```
In [15]: # This Python 3 environment comes with many helpful analytics libraries installed
# It is defined by the kaggle/python Docker image: https://github.com/kaggle/docker-python
# For example, here's several helpful packages to load

import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)

# Input data files are available in the read-only "../input/" directory
# For example, running this (by clicking run or pressing Shift+Enter) will list all files under the input direc

import os
#for dirname, _, filenames in os.walk('/kaggle/input'):
    #for filename in filenames:
        #print(os.path.join(dirname, filename))

# You can write up to 20GB to the current directory (/kaggle/working/) that gets preserved as output when you c
# You can also write temporary files to /kaggle/temp/, but they won't be saved outside of the current session
```

Importing Necessary Libraries

```
In [16]: import numpy as np
import pandas as pd
import nltk
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.decomposition import PCA,SparsePCA
import sklearn.preprocessing as preprocessing
from sklearn.preprocessing import StandardScaler
from sklearn.feature_extraction import DictVectorizer
from sklearn.feature_extraction.text import CountVectorizer,TfidfVectorizer,HashingVectorizer
from sklearn.feature_extraction.text import HashingVectorizer
import numpy as np
import string
from gensim.models import Word2Vec,KeyedVectors
import gensim
```

Read Data and Analyse

```
In [17]: test_d = pd.read_csv("../input/aid-escalating-internet-coverage/test.csv")
train_d = pd.read_csv("../input/aid-escalating-internet-coverage/train.csv")

In [3]: train_d.shape

Out[3]: (4437, 27)

In [4]: df = train_d['page_description']

In [5]: df = df.append(test_d['page_description'])

In [6]: df.shape

Out[6]: (7395,)

In [7]: train_d.head()
```

Out[7]:

	link	link_id	page_description	alchemy_category	alchemy_category_score	avg_link_size	comm
0	http://www.cbc.ca/stevenandchris/2012/11/peggy...	7426	{"url":"cbc ca stevenandchris 2012 11 peggy ks...	arts_entertainment	0.471752	1.725275	
1	http://www.instructables.com/id/Vegan-Baked-Po...	8430	{"title":"Vegan Potato Spinach Balls Fat Free ...	recreation	0.885088	0.847134	
2	http://www.oled-info.com/toshiba-shows-ultra-t...	3469	{"title":"Toshiba shows an ultra thin flexible...	business	0.716379	2.613333	
3	http://www.collegehumor.com/videos/playlist/64...	1326	{"url":"collegehumor videos playlist 6472556 e...	arts_entertainment	0.562999	1.434286	
4	http://sports.yahoo.com/nba/blog/ball_dont_lie...	3580	{"title":"Shaq admits to taking performance en...	sports	0.893246	1.781333	

5 rows × 27 columns

```
In [8]: print(train_d.shape)
print(test_d.shape)

(4437, 27)
(2958, 26)

In [9]: train_d.columns

Out[9]: Index(['link', 'link_id', 'page_description', 'alchemy_category',
       'alchemy_category_score', 'avg_link_size', 'common_word_link_ratio_1',
       'common_word_link_ratio_2', 'common_word_link_ratio_3',
       'common_word_link_ratio_4', 'compression_ratio', 'embed_ratio',
       'frame_based', 'frame_tag_ratio', 'has_domain_link', 'html_ratio',
       'image_ratio', 'is_news', 'lengthy_link_domain', 'link_word_score',
       'news_front_page', 'non_markup_alphanumeric_characters',
       'count_of_links', 'number_of_words_in_url', 'parametrized_link_ratio',
       'spelling_mistakes_ratio', 'label'],
      dtype='object')
```

Checking for Null Values

```
In [10]: train_d.isnull()
```

Out[10]:

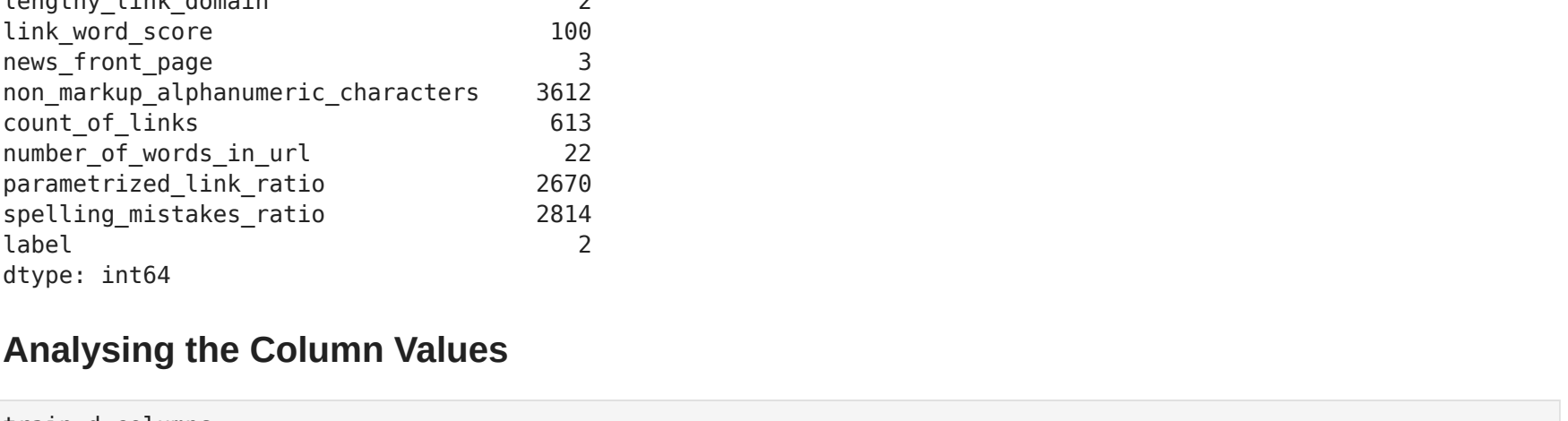
	link	link_id	page_description	alchemy_category	alchemy_category_score	avg_link_size	common_word_link_ratio_1	common_word_
0	False	False	False	False	False	False	False	
1	False	False	False	False	False	False	False	
2	False	False	False	False	False	False	False	
3	False	False	False	False	False	False	False	
4	False	False	False	False	False	False	False	
...	...	...	...	...	...	...	...	
4432	False	False	False	False	False	False	False	
4433	False	False	False	False	False	False	False	
4434	False	False	False	False	False	False	False	
4435	False	False	False	False	False	False	False	
4436	False	False	False	False	False	False	False	

4437 rows × 27 columns

```
In [11]: train_d.isnull().sum()

Out[11]: link                                  0
link_id                               0
page_description                      0
alchemy_category                      0
alchemy_category_score                0
avg_link_size                         0
common_word_link_ratio_1              0
common_word_link_ratio_2              0
common_word_link_ratio_3              0
common_word_link_ratio_4              0
compression_ratio                     0
embed_ratio                           0
frame_based                           0
frame_tag_ratio                       0
has_domain_link                       0
html_ratio                            0
image_ratio                           0
is_news                               0
lengthy_link_domain                   0
link_word_score                       0
news_front_page                       0
non_markup_alphanumeric_characters    0
count_of_links                        0
number_of_words_in_url                0
parametrized_link_ratio               0
spelling_mistakes_ratio               0
label                                 0
dtype: int64

In [12]: train_d.nunique()

Out[12]: link                                  4437
link_id                               4437
page_description                      4437
alchemy_category                        14
alchemy_category_score                2918
avg_link_size                         3636
common_word_link_ratio_1              3038
common_word_link_ratio_2              2778
common_word_link_ratio_3              2270
common_word_link_ratio_4              1881
compression_ratio                     3910
embed_ratio                            243
frame_based                              1
frame_tag_ratio                       3827
has_domain_link                          2
html_ratio                            4430
image_ratio                           3425
is_news                                  2
lengthy_link_domain                      2
link_word_score                        100
news_front_page                          3
non_markup_alphanumeric_characters    3612
count_of_links                         613
number_of_words_in_url                  22
parametrized_link_ratio               2670
spelling_mistakes_ratio               2814
label                                    2
dtype: int64
```

