Palash S Patel | Sem 7 BDA | 22162121012

CGC Mini Project

# Fake News Detection using Transformer

**[ Colab Link (Training): GullibleTransformer-1.ipynb ]**
**[ Github (Entire Project): github.com ]**

---

**Dataset Link:** kaggle.com

## 1. Problem statement:

The goal of this project is to develop a fake news detection system that classifies news headlines as real or fake using an encoder-only transformer model. Using the Kaggle Fake News Dataset, the system focuses exclusively on headline-level analysis to identify linguistic patterns and cues indicative of misinformation, ultimately improving the accuracy and efficiency of automated fake news classification.

## 2. Dataset Description

*Dataset Name*: Fake News Detection:
*Key Characteristics*:

1. Two Separate CSV Files:
   - Fake.csv: Contains news articles labeled as fake.
   - True.csv: Contains real (true) news articles.

2. Columns / Features:
   Each news item in both files has the following attributes:
   - title — The headline of the article.
   - text — The main body / content of the article.
   - subject — Topic or category of the news (e.g., “News”).
   - date — Publication date of the article.

3. Size / Volume

The dataset is fairly large (combined size ~43 MB as per Kaggle).
The exact number of articles is around 44,898 records (both fake + real).

4. Source / Provenance

The dataset is collected from real-world sources. The “truthful” articles come from credible / verified news outlets, while the fake ones are drawn from sources of misinformation.
Because it’s been used in published research (e.g., PLOS ONE), it has some academic validation.

## 3. Data Preprocessing

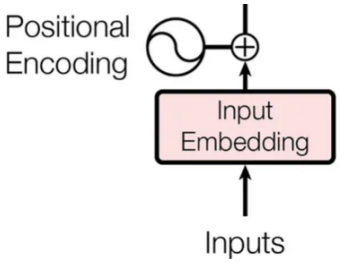
1. **Build the Tokenizer:** A large portion of the Dataset and its multiple columns are merged into a large corpus. This corpus (corpus file) is then used to create a Tokenizer.
   The Tokenizer of choice was my own implementation of the *BPE Tokenizer* (tokenizer code). The Tokenizer is then Trained and saved to file.

2. **Tokenize:** The tokenizer is then used to encode the actual dataset - (the title column).

3. **Transform into Tensors:** The tokens and their labels(0 - real ; 1 - fake) are stored into a torch.Tensor.

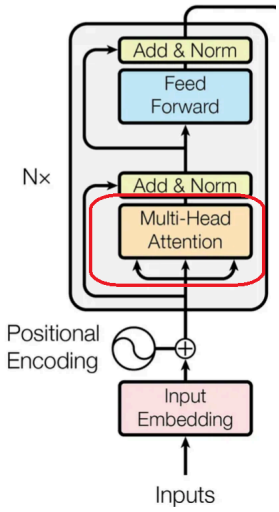
## 4. Model Building

- Embedding Layer (github.com):

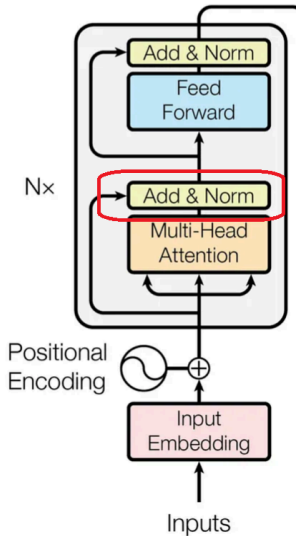



1. **Token Embedding Layer**: *Simple torch.nn.Embedding Layer*
2. **Positional Encoding Layer**: *Custom SinCosine Absolute Positional Encoding Layer. This precalculates the positions of tokens.*

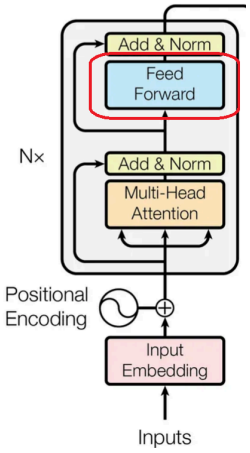
- Encoder Only Transformer Model (github.com):
    1. **Multihead Attention:** *Create K, Q, V from the input tensor. Partitions Q, K, V tensor into total - `n_heads` parts. Pass them through a `torch.nn.functional.scaled_dot_product_attention. Then applies a simple linear layer, to project output back to the same dimension as input and applies a dropout.*



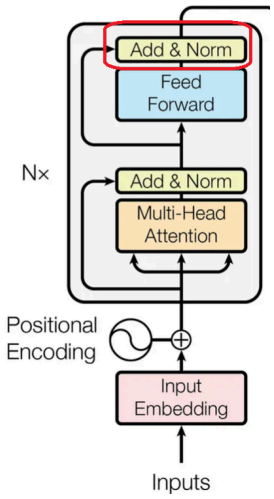

    2. **Residual Add + Normalizing Layer:** *Add before_attention_X + after_attention_X and apply a normalization layer - `torch.nn.functional.layer_norm`*



