Artificial Intelligence:

Limitations in Advancing Modern Technology and Job Automation

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Abstract

This study explores the social effects of job automation in the past and future, as well as examines the limitations of digital computing in the modern world and compares the differences between analog and digital computers. People from all ages in the Ash Grove area were surveyed on their opinion of automation in their daily life and in the workplace. The results of this survey showed that over 50 percent of people have a negative opinion towards automation in the workplace. Through my research, I found data that suggests that analog computers use methods that are more efficient that traditional digital methods. However, rather than completely replacing one with the other, it would be most effective to implement both analog and digital into the same system.

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Introduction

Artificial Intelligence is getting more and more advanced and is requiring more and more computing power, but digital computers are reaching their theoretical limit. Soon, chips will not be able to get any more powerful because of the physical limits of the parts. Transistors, which make up the chips in computers, are approaching the size of an atom and will be impossible to make them any smaller. One possible solution is analog computers, but what is an analog computer and when it comes to neural networks and AI, could they replace digital computers? If so, what effects would an advanced artificial intelligence have on society and our future? The goal of this study is to find the differences between digital and analog computers, understand how AI works using neural networks and determine if analog computing is a better option, then finally determine the effects a supremely powerful AI would have on society. In the case of this research, some terms need to be specifically defined in order to understand its contents. Digital computers refers to traditional computers that use ones and zeros to compute their data. An analog computer is a computer that does not use ones and zeros to compute their data. Artificial Intelligence is defined as a program within a computer that conducts human tasks using reasoning based on an algorithm that often uses neural networks. Moore's Law says that the computing power of chips should double every one to two years.

Literature Review

Hardesty's (2017) research identifies what neural networks are and how they can be used for deep machine learning. Neural networks are modeled loosely similar to the human brain, a neural network has thousands or millions of processing nodes that are all densely connected. Neural nets are organized into layers of nodes that are fed by the nodes before it, and that feed into the nodes below it. The information so far has given us knowledge about how deep machine learning uses neural networks. But has anybody

tried to make an analog chip? Are there any real world examples? Zewe (2022), in his article, explains what analog deep learning is and why it is faster and more energy efficient than its digital counterpart. He says that the first reason is that the computing in analog deep learning is done in the memory, so data does not need to be transferred back and forth between processor and memory, like a digital computer does. The other reason is: “analog processors also conduct operations in parallel. If the matrix size expands, an analog processor doesn’t need more time to complete new operations because all computation occurs simultaneously.” This means that no matter how big the matrix in a neural network gets, the analog processor doesn’t need more time because it does it all at the same time. The new analog processor technology is called a protonic programmable resistor. These resistors are approximately 1 nanometer in length and are arranged in an array, like a checker pattern. Zewe’s research gave a more specific look into how analogous computing works together with neural networking and why it is more efficient than digital computing.

An article from Washington University (2021) described a new type of hardware called processing-in-memory. This hardware combines the memory and processing units into 1 unit and uses properties of the machine to compute, instead of using 1s and 0s. This process, however, hits a bottleneck when it is forced to translate from analog data to digital data. A large scale computer that utilizes PIM technology has the potential to be 10 or even 100 times more powerful than our current computers. The previous articles and research has given us everything we need to know about analog computers and how they can be used for artificial intelligence. So assuming a new supremely powerful artificial intelligence could be created from analog methods of computing, what effects would it have on society?

Research by Kevin Smith (2022) explains the importance of artificial intelligence in our modern world, as well as some history behind it. AI has the ability to automate and take over monotonous tasks and do it reliably, without the downtime that a human would have in the same position. Most Artificial

intelligence programs learn as you use them. Things like Alexa or Siri are constantly using you and your interactions as data to improve their algorithm to make their AI more realistic.

The research already done by these computer scientists has told us how analog computation works and how it might be better for creating artificial intelligence. But we still do not know if analog computing is the solution to the downfall of Moore's law and the physical limitations on the size of transistors.

Methods

In order to gather more research and determine how people feel about advanced artificial intelligence, I conducted a survey that asked people about their opinions on various situations involving artificial intelligence. My survey was sent out to Ash Grove High School students, teachers, and other adults of all genders in the surrounding area. They all had a one week time frame to complete my survey. I started with a few basic demographic questions, asking people their age, gender, and current employment status. I then asked the question, “How do you feel about workers' positions in jobs being replaced by robots or other automated processes?” with answer choices of strongly disagree, disagree, agree, and strongly agree. Following that I asked if they favored a highly advanced and autonomous world, if they would trust a robot in a high government position, and “Would you trust a robot to do certain daily tasks, such as babysit your kids or drive your family to and from places.” I gave the options of either yes or no as answers to the previous three questions. My final question was a paragraph response that asked participants to explain their answers to the previous three questions. These questions and their responses will give me the average person’s opinion on artificial intelligence and the automation of the modern world and why they think that way.

