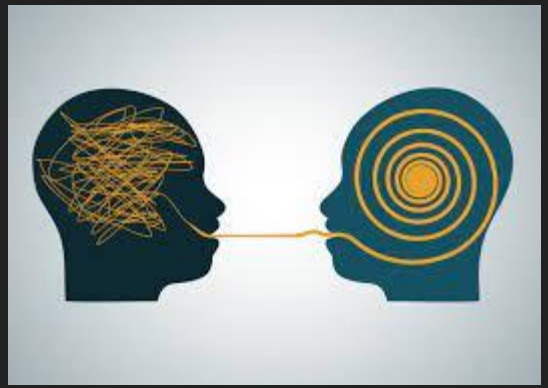
Classifying Movie Reviews with BERT NLP Model

By: Alex Fisher (1117936), Matthew Fernandez (1096397) and Nicholas Moffa (1072386)

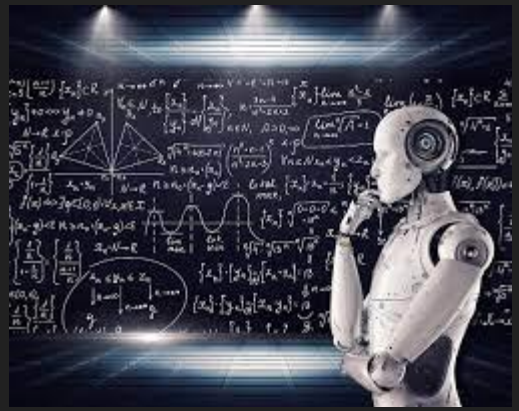
Introduction

- Language is NUANCED
  - Sarcasm
  - Exaggeration
  - Euphemisms
- Goal: train a model to pick up on these idiosyncrasies of language using BERT



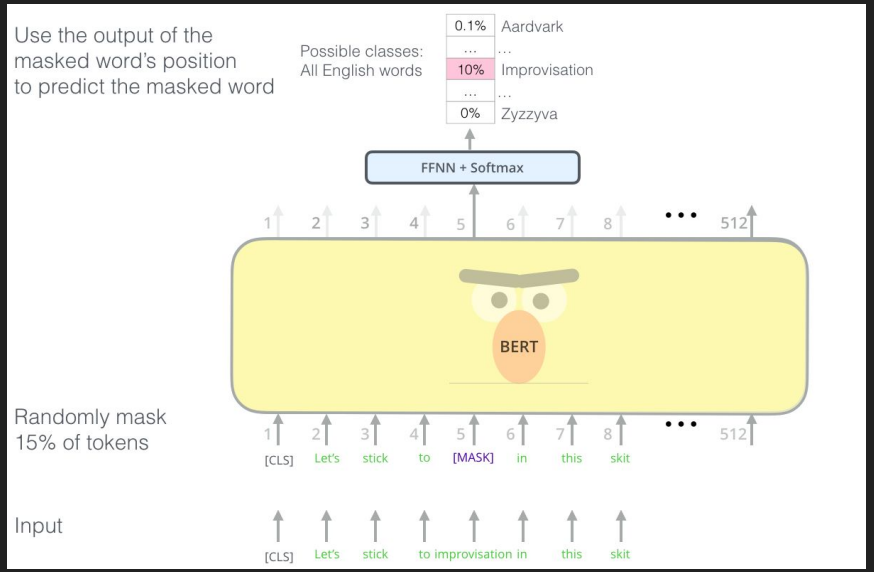
Current state of NLP : what does the literature say?

- Limitations:
  - NeSy AI: (Deep Learning meets Human Reasoning) Still in infancy; next frontier of AI.
  - XAI: (AI that explains what it is) Accuracy vs Interpretability, Scalability, and Metrics.
- Future:
  - Promising applications in medical field for sorting through millions of records at once.
  - Models may be able to better sense sarcasm / figures of speech.