3. **Feed Forward:** *A normal FCC layer with 2 Linear Layers + 1 Activation Layer + 1 Dropout Layer*




4. **Residual Add + Normalizing Layer:** *Add before_Linear_X + after_Linear_X and apply a normalization layer - `torch.nn.functional.layer_norm`*



**- Training Hyperparameter:**

1. Number of Heads (For Multi Head Attention): 12
2. Number of Encoding Layers (MLA + FCC) : 12
3. Token Embedding Dimension: 768
4. Dropout: 0.0
5. Learning Rate: 0.0006
6. Max Token Size (For Attention Layers): 500
7. Epochs: 1

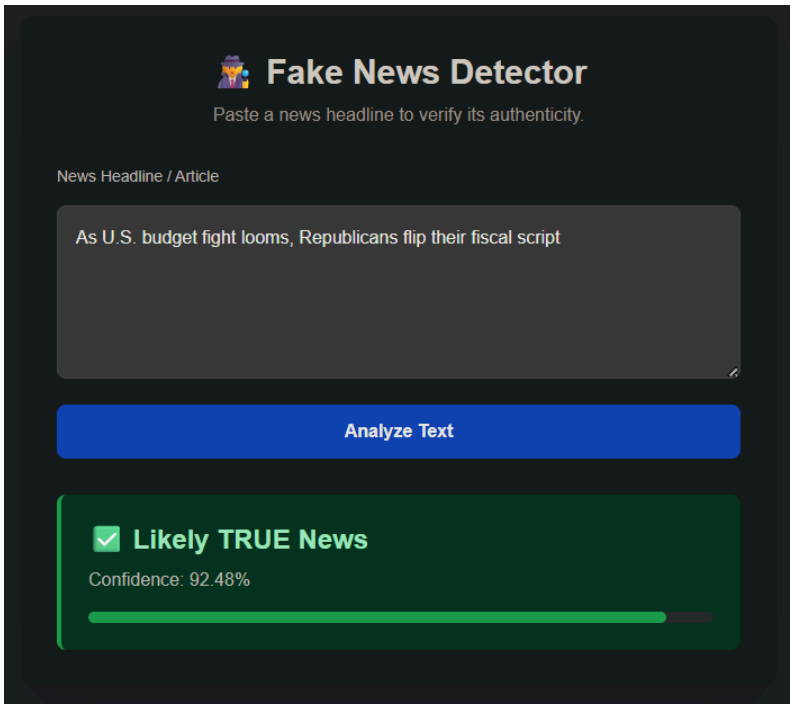
A single Epoch gets the job done - 96.89% Testing Accuracy, because dataset is large + the Batch Size is small - 12 (because of hardware constraints)

## 4. Training Results

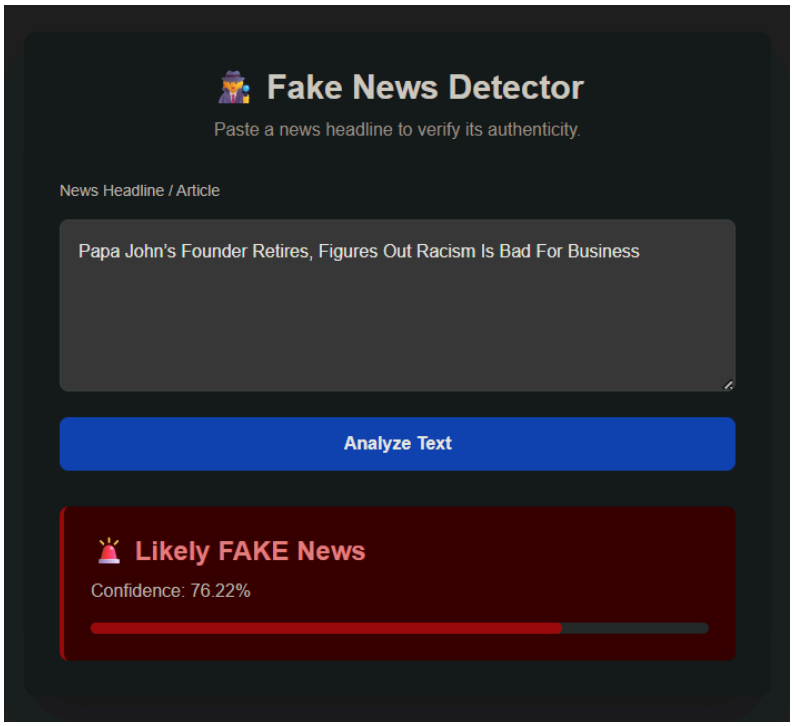
```
---------------  Testing  ----------------
✅ Saved Best Loss Model
✅ Saved Best Accuracy Model
Highest Testing Accuracy:  96.89309576837417  | epoch:  1
Least Testing Loss:  0.10045738680891587  | epoch:  1
Done !!
```

## 5. Model Output on Unseen Data

Example of True News:




Example of Fake News:



## → Some other Examples 😁