NLP for Finance

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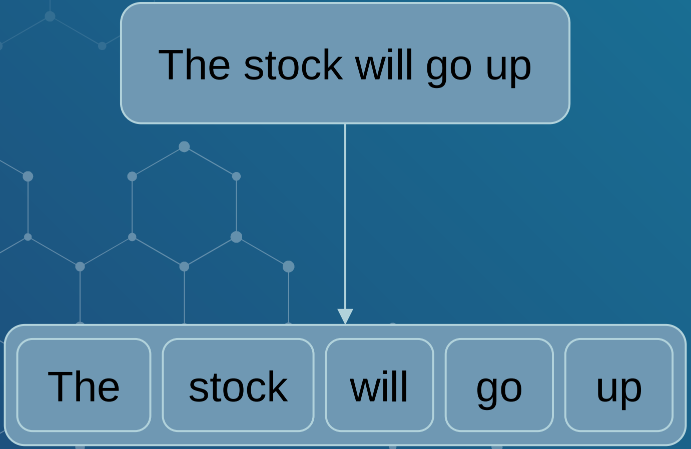
We used NLP to predict sentiments of stock market tweets, involving preprocessing and inputting them to train classification models. Sentiments can help predict changes in stock prices.

NLP pre-processing

Simplify the data

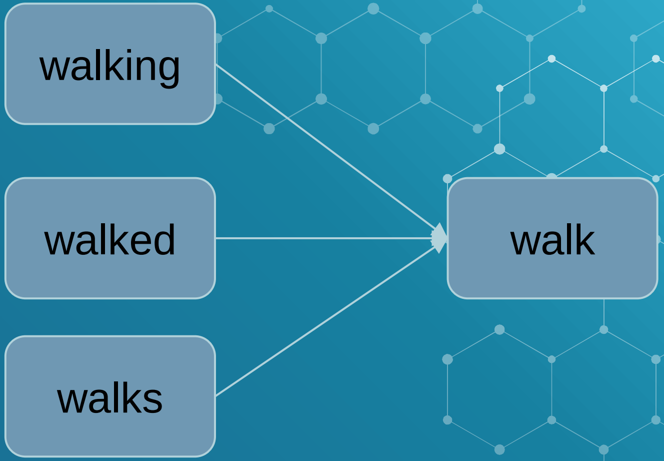
Tokenization

Split the sentence

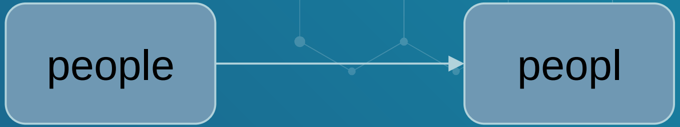


Stemming

Remove prefixes and suffixes



Some words can be incorrectly stemmed



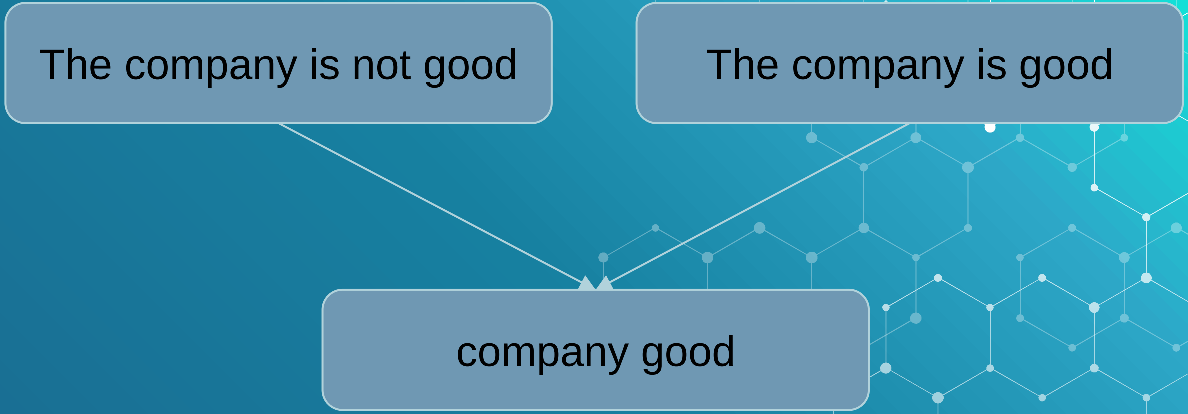
Text Cleaning

- Text cleaning is the process of simplifying a sentence
- One way is by replacing characters such as , . ; “ ‘ with spaces
- Sentences will have the same meaning

Unsimplified Sentence: I was surprised when the stock price increased.