What is BERT?

- BERT stands for Bidirectional Encoder Representations from Transformers
- Developed by Google in 2018
- BERT is a neural network based model that uses the transformers architecture, which is a type of deep learning that is highly skilled at capturing distant relationships between elements in a sequence of data
- In the simplest terms:
- A transformer encoder architecture
- Processes the input text in a way that allows the model to capture dependencies between words in both directions.
- Input is a sequence of word embeddings, where each word is mapped to a high-dimensional vector representation using an embedding layer.



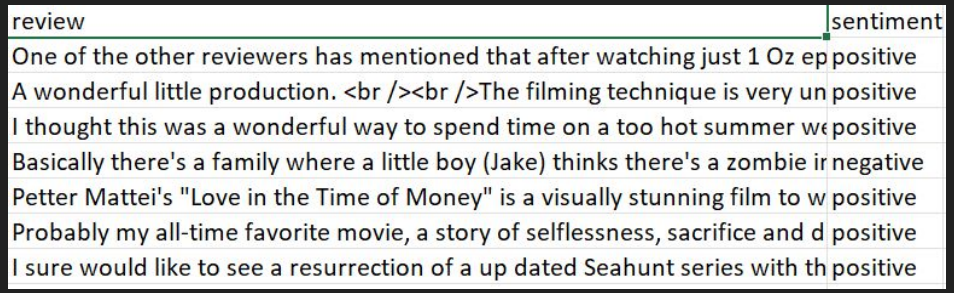
Dataset

- IMDB movie review contains 50k total records
- Consists of two columns:

  - One for the text in the review

  - One for the binary classification of that reviews sentiment (positive or negative)

- Dataset was split into training and test set with a 80-20% ratio



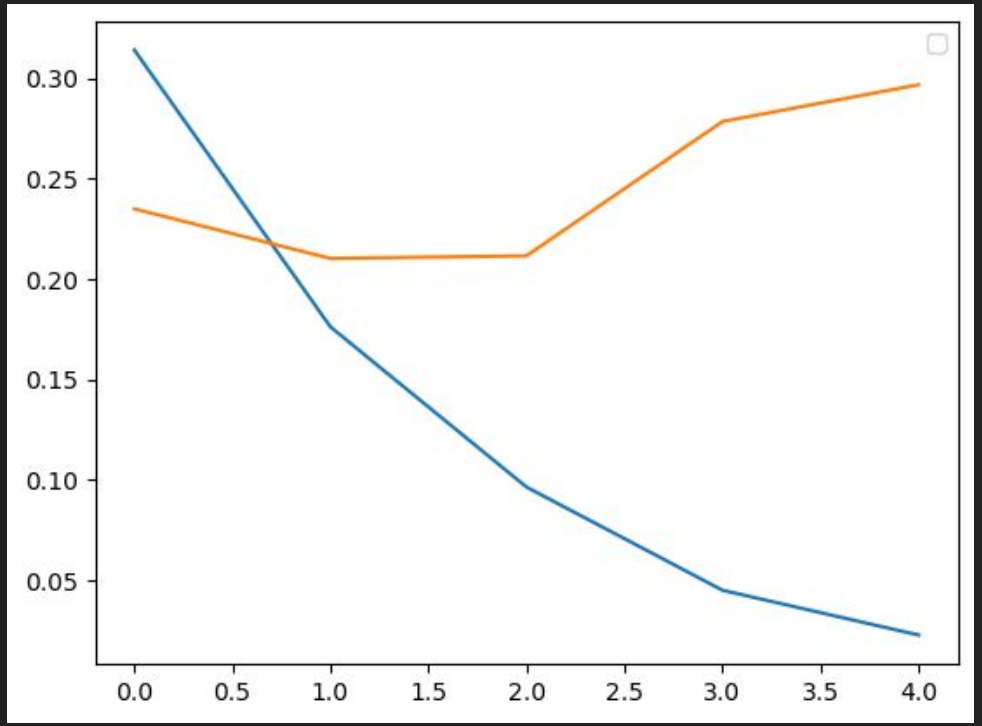
review	sentiment
One of the other reviewers has mentioned that after watching just 1 Oz ep	positive
A wonderful little production. The filming technique is very un	positive
I thought this was a wonderful way to spend time on a too hot summer we	positive
Basically there's a family where a little boy (Jake) thinks there's a zombie ir	negative
Petter Mattei's "Love in the Time of Money" is a visually stunning film to w	positive
Probably my all-time favorite movie, a story of selflessness, sacrifice and d	positive
I sure would like to see a resurrection of a up dated Seahunt series with th	positive

