PROJECT PROPOSAL:
ENHANCING SENTIMENT ANALYSIS WITH DEEP LEARNING AND TRANSFORMER-BASED MODELS

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MSDS458-DL: Artificial Intelligence and Deep Learning
July 30, 2023

Introduction

Sentiment analysis has proven to be a powerful tool in the business world, providing valuable insights into customer satisfaction, brand perception, market trends, and more. As the demand for accurate sentiment classification increases, it becomes essential to explore cutting-edge techniques in natural language processing to achieve even higher performance levels. This proposal aims to build upon existing sentiment analysis approaches by leveraging deep learning models and transformer-based architectures to surpass the benchmark accuracy achieved by previous methods.

Objectives

The main objectives of this project are as follows:

a. Develop a sentiment classification model capable of accurately categorizing text into positive, negative, or neutral sentiments.

b. Investigate the effectiveness of various deep learning methods, including recurrent neural networks (RNNs), long short-term memory networks (LSTMs), and gated recurrent unit networks (GRUs). By exploring these methods, we aim to unlock their potential in capturing complex sequential patterns in textual data.

c. Evaluate the performance of transformer-based models, such as BERT (Bidirectional Encoder Representations from Transformers), and large pre-trained models like GPT (Generative Pre-trained Transformer). These models have shown remarkable success in various NLP tasks and offer the opportunity to uncover how pre-training on vast amounts of data can impact sentiment analysis accuracy.

d. Conduct experiments to identify the optimal hyperparameters (e.g., number of layers, hidden nodes, activation functions, etc.) for the deep learning models. This analysis will aid in refining the model's performance and efficiency.

Dataset

The Twitter Sentiment Analysis Training Corpus (TSATC) (Blanco) and Sentiment140 (Kazanova, 2017) datasets, each with 1.6 million labeled tweets, will serve as the foundation for our training and evaluation processes. These datasets offer a diverse range of real-world tweets with labeled sentiment, ensuring the model's robustness across different contexts.

Methodology

The datasets will be combined and prepared by removing noise, tokenization, stemming, and any other necessary text preprocessing steps. Appropriate embedding methods will be selected and applied to the data. Next, RNNs, LSTMs, and GRUs will be trained using TSATC and Sentiment140 datasets. To determine the effectiveness of large pre-trained models on massive amounts of data, BERT and GPT will be fine-tuned on the same datasets. The models' performance will be assessed using confusion matrices, precision-recall, and F1 scores to understand their strengths and weaknesses in capturing sentiment nuances. To gain a deeper understanding of the representations learned by different nodes within each layer, visualizations of the intermediate hidden layers will be generated, providing insights into how the model is processing information.

Expected Outcomes

a. We anticipate that our deep learning models and transformer-based architectures will outperform the 80% benchmark achieved by previous methods (Go et al., 2009).

b. A comprehensive comparison between the different deep learning approaches and transformer-based models will reveal their relative advantages and limitations in sentiment analysis tasks.

c. Visualizations of intermediate hidden layers will shed light on the features learned by the models, leading to a better understanding of how sentiment information is encoded.

References

Blanco, C. (n.d.). *CARBLACAC/twitter-sentiment-analysis · datasets at hugging face*. carblacac/twitter-sentiment-analysis · Datasets at Hugging Face. https://huggingface.co/datasets/carblacac/twitter-sentiment-analysis

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KAZANOVA, M. (2017, September 13). *Sentiment140 dataset with 1.6 million tweets*. Kaggle. https://www.kaggle.com/datasets/kazanova/sentiment140