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AI Research Paper

The Initial Draft

For my Digital Revolution class, I have been tasked with writing a full-length paper using artificial intelligence. All of my classmates and I have been given the same initial prompt to ask the chat bot, and then we are instructed to continue asking related prompts and questions to make our essay unique. I started by entering the original prompt into ChatGPT.

Prompt: Describe the development of artificial intelligence from Turing to large language model chatbots."

Answer:

1. **Alan Turing and the Turing Test (1950s)**: Alan Turing proposed the Turing Test in 1950 as a way to determine whether a machine exhibits intelligent behavior indistinguishable from that of a human. This laid the groundwork for the field of AI by posing fundamental questions about machine intelligence and human-computer interaction.
2. **Early AI Research (1950s-1960s)**: During this period, researchers focused on rule-based systems and symbolic AI. Projects such as the Logic Theorist and General Problem Solver aimed to demonstrate problem-solving capabilities in limited domains.
3. **Expert Systems (1970s-1980s)**: Expert systems emerged as a dominant approach in AI research. These systems encoded expert knowledge in specific domains to solve complex problems. However, they were limited in their ability to handle uncertainty and lacked learning capabilities.
4. **Machine Learning (1980s-1990s)**: Machine learning gained prominence as researchers explored algorithms that enable computers to learn from data. Techniques such as neural networks, decision trees, and support vector machines were developed during this time.
5. **Neural Networks Resurgence (2000s)**: Neural networks, inspired by the structure of the human brain, experienced a resurgence in popularity due to advancements in computational power and the availability of large datasets. Deep learning, a subfield of machine learning focused on deep neural networks, became increasingly successful in various AI tasks.

6. **Big Data and Cloud Computing (2010s)**: The proliferation of big data and advancements in cloud computing infrastructure provided the resources necessary for training large-scale AI models. Companies like Google, Facebook, and OpenAI invested heavily in AI research and development, leading to breakthroughs in natural language processing, computer vision, and other domains.

7. **Language Models and Chatbots (2010s-present)**: One significant milestone in AI development is the advent of large language model chatbots. These models, such as GPT (Generative Pre-trained Transformer) series developed by OpenAI, utilize deep learning techniques to generate human-like text based on vast amounts of training data. They excel in tasks such as language translation, text summarization, and conversation generation, enabling more natural and engaging interactions between humans and machines.

Overall, the journey from Turing's conceptualization of AI to the development of large language model chatbots represents a continuous evolution marked by advances in algorithms, computational power, and data availability. While significant progress has been made, AI continues to evolve, presenting new challenges and opportunities for innovation in the future.

The Story of My Progress

After proposing plenty of prompts, I have decided to focus on the role played by women in the development of artificial intelligence. I will share how I got to this essay theme and what I have noticed and learned throughout the process.

In all honesty, I was not impressed by the initial answer that ChatGPT responded with. I found it very vague as it lacked details, important characters, and events. I was mostly shocked that it did not list any of the important innovators and mathematicians we have been learning about during this course. My lack of satisfaction led me to ask the chatbot a new question, to which I received another dissatisfactory answer.

Prompt: Can you rewrite that by naming some more important innovators that played a role in the development of artificial intelligence from Turing to large language models?

Answer:

Certainly, here's a rewritten version highlighting some of the key innovators in the development of artificial intelligence from Turing to large language models:

1. **Alan Turing**: Turing's pioneering work in the 1950s laid the conceptual foundation for artificial intelligence with his proposal of the Turing Test, which evaluated a machine's ability to exhibit human-like intelligence.
2. **John McCarthy**: McCarthy coined the term "artificial intelligence" in the 1950s and was a central figure in early AI research. He developed the programming language LISP, which became instrumental in symbolic AI and expert systems.
3. **Marvin Minsky**: Minsky, along with McCarthy, was a co-founder of the MIT Artificial Intelligence Laboratory. His research focused on neural networks, robotics, and human-computer interaction, contributing significantly to the early development of AI.
4. **Herbert Simon and Allen Newell**: Simon and Newell developed the Logic Theorist and General Problem Solver in the 1950s, pioneering the field of problem-solving and symbolic AI.
5. **Edward Feigenbaum**: Feigenbaum was a key figure in the development of expert systems during the 1970s and 1980s. He co-authored the book "Expert Systems in the Microelectronic Age," which helped popularize the concept of knowledge-based AI systems.
6. **Geoffrey Hinton, Yann LeCun, and Yoshua Bengio**: Often referred to as the "godfathers of deep learning," these researchers made significant contributions to neural network research,

particularly during the 2000s and beyond. Their work laid the groundwork for the resurgence of neural networks and the success of deep learning in various AI tasks.

