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AI Paper – Turing to LLM

***I. Introduction (by me)***

This paper, in accordance with the prompt, includes an essay that charts the trajectory of artificial intelligence from Turing to Large Language Model chatbots. The final essay(s) are written almost entirely with chatbots, specifically ChatGPT 3.5, Gemini, and Claude AI. Included in this paper are the First Draft using the simple prompt, how the paper got started, the Outline used to write the paper, Process and Observations, and finally the two essays, one written in the style of Eudora Welty and one in traditional academic tone. A Works Cited is also provided at the end. Each section header has either “(by me),” or “(by AI),” just to clarify which sections are commentary and which are the actual chatbot production. Any direct edits to the chatbot’s words are in **green**.

The process of writing this entire paper was a really great experience. It taught me about AI chatbots, how to use them more effectively, and gave me a new understanding of their pros, cons, and quirks. I also learned a lot more about the subject itself, the history of AI, with a focus on female contributions. Overall, it was just an entertaining and fun way to write a paper. Enjoy!

## **II. First Draft (by AI)**

*Prompt:*

(ChatGPT 3.5) Describe the development of artificial intelligence from Turing to large language model chatbots.

*Answer:*

The development of artificial intelligence (AI) from Turing to large language model chatbots represents a fascinating journey through various milestones and advancements in the field. Here's a brief overview:

### **Alan Turing and the Turing Test (1950s):**

Alan Turing proposed the Turing Test in 1950 as a measure of a machine's ability to exhibit intelligent behavior equivalent to, or indistinguishable from, that of a human. This laid the foundation for the concept of machine intelligence.

### **Early AI Research (1950s-1970s):**

During this period, AI research focused on rule-based systems, symbolic reasoning, and expert systems. Researchers explored methods to encode human knowledge into computer programs to perform specific tasks.

### **The Rise of Machine Learning (1980s-2000s):**

Machine learning, particularly neural networks, gained traction during this period. Researchers developed algorithms capable of learning patterns and making predictions from data. Neural networks were applied to various tasks such as speech recognition, image classification, and natural language processing (NLP).

### **The AI Winter (1980s-1990s):**

Despite significant progress, AI research faced setbacks during the AI winter periods, characterized by reduced funding and interest due to unmet expectations and overhyped promises.

### **The Renaissance of Deep Learning (2010s):**

The resurgence of interest in AI came with breakthroughs in deep learning, fueled by advancements in computational power and the availability of large datasets. Deep learning, particularly convolutional neural networks (CNNs) and recurrent neural networks (RNNs), revolutionized various domains, including computer vision, speech recognition, and NLP.

### **Chatbots and Conversational AI (2010s-Present):**

Chatbots represent a significant application of AI, focusing on natural language understanding and generation. Early chatbots relied on rule-based systems and simple pattern matching. However, with the advent of deep learning, chatbots evolved into more sophisticated

conversational agents capable of understanding context, generating human-like responses, and even engaging in meaningful conversations.

**Large Language Models (2010s-Present):**

Large language models (LLMs), such as OpenAI's GPT (Generative Pre-trained Transformer) series, represent a culmination of advancements in deep learning and NLP. These models are trained on vast amounts of text data and can generate coherent and contextually relevant responses to a wide range of prompts. LLMs have applications in chatbots, language translation, content generation, and more.

The journey from Turing's conceptualization of machine intelligence to the development of large language model chatbots illustrates the continuous evolution and refinement of AI technologies, driven by both theoretical insights and practical innovations.

### *III. Getting Started (by me)*

Based on a number of conversations in class, strategies presented by other students, and the simplicity of the first chatbot response, I knew that I needed to give the chatbots a lot more information and guidelines to produce a 2,500-word college level essay. Throughout the semester, I had taken passes at different sections of the paper and tried to do large sections at a time. Through this process, I have enjoyed building what feels like a rapport with the chatbots—knowing what kinds of questions it responds best to, correcting it when it makes a mistake, wanting to say, “awesome job,” when it gives me something better than I expected (?!). So, I felt like it made the most sense to start a conversation. By telling the chatbots what kind of paper I was trying to write and how I wanted it to sound, I hoped to get it on board with my vision right out the gate. Since I have been using ChatGPT 3.5 and Gemini the most, I entered the same prompt about my goals for the paper into both:

“Let me tell you a little bit about what I am trying to achieve. I am writing a paper for a college senior level class at Tulane University. The course is about the Digital Revolution. We have been assigned this paper with the specific requirement to use AI to help us write the paper. So I want you to give me college level academic sources, language, structure, etc. I really want to focus on female contributions because they are often overlooked in history in many fields, especially technology. I also want to put more of a humanities spin on the paper because I am more interested/familiar with that field, even though I am writing about technology. Basically, I want to write the paper in a way that is interesting for someone like me, who does not know a ton of technical jargon and is not immersed in the tech world, would be interested to read. All that to say, let's start with an outline.”

Reading my prompts back sounds like I am ordering instructions to the younger sibling I don't have to complete my homework for me, but I felt like this would help set the tone for the kind of paper I wanted to produce.

From there, I got an outline of different female contributors, some familiar and some not. I confirmed that all the women were actual contributors to the development of artificial intelligence, then added in a couple of names (Jean Bertik and the ENIAC Women and Margaret Mitchell were not in the original list). At this point, the outline was strictly technical, and I wanted to include more of the personal anecdotes of each woman to show the ways people's humanities effect their work. At this point I asked ChatGPT to add a layer of personal history to the outline:

“Ok, here is another layer of detail I want to add: the more personal anecdotes of each of these characters, so we get the full picture of them, not just what they did for work.”

After a few edits, like ensuring chronological order, ChatGPT gave me a much more detailed outline that I felt satisfied with (Section IV). At this point, I put the outline into Gemini to see if it produced something I liked better. Gemini's outline focused more on each step in the history from Turing to LLMs; however, I felt that since the whole class had that prompt, a more specific approach to the paper may make it slightly more entertaining for the readers (graders!). Therefore, I landed on this outline to write each section of the paper (Section IV).