Simplified Sentence: The stock price increased.

Stopword removal

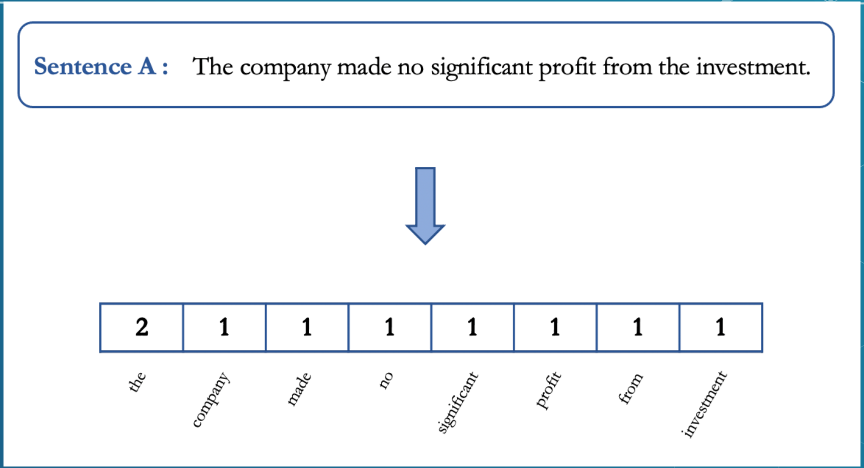


Remove stopwords like

- there
- is
- the
- and

Vectorization

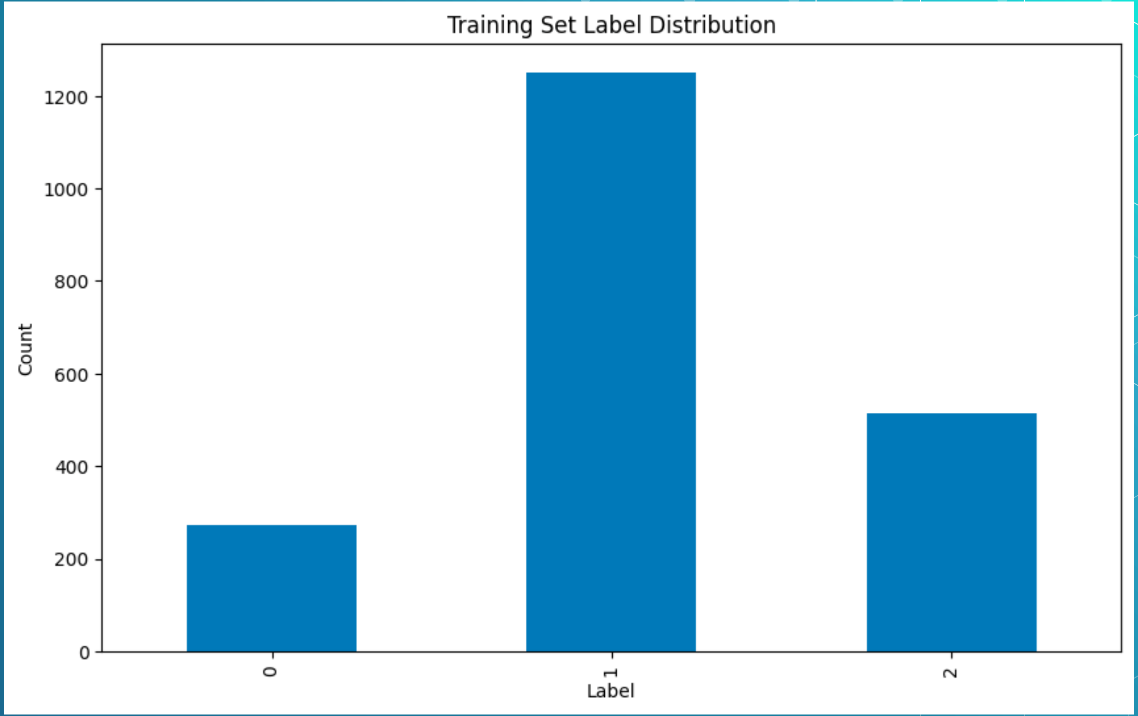
Converts a list of words into a vector of numbers


Sentence A : The company made no significant profit from the investment.
2
1
1
1
1
1
1
1
the
company
made
no
significant
profit
from
investment

Data set balancing

- Data is not balanced
- Lots of neutral data

We did not address this, but we should if we do this again.



