Thesis Project Portfolio

Designing and Implementing a Scalable Data Loss Prevention System: A Full-Stack Approach

(Technical Report)

The Ethics of AI: Addressing Bias in Machine Learning Systems

(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

Natalie Yee

Spring, 2025

Department of Computer Science

Table of Contents

Executive Summary

In both my technical work and STS research paper, I examine how technological systems handle sensitive data, whether to protect it or to process it for decision-making. In my technical work, I focused on how to protect sensitive data at Capital One. While interning there, I contributed to the development of a secure, serverless platform, designed to protect sensitive information across a company of over 50,000 employees. In contrast, my STS research explores how Artificial Intelligence (AI) technologies used in hiring can lead to bias and reinforce social inequalities. While my technical project addressed security and access in data-driven environments, my STS research investigates how the design and deployment of data-intensive systems, such as AI hiring tools, can result in unintended consequences.

Capital One needed to address the challenge of safeguarding sensitive data across a large enterprise, specifically focusing on Data Loss Prevention (DLP). To protect sensitive company data, my team and I developed a scalable, serverless frontend and backend using Amazon Web Services (AWS) Lambda, S3, and DynamoDB. The solution involved the design and implementation of RESTful APIs for violation management, improving data retrieval and security through backend integration with DynamoDB and Single Sign-On (SSO) for secure access. The deployed system successfully improved user access and security for over 50,000 employees. Future work includes expanding the platform's capabilities to allow users to remediate violations and submit suppressions for sensitive data.

Artificial Intelligence (AI) is reshaping how companies hire, yet its impact is not always positive. This STS research paper examines the increasing use of AI in hiring processes and the biases that can result from these technologies. AI hiring tools are promoted by companies as objective and efficient solutions, but they can instead reinforce existing social inequalities when

trained on biased historical data. Amazon's hiring algorithm is an example of this issue because it was found to favor male candidates due to being trained on biased datasets. The research question that this paper is focused on is: What contributes to bias in AI-driven hiring? The framework that is used to explore this question is Actor-Network Theory (ANT). ANT is used to analyze the relationships between non-human and human actors in the hiring network, including AI developers, hiring managers, job applicants, and algorithms. The expected results of this research include understanding how interactions within the hiring network contribute to algorithmic bias and where intervention can lead to more equitable AI models and systems. This research is significant because of its potential to inform the design of more equitable AI-driven hiring systems. Additionally, these research findings can contribute to engineering practices by demonstrating the importance of designing more inclusive AI technologies.

Working on both my technical project and STS research allowed me to approach an engineering challenge with broader societal considerations in mind. While the technical work challenged me to design and implement a secure, scalable system, my STS research pushed me to consider the social implications of technological systems, particularly how these systems can unintentionally reinforce bias or inequality. I've learned from working on these projects that technical solutions must also consider ethical and social impacts. Engineers have a responsibility not to just build systems that work, but to build systems that work equitably.