Thesis Project Portfolio

Towards Semantic Search in Building Metadata: A System Exploration
(Technical Report)

The Impact of Cognitive Bias and Algorithmic Formalism in Enabling the Creation of Discriminatory AI Technologies
(STS Research Paper)

An Undergraduate Thesis

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Aishwarya Gavili

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Department of Computer Science

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Sociotechnical Synthesis

Data and data-related decisions drive the modern world. Whether it be artificial intelligence, predictive big data analytics, or search engine optimization, data driven technology encapsulates modern technology. However, it is important to recognize the vital role humans play in molding the constraints and implications of such technology. After constant interaction between humans and algorithms, algorithms are molded in a way to best fulfill the needs of a human entity. This thesis portfolio consists of a sociotechnical project that explores how algorithmic formalism and the cyclical injection of cognitive biases in machine learning models result in racial and gender inequity, and a technical project that explores refactoring event handling and enhancing query parsing for a search engine application in relation to semantic search. Through the analyses of both projects, the goal is to better understand the interactions between humans and the data they create, mine, study, and utilize in modern technologies and algorithms.

The sociotechnical project examines how algorithmic formalism or an increased level of objectivity results in racial and gender biases present in algorithmic outcomes. More specifically, it highlights how solely using technical considerations such as data availability and quantifiable performance metrics to evaluate machine learning algorithms masks them from the complexity of the real world. In turn, algorithmic realism is introduced as a solution to combat such biases, which involves a porous and contextual approach to evaluating algorithms. Methods taken through this approach include developing bias impact statements, engaging with stakeholders, and unbiasing biased datasets. By analyzing the abstractions of algorithmic formalism and algorithmic realism through the STS SCOT framework, it becomes evident that human involvement through the engagement of stakeholders is vital to debiasing. More

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specifically, human evaluation and a level of subjectivity is needed in every step of the algorithm development and deployment process to ensure algorithms don't have discriminatory outcomes. Consequently, reform is needed when it comes to increasing diversity within developer teams, engaging with civil society groups, and building solidarity amongst computer scientists to recognize their social responsibility and develop algorithms that are in the best interest of society. Evidently, this will be a collective effort.

The technical project involves working on a search engine API that displays building metadata such as room temperatures of buildings across UVA. Due to the size of the system and its multiple dependencies, most of the work done entailed system exploration with regards to containerization, query optimization, and code clean up to reduce redundancy in system code. After revisiting the code present in the technical project, it became especially evident that the system was built using algorithmic formalism or mere technical considerations, highlighting the relationship between the sociotechnical research and the technical research. For instance, parts of the system such as the schema suggestion, the dtw algorithm, and event vectors were all generated with mathematical considerations in mind. Additionally, a WordNet service was used, which was the widely available biased corpus mentioned in the sociotechnical research. However, this technical project did not have that many societal implications, so a resultant bias in algorithmic outcomes was not really a concern.