Thesis Portfolio

Analyzing 2D Material Synthesis Parameters from Scientific Literature with Natural Language Processing

(Technical Report)

How Responsiveness and Anticipation can Guide the Ethical Design of Location-based Services

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Sciences
University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree
Bachelor of Science in Engineering

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May 11, 2021

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SocioTechnical Synthesis

Material monolayers are ultrathin, 2D films of molecular compounds that can be artificially fabricated for applications in nanotechnology and microelectronic devices. Our abilities to characterize, identify, and synthesize these unique microstructures rely heavily on observed material behaviors from past experiments. As part of an ongoing project in the Materials Informatics department, my research project will focus on utilizing machine learning methods such as natural language processing (NLP) to extract and codify synthesis parameters from scientific literature. By providing an automated method for aggregating monolayer synthesis parameters, we believe this approach can significantly expedite the time it takes to discover new material properties and understand the unique behavior of material monolayers.

The use of deep learning methods can offer a powerful tool for identifying patterns in large sums of data but is vulnerable to generating biased results through black-box algorithms and can result in serious ethical implications. Understanding how the ethical dimensions of our algorithm can affect our results will be vital to identifying credible scientific literature from disparate sources to feed into our model. The STS framework of responsible innovation can guide our technical work by anticipating how sources of bias may creep into our model and providing transparency in detailing the methods of text-mining and modeling that we performed to achieve our results. For my STS research, I will be using the same framework of responsible innovation to determine how the dimensions of this framework can achieve the responsible design of Location-Based Services (LBS) and avoid user privacy violations. Through case studies of successful and unsuccessful LBS platforms, I hope to gain an understanding of how the design and planning of these products can shape user behavior and affect social outcomes. I will also be conducting interviews of entrepreneurs who developed LBS platforms to learn about

the measures companies are taking to protect user privacy in future LBS technologies. Through this research, I expect to gather insights on how creators of LBS are using anticipation and responsive design to make modern LBS technology more trustworthy and accessible.

The unpredictability of black-box algorithms in machine learning projects as well as the limited agency creators have in controlling how users interact with LBS technologies require engineers to consider the moral dimensions of technology design early on. For my technical project and STS research, I hope to understand how dimensions of responsible innovation, specifically anticipation and responsiveness, can be used early in the design process to mitigate unwitting ethical implications. The results of my STS research will thus help to guide the planning of my technical project by informing how the outcomes of sociotechnical systems can be controlled through transparent design.