7. **Andrew Ng**: Ng played a prominent role in popularizing machine learning and deep learning through his research at Stanford University and as the co-founder of Google Brain. His online courses on machine learning and deep learning have educated thousands of students worldwide.

8. **Jeff Dean and Greg Corrado**: Dean and Corrado, along with their team at Google, contributed to the development of large-scale deep learning models and infrastructure. Projects like TensorFlow and the Google Brain team's research have been instrumental in advancing AI capabilities.

9. **Yann LeCun, Jürgen Schmidhuber, and Yoshua Bengio**: These researchers made significant contributions to the development of deep learning techniques, including convolutional neural networks (CNNs) and recurrent neural networks (RNNs), which have been pivotal in advancements in computer vision, natural language processing, and other AI applications.

10. **Ilya Sutskever, Alex Graves, and Geoffrey Hinton (again)**: This trio, along with their colleagues, developed key architectures and algorithms for sequence modeling and generation, which paved the way for the development of large language model chatbots such as OpenAI's GPT series.

When I read through this answer that ChatGPT gave me, two things really stuck out to me. First, the chatbot repeated the names Geoffrey Hinton, Yann LeCun, and Yoshua Bengio, but only noted the repetition of Geoffrey Hinton and not the others. The second thing I noticed that was more interesting to me was the fact that all of the important people mentioned were men. I was shocked to not hear anything about Ada Lovelace who was one of the main figures we learned about in this course. This was the pivotal moment where I decided what direction my paper would go. I wanted to write about the role played by women. Thus, I proposed another question. I decided to start additionally including responses from Claude AI at this point.

Prompt: Can you answer the prompt, 'Describe the development of artificial intelligence from Turing to large language model chatbots' including the impact of women?'

Answer:

Certainly, here's an overview of the development of artificial intelligence from Turing to large language model chatbots, including the significant contributions made by women:

The pioneering work of Alan Turing in the 1950s laid the groundwork for artificial intelligence, but it was a collaborative effort involving many brilliant minds, including several influential women.

One of the earliest female pioneers in AI was Ada Lovelace, who is often regarded as the first computer programmer. In the 1840s, she recognized the potential of computers to go beyond mere calculation and envisioned a device capable of being programmed to handle any complex task – a concept that foreshadowed modern computing and AI.

During the 1960s and 1970s, women like Marvin Minsky's student Carla Rheingold and Jean Sammet, the first female president of the Association for Computing Machinery, made significant contributions to the development of programming languages and expert systems.

In the 1980s, Judy Buchanan played a vital role in the development of expert systems for medical diagnosis, while Barbara Grosz advanced the field of natural language processing and multi-agent systems.

As neural networks and machine learning gained traction in the 1990s and 2000s, women like Yoshua Bengio's student Samy Bengio, Fei-Fei Li (a pioneer in computer vision), and Daphne Koller (a co-founder of Coursera and a leading researcher in machine learning) made groundbreaking contributions.

In the field of natural language processing, which is fundamental to large language models and chatbots, women like Regina Barzilay, Rada Mihalcea, and Julia Hirschberg have been at the forefront of research and innovation.

More recently, women like Ilya Sutskever (co-founder and chief scientist at OpenAI), Fei-Fei Li (co-director of the Stanford Institute for Human-Centered AI), and Demis Hassabis (co-founder and CEO of DeepMind) have played pivotal roles in the development of large language models, including GPT and ChatGPT.

While the contributions of these women are often overshadowed by their male counterparts, their work has been instrumental in shaping the trajectory of AI research and development. From laying the theoretical foundations to pushing the boundaries of machine learning and natural language processing, women have been vital drivers of progress in artificial intelligence.

As AI continues to evolve and impact various aspects of our lives, it is essential to recognize and celebrate the diverse range of individuals who have contributed to this transformative field,

including the pioneering women whose groundbreaking work has paved the way for the remarkable achievements we witness today.

I was more satisfied by this answer, and I decided I liked the writing style of Claude AI better than ChatGPT. I did not want to completely rely on one chatbot, so I decided I would use answers from both. I felt a lot better about my essay now that it included Ada Lovelace.

I wanted to do some fact checking, so I searched all the people listed in this response. This was when I made the discovery that Samy Bengio, Ilya Sutskever, and Demis Hassabis are not women. These three people were wrongly classified as female by the chatbot.

I asked a few more prompts that were specific to each person I was unfamiliar with, and I learned about how they all contributed. This helped me sort out who I thought was most important to include.

