Text Classification with FastText & Preprocessed with NLTK Library

- **Official Documentations :**
- what is fasttext : https://fasttext.cc/docs/en/support.html
- Tutorials(Text Classification): https://fasttext.cc/docs/en/supervised-tutorial.html
- Tutorials(Word Representation): https://fasttext.cc/docs/en/unsupervised-tutorial.html
- python module : https://fasttext.cc/docs/en/python-module.html
- Blog post: https://fasttext.cc/blog/2016/08/18/blog-post.html
- why fasttext invented : https://arxiv.org/pdf/1607.04606.pdf
- github : https://github.com/facebookresearch/fastText
- **Articles :**
- https://medium.com/@oleg.tarasov/building-fasttext-python-wrapper-from-source-under-windows-68e693a68cbb
- https://radimrehurek.com/gensim/models/fasttext.html
- https://stackabuse.com/python-for-nlp-working-with-facebook-fasttext-library/

What is fasttext?

fastText is an open-source library, developed by the Facebook AI Research lab.

- **Why fasttext?**
- better and faster **text classification**
- **efficient learning** of **word representations**
- for processing large datasets quickly and accurately.
- fastText stacks impressively in both accuracy and training and testing times against previously published state-of-the-art models.

Dataset :

https://www.kaggle.com/snap/amazon-fine-food-reviews

Workflow :

- Import required libraries
- Basic Data Exploration
- Feature Engineering
- Model creation and Evaluation

___ Importing necessary Libraries_

In [1]:

```
import re
import missingno
import nltk
from nltk.corpus import stopwords
from nltk.stem.porter import PorterStemmer
from nltk.tokenize import word_tokenize

import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import missingno as msno
```

In [2]:

```
df = pd.read_csv(r'C:\Users\ASUS\Desktop\FastText\Dataset\Amazon_FoodReviews.csv')
```

In [3]:

```
df.head()
```

Out[3]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	Summary	Text
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	1	5	1303862400	Good Quality Dog Food	I have bought several of the Vitality canned d...
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	0	1	1346976000	Not as Advertised	Product arrived labeled as Jumbo Salted Peanut...
2	3	B000LQOCH0	ABXLMWJIXXAIN	Natalia Corres "Natalia Corres"	1	1	4	1219017600	"Delight" says it all	This is a confection that has been around a fe...
3	4	B000UA0QIQ	A395BORC6FGVXV	Karl	3	3	2	1307923200	Cough Medicine	If you are looking for the secret ingredient i...
4	5	B006K2ZZ7K	A1UQRSCLF8GW1T	Michael D. Bigham "M. Wassir"	0	0	5	1350777600	Great taffy	Great taffy at a great price. There was a wid...

___ Basic Data Exploration & Preprocessing ___

In [4]:

```
print(df.columns.tolist())
```

```
['Id', 'ProductId', 'UserId', 'ProfileName', 'HelpfulnessNumerator', 'HelpfulnessDenominator', 'Score', 'Time', 'Summary', 'Text']
```

In [5]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 568454 entries, 0 to 568453
Data columns (total 10 columns):
 #   Column                  Non-Null Count   Dtype
---  ------                  --------------   -----
 0   Id                      568454 non-null  int64
 1   ProductId               568454 non-null  object
 2   UserId                  568454 non-null  object
 3   ProfileName             568438 non-null  object
 4   HelpfulnessNumerator    568454 non-null  int64
 5   HelpfulnessDenominator  568454 non-null  int64
 6   Score                   568454 non-null  int64
 7   Time                    568454 non-null  int64
 8   Summary                 568427 non-null  object
 9   Text                    568454 non-null  object
dtypes: int64(5), object(5)
memory usage: 43.4+ MB
```

In [6]:

```
#dropping unnecessary columns
df= df.drop(['Id','ProductId','UserId','ProfileName','HelpfulnessNumerator', 'HelpfulnessDenominator','Time', 'Summary'], axis=1)
```

In [7]:

```
df.head()
```

Out[7]:

	Score	Text
0	5	I have bought several of the Vitality canned d...
1	1	Product arrived labeled as Jumbo Salted Peanut...
2	4	This is a confection that has been around a fe...
3	2	If you are looking for the secret ingredient i...
4	5	Great taffy at a great price. There was a wid...

In [8]:

```
#checking null values

df.isnull().sum()
```

Out[8]:

```
Score    0
Text     0
dtype: int64
```

In [9]:

