

```
In [2]: import pandas as pd

df = pd.read_csv("../datasets/train_df.csv")

df
```

```
Out[2]:
```

	qid	question_text	target
0	dda0b0efc8ba86e81ec4	What are interesting facts about Microsoft his...	0
1	dc708b74a108d0fc0ad9	What are those things which are not gonna happ...	0
2	06a27ec5d82dacd8bfe0	What should I know to avoid being "upsold" whe...	0
3	00cbb6b17e3ceb7c5358	How I add any account with payment bank?	0
4	7c304888973a701585a0	Which Multi level marketing products are actua...	0
...
999995	4bd96088d0b5f0f2c4f4	How is CSE at VIT Chennai?	0
999996	e80edbf0c086f7125940f	How can we prevent a holocaust by robots, AI, ...	0
999997	1506dfad6bd340782a1f	How can I help a student remember key steps an...	0
999998	b56c60fd407f2f85553c	What is the difference between lace closure & ...	0
999999	a1b32d315c2782cdbcc3	What happens when you look into a broken mirror?	0

1000000 rows x 3 columns

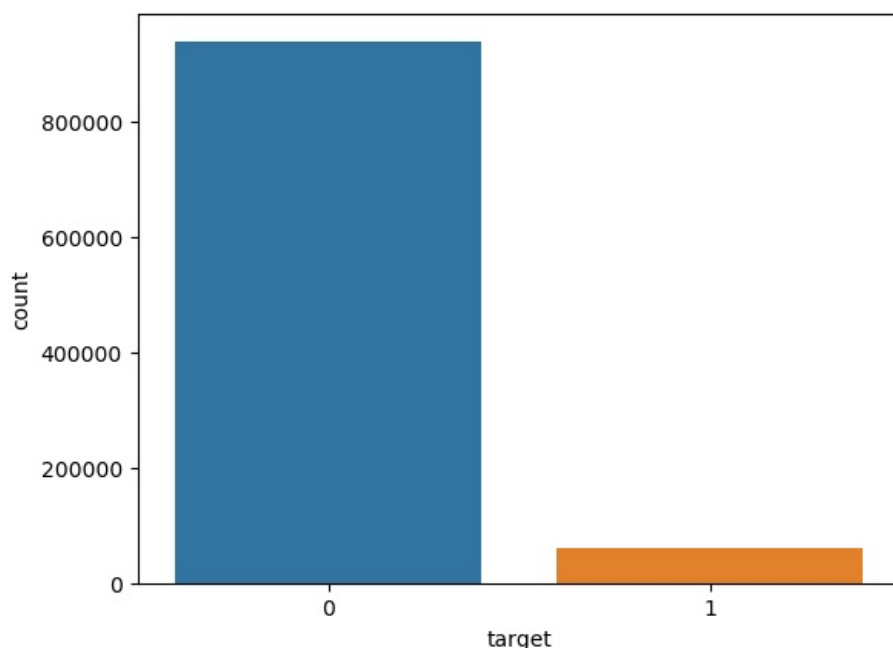
```
In [3]: import seaborn as sns

sns.countplot(df["target"])
```

/home/btv/.local/lib/python3.8/site-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.

warnings.warn(

```
Out[3]: <matplotlib.axes._subplots.AxesSubplot at 0x7f3b31cb4580>
```



Word Tokenizer

```
In [5]: import nltk
nltk.download('punkt')

from nltk.tokenize import word_tokenize

def word_tokenize(sent):
    return nltk.word_tokenize(sent)

print("word tokenizing:", word_tokenize("Life is beautiful so Enjoy everymoment you have."))

word tokenizing: ['Life', 'is', 'beautiful', 'so', 'Enjoy', 'everymoment', 'you', 'have', '.']
[nltk_data] Downloading package punkt to /home/btv/nltk_data...
[nltk_data] Package punkt is already up-to-date!
```

RegexpTokenizer

```
In [6]: from nltk.tokenize import RegexpTokenizer
```

```
def regex_word_tokenizer(sent):
    tokenizer = RegexpTokenizer(r'\w+')

    sample_word_tokens = tokenizer.tokenize(sent)
    sample_word_tokens = [word.lower() for word in sample_word_tokens]
    return sample_word_tokens

words = regex_word_tokenizer(str("Life is beautiful so Enjoy everymoment you have. Runners run hard to win"))
words
```

```
Out[6]: ['life',
         'is',
         'beautiful',
         'so',
         'enjoy',
         'everymoment',
         'you',
         'have',
         'runners',
         'run',
         'hard',
         'to',
         'win']
```