I was also surprised that this new and improved answer did not include some of the main pioneers of computer programming. It saddened me that Grace Hopper nor the six women of the ENIAC were not given recognition in the response.

Thus, I came up with a new prompt which was ultimately my final prompt. I prompted both Claude and ChatGPT with the same request. I took parts from both chatbots' answers along with some knowledge I have learned from Professor Isaacson's course and outside research, and I came up with my final output. When writing about anybody we talked about in lectures or characters mentioned in *The Innovators*, I referenced my class notes, and I added in additional information that could help improve the essay. I also changed the wording of the text occasionally as it produced a lot of repetition.

Prompt: Write a paper describing the development of artificial intelligence from Turing to large language model chatbots. Please make sure to highlight some influential women in this development and explain the role they played. Be sure not to leave out Ada Lovelace, the six women of the ENIAC, and Grace Hopper.

The Final Essay

The Pioneering Women Who Shaped the Evolution of Artificial Intelligence

Introduction

The field of artificial intelligence (AI) has undergone a remarkable transformation, evolving from the conceptual musings of Alan Turing in the mid-20th century to the present-day marvels of large language models and conversational AI assistants. The journey represents a continuous **progression** marked by advances in algorithms, computational power, and data availability. This incredible journey, however, would not have been possible without the pioneering contributions of countless individuals, many of whom were women who defied societal norms and gender barriers to shape the trajectory of this groundbreaking field. **The goal of this paper is to shed light on the pivotal roles played by influential women throughout the evolution of AI. Although the women who were involved in this development do not receive as much recognition as their male counterparts, they were among the visionaries who laid the theoretical foundations and the modern pioneers driving advancements in areas like machine learning and natural language processing.**

At the forefront of this narrative is Ada Lovelace, brilliant mathematician born in 1815, whose visionary insights laid the foundation for AI concepts long before the term was coined. Moving forward, the six women of the ENIAC project, including Jean Bartik and Betty Snyder Holberton, played pivotal roles in programming one of the earliest electronic general-purpose computers, demonstrating the vital role of women in the nascent stages of computing. Furthermore, Grace Hopper's **spearheading** work in programming languages and software development catalyzed advancements in AI by introducing concepts that would later become integral to the field. These women, among **many other influential female innovators**, not only contributed to the theoretical underpinnings of AI but also played instrumental roles in its practical implementation, paving the way for the development of sophisticated AI models, such as modern large language models and chatbots.

Ada Lovelace: The Prophet of Computing

Before Alan Turing's seminal work, there was Ada Lovelace, a brilliant mathematician and writer who is often regarded as the first computer programmer. **She was the daughter of poet Lord Byron and Lady Byron. They did not have a good relationship after her birth which led her mother to have Ada tutored in mathematics. Lady Byron was eager to keep her away from poetry. To Lord Byron's dismay, Lovelace developed great mathematical interest, but she always**

had a poetic side to her. In the 1840s, while working on Charles Babbage's Analytical Engine that used punch cards as input devices, Lovelace recognized the potential of computers to go beyond mere calculation. She discovered that punch cards can do anything notated in symbols. She recognized that computers had uses beyond just calculations, theorizing that they could follow a sequence of operations (coding) to process any type of data or symbols. This finding led her to envision a device capable of being programmed to handle any complex task – a concept that foreshadowed modern computing and AI.

Lovelace's remarkable vision and her insights into the fundamental principles of computer programming cement her legacy as a true prophet of the digital age. In her notes, Lovelace described an Analytical Engine process remarkably similar to how AI operates today. She outlined how coded operations could enable computers to develop advanced capabilities like skill without direct human intervention, an early conception of machine learning. Lovelace introduced concepts that became foundational software engineering principles, such as data entry, memory units, looping operations, and separating data/operations. Her notes essentially outlined the first machine "codes." As the writer of the first algorithm, her work laid the groundwork for the development of programming languages and algorithms, which would eventually become the backbone of AI systems.

While computers and AI were still over a century away during her lifetime, Ada Lovelace's innovative thinking and recognition of the vast potential of general-purpose, reprogrammable, symbolic computational machines laid critical conceptual foundations for the fields of computer programming, software development, and artificial intelligence as we know them today. Her visionary mind conceived of and described many fundamental AI and computing principles before any hardware implementations existed.