0 is negative

1 is neutral

2 is positive

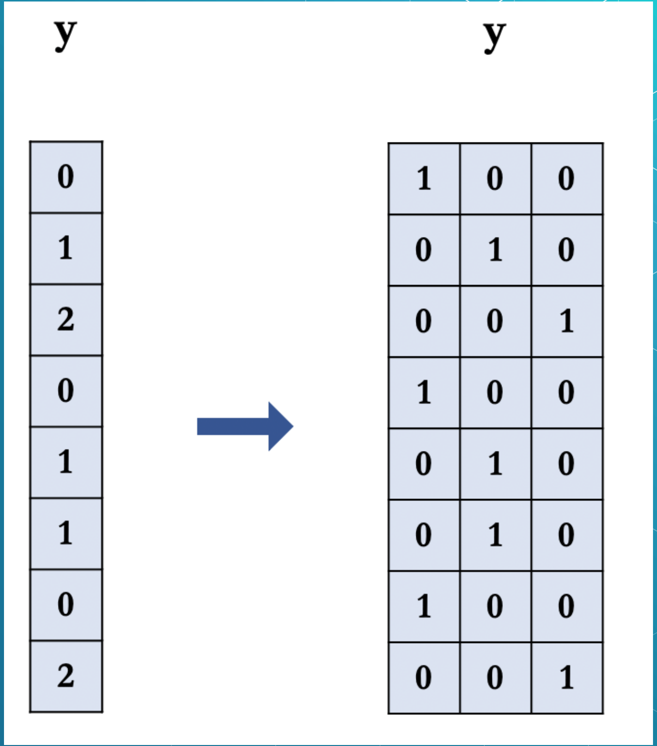
One Hot Encoding

One hot encoding is converting categorical data into numerical data

- 1 column per possible label
- Easy to interpret model's output

Before:
0: negative, 1: neutral, 2: positive

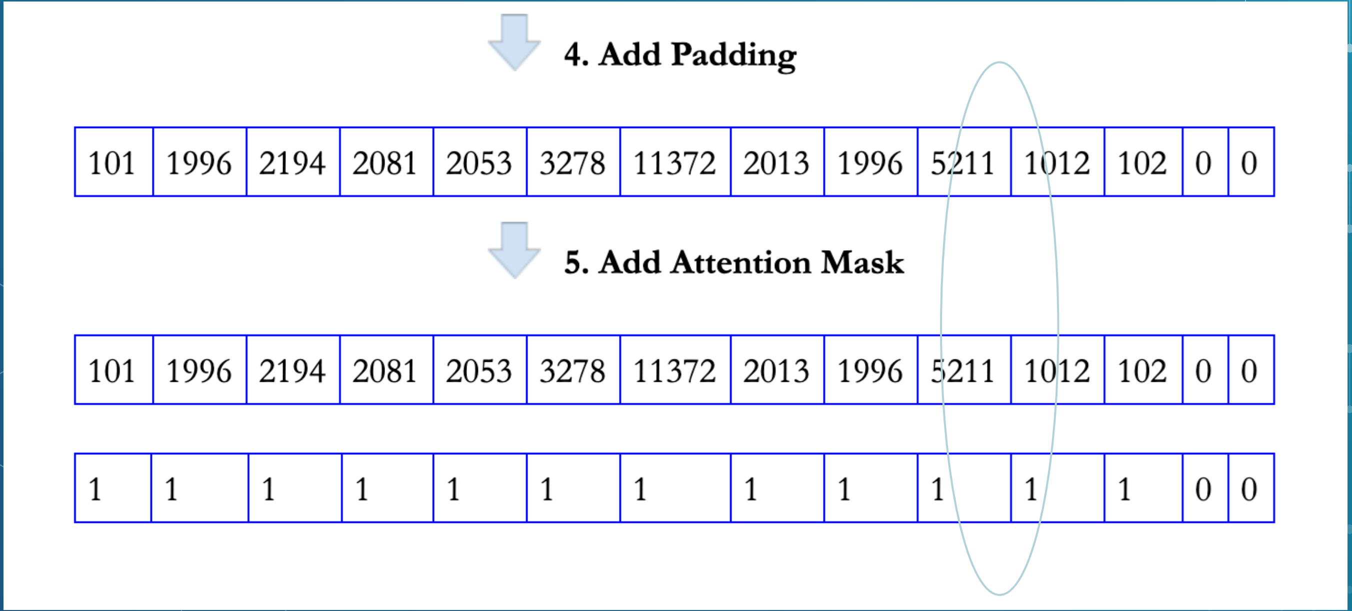
After:
Col 1: negative, Col 2: neutral, Col 3: positive