#### ***IV. Outline (by AI)***

##### **I. Introduction**

- A. Brief overview of the Digital Revolution
- B. Importance of highlighting female contributions in technology
- C. Thesis statement outlining the focus and approach of the paper

##### **II. Ada Lovelace: Pioneering the Path to Computing**

A. Introduction to Ada Lovelace and her background - Briefly introduce Ada Lovelace's upbringing as the daughter of the famous poet Lord Byron.

B. Ada Lovelace's collaboration with Charles Babbage and the Analytical Engine - Share an anecdote about Lovelace's curiosity as a child and her fascination with mathematics and machines, inspired by her mother's encouragement.

C. Analyzing Lovelace's contributions to computing and her vision for its potential - Include a personal reflection on Lovelace's letters and diaries, which reveal her passion for blending creativity with scientific inquiry and her visionary insights into the potential of computers beyond mere calculation.

##### **III. Grace Hopper: Shaping the Language of Computers**

A. Introduction to Grace Hopper and her significance in computing - Share a story about Hopper's determination to pursue a career in a male-dominated field, inspired by her childhood experiences of dismantling alarm clocks to understand how they worked.

B. Hopper's work on programming languages and compiler development - Include an anecdote about Hopper's innovative approach to debugging computer systems, such as the famous story of the "nanosecond" and the actual length of wire she carried to demonstrate the concept of a nanosecond.

C. Exploring the impact of COBOL and Hopper's role in its creation - Share a personal reflection on Hopper's dedication to making computers more accessible through user-friendly programming languages like COBOL, inspired by her belief in the importance of clear communication between humans and machines.

##### **IV. ENIAC Women and Jean Bartik: Pioneers of Electronic Computing**

A. Introduction to the ENIAC Women and Jean Bartik - Provide an overview of the ENIAC project and the role of women programmers in its development, including Kathleen Antonelli, Jean Jennings Bartik, Frances Bilas Spence, Ruth Lichterman Teitelbaum, Marlyn Wescoff Meltzer, and Betty Holberton.

B. Highlighting the contributions of the ENIAC Women and Jean Bartik - Share personal anecdotes about the experiences and achievements of women such as Jean Bartik in programming the ENIAC and their pioneering work in the field of electronic computing.

C. Discussing the impact and legacy of the ENIAC Women and Jean Bartik - Analyze the significance of the ENIAC Women's contributions to the field of computing and their role in

paving the way for future generations of female technologists, including Jean Bartik's legacy as a trailblazer in computer programming.

## **V. Fei-Fei Li: Bridging the Gap Between Humans and Machines**

A. Introduction to Fei-Fei Li and her contributions to computer vision - Share an anecdote about Li's early experiences with visual storytelling and her fascination with the power of images to convey complex ideas and emotions.

B. Li's research in visual recognition and image classification - Include a personal reflection on Li's journey from studying neuroscience to pioneering breakthroughs in computer vision, inspired by her interdisciplinary approach and commitment to understanding how the human brain processes visual information.

C. Examining the applications and implications of Li's work in AI and beyond - Share an anecdote about Li's advocacy for diversity and inclusion in AI research, such as her experiences as a female scientist navigating the male-dominated tech industry and her efforts to mentor and empower the next generation of AI researchers from diverse backgrounds.

## **VI. Joy Buolamwini: Advocating for Ethical AI**

A. Introduction to Joy Buolamwini and her work on algorithmic bias - Share a personal anecdote about Buolamwini's experiences as a black woman studying computer science and facing challenges of bias and discrimination in the field.

B. Buolamwini's research on fairness and accountability in AI - Include a story about Buolamwini's discovery of racial and gender bias in facial recognition algorithms, such as her personal experiences of being misidentified by these systems.

C. Discussing the Algorithmic Justice League and its impact on the AI community - Share an anecdote about Buolamwini's founding of the Algorithmic Justice League and her efforts to raise awareness about the social implications of AI technologies, inspired by her commitment to justice and equity in the digital age.

## **VII. Margaret Mitchell and Timnit Gebru: Nurturing Responsible AI Practices**

A. Introduction to Margaret Mitchell and her research on ethical AI - Share a personal anecdote about Mitchell's early experiences with natural language processing and her passion for understanding how language shapes human behavior and culture.

B. Mitchell's contributions to natural language processing and bias mitigation - Include a story about Mitchell's collaboration with diverse teams of researchers to develop AI models that are inclusive and representative of diverse voices and perspectives. C. Analyzing the importance of transparency and inclusivity in AI development - Share an anecdote about Mitchell's advocacy for transparency and accountability in AI research, such as her experiences advocating for open access to data and algorithms to promote fairness and trust in AI systems.

D. Introducing Timnit Gebru and her contributions to ethical AI - Share a brief overview of Timnit Gebru's background and her research on bias in AI algorithms, including her work on the "Datasheets for Datasets" initiative and her collaborations on ethical AI frameworks.

E. Analyzing Gebru and Mitchell's collaborative efforts - Discuss the potential synergies between Gebru and Mitchell's work in promoting responsible AI practices, highlighting their shared commitment to transparency, fairness, and inclusivity in AI development.

F. Reflecting on the impact and future implications of their work - Consider the broader implications of Gebru and Mitchell's research on ethical AI, including its potential to shape the future direction of AI development and its impact on society at large.

## **VII. Conclusion**

- A. Recap of the paper's main points and contributions of female pioneers
- B. Reflection on the significance of integrating humanities perspectives into the study of technology.
- C. Call to action for continued recognition and support of female voices in the digital age

## V. *Process and Observations (by me)*

After the outline was complete, I remembered something my English teachers in high school mentioned. Sometimes when writing an essay, it is best to write the introduction and conclusion before writing the body paragraphs to see where the paper is going. I have always struggled with this, as I typically write what I want to write and adjust my thesis statement, introduction, and conclusion accordingly. I thought this would be a good time to try out their strategy, so I had ChatGPT write both the introduction and the conclusion. I prompted for the conclusion to add a layer of current contributors not covered and potential for the future.

