Thesis Project Portfolio

Efficiency and Transparency: How a Small Intern Project Can Save Days of Compute Time

(Technical Report)

Analyzing the Effects of COVID-era World Events on the GPU Market

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Contents of Portfolio

Executive Summary

Cloud computing is a model of IT infrastructure allocation that has rapidly developed in the past decade in the tech sphere and is lauded for its flexibility of use, scalability in processing and storage capability, and durability in the face of high internet traffic and hardware failures. All of these qualities are what makes cloud computing an infrastructural model with many advantages over traditional IT infrastructure, as businesses can outsource their IT resources to a cloud provider, who charges them on a pay-as-you-go basis, minimizing overhead costs relating to slowdowns in traffic, or underutilized resources. This is especially enticing to companies that experience variable demand for their web services such as Airbnb, which experiences more web traffic in the spring and summer when people travel in greater numbers, as they can easily expand the capacity of their cloud resources in times of high demand, and then contract after peak usage, without needing to pay for the upkeep of an underutilized server for the rest of the year. My technical thesis discusses my internship experience for Fannie Mae, where I worked on a software application that had just been migrated to cloud infrastructure, but lacked certain UI features that would result in users misusing the application and creating slowdowns that would increase processing time and generate unnecessary costs to the company. I detail my implementation of UI features using a combination of Python, SQL, HTML, and Javascript to create a feedback system for users that would report the status of their requests. These implementations provided a much-needed window of transparency to the user experience that cuts down on erroneous or duplicate requests.

The graphics processing unit, or GPU is a component in a computing system that is responsible for rendering computer graphics. Thanks to the popularization of mobile devices and video gaming, GPUs have become ubiquitous. During the COVID-19 pandemic, lockdowns and border closures resulted in supply shocks that created shortages in many goods, including the GPU, leading to exorbitantly high prices, as well as erratic behaviors such as scamming and price gouging. The GPU market during the pandemic was shaped by various forces, including increased demand for entertainment due to quarantine, as well as developments in the cryptocurrency market in a period of economic turmoil. My STS thesis draws upon various news sources and econometric data to tell the story of the GPU shortage and employs

economic and STS theory to guide my analysis of the state of the market and its network of participants, and what we can learn about how resources and technology are allocated.

While these two papers appear to be unrelated on the surface, they are connected in the sense that cloud computing is a computing application that depends on the GPU due to the large datasets commonly found in cloud solutions. The market conditions shaped by the supply and demand for the GPU are dictated by the prevalence of technologies like cloud computing that rely on the processing power and parallelism that GPUs provide and reflect certain societal values and desires related to computing systems and portability. In the year I spent writing each part of this portfolio, I believe I have achieved all that I have set out to do, and have created a work that I am proud to have published in the University library. I am incredibly grateful to have this opportunity, and I am impressed with myself that I was able to juggle this thesis with my other thesis in the Department of Astronomy. Future works for my technical project may consider backend implementations that might detect erroneous or duplicate requests, as my implemented feature was limited to the front end of the application, and simply provided status information without having any safety nets or input checks that would stop a user from submitting bogus requests. Future works for my STS topic might take a more holistic approach in terms of economic analysis, such as inflationary effects, as well as changes in consumption preferences for US consumers that might have affected consumer behavior in the GPU market, as my paper considers the GPU market in isolation. Additionally, my STS paper did not employ as many quantitative and econometric methods as I had hoped.

I thank my parents for the love and support they have given me all my life leading up to my writing my thesis portfolio. This feels like a keystone moment that all of their efforts have been building up to, but this is by no means the last fruit of their labor. I thank the friends I have met during my time at UVA, as they have defined my college experience, which has been unforgettable, to say the least. I thank my cat, Segmentation Fault, who spent countless nights sleeping on my desk next to my laptop accompanying me as I wrote these papers. I thank my high school teachers, namely Anthony Petras and Steven Barber, who helped me discover and cherish the process of learning at a young age, who I already

included in my acknowledgments section in my technical thesis, but definitely deserve to be included in this one too. I thank my astronomy professors Matthew Pryal, Ed Murphy, Mark Whittle, and Steve Majewski for the academic, professional, and personal support they have provided me in the times I felt quite lost. Finally, I thank my STS professors Travis Elliot and Kent Wayland for the advice and support they have provided me, without which I would not have been able to produce a paper I’m proud of.