

STATEMENT OF PURPOSE

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“How did you become bankrupt?”, Bill asked. *“Two ways,”* Mike said. *“Gradually, then suddenly.”*

(Ernest Hemingway — *The Sun Also Rises*)

Introduction

My primary research interest is the use of machine learning to develop our understanding of natural language, with an emphasis on social discourse. Following my graduate studies, my goal is to remain in academia as a professor or to find employment as a research scientist.

There was no single, grand moment at which this suddenly became clear to me; simply put, my experience was best described by Hemingway’s passage above. My interest steadily increased until, before I knew it, studying natural language became my answer to *“Where do you see yourself in 10 years?”*. I became interested in the field when I first learned about the work done by [1] to correctly forecast the onset of psychosis in adolescents. This motivated me to learn about what enables us to draw such important insights from our language, and it quickly became clear that deeply understanding these mechanisms was something I was truly passionate about. With that in mind, the following statement describes how I’ve pursued these passions, and how completing a thesis-based Master’s in Machine Learning at the Montreal Institute for Learning Algorithms will enable me to continue doing so.

1 Research Experience

I am currently supervised by Professor Majid Komeili, focusing on natural language processing. My experience so far confirms how much I enjoy working on problems in this domain. I am particularly interested by the intersection of natural language and computational social science, examining language dynamics and user safety in online communities. My other areas of focus are machine teaching and interpretability in representation learning.

Malicious Content on Social Media Throughout my undergraduate degree, I have worked with Professor Komeili on understanding disinformation and hate speech in social discourse surrounding major Canadian news events. Our goal is to construct a large-scale dataset characterizing the language use and behavior of malicious users, backed by precise annotations as well as natural language explanations. This involves collecting Twitter data and implementing an annotation platform for Amazon Mechanical Turk. The data annotation process is integral to any machine learning project, so I value the experience I’ve gained in building a stable yet flexible annotation platform, implementing quality control measures, and using the Mechanical Turk service. My senior thesis has taken a similar focus, leveraging natural language instructions from human annotators to develop an interpretable model for identifying hate speech on social media. Allowing the model to identify useful instructions enables a human-in-the-loop process, which could help mitigate bias in hate speech classification [3]. I have enjoyed how this project has tied together so many of my interests, like interpretability, machine teaching, and online safety. This project is supported by the I-CUREUS grant.

Mining Event-Specific Social Commentary Many computational social science projects examine online discourse surrounding a specific event, such as natural disasters, sporting matches, and political events. During our project above, I realized that a costly bottleneck in similar work is identifying relevant social media posts. Normally, an initial corpus would be collected using a high-recall, low-precision keyword search, and filtered manually by human judges. I instead devised a distantly supervised approach by leveraging Reddit comments and tweets associated with news articles as a relevance signal. I used triplet loss to minimize the distance between embeddings of articles and their comments, allowing other researchers to filter corpora by selecting comments most similar to news articles describing the event of interest. The length of the news articles presented many challenges, which I countered with an efficient variant of the Transformer architecture. This saved us thousands of dollars in annotation costs, and I enjoyed working with tens of thousands of documents and learned a lot about representation learning.

Trouble with the Curve In baseball, a scouting report is a written profile about a player describing their characteristics and traits, usually intended for use in player valuation. I constructed and open-sourced a novel dataset of nearly 10,000 scouting reports for amateur baseball players in order to predict whether each player would be successful from just their written profile. I implemented a variety of models such as the Hierarchical Attention Network [4], and countered class imbalance (as most players fail to make the major leagues) using a weighted loss function and data augmentation. This work integrated my research interests with one of my favourite pastimes, and was published after finishing as a finalist in the reproducible research competition at the 2019 Carnegie Mellon Sports Analytics Conference [2].

2 Industry Experience

I am currently a data science intern at Microsoft Search, Assistance, and Intelligence (MSAI). Last summer, I developed a system to detect meeting requests in emails sent with Microsoft Outlook. A substantial challenge was being able to handle incomplete emails for real-time classification. Using both word and character level information with a bi-LSTM improved performance for partial inputs without compromising performance on fully drafted emails. The model was deployed as a service and integrated into a local build of Outlook. The work was part of a broader project, for which a patent application has been filed and is currently pending approval.

3 Coursework

Carleton's accelerated masters program has afforded me the opportunity to experience two graduate courses. It has been invaluable learning the theory behind concepts like the attention mechanism and Siamese networks in COMP5900X (Advanced Machine Learning), and about knowledge representation for both structured and unstructured data in CSI5180 (Topics in Artificial Intelligence). I most enjoyed developing a search engine in CSI4107 (Information Retrieval), with each lecture introducing a new component to the system such as K-Means clustering, Naïve Bayes, or word embeddings.

4 Teaching Experience

When I initially struggled in high school programming, my teacher worked with me every single day during lunch until it finally clicked. This experience tremendously influenced my work as a teaching assistant and interest in becoming a professor. I have previously TA'd courses such as COMP 1005 (Introduction to Computer Science I), COMP1805 (Discrete Structures I), and COMP2406 (Introduction to Web Development), with the goal of introducing students to computing concepts with the same enthusiasm my teacher did for me. This semester, I have had the unique opportunity to TA the graduate course *Storytelling with Data*, which promotes literacy in data science concepts for journalism students. I introduced data collection methods like web scraping and used topic modelling to help the students draw insights from a large dataset of political advertisements on Facebook related to the Canadian federal election.

5 Conclusion

I am very excited to continue my education and research. My experience in research and industry, as well as successfully completing two graduate courses, gives me confidence that I am ready to begin studies at the graduate level. I believe that MILA stands head-and-shoulders above the alternatives as a place to pursue my interests. The wealth of experienced and knowledgeable faculty members gives me confidence that no matter who my supervisor may be, I will have the opportunity to conduct meaningful research and experience a high-quality education.

That said, when considering potential advisors, there are a few whose work and interests particularly stand out to me. I have previously spoken to Siva Reddy, with whom I share interests in representation learning, bias, and interpretability. His work on question answering over knowledge bases is closely related to my coursework in CSI5180. William Hamilton has studied patterns of conflict and language use in online communities, which is an area I particularly hope to explore in my graduate studies. Relatedly, Reihaneh Rabbany currently supervises work centered around the detection of malicious Twitter users in discourse surrounding the Canadian federal election, an exciting area closely related to my senior thesis. I would be thrilled to work with any of them, as well as many other members of the faculty. Thank you again for your consideration.

References

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- [4] Zichao Yang et al. “Hierarchical Attention Networks for Document Classification”. In: *HLT-NAACL*. 2016.