Sentiment Analysis

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Overview

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RoBERTa & other models, tokenization/encoding strategies, stop-word removal

Background 01

Sentiment Analysis

- **Sentiment Analysis**
  - NLP technique
  - Focused on understanding polarity of data
    - how positive or negative (or neutral)
  - Often used in business to gauge customer interest / satisfaction
- **Natural Language Processing (NLP)**
  - The ability of a program to understand a human language (natural language) in a written or spoken context.
  - Uses Artificial Intelligence

Dataset

- Sentiment140
  - 1.6 mil tweets annotated (0 = negative, 4 = positive)
  - Fields
    - target
    - ids
    - date
    - user
    - text
  - 50/50 split of negative & positive sentiment

Methods 02

NLTK Sentiment Vader

- **Valence Aware Dictionary and sEntiment Reasoner**
- **Lexicon and rule-based model**
  - Key words are given a value
  - VADER provides estimates based on key words that appear
- **Downside:**
  - Difficult to upkeep
  - If no keywords appear, VADER will evaluate data as neutral
- Process:
  - Vader is pretrained
  - Using sentiment140 dataset, used Vader to calculate Polarity Scores

Bidirectional Encoder Representations from Transformers (BERT)

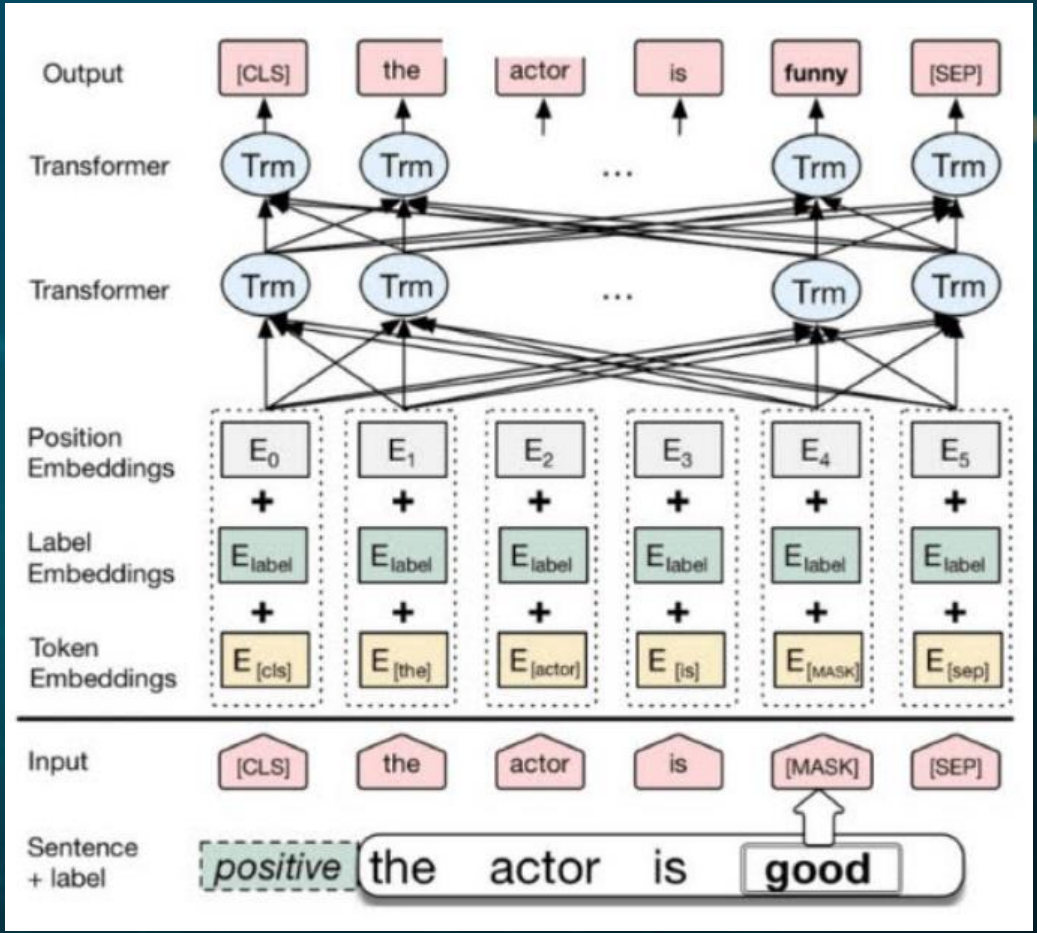
- **Transformer:**
  - every output element connected to every input element, weightings btwn. them dynamically calculated during training
  - self-attention mechanism to **figure out how important all the other "words" in the sentence are** w.r.t. to the aforementioned "word"
    - e.g. "I am hungry."
- **BERT:**
  - Pre-trained with text from Wikipedia (Masked Language Modeling & Next Sentence Prediction
  - Can "read both directions" at once

BERT Tokenization

```
>>> from transformers import BertTokenizer

>>> tokenizer = BertTokenizer.from_pretrained("bert-base-uncased")
>>> tokenizer.tokenize("I have a new GPU!")
["i", "have", "a", "new", "gp", "##u", "!"]
```

BERT Architecture



Results & Analysis

03

NLTK Sentiment Vader vs. BERT

- **Precision:**
  - Measures exactness
  - VADER:
    - Positive: 0.64
    - Negative: 0.78
  - BERT:
    - Positive: 0.89
    - Negative: 0.89

- **Recall:**
  - Measures completeness
  - VADER:
    - Positive: 0.89
    - Negative: 0.44
  - BERT:
    - Positive: 0.89
    - Negative: 0.89

NLTK Sentiment Vader vs. BERT

- **F1 Score:**
  - Harmonic mean of Precision & Recall
  - VADER:
    - Positive: 0.75
    - Negative: 0.56
  - BERT:
    - Positive: 0.89
    - Negative: 0.89

- **Accuracy:**
  - VADER: 0.68
  - BERT: 0.89

Analysis

- **Evaluation of Performance:**
  - recall: BERT
  - precision: BERT
  - f1-score: BERT
  - accuracy: BERT
- Due to its bidirectional transformer encoder architecture and its overall intricate deep learning design (better suited for bigger datasets, i.e. sentiment140), theoretically speaking it should perform better

Conclusion & Future Work

04

Conclusion

- **Conclusion:**
  - Bigger datasets should generally employ/utilize deep learning models
  - Advancement of NLP time & effort -> BERT, RoBERTa, DistilBERT, XLNet
- **Future Work:**
  - Limited due to lack of GPU
  - Tokenizers & Models (RoBERTa, other HuggingFace models)
  - Stop Word removal (“the”, “by”, etc.)
  - Different Hyperparameters (learning rates, epochs)
  - Different Optimization & Error/Loss Functions (AdamW & Cross Entropy Loss)

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Q/A