Comparison of Multiple Neural Network Architectures on Historical Landmark Recognition Tasks

(Technical Paper)

The Detrimental Impact of Artificial Intelligence on The Workers in The American Job Market in The Next 40 Years and How They Can Be Protected
(STS Paper)

A Thesis Prospectus Submitted to the

Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements of the Degree
Bachelor of Science, School of Engineering

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Fall, 2019

On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Introduction

The fear of artificial intelligence killing humans has been replaced by the fear of artificial intelligence displacing humans from the job market. The modern society is centered around the economy, and while more money does not directly relate to happiness, the lack thereof can have a major impact on psychological and physical well-being, as shown by Berger, Collins, and Cuesta (2013). Beyond the financial effects, the western world is known to relate job satisfaction with life satisfaction, and people tend to find it hard to believe that a life without work can be fulfilling. Work not only keeps people occupied, but also gives them a feeling of ownership of their work (Judge, Bono, Erez, and Locke, 2005).

Breakthroughs in machine learning since the start of the 2010s have caused a shift in research to focus on artificial intelligence (Statt, 2018). The continuous development has led to a rise in the realistic expectations of what artificial intelligence will be capable of doing on its own, sufficient to make most human jobs replaceable in a much shorter time frame than one previously expected. The rise of artificial intelligence will impact the job market in the United States (Amicangioli, 2016), and the proposed STS research will explore what that effect might be in the next 40 years, and how the society can brace itself for a potential paradigm shift. The technical research portion of this thesis attempts to exemplify artificial intelligence's abilities, with a software that aims to replace tour guides by using machine learning, as well the wide range of information available online, to allow users to take photos of historical artifacts at the University of Virginia and instantly get detailed information and interesting facts about them.

Technical Topic

Humans have an innate desire to learn more about historical artifacts that they come across, but, due to a lack of resources, often fail to find the information that they seek. Technologies like Google Lens allow users to detect what a user camera is focusing on to a high level, without detecting the specific artifact in focus. However, when it comes to exploring a new area and its history, those details are essential to getting an understanding of what see. The aim of the technical project is to enable such technologies to go one step further into detecting historical artifacts, such as buildings, artwork and statues, on the grounds of University of Virginia, by simply taking photos of them. This enables users to freely learn more about the rich history spread across the University of Virginia.

Working with professor N. Rich Nguyen, I will create machine learning model to detect images. Machine learning, in simple terms, involves a system that can perform tasks, such as image detection, without explicitly being programmed to do so (Chui, Kamalnath, and McCarthy, 2019). This problem is labeled as a classification problem, and in order to achieve an accurate predictive model, transfer learning on well trained Neural Networks such as Google Inception V3 will be used ("Advanced Guide to Inception v3 on Cloud TPU | Cloud TPU"). According to Pan and Yang (2004), transfer learning refers to the machine learning concept of changing the final layer in a Neural Network of several layers, in order to use the finely tuned model to solve different problems.

The first step to achieving this goal involves data collection, which will be done by the researchers and the general public, in order to obtain as large a dataset as possible. In order to collect data, a web tool has been created that allows users to click photos on their phones, tag them as the object that is in the focus of the image, and upload the images to a firebase database.

Lastly, I will manually verify the collected data, by correcting any mislabeled data and deleting unusable images.

Once the data collection and curation process is completed, I will create a machine learning model using transfer learning on Inception V3 in order to detect the correct classes of the images. Then, the model will be fine-tuned to improve the accuracy of the classifier. An application will be made that uses the image classifier to allow users to take photos and classify them as they walk around grounds. The technical research will serve as a proof of concept implementation of an image classifier using transfer learning on Inception V3 for a wide variety of artifacts, as well as a useful tool for visitors of the grounds at the University of Virginia. I will then write a report of the findings from the experiment, as well as detail the methods and technologies used.

STS Topic

Although technological displacement is not a novel concept, displacement of labor caused by the rise of artificial intelligence has the potential to unprecedentedly rattle the American workplace. Previous forms of technological displacement replaced those jobs with alternative occupations, as the systems required creators, maintainers and operators (Autor, 2015). The primary reason that led to transfers in the past was that the displacing technologies were primarily hardware, such as factory machinery. Hardware and software differ greatly in that hardware has a high cost of reproduction, distribution, and can be replicated by opponents in unprotected markets. Software, on the other hand, has negligible costs of reproduction and distribution, and protection laws are in place that allow monopolization (Korinek, 2018). When new technologies displaced the workforce, the tasks of reproducing and distributing technology created new jobs, and these occupational changes occurred over generations because of the high

cost of adopting technology. Companies can implement artificial intelligence at negligible costs universally, maintain it locally, and deploy it rapidly (Brynjolfsson and McAfee, 2014). The ease of implementation is what makes the artificial intelligence revolution concerning to the American workforce.

