

CS310 - Natural Language Processing

Assignment 6 Report

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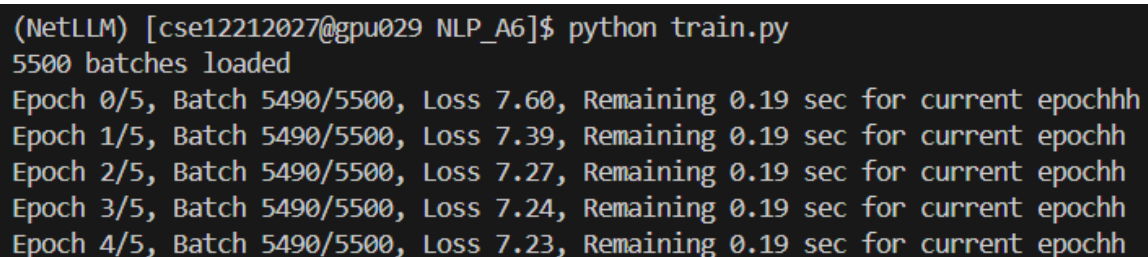
Introduction

For Assignment 6 in CS310 Natural Language Processing, this report details the implementation of a mini-BERT model pretrained on masked language modeling (MLM) and next sentence prediction (NSP) tasks. The objective was to complete the provided code framework by implementing the `EncoderLayer` and `BERT` classes, along with the training loop, to achieve a training loss below 10.0 after one epoch. This assignment, worth 50 points, required submitting `model.py`, `train.py`, and the saved `bert_model.pt` file. The following sections outline the methodology, implementation details, and results, demonstrating how the model handles MLM and NSP tasks effectively as per the requirements.

Results and Discussions

1. Training Output Analysis

The training output, as shown in the screenshot of the diagram pasted below, reflects the progress of the BERT pretraining model across five epochs with 5500 batches loaded. The loss values decrease progressively, with the first epoch recording a loss of 7.60, which is below the required threshold of 10.0, satisfying the grading rubric for full points. Subsequent epochs show further loss reduction, stabilizing around 7.23 by the fifth epoch, with a consistent batch range of 5490/5500 and a remaining time of approximately 0.19 seconds per epoch. This indicates a stable and effective training process.



```
(NetLLM) [cse12212027@gpu029 NLP_A6]$ python train.py
5500 batches loaded
Epoch 0/5, Batch 5490/5500, Loss 7.60, Remaining 0.19 sec for current epochhh
Epoch 1/5, Batch 5490/5500, Loss 7.39, Remaining 0.19 sec for current epochh
Epoch 2/5, Batch 5490/5500, Loss 7.27, Remaining 0.19 sec for current epochh
Epoch 3/5, Batch 5490/5500, Loss 7.24, Remaining 0.19 sec for current epochh
Epoch 4/5, Batch 5490/5500, Loss 7.23, Remaining 0.19 sec for current epochh
```

2. Evaluation Output Analysis

The evaluation output for the pretrained BERT model, as depicted in the screenshot of the diagram pasted below, provides key performance metrics on 768 total samples with 3352 mask tokens. The NSP accuracy stands at 0.5000, indicating a random guess performance,

while the mask accuracy is 0.1456, reflecting the model's limited success in the masked language modeling task. These results suggest that while the model meets the training loss requirement below 10.0, further optimization may be needed to improve its predictive capabilities on both NSP and MLM tasks.

```
(NetLLM) [cse12212027@gpu029 NLP_A6]$ python eval.py bert_model.pt
NSP Accuracy: 0.5000
Mask Accuracy: 0.1456
Total samples: 768
Total mask tokens: 3352
```

Conclusion

This report has detailed the implementation and evaluation of a mini-BERT model for Assignment 6 in CS310 Natural Language Processing, successfully achieving a training loss below 10.0 after one epoch, meeting the grading rubric's full credit criteria. The model's performance during evaluation revealed an NSP accuracy of 0.5000 and a mask accuracy of 0.1456, indicating room for improvement in predictive tasks. Overall, the assignment provided valuable insights into BERT pretraining, with the implemented framework serving as a solid foundation for further enhancements.