Results

From my survey, I received 31 responses in total. Of those 31 responses, 55% of them were 35 years or older, 2 said they were 25 to 35 years old, 1 respondent was 12 years or younger, and the

remaining 11 said that they were 13 to 18 years old. When asked about employment status, 77% of people were employed in some way, and 23% were unemployed. The information about the recipient's age and employment status is important when considering some of the questions in the survey. For example, every respondent that said they were 35 or older said that they would not trust a robot to babysit their family, it was only 13 - 18 year olds that said they would. This makes sense, since the older respondents probably have kids, and can better understand the risks of a robot around their children. For the question about how the recipients felt about workers' jobs being replaced by robots, 84% said they disliked the idea, and 16% said they liked it. Surprisingly, 4 of the 5 people that said they liked the idea also answered that they are employed full time. One hundred percent of the responses to the question, “Would you trust a robot in a high government position, such as President, Senator, or Governor?” was answered with no. When asked if recipients favored a highly advanced and autonomous world, I was surprised that only 19% answered yes. When making the survey, I thought this question would be split more evenly. For my final question, a paragraph response, there were a decent amount of responses that used fictional movies about robot uprisings as a reason for not trusting advanced AI. A few of the responses say that they don’t like the idea of robots taking over jobs because they like the “human” aspect of the job. One respondent said: “I think that there is great value in face to face interaction and when you replace a person with a robot, you get rid of the human nature of emotion.” The majority of the responses also mentioned that they do not think robots are capable of logical or moral reasoning; that they have no sense of human emotion, so they could not possibly make important decisions for humans that would require those emotions.

Discussion

This survey has given me the opportunity to get first hand responses and hear the opinions on job automation from people who are actively working in those jobs. From the results of my survey I have learned that people, especially ones who work full time jobs, do not like the idea of machine automation. I was surprised about how much influence movies about robots going rogue have on people’s opinions of

automation. I didn't think people would take the fictional movies seriously and actually believe that they could happen. It seems that the younger generations don't mind automation as much as the older ones. This makes sense because they are young and don't have as much at risk as the older generations. A survey conducted by Chelsea Gohd from Futurism in 2017 found that 61% of people do not trust robots to replace childcare jobs. The results from their survey match relatively closely to mine. We both found that the majority of people don't trust robots enough to watch over their children. The results from my survey do not tell me if people think their job will be replaced in the future, which could have been useful information to know. Regardless, the information from the results of my survey has given me some very useful insight into the average person's opinion on robots and their place in the workforce, as well as why they don't trust robots to do certain tasks.

Limitations of Modern Technology and Automation's Effect on Society

Analog computers have existed for nearly 100 years, and were thought to be the pinnacle of technology, until the digital revolution came along and the world switched over to digital technology almost entirely. As artificial intelligence gets more powerful, it requires equally as powerful computers to sustain it. But unfortunately, these digital computers that society has become so reliant on, are reaching the limit on their computing power, in terms of AI and neural networking. As AI develops further and further, and we begin to solve this limitation problem, what would happen if these advancements were to create a supremely powerful artificial intelligence. What would society look like in the future, where a powerful robot could think similar to a person? A brand new artificial intelligence that generates text responses based on user input, called ChatGPT and made by OpenAI, uses an extremely expansive neural network to "think" about how it should respond to the user. According to TechMonitor (Morrison, 2022) "A large language model such as GPT-3 requires a significant amount of energy and computing power for its initial training." ChatGPT is one example of the upcoming limitations on AI computing. It already takes so much power just to train these neural networks, and it will take even more to run and utilize

them. It is important that we find a solution to this problem because, as amazing and innovative as it is, ChatGPT isn't all knowing and still has so much room for improvement. In order to access that locked potential, computers need to advance in some way before we hit the limit. It is also important to see what kind of effect a powerful AI would have on society because eventually it will, in some way, be implemented into the public's everyday life.

Computers and Automation Until Now

Before the 1960's analog computers were the most popular and used computer. Despite their size and the amount of power they consumed, they were thought to be the height of technology. But a few years later, a different type of computer that had existed in the background for some time came into the spotlight as its advancements grew exponentially. These computers were called digital computers; they were much smaller and, at the time, much faster than any analog computer. Over time computer scientists and engineers realized that they are extremely powerful and have a far greater potential than analog computers. As these kinds of computers progressed, they started to become so advanced that they could replace some jobs. Given the time frame, the jobs they took over were very monotonous and not too complicated, but it made people realize what these computers were capable of. Some of the first jobs to be replaced by robots were assembly line tasks such as spray painting or welding. As time went on more and more jobs were replaced by robots, AI, and other automated processes. According to research conducted by Jack Flynn at Zippia (2022) there have been at least 260,000 jobs lost since the year 2000 and automation is predicted to displace 20 million manufacturing jobs by 2030.

