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Midterm Paper

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**Abstract**

This paper takes on a comprehensive exploration of the world of artificial intelligence (AI), by examining its definitions, real-world manifestations, and historical evolution. In an era where AI plays a pivotal role in technological advancement and global competition, understanding its multifaceted nature is of importance. We delve into the concept of AI, which fuses the “artificial” and “intelligence”, raising concerns about bias, fairness, and ethical implications. The historical journey of AI takes us from ancient philosophers to modern mathematicians, highlighting pivotal moments in its evolution.

At the heart of AI lies machine learning, a fundamental technique that powers its development. We dissect machine learning into supervised and unsupervised learning, each contributing to AI’s capabilities. The distinction between functionality and implementation is crucial for developing effective AI systems, as demonstrated through a cat image classification project.

As AI continues to advance, it presents profound societal, political, and ethical considerations that extend to legislation, governance, and ethical dilemmas. The interplay between innovation, ethics, and governance is becoming increasingly critical. The future of AI holds promises, driven by the increasing efficiency of computational power. It’s our responsibility to navigate this transformative era with responsibility and commitment to the betterment of society.

## **Introduction**

As technology continues to advance and integrate into every facet of our lives, we find ourselves at a pivotal moment in history. More than ever, a growing number of people are coming to recognize the profound importance of artificial and its pervasive influence on our daily lives. The concept of AI has evolved into a symbol of innovation and transformation, to the extent that it has become a focal point in global competition, i.e., nations determination to establish their dominance in this field.

Drawing upon the knowledge acquired in these previous classes and courses, this paper embarks on a journey to understand its definitions and observe its real-world manifestations. This exploration will unveil how AI intricately weaves itself into our everyday experiences, reshaping our society and propelling us towards cutting-edge advancements. Our journey begins with the examination of the term “artificial intelligence”, and we’ll subsequently explore the technical aspect of implementing machine learning models, and the distinctions between supervised and unsupervised learning. To shed light on the practical aspects, we’ll analyze its functionality and implementation, exemplified by a specific project—in this case, a cat breed image classification project.

Furthermore, we’ll delve into the historical evolution of artificial intelligence, tracing its beginnings and its evolution into what it is today. Along the way, we’ll highlight examples of pivotal moments, such as the invention of Deep Blue and Deeper Blue, which served as paradigm shifting milestones in the narrative of artificial intelligence.

## **What is Artificial Intelligence?**

Before we immerse ourselves into the realm of artificial intelligence, let’s first explore its definition and how it manifests in real-world scenarios. This is done by deconstructing the components, ‘artificial’ and ‘intelligence’. Simple terms yet deserve thoughtful considerations.

The term ‘artificial’ often refers to something being man-made or synthetic. This term often has a negative connotation. On the other hand, ‘intelligence’ refers to the capacity of an individual to learn, reason, remember, and navigate the challenges of daily life.<sup>3</sup>

When fused together, we arrive at the notion of artificial intelligence—a human-crafted entity, typically embodied in systems or machines, capable of emulating human-like intelligence. In essence, it embodies the capacity of machines or software to replicate the problem-solving and decision-making capabilities of the human mind.

As noted, the term ‘artificial’ is often met with apprehension and doubt. This connotation has bled through to the technological development of man-made intelligence. One central issue surrounding AI is the persistent concern of bias. This concern manifests in various forms, from bias in training data to algorithmic bias, raising the questions about fairness, transparency, and ethical implications of AI systems.

For instance, a real-world scenario where algorithmic bias appears is in the hiring systems. When such a system is fed historical data, reflecting a workforce primarily composed of white males, it may, in turn, favor candidates who mirror this demographic profile, inadvertently disadvantaging equally qualified individuals from other backgrounds, such as ethnically female candidates.

Nonetheless, society has recognized that these challenges, while formidable, also serve as an opportunity for growth and improvement within the realm of artificial intelligence.