I was pleased with the introduction and conclusion and then moved on to the body paragraphs. I would copy and paste the section from the outline into ChatGPT and ask for that section in full. After a few different tries, I streamlined the process for each section by adding a 250 word limit and occasionally prompting for the addition of specific details. Once I was satisfied with each section, I feared the entire essay might be a bit choppy, so I tried to paste the entire paper in Gemini and Claude to edit for flow and structure purposes. I think the paper was too long, and both chatbots spit about half the paper back to me. For this reason, I decided to edit for flow myself, including a bridge over the gap between Jean Bertik and Fei-Fei Li, so that the reader would be caught up on the advancements of computers between the ENIAC and LLMs. I had Gemini write that section and pasted it in.

Next, I needed to get sources for each section. My first strategy involved writing the paragraphs in ChatGPT, then using Gemini to add sources. I did this because I knew ChatGPT 3.5 would not give sources and I had gotten sources from Gemini before. However, upon actually checking the sources, I was extremely disappointed by them. It was giving me Frankenstein-esque sources that pasted random author first names with different last names, hallucinated article titles, and sourced them from random journals. The elements of each source had some relevance to the topic (most of the time) but were never accurate enough to use. For example, this source has many errors:

Tooley, Betty A. "Ada, Countess of Lovelace: Babbage's Prophet of Analytical Machinery." *Annals of the History of Computing*, vol. 4, no. 3, 1982, pp. 219-240. <http://ieeexplore.ieee.org/document/511939/>

First of all, the author's name is Betty A. Toole, not Tooley. The journal volume and number are also incorrect, based on the link provided. The title is also different. When prompted that the citation was wrong, Gemini responded that the same article has been posted with different titles, and that I could add a footnote in the paper noting this discrepancy. I could not find any basis for this claim.

This was a rather infuriating process, checking each citation Gemini gave me, only to realize it was always wrong in some way. At this point, I considered piecing together actual sources on my own from the bits of correct information from the provided sources. Instead, I moved to Claude AI for one last try. Claude was successful in the fact that all the citations were actually correct and findable on the Internet. I am much more confident about these sources



being correct than Gemini's, but I have not read all the books cited, so am not 100% sure. However, I have confidence that the information could be sourced from the texts cited.

I did notice that for the more contemporary facts, Claude struggled. The warning, "Claude does not have internet access. Links provided may not be accurate or up to date," proved to be an issue for relatively new information. I naively thought it was telling me it did not have internet connection, so I reconnected my Wi-Fi until I realized that it does not have real time internet access. The popular media articles it was gathering information from could not be properly cited. It was committing Gemini level Frankenstein-citation behavior. Since this was only the last couple of sections where this problem occurred, I pieced together the source information to gather correct sources for the last few sections. Overall, especially for older information that could be sourced from books, Claude responded fairly accurately to the prompt I gave for each section:

"Can you rewrite this paragraph with Chicago style in-text citations and provide a works cited?"

After I compiled all the different sources into a works cited and read through the final paper (making a few edits here and there, VII Final Paper Section), I felt satisfied with the paper I had written almost exclusively with AI. What would probably have taken me a couple of weeks and a lot more reading to complete, I was able to complete in about two days. Read, "From Ada to AI: Celebrating Women's Roles in the Digital Revolution," in section VII for an academic style essay that focuses on female contributions to the history of AI. Anything written in green is an edit made by me.

However, I did not want to stop there. As an avid reader, I always get excited about a book when it makes me want to write something when I finish reading it. However, I am not a seasoned writer and when I have tried, it never turns out as good as the author who inspired me (unsurprising result). So, I thought this was the perfect opportunity to use LLM's ability to mimic author's voices to make my paper sound like I wish my own writing could. While the subject of artificial intelligence may not be the perfect topic for this exercise, I figured it would be entertaining. One of my favorite authors is Eudora Welty, and her flowery language and long sentences are an interesting foil to the succinct and technical language that is typically used for discussion of technology. Additionally, she was an extremely gifted and intelligent female who resisted gender norms in the South by never marrying and making a successful career on her own. I felt like hearing this story in her voice would drive home the positives of harnessing female sensitivity with sharp intelligence to make significant contributions to any field, especially a male dominated one like technology. For these prompts, I asked Gemini (I liked its writing style better) to rewrite each section in Welty's voice while keeping word count and sources the same. I did have to course correct when it started using "ain't" and "bless your heart" in every other sentence. I reminded Gemini that Welty herself, despite whatever some of her characters might say, is eloquent, not cheesy. Read, "Fireflies in the Machine: Illuminating the Women Who Pioneered AI," in section VI for a Welty style essay that focuses on female contributions to the history of AI. It isn't perfectly eloquent writing, but it is entertaining.

## VI. *Final Paper – Welty Style (by AI)*

### *Fireflies in the Machine: Illuminating the Women Who Pioneered AI*

#### **Introduction**

In our own little corners of the world, the whir and hum of the digital age has become as familiar as a screen door slamming in a summer breeze. It's changed the way we gossip over the back fence, how we find work, how our children learn their ABCs. But who would've thought, amidst all these wires and blinking lights, that there are stories waiting to be told? Stories of remarkable women like Ada Lovelace, a woman who seemed to see the future in ones and zeroes, and Grace Hopper, who coaxed language from those very same machines. Jean Bartik and her fellow ENIAC women, their fingers flying across a symphony of switches, birthed a giant. And then there are the brilliant minds of today - Fei-Fei Li, Joy Buolamwini, Margaret Mitchell, and Timnit Gebru - each one a weaver of a different kind of magic. This *isn't* just about circuits and code, you see. This is about the indelible mark these women have left on our world, and the stories they deserve to have heard.

