Fake News Detection

CS3008: Deep Learning

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Overview

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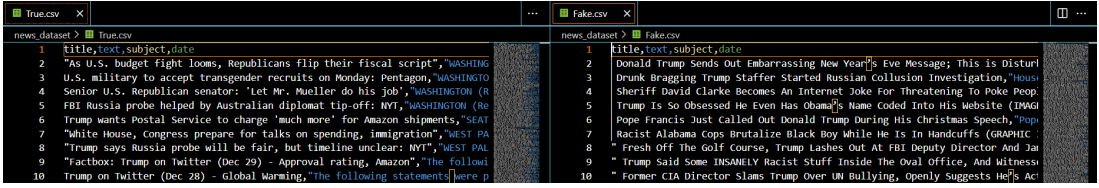
Data Preparation

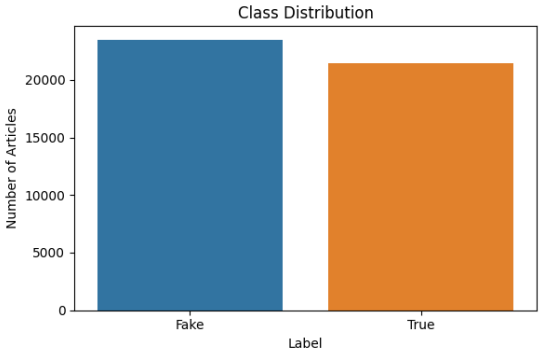
- True.csv, Fake.csv
- Combined ‘title‘ and ‘text‘ fields into a single ‘content‘ column.
- Text cleaning: lowercase conversion, trimming, removal of non-alphanumeric characters.



Sample of the dataset

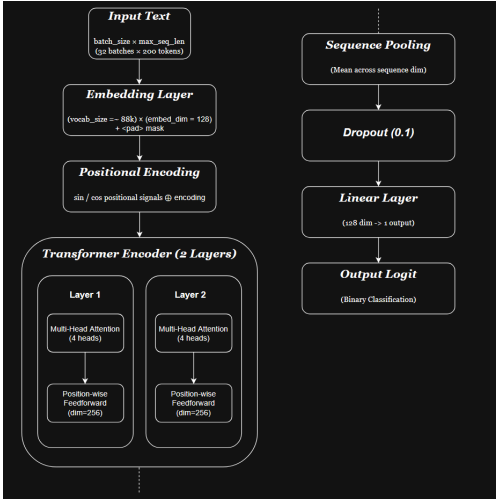
Vocabulary and Dataset

- Fake.csv slightly larger than True.csv
- Built vocabulary from training texts with minimum token frequency threshold of 2.
- Defined custom ‘NewsDataset‘ class to tokenize, numericalize, and pad sequences up to a maximum sequence length of 200.
- Created PyTorch ‘DataLoader‘s for train, validation, and test splits (60-20-20 split).



Model Architecture

- Embedding layer: Maps token indices to 128-dimensional vectors.
- Positional encoding added to embeddings for sequential information.
- Transformer encoder with 2 layers, 4 attention heads, and 256-dimensional feedforward network.
- Classification head: global average pooling + dropout + linear layer to output logit.

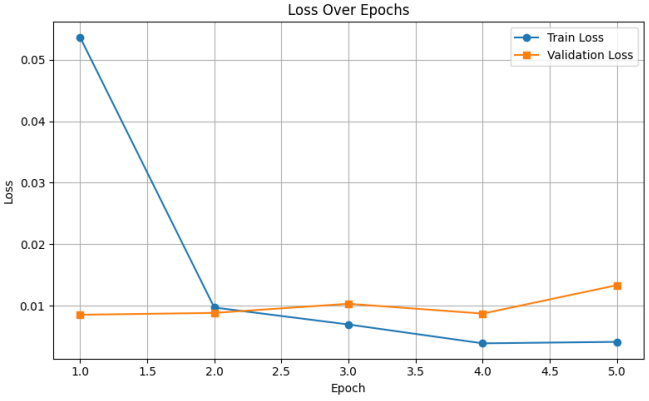


Positional Encoding

- Implemented sinusoidal positional encoding.
- Adds unique position-based vectors to embeddings to retain token order.
- No additional parameters (fixed during training).

Training Process

- Loss: Binary Cross-Entropy with Logits *(BCEWithLogitsLoss)*.
- Optimizer: Adam with learning rate 1×10^{-3}.
- Trained for 5 epochs, tracking training and validation loss.