Methodology

- Pre-process data from CSV
- HuggingFace pre-trained model: bert-base-cased.
- Used auto-tokenizer from transformers library to tokenize samples.
- Converted pandas dataframe of tokenized reviews to PyTorch tensor.
- Fine-tuning through 5 epochs; 40K training samples and 10K test samples each.
- Simple User Interface for anyone to test
    - Front-end: HTML, CSS, jQuery, AJAX, JavaScript
    - Back-end: Python script (RunFineTunedModel.py)

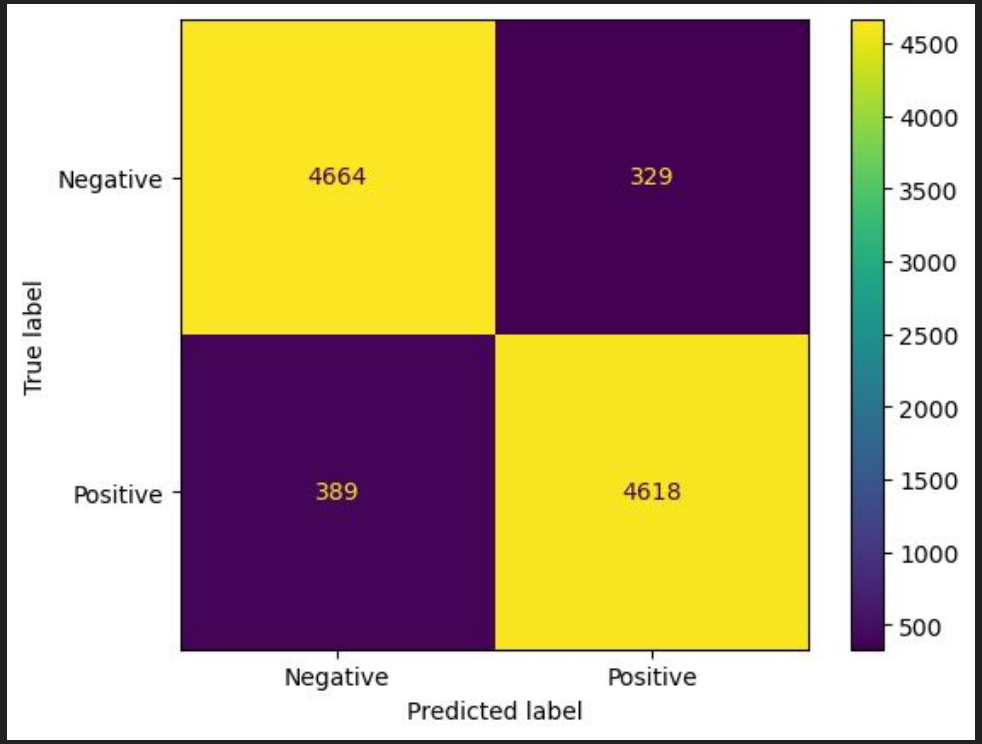
Epoch Training Graph

- Trained over five epochs using:
  - AdamW optimizer
    - Updates learning rate of network weights inidividually
  - 0.00005 learning rate
- Final loss values:
  - Training (blue): 2.26%
  - Validation (orange): 29.67%