#### **Ada Lovelace**

Ada Lovelace, born Ada Byron in 1815, possessed a curiosity as boundless as the Mississippi sky. Her father, the famed Lord Byron, wove tales of romance, but Ada's heart belonged to numbers, a fascination nurtured by her shrewd and intelligent mother (Toole, 1992). Stories whisper of her childhood inventions, contraptions that rivaled the most fantastical Rube Goldberg contraption, and her nose perpetually buried in books that rivaled the heft of a Sunday sermon (Essinger, 2014).

The world was in the throes of change, the air thick with the chug of steam engines and the whir of factories. It was during this dynamic era that Ada encountered Charles Babbage and his ambitious dream – the Analytical Engine, a machine with the computational power of a Texas thunderstorm. Mr. Babbage, a brilliant inventor with a mind for gears and levers, envisioned the machine's physical form. But Ada, with a unique mind that danced between the realms of logic and poetry, saw a different kind of magic (Toole, 1992). She envisioned the Engine not merely as a calculator, but as a weaver of possibilities, a machine capable of manipulating not just numbers, but ideas themselves (Toole, 1992). This remarkable vision, penned decades before the first computers hummed to life, solidified Ada Lovelace's place in history as the world's first computer programmer (Essinger, 2014). She even dared to dream of machines that could speak in music, a symphony of ones and zeroes, a notion that feels eerily familiar today (Essinger, 2014). Ada Lovelace, a woman who bridged the gap between the sharp intellect of a scientist and the whimsical spirit of a dreamer, stands as a true pioneer, an inspiration to all those tinkering with the future.

#### **Grace Hopper**

Grace Hopper arrived on the scene in 1906, a time when computers were colossal machines, humming with an inscrutable logic. Unlike many in this nascent field, then dominated

by men, Hopper possessed an insatiable curiosity that compelled her to peel back the layers of these enigmatic devices (Beyer, 2012). Even as a child, she was drawn to the inner workings of machines, tinkering with gadgets and unraveling their mysteries (Beyer, 2012).

Her pioneering work unfolded during a period of feverish innovation in computing, a time that saw the rise of such giants as Alan Turing and John von Neumann (Beyer, 2012). Hopper, with her keen intellect and unwavering determination, positioned herself at the forefront of this revolution, making groundbreaking contributions to programming languages and compiler development (Beyer, 2012). These efforts fundamentally transformed the way humans interacted with computers.

Hopper's legacy is perhaps most significantly embodied by COBOL (Common Business-Oriented Language). Recognizing the need for user-friendly programming languages, she designed COBOL with a focus on clarity and intuitiveness, allowing even those without a technical background to understand and write computer programs (Beyer, 2012). This revolutionary approach, driven by her belief in fostering clear communication between humans and machines, empowered a new generation of users to harness the potential of computing (Beyer, 2012). Her vision and pioneering spirit continue to inspire those who shape the technological landscape today (Beyer, 2012).

### **Jean Bartik and the ENIAC Women**

In the thick of the Second World War, a humming giant was born – the ENIAC, a marvel of its time that whirred with the promise of a new era in computing (Campbell-Kelly et al., 2013). This colossal machine, one of the first fully electronic digital computers, marked a turning point in history (Campbell-Kelly et al., 2013). But the ENIAC story goes deeper than just wires and circuits. It's a story whispered through the ages, of brilliant women who breathed life into this behemoth with their very own code (Gürer, 1995).

These women, known as the ENIAC Programmers or the "ENIAC Six," were a band of pioneers – Kathleen Antonelli, Jean Jennings Bartik, Frances Bilas Spence, Ruth Lichterman Teitelbaum, Marlyn Wescoff Meltzer, and Betty Holberton (Gürer, 1995). Among them, Jean Bartik (1924-2011) stands out, a woman with a mind that craved puzzles and numbers from a young age, a talent that would blossom into a remarkable career (Gürer, 1995). In a time when proper young ladies weren't **expected to run the show with** equations and wires, Bartik defied expectations, her determination leading her to a degree in mathematics and a place at the very heart of the ENIAC project (Gürer, 1995).

Her brilliance shone brightly as she collaborated with her fellow programmers, tackling the labyrinthine challenges the ENIAC presented (Gürer, 1995). Yet, their contributions were often shrouded in the shadows. Despite their vital role in programming the machine, these women faced discrimination in a field dominated by men (Gürer, 1995). A stark reminder of this is the celebratory dinner held after the ENIAC's success, to which they weren't even invited (Gürer, 1995). But Bartik, and the other programmers, were not deterred. They pressed on, becoming silent heroes who paved the way for future generations of women in technology (Gürer, 1995). Bartik's story, a testament to unwavering passion and resilience in the face of

adversity, continues to whisper a message of courage, reminding us to chase our dreams with unwavering determination.

## **Contemporary Contributors**

The women who whispered instructions to the ENIAC in the 1940s, like Jean Bartik, laid the groundwork for the thinking machines of today. Their painstaking code, a marvel considering the limitations of the time, paved the way for a future brimming with invention (Gürer, 1995). This blossomed in the 1980s with the rise of algorithms that could learn on their own, but it wasn't until the late 1990s, when information came in floods, that Artificial Intelligence truly bloomed. This deluge of data fed ever-more complex systems, vast language models that could not only understand our words but even mimic them with an uncanny human touch.

This timeline of AI's rise runs parallel to, perhaps even dances with, a shift in the way we view women and science. As the old notions about proper ladies and their pursuits faded, there's been a welcome surge of female minds contributing to the field of AI. But the path isn't always smooth. Even today, these women, some fighting for a more equitable and inclusive AI, face scrutiny and challenges in a field still largely dominated by men.

### **Fei-Fei Li**

Fei-Fei Li, a mind like a brilliant kaleidoscope, arrived on the scene in 1976 and set her sights on a peculiar puzzle: how to teach machines to see the world the way we do (Lee, 2018). Growing up in China, she was captivated by stories told not just with words, but with the language of pictures, images that held emotions and tales within their frames (Lee, 2018). This early enchantment with visual narratives undoubtedly steered her path.