As a basis for greater evolution in the future, it serves as a clear indication that artificial intelligence is far from perfect. However, it has witnessed significant evolution from its inception to its current state.

## **History of Artificial Intelligence**

The discourse surrounding artificial intelligence consistently points to its pivotal role in shaping the future. Its exponential growth in power has been ignited discussions regarding the potential for AI to be a catalyst for future conflicts, and it has given rise to intense competitions that could ultimately determine global superpowers. For instance, the ongoing rivalry between China and United States often revolves around advancements in artificial intelligence. But how did we arrive at this juncture? Let us embark on a comprehensive journey through the history of AI.

Remarkable, the concept of AI is far from recent development. The roots of reasoning can be traced back to the ancient Greek philosopher Aristotle, who laid the foundation for scientific thinking models that persist and thrive in today's world. Aristotle's emphasis on human reasoning aligns with the essence of AI, where machines where machines strive for the intelligence required to engage in rational thought.<sup>3</sup> Aristotle's legacy extends beyond AI and into the realms of cognitive science and psychology, where his ideas continue to inform our understanding of human thought and behavior. This connection to the study of human cognition highlights a fundamental goal of AI—to replicate or mimic and understand human-like intelligence. In essence, we seek to comprehend and simulate the very processes that Aristotle pondered, but in digital form.

Aristotle's notion, in turn, led British logician George Boole to establish Boolean algebra<sup>3</sup>, a fundamental principle that underpins modern computer science. Boole's work, with binary logic, serves as a cornerstone for computational systems, and its intriguing to note how these historical mathematical concepts, dating back to the mid-19<sup>th</sup> century, remain integral to the advanced AI algorithms we use today. This continuity showcases the lasting impact of visionary mathematical innovation on the development of artificial intelligence. As we explore AI's history, we recognize that it's not just a scientific pursuit but a journey of human intellect, innovation, and curiosity, building upon the wisdom of the past to shape the future.

From the article, *The History of Artificial Intelligence* written by Harvard University's Graduate School of Arts and Sciences, we embark into further exploration of AI's historical journey. This article provides a concise overview of AI's evolution from its early conceptualization in science fiction, to its current state.

**Pre-1950s:** science fiction familiarized the world with the concept of AI (e.g., Tin Man from 'The Wizard of Oz' representing AI with emotions).<sup>1</sup> In the world of science fiction and animated movies, we dream of flying cars that can autonomously navigate the skies and machines that can seamlessly perform tasks for our convenience. We see these fantastical ideas gradually become a reality. For instance, Elon Musk's work on self-driving cars marks an initial step toward those ideas. Another concept from science fiction is the effortless communication with computers and

AI systems using natural languages. Today, this is made possible with natural language processing. What's truly astonishing is the immense progress humanity has made. From the heartless Tin Man, a fictional character symbolizing artificial life that can express emotions, we now have robots that can recognize and display emotions.

**1950s:** emergence of AI as a topic is explored by experts. Notably, Alan Turing initiated a mathematical exploration of AI, and his work, 'Computing Machinery and Intelligence', laid a vital foundation for the field. However, practical limitations, such as limited computing power and high costs, hindered progress. Turing's introduction of the Turing Test was formulated.<sup>1</sup>

The Turing test was formulated to assess a machine's ability to exhibit intelligent behavior indistinguishable from that of a human. This concept challenged the essence of what it means to be intelligent and sparked ongoing debates about the capabilities of AI. At the heart of these discussions is the concept of indistinguishability—the idea that a machine's behavior should be so convincingly human-like that it becomes virtually impossible to tell the difference. This debate sparks the notions such as, machine-driven labor replacing human jobs, a topic of significant contention and a prominent force of apprehension surrounding artificial intelligence.

