Thesis Portfolio

Hyperparameter Tuning on Text Classification using CNNs (Convolutional Neural Networks)

(Technical Report)

The Integration of Social Factors in the Development and Implementation of Autonomous Vehicles

(STS Research Paper)

An Undergraduate Thesis

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Sarah Lei
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Department of Computer Science

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Sociotechnical Synthesis

Introduction

Both projects in the following portfolio, the Capstone project and STS research, focus on the implementation of Autonomous Vehicles (AVs) and its effects on society. Specifically, the Capstone project focuses on the prediction of surrounding entities and using information learned to form a decision. An explainable deep learning-based model for predicting intent of maritime entities was developed as a part of Center for Visual and Decision Informatics (CVDI) Year 7 Project 'Improved Decision Making for Autonomous Systems' which models intent based on past observations, while also incorporating spatial interactions and temporal dependencies. The Capstone project supports this ongoing project by providing a more efficient, optimized approach to training this deep learning-based model for classification. This focus remains on maximizing model training using minimal resources, or training optimization. The Capstone project parallels image-classification by exploring the effect of hyperparameter tuning on a CNN for text classification using Natural Language Processing (NLP) techniques. The STS research paper implores the integration of social factors in these models used in AVs. As an emerging technology that makes critical decisions modeled after human behavior, it is important to assess the decision-making logic in AVs, and how that logic might in turn create a technologically deterministic future of AVs.

Technical Report

Autonomous vehicles, also known as self-driving cars, "require methods that generalize to unpredictable situations and reason in a timely manner in order to reach human-level reliability" (Schwarting, Alonso-Mora, & Rus, 2018). These methods incorporate many elements in their logic that are developed through a deep learning-based model. These models

include end-to-end motion planning to learn a navigation policy in simulation from an expert operator. The knowledge gained from training is then transferred to real-world environments to perform target-oriented navigation and collision avoidance (Schwarting et al., 2018). The Capstone project aims to construct an explainable decision-making process inclusive of human expert feedback for autonomous navigation in complex environments through maximizing model training using minimal resources. This is done through the analysis of hyperparameter tuning on CNN models for text classification.

This Capstone project focuses on the applications of automated machine learning in text-classification models. Text classification, the activity of labeling natural language texts with relevant categories from a predefined set, is a foundational task in many NLP (natural language processing) applications. These applications include sentiment analysis, web searching, and information filtering. By using text classifiers, companies can structure business information such as email, legal documents, web pages, chat conversations, and social media messages in a fast and cost-effective way. This allows companies to save time when analyzing text data, help inform business decisions, and automate business processes [1]. In this paper, we discuss the implementation of a model similar to Kim Yoon's Convolutional Neural Networks for Sentence Classification. We then discuss the performance of hyperparameter tuning on the model for training optimization. Following, we propose additional ways to improve the performance of the model.

STS Research Paper

The STS research paper implores the integration of social factors in the implementation and development of AVs. Social demands of safety and ease have affected the development and implementation of AVs through modelling the technology around human decision-making. The

STS research paper uses the Social Construction of Technology (SCOT) framework to analyze the definition and translation of social practices concerning safety and ease into implementable algorithms in the AVs. However, due to the extensive roles and relationships in the sociotechnical environment of AVs, several limitations exist that impede the successful realization of societal demands. Through the lens of the Wicked Problem framework, it is possible to then assess the complex network of social, economic, and political factors limiting proposed solutions for ethical decision-making in AVs. The examination of these limited proposals reveals a technologically deterministic future for AVs that include social, political, economic, and environment implications.

Conclusion

Working on both the Capstone project and STS research paper simultaneously allows the realization of how decision-making models are formed, and how those models translate visual input into actionable decisions. Additionally, the text-classification models can be analyzed through the lens of social factors - the focus of the STS research paper. The Capstone project provides clarity on exactly how AVs assess input to make an informed decision. Furthermore, the Capstone project provides a foundational system for the STS research paper to analyze. By performing both concurrently, it is possible to discern how AV technology is being developed in regards to societal demands, and how the implementation of those demands is driving how AVs influence society.