

AI_PHASE 2 PROJECT

BY

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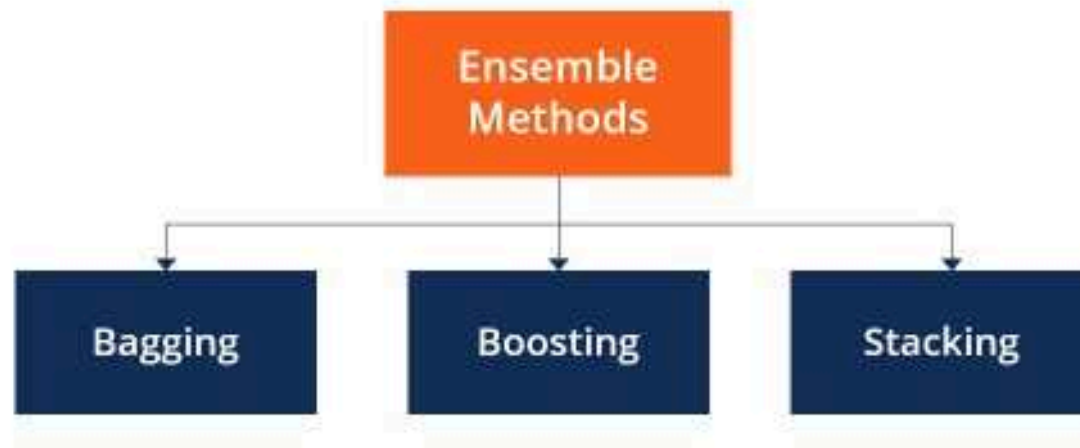
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ENSEMBLE METHODS

- Ensemble methods are machine learning techniques that combine multiple models or model instances to improve overall prediction accuracy and robustness.
- Instead of relying on a single model, ensemble methods leverage the outputs of multiple models to make more accurate predictions.
- Ensemble methods aim at improving predictability in models by combining several models to make one very reliable model. The most popular ensemble methods are boosting, bagging, and stacking.