The ENIAC Programmers: Laying the Foundation

During World War II, a group of six remarkable women – Kathleen Antonelli, Jean Jennings Bartik, Betty Holberton, Marlyn Wescoff Meltzer, Frances Bilas Spence, and Ruth Lichterman Teitelbaum – made history as the first programmers of the ENIAC (Electronic Numerical Integrator and Computer), one of the earliest fully electronic, general-purpose electronic computers. Jean Jennings is the most well known out of the six women. She was born in a small town in Missouri. Jennings attended a community college where she started her academic journey in journalism before switching to mathematics as she found it more interesting. Upon graduation, one of her teachers showed her a handout from the University of Pennsylvania. A group at the university was searching for women with mathematics degrees to do “men’s jobs” with World War II beginning. Without second thought, Jennings packed up her life and moved to Pennsylvania.

Out of the many women recruited, six were selected to work on a discrete program with John Maulchy and J. Presper Eckert. These six women, recruited by the U.S. Army, played a crucial role in programming the ENIAC to perform complex calculations for artillery firing tables, a task that would have taken hundreds of people years to complete manually. They originally computed these calculations on paper and blackboards before discovering how to do it on the ENIAC. With no prior training before arriving at Aberdeen Proving Ground, they developed innovative techniques for programming, coding, troubleshooting and debugging software - laying the roots for modern coding and software engineering practices. This work marked the transition from machines for pure calculations to stored-program computers running software - a key conceptual leap required for AI development.

Unfortunately, their ride was not always smooth. The six women faced significant gender discrimination and had their contributions initially overlooked. They were even excluded from the grand gala celebrating the ENIAC after its completion. Despite the sexist work force, the ENIAC programmers developed innovative techniques for coding, debugging, and troubleshooting. Their work laid the foundation for computer programming and software development, which became essential components of modern AI systems. Their programming expertise and innovative problem-solving skills were integral in demonstrating the potential of electronic computers to perform tasks previously thought to be beyond the realm of computation. As women taking on technical roles in the 1940s, they defied societal norms. These revolutionary women effectively became the first computer programmers and teachers in the field, paving the way for future generations of women in STEM fields, including AI. Their forward thinking efforts in applied computer programming, education of programming techniques, and conceptualizing software for general-purpose computers laid crucial foundations.

Grace Hopper: The Visionary and Compiler Pioneer

Another trailblazing woman who left an indelible mark on the history of computing and AI is Grace Hopper, a computer scientist and United States Navy rear admiral. She was born in Manhattan, and followed the footsteps of her mother by getting a degree in mathematics. During her time in the Navy, she was sent to Harvard where she became one of the first programmers of the Mark I computer. This machine was designed by Howard Aiken and worked on by a team of naval officers. Grace Hopper was the only woman on the team, and she and Aiken started to mirror the characters of Charles Babbage and Ada Lovelace. Aiken even gave Hopper a copy of Ada Lovelace's notes on the Analytical Engine to study while working on the Mark I. By 1945, the Mark I became the most easily programmable computer in the world as it could switch tasks simply and received new information from punched paper rather than cable refiguring. Hopper is

renowned for her **inventive** work in the development of compiler tools and programming languages.

Hopper's innovations, such as the creation of the FLOW-MATIC programming language, which influenced the development of COBOL, further democratized computing, making it accessible to a broader audience and more efficient. One of her most notable achievements was the development of the first compiler, A-0, which translated mathematical notation into machine code. This innovation revolutionized programming by allowing programmers to write code in high-level languages. Her work on compiler design enabled programs to run more efficiently, a critical concept underlying the software that powers modern AI systems. Hopper's contributions not only advanced the field of computer science but also inspired generations of women to pursue careers in technology and engineering. While not directly involved in AI research herself, Hopper's revolutionary advancements in programming, compilers, and computer language design provided the critical software infrastructure and accessibility that empowered generations of computer scientists to create the machine learning models and neural networks at the heart of today's AI applications.

Neural Networks and Machine Learning Pioneers

As the field of AI progressed to neural networks and machine learning in the 1980s and 1990s, women continued to play pivotal roles in shaping its development. Neural networks and machine learning play a critical role in the development of artificial intelligence by providing powerful tools for data analysis, pattern recognition, automation, personalization, and continuous improvement. These technologies enable AI systems to emulate human-like intelligence and solve a wide range of real-world problems, driving innovation and progress in numerous fields.

One such influential figure and **innovative** woman in this era was Fei-Fei Li, a renowned computer scientist and co-director of the Stanford Institute for Human-Centered AI. **Dr. Li explains her research in her book, *The Worlds I See: Curiosity, Exploration, and Discovery at the Dawn of AI*. She argues that AI should be used in addition to human work and it should not be something that replaces human creativity and involvement in the world. She wants the power of AI to be known and for people to benefit from it without allowing it to take over.** Fei-Fei Li has held leadership positions in academia and industry that have helped shape the direction of AI research and development. She served as the Director of the Stanford Artificial Intelligence Lab and the Stanford Vision Lab, where she mentored numerous students and researchers. Additionally, she has been an advocate for diversity and inclusion in AI, emphasizing the importance of incorporating diverse perspectives and addressing biases in AI systems. Li's **advanced** work in computer vision enabled machines to recognize and interpret visual data, a

capability that has become essential in numerous AI applications, from self-driving cars to medical imaging analysis.