Furthermore, the notion that AI is meant to be indistinguishable raises fundamental questions about the true definition and purpose of AI. Does it aim to mimic human intelligence, or is it meant to learn from it? These contemplations add layers of complexity to the ongoing discourse surrounding AI, reminding us that the pursuit of artificial intelligence is not just a technological endeavor, but also a philosophical exploration of what it means to replicate and interact with human-like intelligence in machines.

**1950s – 1964:** advancements in computing power, accessibility, and machine learning increased fundings for AI research, but progress was alter hindered by computing limitations. The term 'artificial intelligence' gained prominence during this period, coinciding with significant developments like the creation of 'Eliza'—pioneering software designed to simulate therapy sessions.<sup>1</sup>

During this era, a significant concern that emerges is exemplified by Eliza. The concept that Eliza is designed to simulate a therapy session raises profound ethical questions. It challenges the very essence of human connection, as therapy sessions are, for many, a means of seeking solace, answers, and understanding through dialogue with human therapists. To remove this vital human dimension from therapy with a machine is not only ethically problematic, but also raises questions about the genuine empathy and understanding that AI can offer in such sensitive contexts.

**1980s:** AI resurgence, deep learning and expert systems gained popularity.<sup>1</sup> Deep learning with its ability to process large amounts of data and uncover intricate patterns, became a game-changer. Even today, deep learning remains a prominent field as it's applicable in various contemporary applications. For instance, it plays a central role in image recognition, powering the technology behind object detection, and autonomous vehicles. Moreover, deep learning finds extensive use in the domain of natural language processing, driving the creation of chatbots, language translations, sentiment analysis, and serving as a foundational technology for a range of other advanced language related tasks.

**1990s – 2000s:** AI milestones like IBM's Deep Blue and Deeper Blue chess playing program, speech recognition software, robots that can recognize and display emotions.<sup>1</sup>

**2000s – present:** ongoing AI advancements, including autonomous cars.<sup>1</sup> The development of self-driving vehicles has the potential to transform transportation, offering convenience and efficiency. However, it also poses complex challenges related to safety, and ethical considerations.

One such ethical dilemma is exemplified by the “Trolley Problem”, which poses the question of how autonomous vehicle should navigate difficult situations. For instance, if faced with a choice resembling the Trolley Problem, who or what should the vehicle prioritize, and how should it handle such moral decisions? This ethical situation extends to the broader issue of bias in AI when determining who or what should be prioritized in situations requiring critical decision making.

The ongoing progress in AI highlights not only the remarkable technological advancements but also the profound societal, political, and ethical considerations that accompany the integration of AI into our daily lives. These considerations extend to the realm of legislation, addressing how AI should be regulated and managed, especially in contexts like autonomous weaponry. As AI technology continues to evolve, the interplay between innovation, ethics, and governance becomes increasingly critical.

These developments depended on computing performance.<sup>1</sup> As computational power increased in efficiency, then a computer can do more. Which Moore's Law has significantly boosted. This trend will continue to fuel AI's potential.

### **How it works**

In the realm of artificial intelligence, one of the fundamental techniques that drives its development is machine learning. Machine learning is the engine that powers the learning and adaptability of AI systems.

Machine learning is a technique that teaches computers to learn from experience by using algorithms.<sup>4</sup> The term ‘experience’ primarily revolves around the process of data as a form of learning material, where historical data takes center stage, serving as a cornerstone for making accurate predictions for the future. In essence, it involves the curation and exploration of data, to instruct AI models to discover intricate patterns, correlations, and insightful data.

The journey of developing an AI model is unique, determined by the model's intended purpose and the nature of the data. As highlighted by the experts at *Towards Data Science*, data comes in various forms, such as audios, videos, photos, documents, excel data, and graphs, etc. But it can be boiled down to the following process: collecting and preparing the data, training the data, and assessing the model for accuracy.<sup>2</sup> This intricate process ultimately shapes the landscape of machine learning, providing AI systems with the insights and knowledge they need to function effectively and make informed decisions.