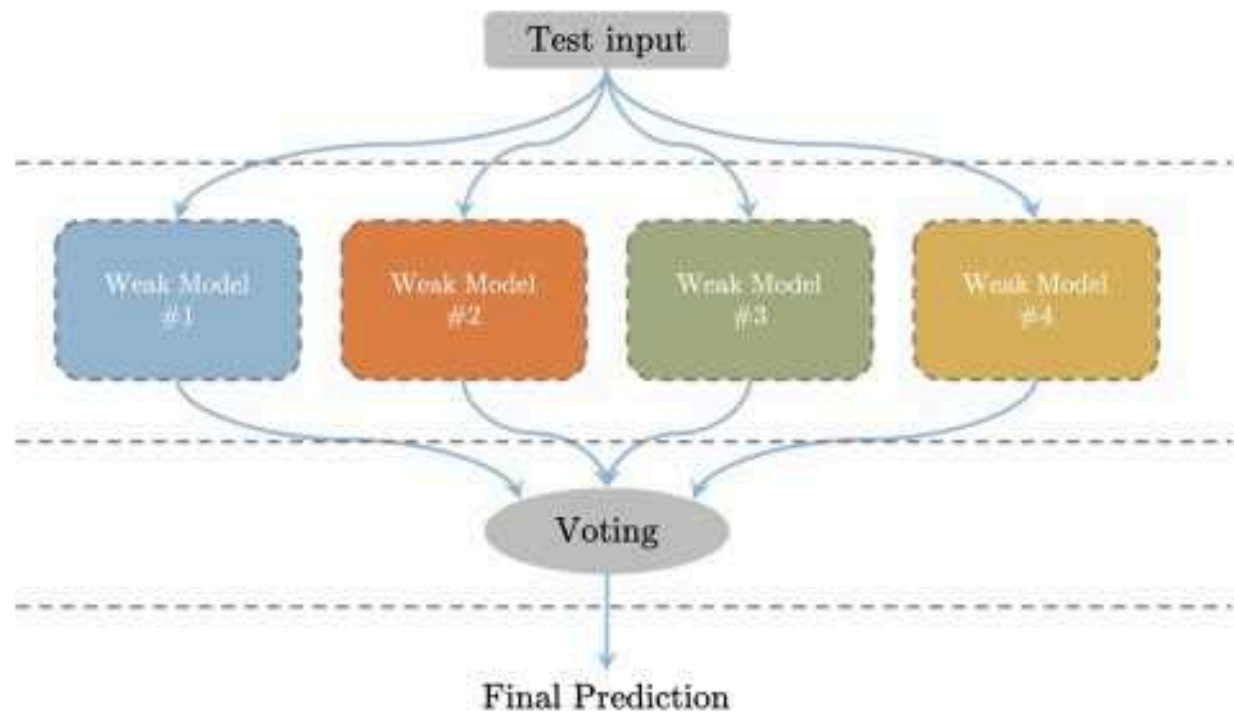
OVERVIEW ENSEMBLES METHODS



Ensemble methods in deep learning are used to improve the performance of neural networks and can take many forms including:

- **Stacking:** Training multiple deep learning models and utilizing the outputs of each model to train a “meta-model”, a machine learning model that takes other models’ outputs as inputs. The meta-model takes the base model predictions as inputs and learns how to best combine them to make the final prediction. This approach can enhance the model's predictive power and capture complex relationships in the data.
- **Bagging:** Training multiple instances of the same model on different subsets of data and combining the model outputs through averaging or voting. This approach can improve the model's generalizability.
- **Model Averaging:** Independently training multiple instances of the same deep learning model with different initializations (the initial values of the parameters or weights of a model before training), and averaging the model outputs to obtain a final prediction. This approach can reduce the impact of varying initializations among models and provide more stable predictions.
- **Boosting,** a very common ensemble method in classical machine learning is not prevalent in deep learning. Boosting entails combining weaker machine learning models, such as decision trees in classical machine learning, to create a single strong model. While there are some recent examples of boosting in deep learning, deep learning models are often capable of achieving high accuracy without the need for boosting.

FLOW CHART



DATASET:

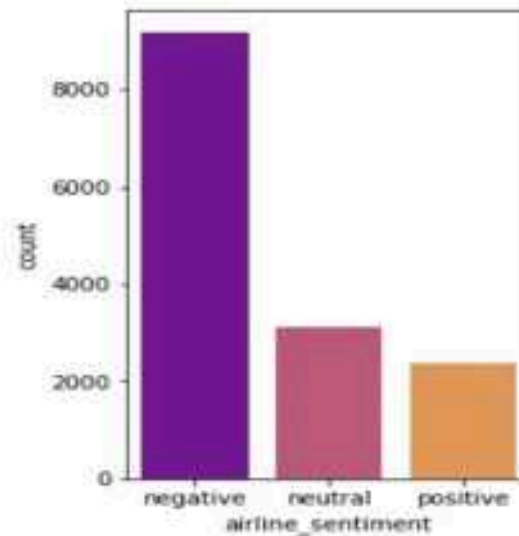
Dataset Link: <https://www.kaggle.com/datasets/crowdflower/twitter-airline-sentiment>

tweet_id	airline_pos	airline_neg	negative_pos	negative_neg	airline	airline_pos	name	negative_pos	retweet
5.76+17	neutral	1			Virgin America		cardin		
5.76+17	positive	0.3486			Virgin America		guardina		
5.76+17	neutral	0.6837			Virgin America		yvonnalyrm		
5.76+17	negative	1	Bad Flight	0.3023	Virgin America		cardin		
5.76+17	negative	1	Can't Tell	1	Virgin America		cardin		
5.76+17	negative	1	Can't Tell	0.6842	Virgin America		cardin		
5.76+17	positive	0.6745			Virgin America		cardin		
5.76+17	neutral	0.634			Virgin America		cardin		
5.76+17	positive	0.6559			Virgin America		cardin		
5.76+17	positive	1			Virgin America		cardin		
5.76+17	neutral	0.6768			Virgin America		cardin		
5.76+17	positive	1			Virgin America		cardin		
5.76+17	positive	1			Virgin America		cardin		
5.76+17	positive	0.6451			Virgin America		cardin		
5.76+17	positive	1			Virgin America		cardin		
5.76+17	negative	0.6842	Late Flight	0.3084	Virgin America		cardin		
5.76+17	positive	1			Virgin America		cardin		
5.76+17	negative	1	Bad Flight	1	Virgin America		cardin		
5.76+17	positive	1			Virgin America		cardin		
5.76+17	positive	1			Virgin America		cardin		
5.76+17	negative	0.6709	Can't Tell	0.3814	Virgin America		cardin		
5.76+17	positive	1			Virgin America		cardin		
5.76+17	positive	1			Virgin America		cardin		
5.76+17	neutral	1			Virgin America		cardin		
5.76+17	negative	1	Customer	0.2557	Virgin America		cardin		
5.76+17	negative	1	Customer	1	Virgin America		cardin		
5.76+17	negative	1	Can't Tell	0.6614	Virgin America		cardin		
5.76+17	neutral	0.6854			Virgin America		cardin		
5.76+17	negative	1	Bad Flight	1	Virgin America		cardin		
5.76+17	neutral	0.635			Virgin America		cardin		
5.76+17	negative	1	Flight Boo	1	Virgin America		cardin		
5.76+17	neutral	1			Virgin America		cardin		
5.76+17	negative	1	Customer	1	Virgin America		cardin		
5.76+17	negative	1	Customer	1	Virgin America		cardin		
5.76+17	positive	1			Virgin America		cardin		
5.76+17	neutral	0.6207			Virgin America		cardin		