```
#checking nan values

df.isna().sum()
```

Out[9]:

```
Score    0
Text     0
dtype: int64
```

In [10]:

```
print(df['Score'].unique())  #checking scores
```

```
[5 1 4 2 3]
```

In [11]:

```
a = df['Score'].value_counts()
a
```

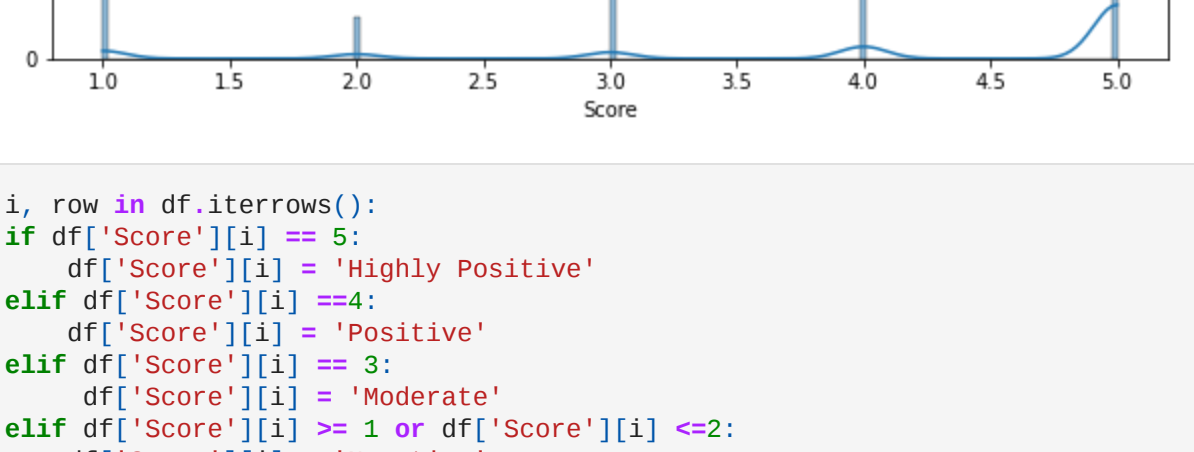
Out[11]:

```
5    363122
4     80655
1     52268
3     42640
2     29769
Name: Score, dtype: int64
```

In [12]:

```
plt.figure(figsize = (10, 5))
sns.histplot(x ="Score",data=df, kde = True,palette="dark")
```

Out[12]: `<AxesSubplot:xlabel='Score', ylabel='Count'>`



In [13]:

```
for i, row in df.iterrows():
    if df['Score'][i] == 5:
        df['Score'][i] = 'Highly Positive'
    elif df['Score'][i] ==4:
        df['Score'][i] = 'Positive'
    elif df['Score'][i] == 3:
         df['Score'][i] = 'Moderate'
    elif df['Score'][i] >= 1 or df['Score'][i] <=2:
        df['Score'][i] = 'Negative'
    elif df['Score'][i] == 0:
        df['Score'][i] = 'Neutral'
```

```
<ipython-input-13-7a11bfd5a22e>:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df['Score'][i] = 'Highly Positive'
C:\ProgramData\Anaconda3\lib\site-packages\pandas\core\indexing.py:1637: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  self._setitem_single_block(indexer, value, name)
```

In [14]:

```
df.head()