Analysing the Column Values

```
In [13]: train_d.columns

Out[13]: Index(['link', 'link_id', 'page_description', 'alchemy_category',
       'alchemy_category_score', 'avg_link_size', 'common_word_link_ratio_1',
       'common_word_link_ratio_2', 'common_word_link_ratio_3',
       'common_word_link_ratio_4', 'compression_ratio', 'embed_ratio',
       'frame_based', 'frame_tag_ratio', 'has_domain_link', 'html_ratio',
       'image_ratio', 'is_news', 'lengthy_link_domain', 'link_word_score',
       'news_front_page', 'non_markup_alphanumeric_characters',
       'count_of_links', 'number_of_words_in_url', 'parametrized_link_ratio',
       'spelling_mistakes_ratio', 'label'],
      dtype='object')

In [14]: train_d['embed_ratio'].value_counts()

Out[14]:  0.000000    3674
-1.000000     480
 0.010000       3
 0.011364       3
 0.001522       3
             ...
 0.029851       1
 0.000777       1
 0.009804       1
 0.002312       1
 0.004662       1
Name: embed_ratio, Length: 243, dtype: int64

In [15]: train_d['frame_based'].value_counts()

Out[15]: 0    4437
Name: frame_based, dtype: int64

In [16]: train_d['has_domain_link'].value_counts()

Out[16]: 0    4344
1      93
Name: has_domain_link, dtype: int64

In [17]: fig, axes = plt.subplots(1, 11, figsize=(28, 6), sharey=True)
sns.histplot(train_d, ax=axes[0], x="alchemy_category", kde=True, color='r')
sns.histplot(train_d, ax=axes[1], x="alchemy_category_score", kde=True, color='b')
sns.histplot(train_d, ax=axes[2], x="common_word_link_ratio_1", kde=True,color='g')
sns.histplot(train_d, ax=axes[3], x="common_word_link_ratio_2", kde=True,color='r')
sns.histplot(train_d, ax=axes[4], x="common_word_link_ratio_3", kde=True,color='y')
sns.histplot(train_d, ax=axes[5], x="common_word_link_ratio_4", kde=True,color='b')
sns.histplot(train_d, ax=axes[6], x="compression_ratio", kde=True,color='g')
sns.histplot(train_d, ax=axes[7], x="frame_tag_ratio", kde=True,color='y')
sns.histplot(train_d, ax=axes[8], x="number_of_words_in_url", kde=True,color='g')
sns.histplot(train_d, ax=axes[9], x="non_markup_alphanumeric_characters", kde=True,color='g')
sns.histplot(train_d, ax=axes[10], x="count_of_links", kde=True,color='y')

Out[17]: <AxesSubplot:xlabel='count_of_links', ylabel='Count'>
```



Checking Correlation Between the Columns:

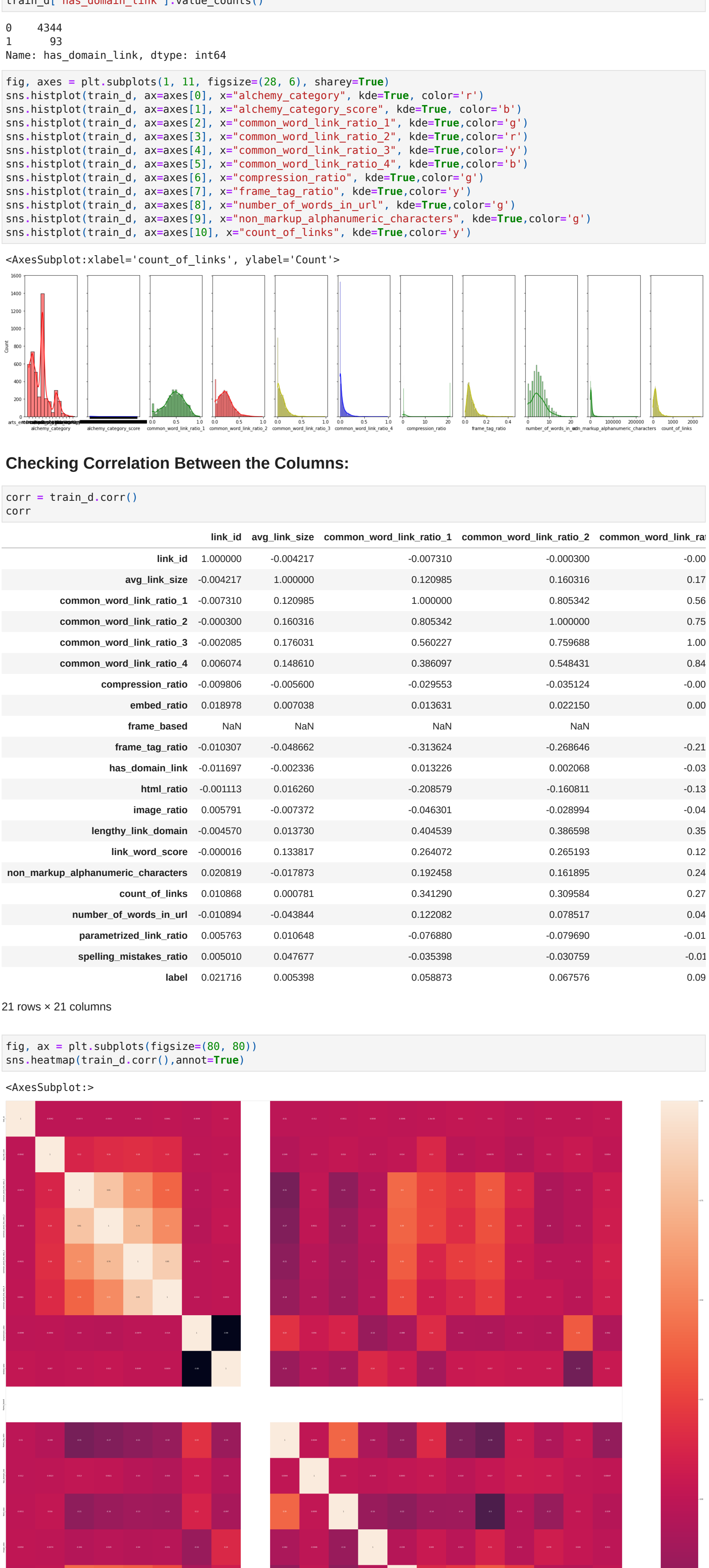
```
In [18]: corr = train_d.corr()
corr
```

Out[18]:

	link_id	avg_link_size	common_word_link_ratio_1	common_word_link_ratio_2	common_word_link_ra
link_id	1.000000	-0.004217	-0.007310	-0.000300	-0.00
avg_link_size	-0.004217	1.000000	0.120985	0.160316	0.17
common_word_link_ratio_1	-0.007310	0.120985	1.000000	0.805342	0.56
common_word_link_ratio_2	-0.000300	0.160316	0.805342	1.000000	0.75
common_word_link_ratio_3	-0.002085	0.176031	0.560227	0.759688	1.00
common_word_link_ratio_4	0.006074	0.148610	0.386097	0.548431	0.84
compression_ratio	-0.009806	-0.005600	-0.029553	-0.035124	-0.00
embed_ratio	0.018978	0.007038	0.013631	0.022150	0.00
frame_based	NaN	NaN	NaN	NaN	
frame_tag_ratio	-0.010307	-0.048662	-0.313624	-0.268646	-0.21
has_domain_link	-0.011697	-0.002336	0.013226	0.002068	-0.03
html_ratio	-0.001113	0.016260	-0.208579	-0.160811	-0.13
image_ratio	0.005791	-0.007372	-0.046301	-0.028994	-0.04
lengthy_link_domain	-0.004570	0.013730	0.404539	0.386598	0.35
link_word_score	-0.000016	0.133817	0.264072	0.265193	0.12
non_markup_alphanumeric_characters	0.020819	-0.017873	0.192458	0.161895	0.24
count_of_links	0.010868	0.000781	0.341290	0.309584	0.27
number_of_words_in_url	-0.010894	-0.043844	0.122082	0.078517	0.04
parametrized_link_ratio	0.005763	0.010648	-0.076880	-0.079690	-0.01
spelling_mistakes_ratio	0.005010	0.047677	-0.035398	-0.030759	-0.01
label	0.021716	0.005398	0.058873	0.067576	0.09