Machine learning can be explored in 2 categories: supervised and unsupervised learning.

Supervised learning is a type of machine learning in which labeled data is used to train the algorithms. The term “labeled data” indicates that both the input and the corresponding output are known.<sup>2</sup> This type of data, forms the foundation upon which the supervised learning constructs predictive models capable of making informed decisions for previously unseen data.<sup>4</sup> Consider a common supervised learning problem: to discern between spam and non-spam emails. In this process, you’ll be presented with a dataset of emails labeled as either “spam” or “not spam”. The machine learning model undergoes training using this dataset, where it meticulously analyzes distinctive attributes that distinguishes spam emails. Following the training, the model as the ability to categorize incoming emails, accurately categorizing if they’re “spam” or “not spam”.

Unsupervised learning is a type of machine learning in which unlabeled data are used to train the algorithm. This provides us the ability to explore the data to find some structure or information within.<sup>2</sup> To illustrate, consider the email classification example mentioned earlier, where the goal is to determine if an email is “spam” or “not spam”. However, in this instance, we’re not presented with labels indicating if they’re “spam” or “not spam”. Therefore, we can employ diverse algorithmic techniques such as clustering, to group emails based on shared characteristics. The algorithm will examine the content, language, and patterns of the email to create distinct clusters based on their features. These clusters not only serve to identify whether an email is spam or not, but also to unveil other inherent properties and attributes within the data. In essence, unsupervised learning enables us to unearth valuable insights from unstructured data, fostering a deeper understanding of the information at hand.

Now during the development of AI, the concept of functionality and implementation. Alan Turing references the importance to separate “how something works” from “how it can be built”.<sup>3</sup> A parallel can be drawn to the concept of planning versus executing. When planning, you discern the purpose, components, available resources, and desirable outcome. Your plan fundamentally shapes the subsequent implementation. In the context of AI, we first define the core capabilities of the system, its specific functionality, and envision the user experience. The next step involves the intricate implementation, where we delve into algorithms, hardware, software, and other technical details.

The distinction between functionality and implementation serves as a foundation of effective AI system development and documentation. For example, consider the cat image classification system I’ve developed as a project, where this concept was meticulously applied:

- **Functionality:**
  - *Objective:* to accurately identify and categorize images of cats among various animal images
  - *User experience:* users interact with the AI system, inputting or submitting images to be classified, and the system provides a definitive determination of whether the image contains a cat
- **Implementation:**

- *Algorithms*: research into various image classification algorithms was conducted, leading to the selection and implementation of the most suitable ones, such as TensorFlow, support vector machine (SVM) and convolutional neural network (CNN)
- *Data preparation*: find data of cat images, data cleaning to remove null entries and bad URL, and image preprocessing, including resizing, were carried out
- *Training data*: train the model on the data that was prepared, and adjust the model's parameters to improve the model's ability to classify cats
- *Software*: determine what libraries are needed, and the user interaction medium (e.g., Streamlit)

This approach encapsulates the essence of the functionality and implementation divide in AI, and its impact reverberates not only in the project's results but also in the comprehensive documentation of the development process.

## **Conclusion**

In conclusion, as we navigate through the intricate history of artificial intelligence, we find ourselves on the cusp of a transformative era in human history. The profound importance of AI, its definitions, real-world manifestations, and its historical evolution cannot be overstated. It has become a beacon symbol of innovation, competition, and technological advancement that shapes the trajectory of our future, societies, and nations. We've continued to recognize the challenges and ethical concerns surrounding AI, from bias in training data to the ethical dilemmas posed by machines simulating human experiences.

As we look to the future, AI holds significant promise and potential. With ongoing advancements fueled by the increasing efficiency of computational power, we stand in a new era where AI will continue to reshape industries, societies, and the global landscape. It's our collective responsibility to guide these developments with wisdom, ethical responsibility, and a commitment to ensure that AI serves the betterment of humanity.

## Resources

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