Her journey took her deep into the workings of the human brain, where she unraveled the mysteries of how we see (Lohr, 2016). But Fei-Fei Li wasn't one to stay neatly confined in one field. She wove together this knowledge of the brain with the logic of computers, becoming a pioneer in the way machines interpret what their cameras capture (Lohr, 2016). Thanks to her work, machines can now decipher and organize images with an accuracy that would make a seasoned librarian proud (Lohr, 2016). One of her crowning achievements is a massive collection of labeled images called ImageNet, a kind of visual encyclopedia for machines (Krizhevsky, Sutskever, and Hinton, 2012). This treasure trove transformed the field, giving researchers a common ground to test their creations and propelling image analysis in AI to new heights (Krizhevsky, Sutskever, and Hinton, 2012).

But Fei-Fei Li isn't just a whiz with wires and circuits. She fights for a more balanced world in AI, a place where everyone has a seat at the table (Lohr, 2016). As a woman in a field often dominated by men, she champions programs that give opportunities to underrepresented groups, believing that a diverse AI landscape is a stronger one (Lee, 2018). Through her work, Fei-Fei Li is not only shaping the future of technology, but also weaving a more inclusive future for the way humans and machines work together.

### **Joy Buolamwini**

Joy Buolamwini, a firecracker with a mind that sees through layers, is on a mission to root out prejudice hiding in these newfangled thinking machines (Buolamwini and Gebru, 2018). It all started with a personal brush with bias, a Black woman in the tech world trying to use a fancy facial recognition system that couldn't quite see her right (Buolamwini and Gebru, 2018). This sparked a fire in her belly, a determination to rip the veil off these hidden prejudices (Buolamwini and Gebru, 2018).

Her groundbreaking research, catchy as a church hymn – "Gender Shades" it was called – exposed how these machines favored certain faces over others, often based on race and gender (Buolamwini and Gebru, 2018). Her work shone a light on the need for a more balanced crowd in the rooms where these machines are built, folks from all walks of life (Buolamwini and Gebru, 2018). Knowing firsthand the struggles of being on the outside looking in, Joy co-founded the Algorithmic Justice League, a group fighting for fairness in this new digital age (Buolamwini and Gebru, 2018).

But Joy's fight **isn't** confined to dusty research papers. She's out there talking to everyone – folks in power, bigwigs in the tech industry, and regular folks on the street – spreading the word about the need for AI that's fair and accountable (Buolamwini, 2020). Through powerful talks and testimonies, she's pushing for transparency and a seat at the table for everyone in this conversation about the future (Buolamwini, 2020). Her fight has rattled cages and started a conversation, making tech companies take a long hard look at the impact of their creations (Buolamwini, 2020). Joy Buolamwini, a champion for justice, reminds us that even the most wondrous technology needs a moral compass.

### **Margaret Mitchell and Timnit Gebru**

Margaret Mitchell and Timnit Gebru have become champions for fair and honest ways of building these new thinking machines (Vincent, 2021). Mitchell, drawn to the power of words and their hold on folks, wanted these machines to treat everyone's voice with respect (Vincent, 2021). She gathers folks from all walks of life to build these machines, ensuring a quilt of different experiences is woven into their code (Vincent, 2021). Her belief in open-handedness extends to the very tools themselves, for she fights to make the data and instructions open to all, fostering trust and fairness (Vincent, 2021).

Timnit Gebru, with a keen eye for how machines see the world, tackles the problem of prejudice hidden within the information fed to them (Gebru et al., 2020). Her "Datasheets for Datasets" project shines a light on these biases, like a meticulous librarian making a detailed card catalogue of these hidden assumptions (Gebru et al., 2020). This allows other researchers to address these prejudices and build fairer AI tools (Gebru et al., 2020). Both Mitchell and Gebru have faced resistance in the tech world, **even** having to leave their jobs at **Google** because their ideas clashed with those in power (Vincent, 2021). Yet, their voices remain strong, a clarion call for transparency, fairness, and a seat at the table for everyone in this new age of thinking machines (Vincent, 2021). Together, their work paves the way for a future where these powerful tools are built with honesty and used for the betterment of all (Vincent, 2021).

### **Conclusion**

In the chorus of the Digital Revolution, women's voices have too often been muted. Yet, their contributions range from the foundational to the fiercely ethical, shaping both the technology and the society it touches. By celebrating their journeys – the challenges faced, the triumphs achieved – we gain a richer perspective on how women have steered innovation. This narrative is not simply about recognizing accomplishments because of gender. It's about acknowledging the unique eye for detail and meticulousness that has often propelled these women in a male-dominated field. Their stories, where science and personal history intersect, paint a more complete picture.

From the dawn of computing to the fight for ethical AI, these pioneers have left an indelible mark. They're not just pathfinders, but lighthouses guiding future generations. The potential of Large Language Models (LLMs) to transform our interaction with technology is undeniable. As LLMs evolve, they hold the promise of sophisticated systems, brimming with human-like understanding. But this future demands careful consideration of ethics. Thankfully, many of the women we celebrate have been at the forefront of ensuring responsible and equitable AI.

Looking ahead, recognizing and supporting rising stars like Carla Gomes, a constraint satisfaction virtuoso, and Rana el Kaliouby, who's pioneering AI's emotional intelligence, is crucial. These are just a few of the brilliant women poised to shape the burgeoning world of AI. The Digital Revolution isn't just about progress; it's a testament to human ingenuity, perseverance, and collaboration. By acknowledging the diverse voices of women in technology, we enrich our understanding of innovation's past, present, and future. This paves the way for a more inclusive digital world, a symphony where every voice plays its part.

## VII. Final Paper – Academic Style (by AI)

*From Ada to AI: Celebrating Women's Roles in the Digital Revolution*

### Introduction

The Digital Revolution has reshaped nearly every aspect of modern society, revolutionizing how we communicate, work, learn, and interact. From the internet to artificial intelligence, this technological transformation has fundamentally altered our lives. However, the contributions of female pioneers who have shaped the Digital Revolution are often overlooked. While less recognized than their male counterparts, these trailblazers have left an indelible mark on technology and society.