21 rows × 21 columns

```
In [19]: fig, ax = plt.subplots(figsize=(80, 80))
sns.heatmap(train_d.corr(),annot=True)

Out[19]: <AxesSubplot:>
```



Drop some column based on correlation

```
In [20]: train_d.drop(['embed_ratio','frame_based','has_domain_link'], axis = 1, inplace =True)

In [21]: test_d.drop(['embed_ratio','frame_based','has_domain_link'], axis = 1, inplace =True)

In [22]: print(train_d.shape)
print(test_d.shape)

(4437, 24)
(2958, 23)
```

Normalizing Some Columns

```
In [23]: columns=['link_word_score','non_markup_alphanumeric_characters','count_of_links','number_of_words_in_url']
for column in columns:
    train_d[column] = (train_d[column] - train_d[column].min()) / (train_d[column].max() - train_d[column].min(

In [30]:

Out[30]: 0       elle new england kitchen elle new england kitc...
1       alternet org story study confirms that fox new...
2                                            wiredberries
3       the health benefits of cayenne pepper brief hi...
4       recipe hearty mushroom potato soup if you re f...
                              ...
2953    whole wheat or bust blog of healthy and delici...
2954    maybe first since jesus to prevent and treat e...
2955    emptees from to emptees was vibrant community ...
2956    cost of living now outweighs benefits the onio...
2957    jokes just hanging on the wall just hanging on...
Name: page_description, Length: 2958, dtype: object
```

Cheking the missing/Null/special character values:

```
In [ ]: train_d['alchemy_category'].value_counts()

In [ ]: plt.figure(figsize=(15,5))
sns.countplot(x = 'alchemy_category', data=train_d)
plt.xticks(rotation = 90)

In [ ]: (train_d == "?").sum()

In [ ]: (test_d == '?').sum()

In [ ]: train_d["alchemy_category"].unique()

In [ ]: #test_d['alchemy_category'] = test_d['alchemy_category'].replace(['?'],'others')
```

Label Encoding: Using category codes approach:

Apply on "alchemy_category"

```
In [ ]: #train_d["alchemy_category"] = train_d["alchemy_category"].astype('category')
#test_d["alchemy_category"] = test_d["alchemy_category"].astype('category')

In [ ]: #train_d.dtypes

In [ ]: #train_d["alchemy_category"] = train_d["alchemy_category"].cat.codes
#test_d["alchemy_category"] = test_d["alchemy_category"].cat.codes

In [ ]: #train_d["alchemy_category"].unique()

In [ ]: #test_d["alchemy_category"].unique()

In [ ]: #train_d["alchemy_category"].value_counts()
```

Handling "?" from "alchemy_category_score"

```
In [ ]: train_d["alchemy_category_score"].value_counts()

In [ ]: #train_d['alchemy_category_score'] = train_d['alchemy_category_score'].replace(['?'],0).astype('float64')
#test_d['alchemy_category_score'] = test_d['alchemy_category_score'].replace(['?'],0).astype('float64')

In [ ]: #train_d.dtypes

In [ ]: #train_d["alchemy_category_score"].unique()

In [ ]: d=train_d["alchemy_category_score"].unique()
print(d)

In [ ]: train_d.describe()

In [ ]:

In [ ]: #train_d['alchemy_category_score'] = train_d['alchemy_category_score'].replace([0.000000],0.4139967509803922).a
#test_d['alchemy_category_score'] = test_d['alchemy_category_score'].replace([0.000000],0.4139967509803922).ast
```

Use Intermediate Model for predicting "?" from alchemy_category and alchemy_category_score

Converting individual category into numbers

```
In [ ]:  types=train_d['alchemy_category'].unique()
print(types)
for i,name in enumerate(types):
        train_d['alchemy_category']=train_d['alchemy_category'].replace(name,i)

testtype=test_d['alchemy_category'].unique()
print(testtype)
for i,name in enumerate(testtype):
        test_d['alchemy_category']=test_d['alchemy_category'].replace(name,i)
```