$$\begin{array}{c} \mathbf{y} \\ \hline 0 \\ 1 \\ 2 \\ 0 \\ 1 \\ 1 \\ 0 \\ 2 \end{array} \longrightarrow \begin{array}{ccc} & \mathbf{y} & \\ \hline 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{array}$$

Padding and Attention Masks

- Extends vectors with padding to have equal length inputs
- Attention mask draws model attention away from padding



4. Add Padding

101	1996	2194	2081	2053	3278	11372	2013	1996	5211	1012	102	0	0

5. Add Attention Mask

101	1996	2194	2081	2053	3278	11372	2013	1996	5211	1012	102	0	0
1	1	1	1	1	1	1	1	1	1	1	1	0	0

Word Order

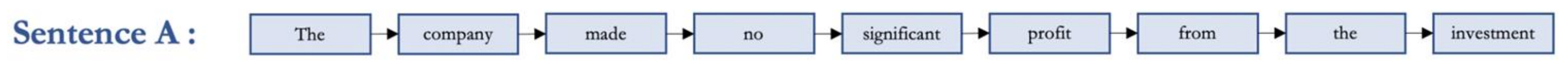
- Changes the meaning of a sentence
- Very important

Sentence A : The company made no significant profit from the investment.

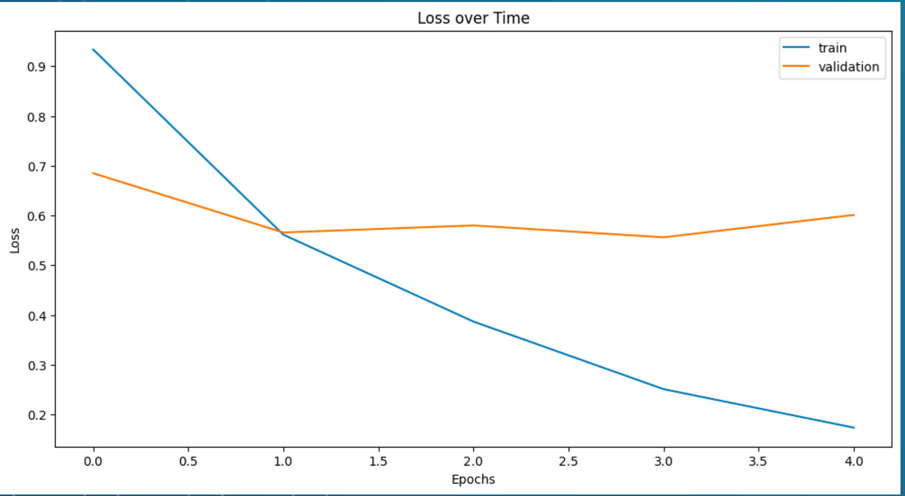
Sentence B : No, the company made significant profit from the investment.