Stopwords Removal

```
In [7]: from nltk.corpus import stopwords
```

```
def stop_words_removal(words):
    stop_words = [word.lower() for word in stopwords.words('english')]
    word_tokens = [word for word in words if word.lower() not in stop_words]
    return word_tokens

stop_words_removal(words)
```

```
Out[7]: ['life', 'beautiful', 'enjoy', 'everymoment', 'runners', 'run', 'hard', 'win']
```

Lemmatizer

```
In [8]: from nltk.stem import WordNetLemmatizer
```

```
def Lemmatizer(words):
    lemmatizer = WordNetLemmatizer()
    lemmatized_words = [lemmatizer.lemmatize(word) for word in words]
    return lemmatized_words

Lemmatizer(stop_words_removal(words))
```

```
Out[8]: ['life', 'beautiful', 'enjoy', 'everymoment', 'runner', 'run', 'hard', 'win']
```

Stemming

```
In [9]: from nltk.stem import PorterStemmer
```

```
def stemmer(words):
    ps = PorterStemmer()
    stemmed_words = [ps.stem(w) for w in words]
    return stemmed_words

stemmer(stop_words_removal(words))
```

```
Out[9]: ['life', 'beauti', 'enjoy', 'everymo', 'runner', 'run', 'hard', 'win']
```

```
In [13]: def format_sentence(sent):
          tokens = regex_word_tokenizer(sent)
          tokens = stop_words_removal(tokens)
          tokens = Lemmatizer(tokens)

          sentence = ""
          for word in tokens:
              sentence += word + " "
          return sentence

format_sentence("Life is beautiful so Enjoy everymoment you have. Runners run hard to win")
```

```
Out[13]: 'life beautiful enjoy everymoment runner run hard win '
```

```
In [20]: X = []
Y = []

for index, row in df.iterrows():
    if(row['target']==1):
        X.append(format_sentence(row['question_text']))
        Y.append(1)
    else:
        X.append(format_sentence(row['question_text']))
        Y.append(0)

X = pd.DataFrame(X, columns=["text"])
Y = pd.DataFrame(Y)
X
```

```
Out[20]:
```

	text
0	interesting fact microsoft history
1	thing gonna happen ever
2	know avoid upsold getting car brake changed
3	add account payment bank
4	multi level marketing product actually worth p...
...	...
999995	cse vit chennai
999996	prevent holocaust robot ai alien
999997	help student remember key step information wri...
999998	difference lace closure lace frontal
999999	happens look broken mirror

1000000 rows x 1 columns

```
In [21]: from sklearn.model_selection import train_test_split
X_train,X_test,Y_train,Y_test = train_test_split(X["text"],Y,random_state = 50)
print(X_train)
```

```
36189      medical treatment chronic shoulder instability
496201                                owner webnovel
321519      find equivalence capacitance unbalanced wheats...
841957                                paris commune considered important
526237      probability density rolling die equilateral tr...
...
441633                                spider belong arthropoda insect
677997      accurate forecast futurist area accurate
239499      program use programming ftp connect server mac
103904      quality highly successful man manager
931504      mobile ram rom reduced software prpblem
Name: text, Length: 750000, dtype: object
```

```
In [24]: from sklearn.feature_extraction.text import CountVectorizer

vect = CountVectorizer().fit(X_train)

vect.get_feature_names()[::1000]
```

```
Out[24]: ['00',
'13a',
'1mole',
'2ch',
'40ft',
'5hp',
'8124',
'aberforth',
'additional',
'agree',
'allama',
'ana',
'antwerpen',
'ari',
'asterisk',
'avenjet',
'bakugo',
'bbazelon',
'besagent',
'bioinformaticians',
'bnys',
'brainstem',
'budy',
'caisson',
```

'carnelia',
'centrosymmetric',
'chera',
'circled',
'cochichina',
'compense',
'constrictor',
'couldd',
'cruise',
'd2h',
'debardeleben',
'democracy',
'developmental',
'dimseng',
'divivde',
'dramaturgy',
'dysuria',
'eill',
'enceladus',
'equivalence',
'eviscerated',
'f7',
'feeric',
'fjr1300',
'formulary',
'fuissé',
'gastroc',
'gianor',
'goodwill',
'grounded',
'hager',
'hat4e',
'hertforshire',
'homefreejob',
'hummer',
'ico',
'impedence',
'infest',
'intercellular',
'irresponsibly',
'janoski',
'jorhat',
'kannnda',
'khader',
'kohlraabi',
'labor',
'leaker',
'ligo',
'longbottom',
'm9',
'malingerer',
'marsha',
'mcreynolds',
'mesmerizing',
'millbrae',
'mockingbird',
'mostlynused',
'murderer',
'naphthaldehyde',
'neptunium',
'nit',
'nttf',
'ofno',
'orchidectomy',
'oversell',
'panphycism',
'pave',
'pero',
'physicl',
'plse',
'positivistic',
'prepopulate',
'prophecy',
'purify',
'qustion',
'rater',
'redevelop',
'renege',
'revealing',
'roderick',
'rxn',
'sanitization',
'scholarships',
'selfishly',
'shamu',
'shrif',
'situationally',
'snout',
'spankophile',

```
'ssrs',
'storeuserdata',
'subverting',
'surved',
'tafsirs',
'techniques',
'thang',
'tights',
'touching',
'trignometry',
'twink',
'unconvicted',
'unrealistic',
'v15',
'verifies',
'vme',
'waterbeds',
'whisky',
'woof',
'yadhav',
'zbrush',
'ἀριστοκράτης']
```