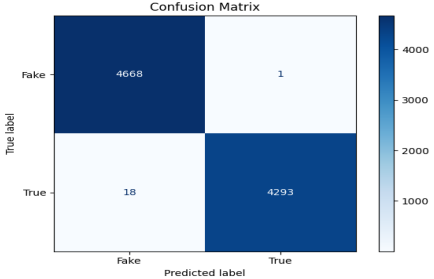
Model Saving and Deployment

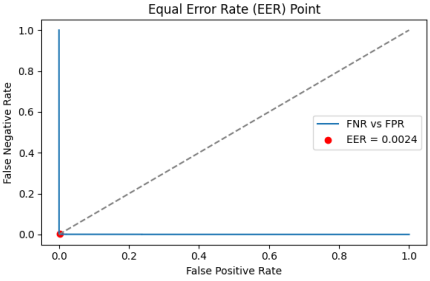
- Saved trained model state to ‘transformer_fake_news_model.pth‘.
- Vocabulary serialized to ‘vocab.pkl‘ using Python ‘pickle‘.
- Ready for inference: Load model and vocab, run prediction on custom text input.

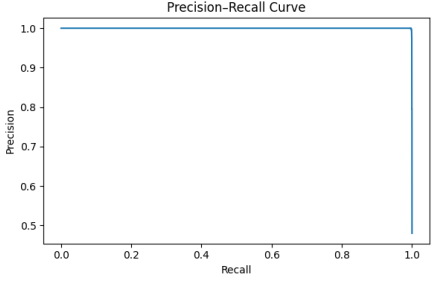
Evaluation Metrics

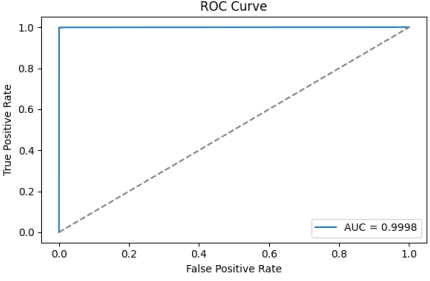
- Accuracy: Correct classifications over total samples = 0.9979
- AUC: Area under ROC curve for model discrimination = 0.9998
- Precision: True positives divided by predicted positives = 0.9998
- Equal Error Rate (EER): Point where False Positive Rate equals False Negative Rate = 0.0024 at threshold 0.0131

Results Visualization









Custom Input Prediction

- Cleans and tokenizes input text.
- Pads/truncates to max sequence length.
- Outputs predicted class (‘True‘ or ‘Fake‘) and confidence score.

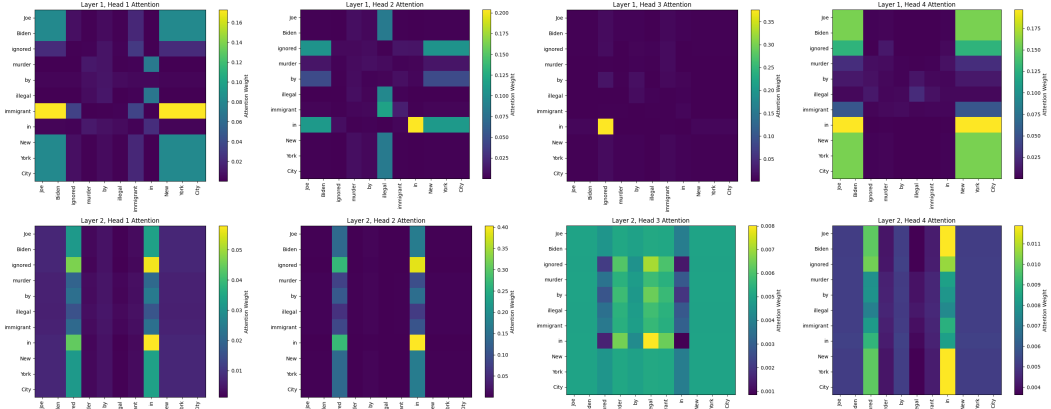
```python
model = TransformerClassifier(
    vocab_size=vocab_size,
    embed_dim=128,
    nhead=4,
    num_encoder_layers=2,
    dim_feedforward=256,
    dropout=0.1,
    max_seq_len=max_seq_len,
    num_classes=1
)

device = torch.device("cuda" if torch.cuda.is_available() else "cpu")
model.load_state_dict(torch.load(model_save_path, map_location=device))
model = model.to(device)
model.eval()

if __name__ == "__main__":
    custom_text = "Joe Biden ignored murder by illegal immigrant in New York City" # Change this prompt
    predicted_label, confidence = predict_custom_input(custom_text, model, vocab, max_seq_len, device)
    print("Custom Input Prediction: ")
    print("(Only works on US geopolitics and internal politics between 2016 and 2017 due to the nature of the dataset)")
    print("-----------------------")
    print(f"Input Text       : {custom_text}")
    print(f"Predicted Label  : {predicted_label}")
    print(f"Confidence Score (0 for Fake, 1 for True): {confidence:.4f}")
```

✓ 4.1s

```
Custom Input Prediction:
(Only works on US geopolitics and internal politics between 2016 and 2017 due to the nature of the dataset)
-----------------------
Input Text       : Joe Biden ignored murder by illegal immigrant in New York City
Predicted Label  : Fake
Confidence Score (0 for Fake, 1 for True): 0.0001
```

Attention Visualization

- Patched multi-head attention to extract weight matrices for selected layer and head to interpret model focus on token relationships.



Thank You