Assignment 1

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Abstract

This report explores the development and evaluation of neural network models for part-of-speech (POS) tagging, utilizing a dependency treebank dataset. It highlights the process of data extraction, length normalization, tokenization, vocabulary creation, and the integration of pre-trained GloVe embeddings. The focus is on examining three distinct neural network models, each assessed through validation accuracy and various metrics, to understand their efficacy in POS tagging.

1 Introduction

This assignment explores Natural Language Processing (NLP), focusing on the development of neural network models for part-of-speech (POS) tagging using a dependency treebank dataset. It encompasses five key tasks: developing models for accurate POS tagging, managing out-of-vocabulary (OOV) tokens, establishing a baseline model with architectural variations, training and evaluating these models, and visualizing and interpreting the results. The approach blends traditional NLP techniques with modern deep learning advancements, like the use of GloVe embeddings, to enhance performance and address common challenges in POS tagging.

2 System description

In this assignment, Google Colab was utilized as the primary platform for both programming and collaborative work, enabling efficient teamwork. The coding and architectural design of the system were developed through a combined effort of the team, with each member working on and improving various tasks within the assignment. Three distinct neural network models for part-of-speech tagging were designed and implemented, as per the instructions of the assignment task. The Baseline model features a Bidirectional LSTM network with an extra Dense layer, selected for its effective handling of sentence context from both ends. Model 1 adds another LSTM layer to

enhance its learning of sequential data. Model 2 includes an extra Dense layer, designed to better understand complex patterns from the LSTM's output. Each model showcases a creative architectural design, carefully developed to fulfill the assignment's goals.

3 Experimental setup and results

For the assignment, Keras models was used to construct and evaluate the three neural network models, each with varying architectures to assess their performance in POS tagging. Each model's architecture was designed to address different aspects of sequence learning and pattern recognition within POS tagging tasks. The 'adam' optimizer was utilized in our models, a popular choice for its efficiency in handling sparse gradients on noisy problems.

For evaluation metrics, we integrated functions from the sklearn library, focusing on precision, recall, and the F1-score. Analyzing the results, Model 2 consistently shows high F1-scores across the majority of POS tags.

4 Discussion

From the results, it is clear that Model 2 consistently demonstrated highest F1 scores indicating its superior performance in capturing the nuances of POS tagging. The F1-score graph reflects an extensive evaluation of each model, and from this visual analysis, it's clear that Model 2's additional Dense layer contributes to its ability to outperform the other configurations, making it the best model among the ones tested.

5 Conclusion

In this assignment, neural network models were developed and evaluated for the task of part-of-speech tagging, using a dataset consisting of words and their grammatical categorization. The most effective model that was built included an extra layer that helped it recognize complex language patterns, leading to better performance than the other models tested. The results confirmed the benefit of using deeper neural networks for this task can lead to better performance. Future work could look into refining the models further, testing with more diverse data, or trying out even more sophisticated model architectures to enhance the accuracy of part-of-speech tagging.

6 References

https://journalofbigdata.springeropen.com/articles/10.1186/s40537-022-00561-y
https://nlp.stanford.edu/projects/glove/
https://www.linkedin.com/advice/0/how-can-you-handle-out-of-vocabulary-words-nlp
https://statquest.org/