b = df['Score'].value_counts()
b
```

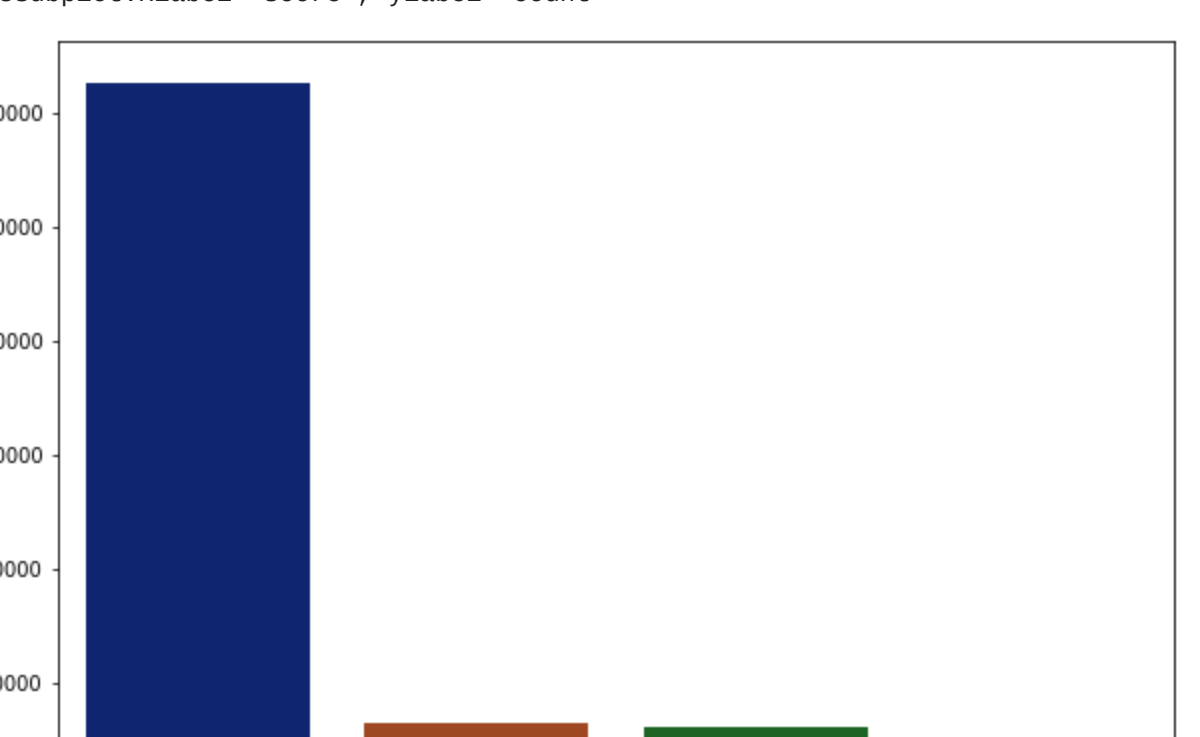
Out[14]:

```
Highly Positive    363122
Negative            82037
Positive            80655
Moderate            42640
Name: Score, dtype: int64
```

In [15]:

```
plt.figure(figsize = (10,8))
sns.countplot(x="Score",data=df, palette="dark")
```

Out[15]: `<AxesSubplot:xlabel='Score', ylabel='count'>`



In [17]:

```
ps = PorterStemmer()
def clean_text(Text):
    Text = str(Text).lower() # convert to lowercase
    Text = re.sub('\[.*?\]', '', Text)
    Text = re.sub(r"\s+[a-zA-Z]\s+", ' ', Text) # remove single letter
    Text = Text.replace('n\'t', ' not') # convert n't to not
    Text = re.sub('https?://\S+|www\.\S+', '', Text) # Remove URls, whitespace characters
    Text= re.sub('<.*?>+', '',Text)
    Text = re.sub(r'[^a-z0-9\s]', '', Text) # Remove punctuation
    Text= re.sub('\n', '', Text)
    Text= re.sub('\w*\d\w*', '', Text) #\d matches a digit between 0 to 9
    Text = Text.split() #tokenization
    Text = [ps.stem(word) for word in Text if not word in stopwords.words('english')] #stemming and removing stopwords
    Text = ' '.join(Text)
    return Text
```

In [18]:

```
df['Text'] = df['Text'].apply(clean_text)
```

In [19]:

```
df
```

Out[19]:

	Score	Text
0	Highly Positive	bought sever vital can dog food product found ...
1	Negative	product arriv label jumbo salt peanutsth peanu...
2	Positive	confect around centuri light pillowi citru gel...
3	Negative	look secret ingredi robitussin believ found go...
4	Highly Positive	great taffi great price wide assort yummi taff...
...	...	...
568449	Highly Positive	great sesam chickenthi good better restur eate...
568450	Negative	im disappoint flavor chocol note especi weak m...
568451	Highly Positive	star small give one train session tri train do...
568452	Highly Positive	best treat train reward dog good groom lower c...
568453	Highly Positive	satisfi product advertis use cereal raw vinega...

568454 rows × 2 columns

Data splitting

In [20]:

```
train_df= df[:420000]  #taking the first 420000 data from the huge dataset
print(train_df['Text'].iloc[0])
train_df
```