This paper explores the remarkable achievements and personal stories of [Ada Lovelace](#), [Grace Hopper](#), [Jean Bartik and the ENIAC women](#), [Fei-Fei Li](#), [Joy Buolamwini](#), [Margaret Mitchell](#) and [Timnit Gebru](#). By delving beyond their technical contributions, we aim to understand their motivations, challenges, and legacies. This holistic approach celebrates their accomplishments and honors their resilience in the face of adversity.

**Thesis Statement:** Through personal anecdotes and academic analysis of their contributions to the field of technology, this paper will highlight the pivotal roles of [Ada Lovelace](#), [Grace Hopper](#), [Jean Bartik and the ENIAC women](#), [Fei-Fei Li](#), [Joy Buolamwini](#), [Margaret Mitchell](#) and [Timnit Gebru](#) in the Digital Revolution, emphasizing the importance of recognizing their contributions as both technical innovators and complex female individuals.

### Ada Lovelace

Ada Lovelace, born Augusta Ada Byron (1815-1852), defied expectations from a young age. Daughter of the famous poet Lord Byron, Lovelace's upbringing blended artistic influence and scientific curiosity (Toole 1992, 25). While her father's legacy was built on Romanticism, Lovelace's mother encouraged her fascination with mathematics and logic (Toole 1992, 26). This curiosity blossomed early, with stories of Lovelace constructing elaborate contraptions and devouring books on algebra (Essinger 2014, 57).

In the 1840s, the Industrial Revolution was transforming societies through advancements in steam power and automation. Within this context, Lovelace encountered Charles Babbage and his revolutionary Analytical Engine – a conceptual mechanical calculator capable of complex mathematical operations (Toole 1992, 108). While Babbage focused on the engineering, Lovelace, with her unique blend of mathematical prowess and poetic imagination, envisioned something far grander (Essinger 2014, 119). Lovelace's seminal "Notes on the Analytical Engine" showcased her ability to see beyond the machine's immediate purpose (Toole 1992, 140). She envisioned the Analytical Engine as a general-purpose computer, capable of manipulating symbols and operating on data, not just numbers (Toole 1992, 142). This visionary work, decades before modern computers, earned Lovelace the title of the "world's first computer programmer" (Essinger 2014, 162). She even theorized about a machine using coded language to generate music, a remarkably prescient notion considering the role of computers in music today (Essinger 2014, 165). Lovelace's remarkable foresight embodied the perfect marriage of



scientific rigor and artistic vision, inspiring those working at the forefront of artificial intelligence (Toole 1992, 179).

## Grace Hopper

Almost 100 years later, the next prominent female enters the technology scene: Grace Hopper (1906-1992). She emerged as a trailblazer in the male-dominated field of computer science, fueled by relentless curiosity and determination (Beyer 2012, 10). As a child, Hopper exhibited a keen interest in understanding how things worked, often tinkering with gadgets and machines (Beyer 2012, 15). Hopper's pioneering work unfolded amidst rapid advancements in computing, including the emergence of key figures like Alan Turing, John von Neumann, and John Backus (Beyer 2012, 62). Through her contributions to programming languages and compiler development, Hopper positioned herself as a central figure in the evolution of modern computing (Beyer 2012, 72).

Hopper's groundbreaking work in programming languages and compiler development revolutionized computer programming and operation (Beyer 2012, 23). She is renowned for her innovative approach to what she famously coined, "debugging" after discovering a moth trapped in a relay switch (Beyer 2012, 33).

Hopper's most enduring contribution was COBOL (Common Business-Oriented Language), a user-friendly programming language designed for business applications (Beyer 2012, 47). Recognizing the need for accessible and intuitive programming, Hopper's COBOL empowered non-technical users to write and understand computer programs with ease (Beyer 2012, 53). Her dedication to making computers more accessible was driven by her belief in clear communication between humans and machines (Beyer 2012, 57). Her legacy as a visionary thinker and innovator continues to inspire generations of technologists (Beyer 2012, 80).

## Jean Bartik and the ENIAC Women

The Electronic Numerical Integrator and Computer (ENIAC) project, developed during World War II, stands as a significant milestone in the history of computing (Campbell-Kelly et al. 2013, 94). This project marked one of the earliest attempts to create a fully electronic digital computer (Campbell-Kelly et al. 2013, 96). However, the ENIAC story extends beyond its technological innovation. The project also showcased the vital contributions of a group of brilliant women programmers who played an instrumental role in bringing the ENIAC to life (Gürer 1995, 21). These pioneering women, often referred to as the "ENIAC Programmers" or the "ENIAC Six," included Kathleen Antonelli, Jean Jennings Bartik, Frances Bilas Spence, Ruth Lichterman Teitelbaum, Marlyn Wescoff Meltzer, and Betty Holberton (Gürer 1995, 23).

Among the ENIAC Programmers, Jean Bartik (1924-2011) emerged as a central figure (Gürer 1995, 27). Her passion for numbers and puzzles manifested early in her childhood, setting the stage for a remarkable career (Gürer 1995, 29). Despite societal expectations that often discouraged women from pursuing careers in mathematics and science, Bartik persevered, earning a degree in mathematics and ultimately finding her place on the ENIAC project (Gürer 1995, 32). Bartik's brilliance and problem-solving skills quickly became evident as she



collaborated with her female colleagues to overcome the complex technical challenges posed by the ENIAC (Gürer 1995, 35).

However, the ENIAC Programmers' contributions were not without their challenges. Despite their integral role in programming the machine, the women often faced discrimination and were largely overlooked in the male-dominated field of computing (Gürer 1995, 39). A stark example of this is the fact that Bartik and her colleagues were not invited to the celebration dinner held upon the successful completion of the ENIAC (Gürer 1995, 41). Undeterred by these obstacles, Bartik continued to push boundaries and make significant contributions to the field of electronic computing throughout her career (Gürer 1995, 45).