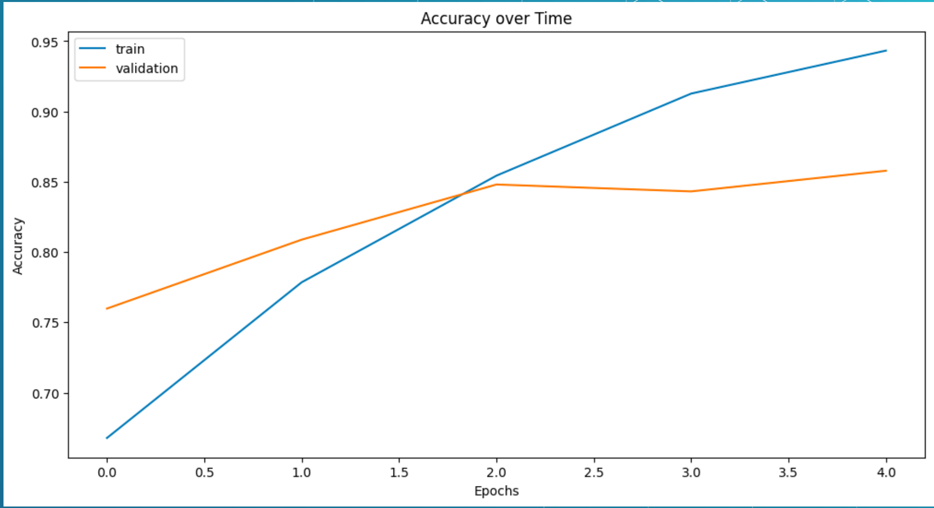
LSTM

- LSTM stands for long short-term memory
- It can help to solve word order issues
- A sequence of words rather than bag



LSTM Result





83.70% Accuracy

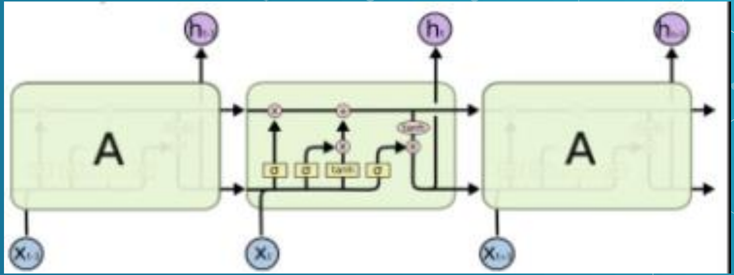
Model Architecture and Hyperparameters

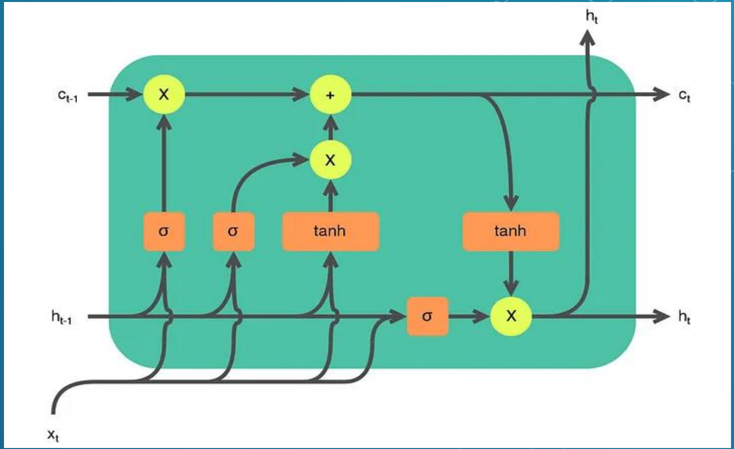
Model layers

- Embedding
- Dropout
- LSTM
- Dense

Hyperparameters

- Epochs
- Max Sequence Length
- Max NB Words





BERT Pre-trained Model

BERT is a pre-trained model from Google

- Very accurate
- Needs less effort than new model
- Speeds up training
- Needs less data

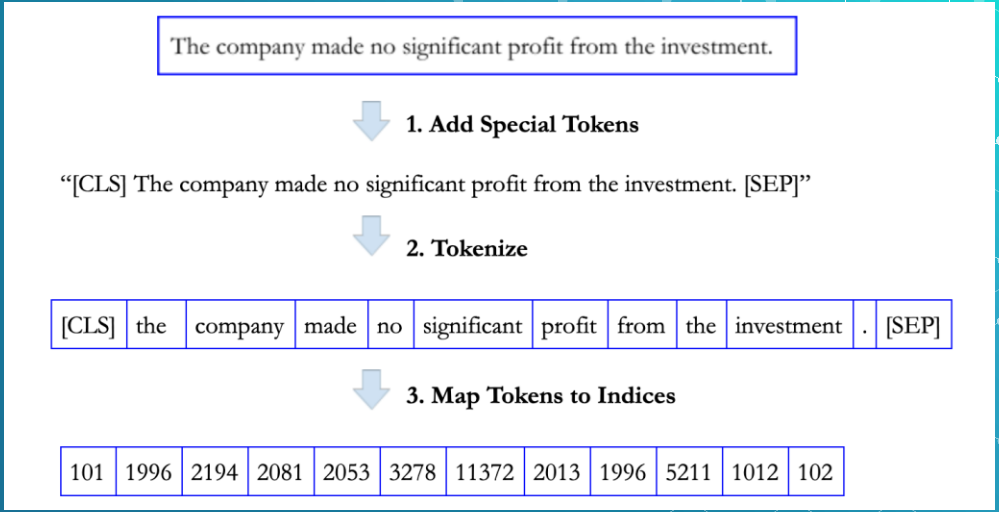
Setting Up BERT

Pre-processing steps

- Add special tokens
- Tokenize
- Convert tokens to indexes
- Add padding and attention mask