```
bought sever vital can dog food product found good qualiti product look like stew process meat smell better labrador finicki appreci product better
```

Out[20]:

	Score	Text
0	Highly Positive	bought sever vital can dog food product found ...
1	Negative	product arriv label jumbo salt peanutsth peanu...
2	Positive	confect around centuri light pillowi citru gel...
3	Negative	look secret ingredi robitussin believ found go...
4	Highly Positive	great taffi great price wide assort yummi taff...
...	...	...
419995	Highly Positive	im familiar brand alreadi like one realli enjo...
419996	Highly Positive	starbuck coffe opinon second none best coffe ever
419997	Highly Positive	maxwel hous lite coffe quit similar folger hal...
419998	Positive	ca go wrong wolfgang puck qualiti alway great ...
419999	Negative	wife love wolfgang puck caramel cream tri kcup...

420000 rows × 2 columns

In [21]:

```
test_df= df[420000:]  #taking the first 20000 data from the huge dataset
print(test_df['Text'].iloc[0])
test_df
```

```
im coffe drinker thought id give tri sinc like caramel latt occas ive ad plu littl sugar good tast good balanc coffeecreamersugar make sicki sweet like barrista version bitter like
coffe
```

Out[21]:

	Score	Text
420000	Positive	im coffe drinker thought id give tri sinc like...
420001	Positive	never tast thisbut wife stepdaught love cheapb...
420002	Highly Positive	lot choic net buy hazelnut went klein simpli p...
420003	Highly Positive	love garlic marinara sauc tast like homemad ad...
420004	Highly Positive	hope said lol sauc amaz size perfect great man...
...	...	...
568449	Highly Positive	great sesam chickenthi good better restur eate...
568450	Negative	im disappoint flavor chocol note especi weak m...
568451	Highly Positive	star small give one train session tri train do...
568452	Highly Positive	best treat train reward dog good groom lower c...
568453	Highly Positive	satisfi product advertis use cereal raw vinega...

148454 rows × 2 columns

In [22]:

```
# fastText expects the category first, with the prefix '__label__' before each category, and then the input text
```

In [23]:

```
train_dataset = train_df[['Text', 'Score']].rename(columns = {'Text': 'Reviews', 'Score': 'category'})
test_dataset = test_df[['Text', 'Score']].rename(columns = {'Text': 'Reviews', 'Score': 'category'})
```

In [24]:

```
# Prefixing each row of the category column with '__label__'
train_dataset.iloc[:, 1] = train_dataset.iloc[:, 1].astype(str).apply(lambda x: '__label__' + x)
test_dataset.iloc[:, 1] = test_dataset.iloc[:, 1].astype(str).apply(lambda x: '__label__' + x)
```

In [25]:

```
train_dataset.head()
```

Out[25]:

	Reviews	category
0	bought sever vital can dog food product found ...	__label__Highly Positive
1	product arriv label jumbo salt peanutsth peanu...	__label__Negative
2	confect around centuri light pillowi citru gel...	__label__Positive
3	look secret ingredi robitussin believ found go...	__label__Negative
4	great taffi great price wide assort yummi taff...	__label__Highly Positive

In [26]:

```
test_dataset.head()
```

Out[26]:

	Reviews	category
420000	im coffe drinker thought id give tri sinc like...	__label__Positive
420001	never tast thisbut wife stepdaught love cheapb...	__label__Positive
420002	lot choic net buy hazelnut went klein simpli p...	__label__Highly Positive
420003	love garlic marinara sauc tast like homemad ad...	__label__Highly Positive
420004	hope said lol sauc amaz size perfect great man...	__label__Highly Positive

In [ ]:

In [27]:

```
df_train = pd.DataFrame(train_dataset, columns = ['category', 'Reviews'])
```

In [28]:

```
df_train
```

Out[28]:

	category	Reviews
0	__label__Highly Positive	bought sever vital can dog food product found ...
1	__label__Negative	product arriv label jumbo salt peanutsth peanu...
2	__label__Positive	confect around centuri light pillowi citru gel...
3	__label__Negative	look secret ingredi robitussin believ found go...
4	__label__Highly Positive	great taffi great price wide assort yummi taff...
...	...	...
419995	__label__Highly Positive	im familiar brand alreadi like one realli enjo...
419996	__label__Highly Positive	starbuck coffe opinon second none best coffe ever
419997	__label__Highly Positive	maxwel hous lite coffe quit similar folger hal...
419998	__label__Positive	ca go wrong wolfgang puck qualiti alway great ...
419999	__label__Negative	wife love wolfgang puck caramel cream tri kcup...

420000 rows × 2 columns

In [29]:

```
df_test = pd.DataFrame(test_dataset, columns = ['category', 'Reviews'])
```

In [30]:

```
df_test
```

Out[30]:

	category	Reviews
420000	__label__Positive	im coffe drinker thought id give tri sinc like...
420001	__label__Positive	never tast thisbut wife stepdaught love cheapb...
420002	__label__Highly Positive	lot choic net buy hazelnut went klein simpli p...
420003	__label__Highly Positive	love garlic marinara sauc tast like homemad ad...
420004	__label__Highly Positive	hope said lol sauc amaz size perfect great man...
...	...	...
568449	__label__Highly Positive	great sesam chickenthi good better restur eate...
568450	__label__Negative	im disappoint flavor chocol note especi weak m...
568451	__label__Highly Positive	star small give one train session tri train do...
568452	__label__Highly Positive	best treat train reward dog good groom lower c...
568453	__label__Highly Positive	satisfi product advertis use cereal raw vinega...

148454 rows × 2 columns

In [31]:

```
import csv
df_train[['category', 'Reviews']].to_csv('train.txt',
                                          index = False,
                                          sep = ' ',
                                          header = None,
                                          quoting = csv.QUOTE_NONE,
                                          quotechar = "",
                                          escapechar = " ")
```

In [32]:

```
df_test[['category', 'Reviews']].to_csv('test.txt',
                                          index = False,
                                          sep = ' ',
                                          header = None,
                                          quoting = csv.QUOTE_NONE,
                                          quotechar = "",
                                          escapechar = " ")
```

Model Training, Evaluation,Text Classification

https://fasttext.cc/blog/2019/06/25/blog-post.html

In [33]:

```
#!pip install fasttext
```

In [34]:

```
import fasttext
from fasttext import load_model
```

In [35]:

```
# Training the fastText classifier
model = fasttext.train_supervised("train.txt", lr=0.1, dim=100, epoch=5, word_ngrams=2, loss='softmax')
model.save_model("model_file.bin")
```

In [74]:

```
# Save the trained model
model.save_model('model_file.bin')
```

In [37]:

```
ft_model = load_model('model_file.bin')
```

```
Warning : `load_model` does not return WordVectorModel or SupervisedModel any more, but a `FastText` object which is very similar.
```

To evaluate our model by computing the precision at 1 (P@1) and the recall on a test set, we use the test function:

In [38]:

```
#N = Number of data
# precision value
# Recall value
```

In [39]:

```
def print_results(N, p, r):
    print("N\t" + str(N))
    print("P@{}\t{:.3f}".format(1, p))
    print("R@{}\t{:.3f}".format(1, r))

print_results(*ft_model.test('test.txt'))
```

```
N       148454
P@1     0.928
R@1     0.928
```

In [40]:

```
# Evaluating performance on the entire test file
ft_model.test('test.txt')
```

Out[40]:

```
(148454, 0.9276072049254315, 0.9276072049254315)
```

In [41]:

```
def print_results(N, p, r):
    print("N\t" + str(N))
    print("P@{}\t{:.3f}".format(1, p))
    print("R@{}\t{:.3f}".format(1, r))

print_results(*ft_model.test('train.txt'))
```

```
N       420000
P@1     0.986
R@1     0.986
```

In [42]:

```
ft_model.test('train.txt')
```

Out[42]:

```
(420000, 0.9859928571428571, 0.9859928571428571)
```

In [43]:

```
# Predicting on a single input
ft_model.predict(df_test.iloc[2, 0])
```

Out[43]:

```
(('__label__Highly',), array([1.00001001]))
```

In [44]:

```
print(df_test.iloc[2, 0])
```

```
__label__Highly Positive
```

In [45]:

```
ft_model.predict("hey! you're so talented")
```

Out[45]:

```
(('__label__Negative',), array([0.96972424]))
```

In [46]:

```
ft_model.predict(" The food doesn't taste good")
```

Out[46]:

```
(('__label__Positive',), array([0.9933393]))
```

By default, predict returns only one label : the one with the highest probability. You can also predict more than one label by specifying the parameter k:

In [48]:

```
ft_model.predict(" The food tastes good")
```

Out[48]:

```
(('__label__Positive',), array([0.93136156]))
```

In [49]:

```
ft_model.predict("I hate you")
```

Out[49]:

```
(('__label__Negative',), array([0.99675608]))
```

In [50]:

```
ft_model.predict("You're so toxic")
```

Out[50]:

```
(('__label__Negative',), array([0.99993718]))
```