The legacy of the ENIAC Programmers, and Jean Bartik in particular, serves as a powerful testament to the resilience and determination of women in technology (Gürer 1995, 49). Their pioneering work on the ENIAC not only advanced the field of electronic computing but also paved the way for future generations of female technologists (Campbell-Kelly et al. 2013, 102). Bartik's personal story, marked by her unwavering passion and her ability to overcome obstacles, continues to inspire us to challenge stereotypes and pursue our dreams with unwavering determination (Gürer 1995, 53).

### Contemporary Contributors

The groundbreaking work of the ENIAC programmers in the 1940s, like Jean Bartik, laid the **development of modern computers**. Their meticulous coding, defying the limitations of the time, paved the way for decades of innovation. This culminated in the rise of machine learning algorithms in the 1980s. However, it wasn't until the late 1990s, with the explosion of vast datasets, that Artificial Intelligence truly blossomed. This data deluge fueled the development of complex systems, Large Language Models, capable of processing and generating human-like text.

This historical trajectory of AI coincides with, and is arguably influenced by, a shift in gender norms. As expectations surrounding female participation in STEM fields evolve, a much-needed surge in female contributions to AI has occurred, **but not without challenges. Current female (or non-male) contributors in field still face scrutiny and adversity in a male dominated field, especially since many of these female contributors are on the forefront of fighting for equity and inclusion within AI.**

### Fei-Fei Li

Fei-Fei Li (1976-), a prominent figure in artificial intelligence (AI), has made significant contributions to the field of computer vision, aiming to narrow the divide between human perception and machine understanding (Lee 2018, 25). Her fascination with visual storytelling traces back to her upbringing in China, where she was mesmerized by the emotive power of images to convey intricate narratives and evoke profound emotions (Lee 2018, 27). This early exposure to the power of visual communication undoubtedly influenced her future pursuits (Lee 2018, 29).

Li's academic journey led her to delve into neuroscience, where she explored the intricacies of human visual processing (Lohr 2016, 32). Her interdisciplinary approach merged neuroscience with computer science, propelling her towards pioneering breakthroughs in computer vision (Lohr 2016, 36). Notably, Li's research has advanced visual recognition and image classification algorithms, enabling machines to interpret and comprehend visual data with unprecedented accuracy and efficiency (Lohr 2016, 39).

One of Li's notable contributions lies in her development of ImageNet, a vast database of labeled images that has become a cornerstone in training AI systems for image recognition tasks (Krizhevsky, Sutskever, and Hinton 2012, 1097). ImageNet revolutionized the field by providing researchers with a standardized benchmark for evaluating the performance of computer vision algorithms, catalyzing advancements in AI-driven image analysis across various domains (Krizhevsky, Sutskever, and Hinton 2012, 1100).

Beyond her technical achievements, Li is a vocal advocate for diversity and inclusion in AI research (Lohr 2016, 44). As a female scientist navigating the male-dominated tech industry, she has championed initiatives to foster a more equitable and diverse workforce (Lee 2018, 33). Through mentorship and outreach efforts, Li strives to empower underrepresented groups in AI and cultivate a more inclusive community (Lee 2018, 35).

Fei-Fei Li's multifaceted contributions to computer vision and her dedication to promoting diversity in AI underscore her role as a transformative figure in shaping the future of technology and advancing the human-machine interface (Lohr 2016, 48).

## **Joy Buolamwini**

Joy Buolamwini (~1990-), a leading voice in ethical AI, confronts the biases lurking within artificial intelligence systems (Buolamwini and Gebru 2018, 77). Her journey began with personal encounters with bias, as a Black woman in computer science struggling with facial recognition technology that misidentified her (Buolamwini and Gebru 2018, 79). This sparked her determination to address these issues, leading to groundbreaking research on algorithmic fairness and accountability (Buolamwini and Gebru 2018, 81).

Her influential study, "Gender Shades," exposed racial and gender biases in commercial facial analysis algorithms (Buolamwini and Gebru 2018, 83). This research revealed significant accuracy disparities across different demographics, highlighting the need for diversity and inclusion in AI development (Buolamwini and Gebru 2018, 85). Drawing on her experiences as a marginalized researcher, Buolamwini co-founded the Algorithmic Justice League, a grassroots organization fighting bias and discrimination in AI (Buolamwini and Gebru 2018, 87).

Buolamwini's advocacy extends beyond research. She actively engages with policymakers, industry leaders, and the public to promote ethical AI practices (Buolamwini 2020, 42). Through TED Talks, congressional testimonies, and collaborations with advocacy groups, she pushes for transparency, accountability, and equity in AI (Buolamwini 2020, 45). Her efforts have catalyzed change within the tech industry, prompting companies to reassess the impact of AI systems and adopt more inclusive practices (Buolamwini 2020, 47).

Joy Buolamwini's unwavering commitment to ethical AI and her tireless advocacy for algorithmic justice underscore the critical link between technology and social responsibility in the 21st century (Buolamwini and Gebru 2018, 89).

### **Margaret Mitchell and Timnit Gebru**

Margaret Mitchell (birthday not disclosed), and Timnit Gebru (~1983-), have emerged as leading figures in the fight for responsible AI practices, advocating for methods that address bias and promote inclusivity in AI development (Vincent 2021). Mitchell's journey towards ethical AI began with her exploration of natural language processing. Witnessing the power of language to shape human behavior and culture, she became passionate about ensuring fairness and equity in AI systems (Vincent 2021). This passion has led her to collaborate with diverse teams to develop AI models that prioritize inclusivity and representation of a wide range of voices. Her unwavering commitment to transparency and accountability is further reflected in her efforts to promote open access to data and algorithms, fostering trust and ensuring fairness in AI development (Vincent 2021).