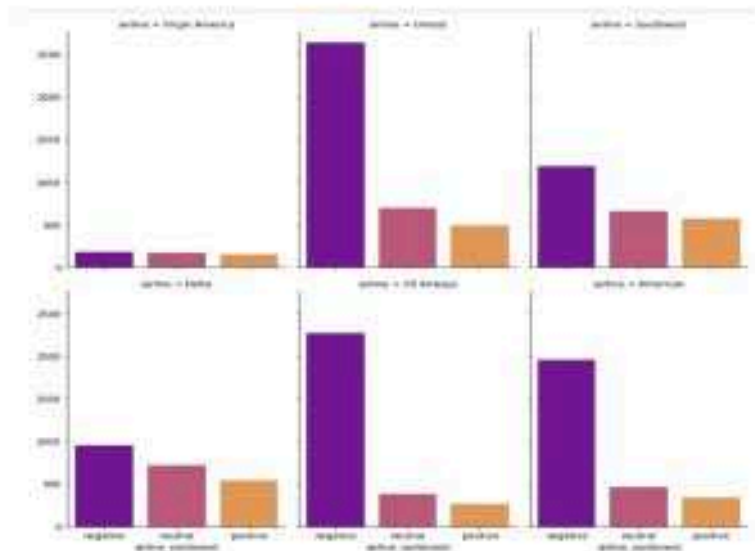
- `tweets = pd.read_csv('Tweets.csv')`
- Let's look at features included in dataset:
- `tweets.head()`
- `tweets.info()`


```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 14640 entries, 0 to 14639
Data columns (total 15 columns):
tweet_id                14640 non-null int64
airline_sentiment       14640 non-null object
airline_sentiment_confidence 14640 non-null float64
negativereason          9178 non-null object
negativereason_confidence 10522 non-null float64
airline                 14640 non-null object
airline_sentiment_gold  40 non-null object
name                    14640 non-null object
negativereason_gold     32 non-null object
retweet_count           14640 non-null int64
text                    14640 non-null object
tweet_coord             1019 non-null object
tweet_created           14640 non-null object
tweet_location          9907 non-null object
user_timezone           9820 non-null object
dtypes: float64(2), int64(2), object(11)
memory usage: 1.7+ MB
```

- `plt.figure(figsize=(3,5))`
`sns.countplot(tweets['airline_sentiment'],`
`order=tweets.airline_sentiment.value_counts().index,palette='plasma'`
`)`
`plt.show()`



- `g = sns.FacetGrid(tweets, col="airline", col_wrap=3, height=5, aspect=0.7)`
`g = g.map(sns.countplot, "airline_sentiment", order=tweets.airline_sentiment.value_counts().index, palette='plasma')`
`plt.show()`