Analog Computers and Public Opinions

Given the problem of digital computers not being able to keep up with artificial intelligence technology, we need a new breakthrough in technology. When it comes to it, analogous methods of computing are the only currently reasonable solutions that can help advance AI even further. Any

powerful AI resulting from this advance in technology would not be taken well by the public, as they do not want their jobs taken. This would have an overall negative impact on society in the future.

Evidence for Analog Computers and Public Disapproval

Analog computers have come a long way since they were forgotten in the 1970's. The few companies that have been innovating analog technology have made huge advancements in the capabilities of the old technology. The new chips that one company in particular, Mythic, has made could be the next big step for analog technology. Mythic (2022) explains that "Mythic Analog Matrix Processors (Mythic AMP™) offer huge advantages in power, performance, and cost. They lower the barriers to innovation, bringing powerful AI solutions to the edge." Today's processors for digital computers are extremely expensive and reliant on the traditional computer architecture, limiting their innovation to the large technology companies that have the money. Mythic offers an inexpensive and innovative solution to this with their new chip. Besides Mythic's new technology, there is lots of evidence that says analog computers in general are just as, or even more efficient than digital. Zewe (2022) from MIT News explains that one advantage of analog processors is the fact that they "conduct operations in parallel." If the matrix size of a neural network expands, an analog processor wouldn't need more time to do the computations because it does all calculations at the same time. These kinds of technology could be what revolutionizes AI even further.

It is undeniable that robots have worked their way into our everyday lives, one way or another. These robots are things like Amazon Alexa or Siri that use neural networks for speech recognition. These types of robots are, for the most part, harmless and most people don't mind having them in their home. But as for futuristic and advanced robots, people tend to dislike them much more. Research conducted by A.W. Geiger (2019) from the Pew Research Center found that 48 percent of adults say that automation in the workplace will mostly hurt American workers. The same survey also found that nearly 60 percent of Americans think that corporations and businesses should have a limit on the amount of jobs they can

replace with robots or machines. This suggests that people fear that their job might be threatened by automation in the future so much that businesses shouldn't be allowed to automate some positions. This negative public opinion on automation is what makes job replacement a potentially bad thing for society in the future.

Analog Isn't Needed for Everything

Some people may argue that it would be impractical for us to switch to an all analog technology, especially since our modern world has become so reliant on digital technology. If analog computers are so good, why did we make the switch to digital 50 years ago? These are very reasonable concerns to have, but there is a logical explanation for why. Firstly, we made the switch because, at the time, digital was the better option and had much more room to grow. It was a good solution for the time being, but that time has passed and now we need to find another alternative. As for the world switching to analog technology, the world does not need to completely switch from digital to analog computing. For the most part, the processing power of digital computers is plenty for tasks like gaming, server hosting, and other processes that do not include computations as large as neural networks involved in AI. According to Techspot (Walton, 2022) NVIDIA's new graphics card, the GeForce RTX 4090, runs even the newest games while only under low to moderate load. This means that modern computers are plenty powerful enough, and most of the world is able to stay digital and be completely fine. Additionally, an all analog computer would definitely help, but would not be the best fit for solving neural network matrices; analog and digital are efficient at certain things, and inefficient at others. So the best method would be to integrate them both so they can work together to make AI more powerful than ever.

For the social side, some people argue that a powerful AI and job automation could be a good thing for society; just because workers don't like AI doesn't mean it's a bad thing for society as a whole. There would definitely be benefits from such an AI being created and implemented into our world. Corporations would make more money, as they do not have to pay the replaced employees, and certain

factories would become more efficient since communications between the robotic workers would be perfect and instantaneous. But when it comes to determining if it's an overall good or bad thing for society, public opinion is one of the largest things to consider. In the event that the public does not respond well, there could potentially be civil unrest. This unrest would almost certainly begin to have a negative impact on society as a whole.

Analog and Digital Implementation

The preceding articles, examples, and proof show that analog computers, despite being known for inefficiency, are a very real solution to solving the digital computational problems. However, analog is not the final solution; in order to fully utilize the technology and innovate AI as much as possible, analog computing should be coupled with digital. They should be implemented into the same system and work together to make as powerful a computer as possible. As for the social part, the evidence has suggested that the people do not approve of job automation. They dislike and reject the idea of robots impeding on their daily and personal lives. A powerful AI would certainly have a negative impact on society, considering all preceding research and proof.

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