? is replaced with '4' hence splitting the dataset based on value 4

```
In [ ]: df2=train_d[train_d['alchemy_category'] == 4]

In [ ]: df1 = train_d[train_d['alchemy_category'] != 4]

In [ ]: df1.shape
```

Predicting the value of ? using a model

```
In [ ]: from sklearn.ensemble import RandomForestClassifier
y_train = df1['alchemy_category']
X_train=df1[['common_word_link_ratio_1','common_word_link_ratio_2','common_word_link_ratio_3','common_word_link
X_test=df2[['common_word_link_ratio_1','common_word_link_ratio_2','common_word_link_ratio_3','common_word_link_
from sklearn.naive_bayes import GaussianNB


gnb = RandomForestClassifier(n_estimators = 100).fit(X_train, y_train)
gnb_predictions = gnb.predict(X_test)

In [ ]: pd.options.mode.chained_assignment = None  # default='warn'
gnb_predictions[:50]

In [ ]: df2['alchemy_category']=gnb_predictions

In [ ]: (np.unique(gnb_predictions,return_counts=True))
```

Replacing numbers with original alchemy category for one hot encoding

```
In [ ]: print(types)
for i,name in enumerate(types):
        df1['alchemy_category']=df1['alchemy_category'].replace(i,name)
for i,name in enumerate(types):
        df2['alchemy_category']=df2['alchemy_category'].replace(i,name)
```

One hot encoding for alchemy category

```
In [ ]:  # Get all the unique values in a column
  col_types = df1['alchemy_category'].unique()

  # Insert all unique values as columns in the dataframe
  for col_type in col_types:
    df1[col_type] = [0 for i in range(len(df1['link_id']))]

  # Set the value of the column with the same name as value in the cell.
  for i, cell in enumerate(df1['alchemy_category']):
    df1[cell][i] = 1

  df1 = df1.drop('alchemy_category', 1)

In [ ]:  # Get all the unique values in a column
  col_types = df2['alchemy_category'].unique()

  # Insert all unique values as columns in the dataframe
  for col_type in col_types:
    df2[col_type] = [0 for i in range(len(df2['link_id']))]

  # Set the value of the column with the same name as value in the cell.
  for i, cell in enumerate(df2['alchemy_category']):
    df2[cell][i] = 1

  df2 = df2.drop('alchemy_category', 1)

In [ ]: # printing all columns of the dataframe
print(df1.columns.tolist())

print(df2.columns.tolist())
```

Predicting alchemy category score by using alchemy category

```
In [ ]: from sklearn.linear_model import LinearRegression
y=df1['arts_entertainment']
x_train=df1[['arts_entertainment','recreation','sports','computer_internet','health','gaming','unknown','label'
x_test=df2[['arts_entertainment','recreation','sports','computer_internet','health','gaming','unknown','label']
Y_train = df1['alchemy_category_score']
reg = LinearRegression().fit(x_train, Y_train)
pre=reg.predict(x_test)

In [ ]: print(np.unique(pre,return_counts=True))

df2['alchemy_category_score']=pre;

In [ ]: import gc
combined=[df1,df2]
traindf1=pd.concat(combined)
```

Training a model using TF IDF and other columns

```
In [ ]: vectorizer = TfidfVectorizer()
X = vectorizer.fit_transform(traindf1["page_description"])

index=vectorizer.get_feature_names()
#print(index)

example = pd.DataFrame(X.toarray().transpose(),
                index=vectorizer.get_feature_names())
example1=example.T

#example1['new']=traindf['common_word_link_ratio_1']
example1.insert(1,"ratio1",traindf1['common_word_link_ratio_1'],True)
example1.insert(2,"ratio2",traindf1['common_word_link_ratio_2'],True)
example1.insert(3,"ratio3",traindf1['common_word_link_ratio_3'],True)
example1.insert(4,"ratio4",traindf1['common_word_link_ratio_4'],True)
#example1.insert(5,"linkwordscore",traindf1['link_word_score'],True)
#example1.insert(6,"alchemy_category_score",traindf1['alchemy_category_score'],True)
#example1.insert(7,"arts_entertainment",traindf1['arts_entertainment'],True)
#example1.insert(8,"gaming",traindf1['gaming'],True)
#example1.insert(9,"recreation",traindf1['recreation'],True)
#example1.insert(10,"health",traindf1['health'],True)
#example1.insert(11,"computer_internet",traindf1['computer_internet'],True)
#example1.insert(12,"sports",traindf1['sports'],True)
#example1.insert(13,"unknown",traindf1['unknown'],True)

example1.head()

In [ ]: ydata = traindf1["label"]
model = RandomForestClassifier(n_estimators = 100)
model.fit(example1,ydata)
```