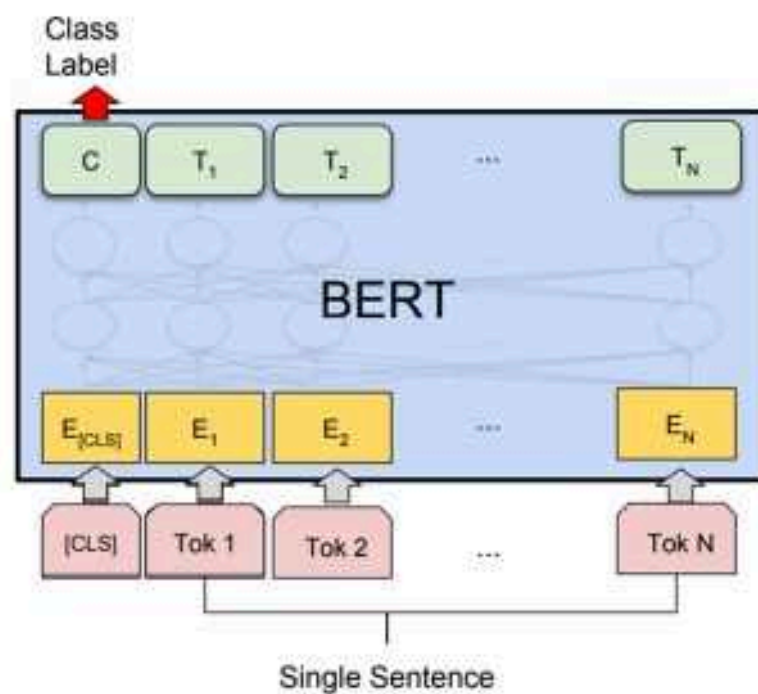
- To do sentiment analysis, we need to import a few libraries. Since this is a classification problem, I use LGBMClassifier.
- `from lightgbm import LGBMClassifier`
- We need to convert these tweets (texts) to a matrix of token counts.
- `from sklearn.feature_extraction.text import CountVectorizer`
- The next step is to normalize the count matrix using tf-idf representation.
- `from sklearn.feature_extraction.text import TfidfTransformer`
- I used the pipeline function to do all steps together.

- `twitter_sentiment = Pipeline([('CVec', CountVectorizer(stop_words='english')),`
 - `('Tfidf', TfidfTransformer()),`
 - `('norm', Normalizer()),`
 - `('tSVD', TruncatedSVD(n_components=100)),`
 - `('lgb', LGBMClassifier(n_jobs=-1))])`
 - In the end, `CROSS_VALIDATE` is used with `ROC_AUC` metrics.
-
- `%%time`
 - `cv_pred = cross_validate(twitter_sentiment,`
 - `tweets['text'],`
 - `tweets['airline_sentiment'],`
 - `cv=5,`
 - `scoring=('roc_auc_ovr'))`
 - The results we have measured using `ROC_AUS` are as follows.

Bidirectional Representation for Transformers (BERT)

- BERT is a powerful technique for natural language processing that can improve how well computers comprehend human language. The foundation of BERT is the idea of exploiting bidirectional context to acquire complex and insightful word and phrase representations. By simultaneously examining both sides of a word's context, BERT can capture a word's whole meaning in its context, in contrast to earlier models that only considered the left or right context of a word.
- This enables BERT to deal with ambiguous and complex linguistic phenomena including polysemy, co-reference, and long-distance relationships.
- For that, the paper also proposed the architecture of different tasks. In this post, we will be using BERT architecture for Sentiment classification tasks specifically the architecture used for the CoLA (Corpus of Linguistic Acceptability) binary classification task.

SINGLE SENTENCE CLASSIFICATION TASK



Step 1: Import the necessary libraries

- PROGRAM:
- `import os`
- `import shutil`
- `import tarfile`
- `import tensorflow as tf`
- `from transformers import BertTokenizer, TFBertForSequenceClassification`
- `import pandas as pd`
- `from bs4 import BeautifulSoup`
- `import re`
- `import matplotlib.pyplot as plt`
- `import plotly.express as px`
- `import plotly.offline as pyo`
- `import plotly.graph_objects as go`
- `from wordcloud import WordCloud, STOPWORDS`
- `from sklearn.model_selection import train_test_split`
- `from sklearn.metrics import classification_report`