Over the course of the next 40 years, more jobs will be easily replaced by artificial intelligence, to the point that the workplace might become human-independent. Whether that future is utopic or dystopic is up for debate and hard to predict, however, the future that lies between the present and the distant future is cause for concern. Self-driving technology is on the horizon, with Waymo close to offering self-driving vehicles without backup drivers (Moon, 2019), and professional drivers might be the first to lose careers to the artificial intelligence revolution. An estimate from Business Insider in 2018 showed that self-driving technology could displace as many as 4,000,000 jobs in the United States within the next two decades (Rapier, 2018). American Political blogger, Kevin Drum, who rose to popularity with his independent blog Calpundit*,* wrote in an article for the blog Mother Jones that "until we figure out how to fairly distribute the fruits of robot labor, it will be an era of mass joblessness and mass poverty." (Drum, "You Will Lose Your Job to a Robot—and Sooner than You Think.") The introduction of artificial intelligence can be so dramatic as to change the way the American economy functions. Policies to prevent, prohibit or even slow down such drastic changes to the labor sector are not present, leading to an increase in wealth distribution policies to prevent mass poverty, starvation and lack of healthcare (Korinek and Stiglitz, 2017).

The STS research paper will first analyze the rise of artificial intelligence (AI) and the current position of AI in the workplace. Then, I will read predictive articles and present a timeline of expected change in the workforce, along with the reasons behind the change. In order

to prepare the reader for the future, the research will finally analyze suggested preventive policies, such as Universal Basic Income (Kignma, 2019).

I will use the theory paradigm shift, as described by Thomas Kuhn in the book *The Structure of Scientific Revolution,* to address this topic. Paradigm shift in a non-scientific perspective is simply defined as a fundamental change in a system. The theory fits the research topic as the workplace will be fundamentally changed upon the introduction of artificial intelligence. Popular criticism of paradigm shift by Martin Cohen (2015) focuses on the natural science perspectives of paradigm shift, and the opinion that Kuhn alludes to scientific facts being mere opinions. However, a social science perspective of Kuhn's theory alludes to the real world and does not restrict itself to natural sciences, and society and its constructs are perspectives of humanity as a whole, and thus are fallible and can be changed upon profound changes.

Research Question and Methods

Research Question: How will the rise of artificial intelligence effect the American Job Market in the next 40 years?

I intend on using discourse analysis and documentary research methods. I will read scholarly articles by Economists such as David Autor, Kevin Drum, and Erik Brynjolfsson. Artifacts from Twitter and company statements will also help explain why artificial intelligence will impact the job market, and how these changes will come about. The two methods listed above will be used together as this gives me freedom to explore both scholarly work as well as non-traditional forms of expressing opinions, which are important for such a topic. I also plan to conduct an interview of Anton Korinek, an expert on artificial intelligence in Economy. Dr. Korinek is an Associate Professor and Researcher in the Economics department at the University of Virginia. I hope to get a better insight into the precise reasons why economic experts are

worried about the rise of artificial intelligence, as well as seek suggestions for some of the better preventive measures. With a combination of the three research methods listed above, I hope to answer my research question to the best of my ability.

Conclusion

Artificial intelligence will affect the careers of most people within the next few decades. The STS thesis aims to predict the impact of artificial intelligence on the job market, and prepare the readers such that they can properly prepare themselves for the expected future. Readers can expect to learn how their jobs might change over time and some of the methods to prevent and manage the potential societal dangers. The deliverable for the STS thesis will be a report that analyses the effect of artificial intelligence in the job market, and suggests mitigative techniques.

Visitors of historical areas and heritage sites should be able to learn about the history freely and at their own paces. The technical project will create a tool to classify images of historical artifacts on grounds correctly. The project will lead to a proof of concept application that shows transfer learning on pre-trained models such as Inception V3 can be successfully applied such that it can detect a large range of artifacts. The deliverable for the technical topic is a machine learning model that can successfully classify the historical artifacts on grounds with a high accuracy.

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