Using the model

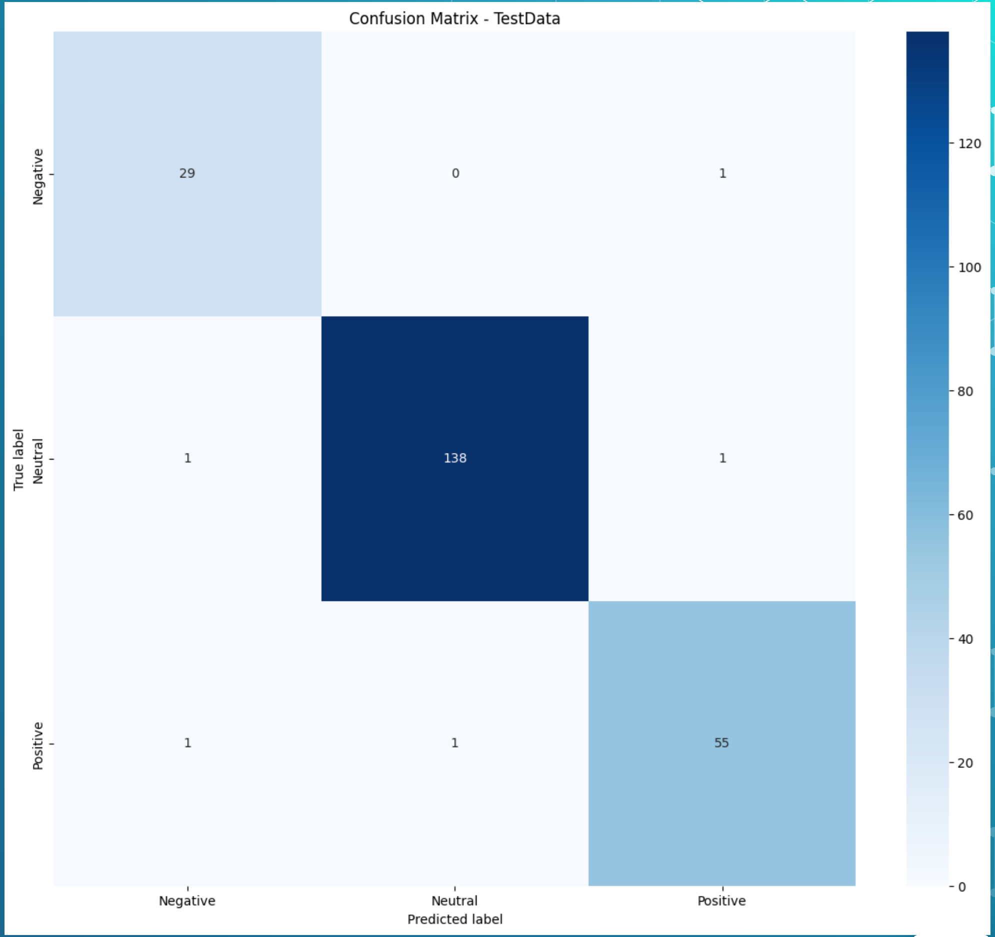
- Huggingface Pytorch has a BERT implementation
- Add an output layer to BERT
- Train like any other model


The company made no significant profit from the investment.
1. Add Special Tokens
"[CLS] The company made no significant profit from the investment. [SEP]"
2. Tokenize
[CLS] | the | company | made | no | significant | profit | from | the | investment | . | [SEP]
3. Map Tokens to Indices
101 | 1996 | 2194 | 2081 | 2053 | 3278 | 11372 | 2013 | 1996 | 5211 | 1012 | 102

BERT Results

Highly accurate in testing with no hyperparameter optimization

Only 5/227 wrong answers (98% accuracy)



Thank You