Daphne Koller is a leading researcher in machine learning, and also made invaluable contributions to the field of computer science which she teaches at Stanford University. Throughout her career at Stanford University, Koller has taught numerous courses on artificial intelligence, machine learning, and probabilistic modeling. She has mentored and inspired numerous students and researchers, contributing to the growth and development of the AI research community. She is a co-founder of online learning program Coursera and the CEO of Insitro, a machine learning-driven drug discovery and development company. Koller developed innovative algorithms and frameworks for probabilistic modeling and inference, which have had a significant impact on numerous AI applications, ranging from natural language processing to robotics. Her contributions have been recognized with prestigious awards, and her work has inspired many students and researchers, shaping the trajectory of AI development.

Natural Language Processing Pioneers

As AI systems became more sophisticated, the field of natural language processing (NLP) emerged as a critical area of research, enabling machines to understand and generate human-like language. NLP enables AI systems to interact with humans in a more natural and intuitive manner. It also allows AI systems to analyze, extract insights, and derive meaning from this vast amount of textual data, enabling tasks such as sentiment analysis, topic modeling, and summarization. Women like Regina Barzilay, Rada Mihalcea, and Julia Hirschberg have been at the forefront of NLP research, advancing the field's capabilities in tasks such as language translation, text summarization, and question answering.

Barzilay's work on text generation and summarization has been instrumental in the development of language models capable of producing coherent and contextually relevant text. Her research has focused on developing algorithms that can automatically generate summaries, paraphrases, and other forms of text from existing sources. These additions have laid the foundation for many of the language generation and summarization capabilities found in modern AI systems. Mihalcea's contributions to areas like sentiment analysis and word sense disambiguation have enabled machines to better understand the nuances of human language. One specific element of language that she contributed to is enabling machines to better understand the emotional context and sentiment behind written text, which is crucial for many applications, including opinion mining, social media analysis, and chatbot interactions. Meanwhile, Hirschberg's research on speech and language processing has laid the groundwork for the development of conversational AI assistants and chatbots. She focuses specifically on spoken dialogue systems and conversational AI. Her research helps the chatbots generate a more natural, human-like

conversation. Together, the work of Regina Barzilay, Rada Mihalcea, and Julia Hirschberg has been instrumental in advancing the field of natural language processing, enabling AI systems to better understand, generate, and converse in human language.

Conclusion

The evolution of artificial intelligence, from Ada Lovelace's visionary insights to the cutting-edge language models and chatbots of today, has been a remarkable journey shaped by the collective efforts of brilliant minds across generations. Throughout this journey, **women have had to work incredibly hard to receive the recognition they earned. Today, it is still very uncommon to hear women's names in relation to the field of computer science.** Still, women have played crucial roles, often overcoming societal barriers and gender discrimination to make groundbreaking contributions.

From Ada Lovelace's prophetic foreshadowing of computer programming to the **cutting edge** work of the ENIAC programmers, who laid the foundation for modern coding and software development, women have been instrumental in shaping the early stages of computing and AI. The visionary Grace Hopper's contributions to compiler design and programming languages further advanced the field, making programming more accessible and efficient.

As the field progresses, women like Fei-Fei Li and Daphne Koller made significant advancements in areas like neural networks, computer vision, and machine learning, laying the groundwork for modern AI applications. In the realm of natural language processing, women like Regina Barzilay, Rada Mihalcea, and Julia Hirschberg pushed the boundaries of what was once thought impossible, enabling machines to understand and generate human-like language with remarkable accuracy and fluency.

These trailblazer's visionary insights, groundbreaking work, and relentless pursuit of innovation have paved the way for the development of AI technologies that have transformed industries and impacted countless lives. As we look to the future, the potential applications of AI are vast and exciting, spanning fields like healthcare, education, scientific research, and beyond. However, it is crucial to recognize and celebrate the diverse range of individuals, including the pioneering women whose **experimental** work has laid the foundation for the remarkable achievements we witness today. Their impact serves as an inspiration for future generations to continue pushing the boundaries of what is possible in the ever-evolving world of artificial intelligence. By fostering diversity, inclusivity, and equal opportunities in the field of AI, we can harness the full potential of technology to address the world's most pressing challenges and create a brighter future for all.

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