Model Evaluation

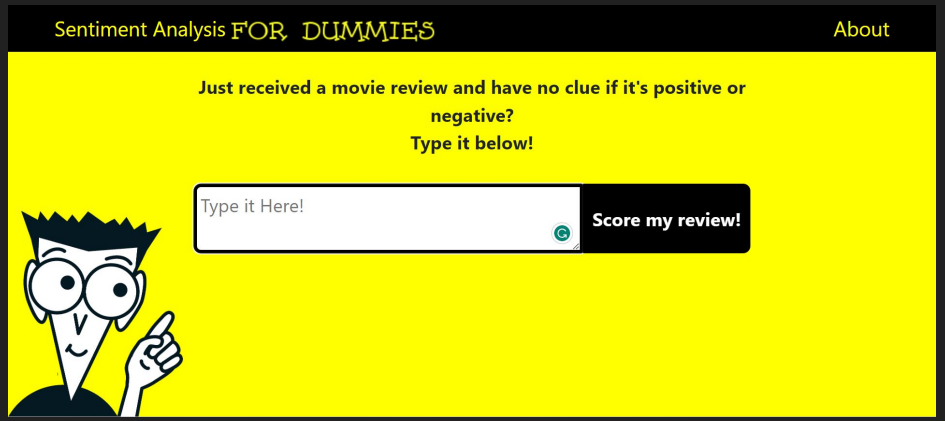
- Final evaluation:
  - Accuracy: 92.82%
  - Precision: 93.34%
  - Recall: 92.23%



Our Implementation

- Saved fine-tuned model to .sav file using JobLib python module
- Uploaded model to obi server
- Created a python script to retrieve and run the fine-tuned model upon review submission
- jQuery, AJAX, JavaScript
- Python
- HTML, CSS

https://obi.kean.edu/~fisheral/movie_review_sentiment/index.html



Sources:

1) Bhatt, D. (2023, February 14). Neuro symbolic ai: Enhancing common sense in ai. Analytics Vidhya. Retrieved May 7, 2023, from https://www.analyticsvidhya.com/blog/2023/02/neuro-symbolic-ai-enhancing-common-sense-in-ai/
2) Danilevsky, M., Qian, K., Aharonov, R., Katsis, Y., Kawas, B., Sen, P. (2020, October 1). A survey of the state of explainable AI for natural language processing. arXiv.org. Retrieved March 31, 2023, from https://arxiv.org/abs/2010.00711v1
3) Hamilton, K., Nayak, A., Bozi˘ c, B., Longo, L. (2022, January 1). Is ´ neuro-symbolic AI meeting its promises in Natural Language Processing? A structured review. Semantic Web. Retrieved March 31, 2023, from https://content.iospress.com/articles/semantic-web/sw223228
4) Juhn, Y., Liu, H. (2019, December 26). Artificial intelligence approaches using natural language processing to advance EHR-based Clinical Research. Journal of Allergy and Clinical Immunology. Retrieved March 31, 2023, from https://www.sciencedirect.com/science/article/abs/pii/S0091674919326041
5) Maas, A. L., Daly, R. E., Pham, P. T., Huang, D., Ng, A. Y., Potts, C. (n.d.). Learning word vectors for sentiment analysis - Stanford University. Retrieved April 1, 2023, from https://ai.stanford.edu/ amaas/papers/wvSent acl2011.pdf
6) Nest, E. | T. R. (2020, April 12). Explainable AI - what is it and why do we need it? Medium. Retrieved May 7, 2023, from https://medium.com/the-research-nest/explainable-ai-what-is-it-and-why-do-we-need-it-261509e48cc
7) N, L. (2019, March 9). IMDB dataset of 50K movie reviews. Kaggle. Retrieved March 31, 2023, from https://www.kaggle.com/datasets/lakshmi25npathi/imdb-dataset-of50k-movie-reviews