Predicting alchemy category and score for test dataset

? is replaced with '2' hence splitting the dataset based on value 2

```
In [ ]: df3 = test_d[test_d['alchemy_category'] != 2]

In [ ]: df4 = test_d[test_d['alchemy_category'] == 2]
```

Predicting ? using a model

```
In [ ]: ytrain = df3['alchemy_category']
Xtrain=df3[['common_word_link_ratio_1','common_word_link_ratio_2','common_word_link_ratio_3','common_word_link_
Xtest=df4[['common_word_link_ratio_1','common_word_link_ratio_2','common_word_link_ratio_3','common_word_link_r



gnb = RandomForestClassifier(n_estimators = 100).fit(Xtrain, ytrain)
predi = gnb.predict(Xtest)
df4['alchemy_category']=predi
```

Replacing alchemy category numbers with its original value to perform one hot encoding

```
In [ ]: for i,name in enumerate(testtype):
        df3['alchemy_category']=df3['alchemy_category'].replace(i,name)
for i,name in enumerate(testtype):
        df4['alchemy_category']=df4['alchemy_category'].replace(i,name)

In [ ]: # Get all the unique values in a column
col_types = df3['alchemy_category'].unique()

  # Insert all unique values as columns in the dataframe
for col_type in col_types:
    df3[col_type] = [0 for i in range(len(df3['link_id']))]

  # Set the value of the column with the same name as value in the cell.
for i, cell in enumerate(df3['alchemy_category']):
    df3[cell][i] = 1
df3 = df3.drop('alchemy_category', 1)

In [ ]: # Get all the unique values in a column
col_types = df4['alchemy_category'].unique()

  # Insert all unique values as columns in the dataframe
for col_type in col_types:
    df4[col_type] = [0 for i in range(len(df4['link_id']))]

  # Set the value of the column with the same name as value in the cell.
for i, cell in enumerate(df4['alchemy_category']):
    df4[cell][i] = 1

testdf = df4.drop('alchemy_category', 1)

In [ ]: df4.columns

In [ ]: from sklearn.linear_model import LinearRegression

x_train=df3[['arts_entertainment','recreation','health']]
x_test=df4[['arts_entertainment','recreation','health']]
Y_train = df3['alchemy_category_score']
reg = LinearRegression().fit(x_train, Y_train)
pr=reg.predict(x_test)

In [ ]: print(np.unique(pr,return_counts=True))

In [ ]: df4['alchemy_category_score']=pr

combined1=[df3,df4]
testdf1=pd.concat(combined1)

In [ ]: Y = vectorizer.transform(testdf1["page_description"])
example = pd.DataFrame(Y.toarray().transpose(),
                index=vectorizer.get_feature_names())
exampletest=example.T

#example1['new']=traindf['common_word_link_ratio_1']
exampletest.insert(1,"ratio1",testdf1['common_word_link_ratio_1'],True)
exampletest.insert(2,"ratio2",testdf1['common_word_link_ratio_2'],True)
exampletest.insert(3,"ratio3",testdf1['common_word_link_ratio_3'],True)
exampletest.insert(4,"ratio4",testdf1['common_word_link_ratio_4'],True)
#exampletest.insert(5,"linkwordscore",testdf1['link_word_score'],True)
#exampletest.insert(6,"alchemy_category_score",testdf1['alchemy_category_score'],True)
#exampletest.insert(7,"arts_entertainment",testdf1['arts_entertainment'],True)
#exampletest.insert(8,"gaming",testdf1['gaming'],True)
#exampletest.insert(9,"recreation",testdf1['recreation'],True)
#exampletest.insert(10,"health",testdf1['health'],True)
#exampletest.insert(11,"computer_internet",testdf1['computer_internet'],True)
#exampletest.insert(12,"sports",testdf1['sports'],True)

ypred = model.predict_proba(exampletest)

In [ ]: ypred
```