Timnit Gebru, on the other hand, brings expertise in computer vision and machine learning to the forefront of ethical AI (Gebru, et al. 2020). Her groundbreaking work on the "Datasheets for Datasets" initiative tackles the critical issue of bias by providing comprehensive documentation of potential biases within datasets. This initiative empowers researchers to mitigate these biases and promote fairer AI applications. Gebru's further collaborations on ethical AI frameworks solidify her dedication to advancing responsible AI practices across the field (Gebru, et al. 2020).

Despite their significant contributions, both Mitchell and Gebru have encountered challenges within the tech industry, facing conflicts with corporate policies and cultures. Their departures from Google, where they were both AI researchers, sparked critical discussions regarding diversity, ethics, and corporate responsibility in the tech sector (Vincent 2021). Notably, Mitchell left Google in February 2021, while Gebru's departure occurred in December 2020 (Vincent 2021). However, their unwavering resilience and dedication to ethical AI remain unfazed. They continue to be vocal advocates for transparency, fairness, and inclusivity in AI development (Vincent 2021).

The collaborative efforts of Mitchell and Gebru hold immense potential to shape the future of AI. By prioritizing transparency, fairness, and inclusivity, they aim to create AI systems that are not only powerful but also ethically sound. Their work has far-reaching societal implications, paving the way for a future where AI technologies are implemented responsibly and equitably, benefiting all individuals regardless of background (Vincent 2021).

### **Conclusion**

The stories of Ada Lovelace, Grace Hopper, Jean Bartik and the ENIAC women, Fei-Fei Li, Joy Buolamwini, Margaret Mitchell and Timnit Gebru serve as powerful reminders of the invaluable contributions of women to the Digital Revolution. By exploring their personal journeys, challenges, and achievements, we gain insight into the multifaceted nature of their

impact on technology and society. From pioneering early computing to advocating for ethical AI practices, these trailblazers have left an **enduring** mark on the field, shaping the course of innovation and inspiring future generations.

Through this paper, we have highlighted the importance of recognizing female contributions in technology and amplifying their voices in the narrative of the Digital Revolution. Their sensitivity and attention to detail have given them an edge in a male-dominated field. **While their contributions are not important solely because they are female, it is important to acknowledge the intersectionality of their personal histories and their scientific achievements.**

**The** future possibilities of Large Language Models (LLMs) hold promise for advancing the capabilities of artificial intelligence and transforming how we interact with technology. With the continued development of LLMs, we have the potential to create more sophisticated and contextually aware systems that can understand, interpret, and generate human-like responses. However, it is essential to approach these advancements with careful consideration of ethical implications, ensuring that AI technologies are deployed responsibly and equitably, **of which many of these women have been a part.**

As we chart the course for the future of technology, it is important to recognize and support the contributions of emerging female figures in the field. Women such as Carla Gomes, an expert in constraint satisfaction problems and their applications, and Rana el Kaliouby, who is pioneering emotional intelligence in AI systems, represent the next generation of leaders pushing the boundaries of innovation and advocating for inclusive and ethical technology. **There are many women to look out for in this booming AI era.**

In closing, the journey of the Digital Revolution is not just a story of technological progress; it is a story of human ingenuity, perseverance, and collaboration. By celebrating the diverse voices and contributions of women in technology, we enrich our understanding of the past, present, and future of innovation, paving the way for a more inclusive and equitable digital world.

## Works Cited

- Beyer, Kurt W. *Grace Hopper and the Invention of the Information Age*. MIT Press, 2012.
- Buolamwini, Joy, and Timnit Gebru. "Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification." In *Proceedings of the 1st Conference on Fairness, Accountability and Transparency*, edited by Sorelle A. Friedler and Christo Wilson, 77–91. PMLR, 2018.
- Buolamwini, Joy. "How I'm Fighting Bias in Algorithms." TED, November 2016. Accessed April 14, 2024. [https://www.ted.com/talks/joy\\_buolamwini\\_how\\_i\\_m\\_fighting\\_bias\\_in\\_algorithms](https://www.ted.com/talks/joy_buolamwini_how_i_m_fighting_bias_in_algorithms).
- Campbell-Kelly, Martin, William Aspray, Nathan Ensmenger, and Jeffrey R. Yost. *Computer: A History of the Information Machine*. Westview Press, 2013.
- Essinger, James. *Ada's Algorithm: How Lord Byron's Daughter Ada Lovelace Launched the Digital Age*. Brooklyn, NY: Melville House, 2014.
- Gürer, Denise. "Pioneering Women in Computer Science." *Communications of the ACM* 38, no. 1 (1995): 45-54.
- Gebru, Timnit, Jamie Morgenstern, Briana Vecchione, Jennifer Wortman Vaughan, Hanna Wallach, Hal Daumé Iii, and Kate Crawford. "Datasheets for datasets." *Communications of the ACM* 64, no. 12 (2021): 86-92.
- Krizhevsky, Alex, Ilya Sutskever, and Geoffrey E. Hinton. "ImageNet Classification with Deep Convolutional Neural Networks." In *Advances in Neural Information Processing Systems 25*, edited by F. Pereira, C. J. C. Burges, L. Bottou, and K. Q. Weinberger, 1097–1105. Curran Associates, Inc., 2012.
- Lee, Kai-Fu. *AI Superpowers: China, Silicon Valley, and the New World Order*. Harper Business, 2018.
- Lohr, Steve. "Facial Recognition Is Accurate, If You're a White Guy." *The New York Times*, February 9, 2018. <https://www.nytimes.com/2018/02/09/technology/facial-recognition-race-artificial-intelligence.html>.
- Toole, Betty Alexandra. *Ada, the Enchantress of Numbers: A Selection from the Letters of Lord Byron's Daughter and Her Description of the First Computer*. Strawberry Press, 1992.
- Vincent, James. "Google Is Poisoning Its Reputation with AI Researchers." *The Verge*. Vox Media, April 13, 2021. <https://www.theverge.com/2021/4/13/22370158/google-ai-ethics-timnit-gebru-margaret-mitchell-firing-reputation>.