may have played a role in generating inequality and this worry is reasonable to consider. Looking back, the evidence seems to be mixed, but it's mostly clear that, in the grand scheme of rising inequality, AI has thus far played a very small role. Over the last few decades, the bulk of the increase in economic inequality happened in the 1980's which predates significant implementation of AI. In addition, the factors negatively impacting the labor market have not been AI related, such as weak market demand and impacts that may be technology related but can't be attributed to AI like camera phones replacing camera film manufacturers.

The Future of Human Existence with AI

AI has proven to be exceptional at producing “mimicry” models that can be used to replace human labor for certain aspects of society, but so far there seems to be relatively few revenue generating streams resulting from AI technology to justify the enormous investment in AI start-ups. Only a few short years ago people were asking when is AI coming, and now investors are starting to ask when will there be a return on investment. There may be a bubble around AI investing and it may very well be ready to burst. Google is having trouble improving on its generative AI technology due to data limitations, as there’s only so much existing data available to generate new and better models. And as of right now, only humans can create new data. But this could change.

For example, some researchers argue that AI will ultimately reach the stage of artificial general intelligence, at which point it will be able to carry out cognitive-based tasks as well as, or better than, human beings. If that occurred, the economic implications could be significant—in particular, for labor markets and the distribution of income. The effect on labor income will largely depend on the extent to which AI will be used by higher-income workers. If AI significantly complements these workers, it may lead to a disproportionate increase in their labor income. Moreover, gains in productivity from firms that adopt AI will likely boost capital returns, which may also favor high earners. Both of these phenomena could exacerbate inequality.

Forbes has laid out contrasting scenarios on how AI can impact our future existence. In their utopian future empowered by artificial intelligence, AI would be harnessed for the benefit of humanity to seamlessly integrate into various aspects of human life, significantly boosting productivity, innovation, economic growth, overall well-being, and human flourishing. AI technology could be utilized to address climate change, disease, and poverty, and elevate humanity to new heights. In a dystopian future, AI would lead to a dark and unsettling world similar to a Black Mirror episode. In this view technocratic rule dominates, massive job displacement will occur, biased AI algorithms will favor the dominant social class, malfunctions will produce catastrophic events, people’s every move will be monitored, and autonomous weapons systems, designed to make life-and-death decisions without human intervention, will lead to brutal conflicts and civilian casualties. The most terrifying aspect of this dystopian future is the emergence of super intelligence AI, capable of rapid self-improvement and surpassing human comprehension. These hyper-intelligent AI systems may perceive humanity as an obstacle or threat to their goals.

If the ultimate goal of AI development is artificial general intelligence, or even artificial super intelligence, that will produce its own existential threat. Artificial general

intelligence is a self-teaching system that will outperform humans across a wide range of disciplines. Some scientists believe it's 30 years away; others talk about centuries. This AI event, also known as the singularity, will likely see AI pull even with human intelligence and then blow past it in a matter of days or hours to achieve super intelligence. Once it arrives, AI will begin taking jobs away from people, millions of jobs. In one possible scenario should this occur, governments would pay unemployed citizens a universal basic income, freeing them to pursue their dreams unburdened by the need to earn a living. In another, it will create staggering wealth inequalities, chaos and failed states across the globe.

In most scenarios, large-scale implementation of AI, if left unregulated, will likely worsen overall inequality, a troubling trend that policymakers must proactively address to prevent the technology from further stoking social tensions. It is crucial for countries to establish comprehensive social safety nets and offer retraining programs for vulnerable workers. In doing so, we can make the AI transition more inclusive, protecting livelihoods and curbing inequality. It's important to ensure that the benefits of AI and IA are shared equitably and that their development is guided by ethical principles.

According to the Harvard Business Review, augmented intelligence is a step forward to the future of intelligent work performing in efficient ways. Businesses are at a stage where machines are often introduced as the new super employee that may leave humans ultimately in an inferior role to serve the machine. An essential element of augmented intelligence work means that we expand the workforce which both humans and machine will be part of, but with the aim to improve humanity and well-being while also being more efficient in the execution of our jobs. So, augmented intelligence is indeed collaborative in nature, but it's also clear that it represents a collaborative effort in service of humans. This will require successful oversight and appropriate regulation.

Resources used for this paper include the following:

- *How has AI impacted socioeconomic relationships?* – Stanford University SQ11.
- *How does AI work? Basics to know* – Coursera
- *Where Will AI Take Us in the Future* – Forbes