Step 2: Load the dataset

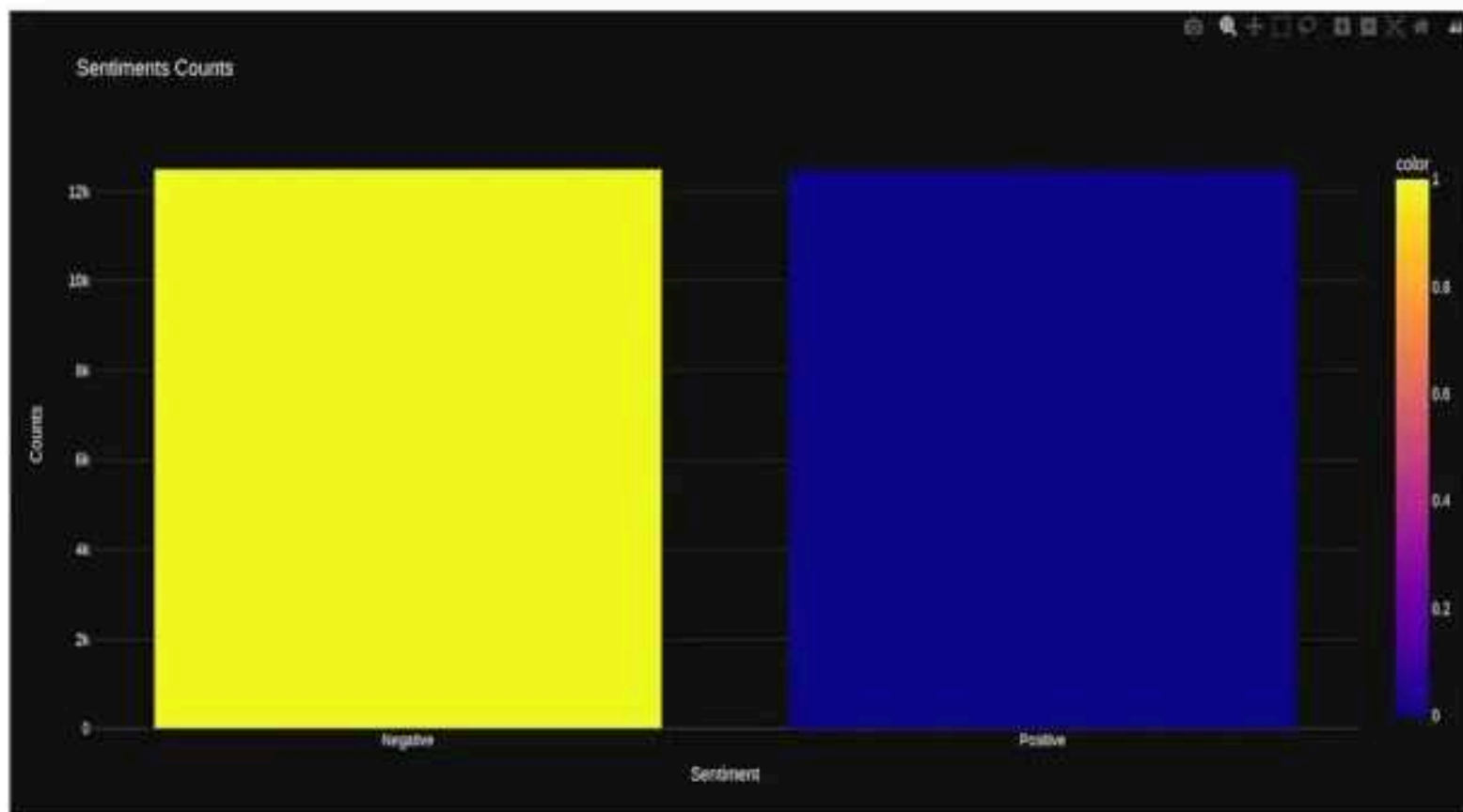
- # Get the current working directory
- `current_folder = os.getcwd()`
- `dataset = tf.keras.utils.get_file(`
 - `fname="aclImdb.tar.gz",`
 - `origin`
`="http://ai.stanford.edu/~amaas/data/sentiment/aclImdb_v1.tar.gz",`
 - `cache_dir=current_folder,`
 - `extract = True)`

- Output:
- ['acllmbd.tar.gz', 'acllmbd']

Step 3: Preprocessing

```
sentiment_counts = train_df['sentiment'].value_counts()

fig = px.bar(x= {0:'Negative',1:'Positive'},
              y= sentiment_counts.values,
              color=sentiment_counts.index,
              color_discrete_sequence =
px.colors.qualitative.Dark24,
              title='<b>Sentiments Counts')
```



CONCLUSION:

Sentiment analysis deals with the classification of texts based on the sentiments they contain. This article focuses on a typical sentiment analysis model consisting of three core steps, namely data preparation, review analysis and sentiment classification, and describes representative techniques involved in those steps.