In [25]: `len(vect.get_feature_names())`

```
/home/btv/.local/lib/python3.8/site-packages/sklearn/utils/deprecation.py:87: FutureWarning: Function get_featu
re_names is deprecated; get_feature_names is deprecated in 1.0 and will be removed in 1.2. Please use get_featu
re_names_out instead.
  warnings.warn(msg, category=FutureWarning)
```

Out[25]: 134235

In [28]: `X_train_vectorised = vect.transform(X_train)`
`X_train_vectorised`

Out[28]: <750000x134235 sparse matrix of type '<class 'numpy.int64'>'
with 4664290 stored elements in Compressed Sparse Row format>

In [35]: `from sklearn.naive_bayes import MultinomialNB`
`import numpy as np`

`mnb = MultinomialNB()`
`mnb.fit(X_train_vectorised, np.array(Y_train[0]))`

Out[35]: `▼ MultinomialNB`
`MultinomialNB()`

In [36]: `predictions = mnb.predict(vect.transform(X_test))`

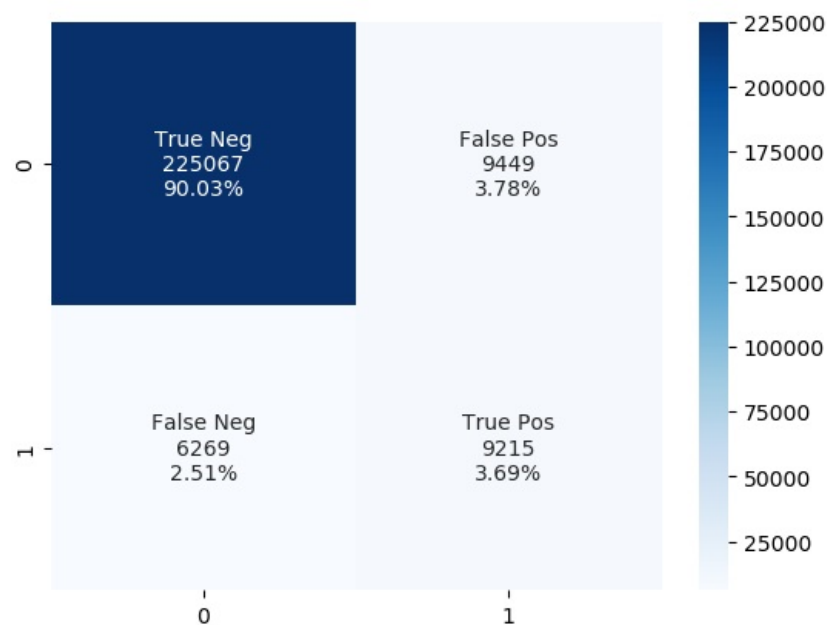
In [39]: `from sklearn.metrics import confusion_matrix`

`cf_matrix = confusion_matrix(np.array(Y_test[0]), predictions)`
`print(cf_matrix)`


```
[[225067  9449]
 [ 6269  9215]]
```

In [40]: `group_names = ["True Neg", "False Pos", "False Neg", "True Pos"]`
`group_counts = [{"0:0.0f}".format(value) for value in`
 `cf_matrix.flatten()]`
`group_percentages = [{"0:.2%}".format(value) for value in`
 `cf_matrix.flatten()/np.sum(cf_matrix)]`
`labels = [f"{v1}\n{v2}\n{v3}" for v1, v2, v3 in`
 `zip(group_names, group_counts, group_percentages)]`
`labels = np.asarray(labels).reshape(2,2)`
`sns.heatmap(cf_matrix, annot=labels, fmt='', cmap='Blues')`

Out[40]: <matplotlib.axes._subplots.AxesSubplot at 0x7f3add4b8f70>



```
In [41]: from sklearn.metrics import f1_score  
f1_score(np.array(Y_test[0]), predictions, average='macro')
```

```
Out[41]: 0.7529845851387855
```

```
In [43]: from sklearn.metrics import accuracy_score  
accuracy_score(Y_test[0], predictions)
```

```
Out[43]: 0.937128
```