Check random 20 rows :

Apply NLP and text cleaning

```
In [18]: import gensim

In [19]: def remove_title(df):
    ans = ""
    for text in df:
        ans+=text
        ans+=" "
    return ans
text = train_d['page_description'].apply(gensim.utils.simple_preprocess)
train_d['page_description'] = text.apply(lambda x:remove_title(x))
text = test_d['page_description'].apply(gensim.utils.simple_preprocess)
test_d['page_description'] = text.apply(lambda x:remove_title(x))
train_d.head()
```

Out[19]:

	link	link_id	page_description	alchemy_category	alchemy_category_score	avg_link_size	commo
0	http://www.cbc.ca/stevenandchris/2012/11/peggy...	7426	url cbc ca stevenandchris peggy ks sexy mood b...	arts_entertainment	0.471752	1.725275	
1	http://www.instructables.com/id/Vegan-Baked-Po...	8430	title vegan potato spinach balls fat free vega...	recreation	0.885088	0.847134	
2	http://www.oled-info.com/toshiba-shows-ultra-t...	3469	title toshiba shows an ultra thin flexible ole...	business	0.716379	2.613333	
3	http://www.collegehumor.com/videos/playlist/64...	1326	url collegehumor videos playlist epic sports f...	arts_entertainment	0.562999	1.434286	
4	http://sports.yahoo.com/nba/blog/ball_dont_lie...	3580	title shaq admits to taking performance enhanc...	sports	0.893246	1.781333	

5 rows × 27 columns

```
In [20]: from nltk.corpus import stopwords
stop = stopwords.words('english')

train_d["page_description"].apply(lambda words: ' '.join(word.lower() for word in words.split() if word not in
test_d["page_description"].apply(lambda words: ' '.join(word.lower() for word in words.split() if word not in s
stop2 = ['title','body','url']

train_d["page_description"].apply(lambda words: ' '.join(word.lower() for word in words.split() if word not in
test_d["page_description"].apply(lambda words: ' '.join(word.lower() for word in words.split() if word not in s

Out[20]: 0       elle new england kitchen elle new england kitc...
1       alternet org story study confirms that fox new...
2                                            wiredberries
3       the health benefits of cayenne pepper brief hi...
4       recipe hearty mushroom potato soup if you re f...
                              ...
2953    whole wheat or bust blog of healthy and delici...
2954    maybe first since jesus to prevent and treat e...
2955    emptees from to emptees was vibrant community ...
2956    cost of living now outweighs benefits the onio...
2957    jokes just hanging on the wall just hanging on...
Name: page_description, Length: 2958, dtype: object
```

Analyzing the frequency of words in "page_description"

```
In [21]: from nltk.corpus import stopwords
#More frequently occuring words appear larger.


from wordcloud import WordCloud,STOPWORDS
content=''
stopwords_d=set(STOPWORDS)

for i in train_d['page_description']:
    tokens=i.split(' ')

    content=content+' '.join(tokens)+' '

wordcloud_d=WordCloud(width=800,height=600,background_color='white',stopwords=stopwords_d).generate(content)
plt.figure(figsize=(8,8))
plt.axis('off')
plt.imshow(wordcloud_d)

Out[21]: <matplotlib.image.AxesImage at 0x7fd8c9fe2b10>
```

Apply TF-IDF:

```
In [ ]: vectorizer = TfidfVectorizer(max_features = 45000, ngram_range = (1,5))
X = vectorizer.fit_transform(train_d["page_description"])

In [ ]: X.shape

In [ ]: train_d.shape

In [ ]: X.shape

In [ ]: #X = X.toarray()

In [ ]: train_d["news_front_page"].value_counts()

In [ ]: train_d["is_news"].value_counts()

In [ ]: doc1 = X

In [ ]: doc1

In [ ]: #doc1 = np.hstack(X,)

In [ ]: ydata = train_d["label"]
```

Hyperparameter Tuning with GridserchCV on SVM

In [ ]:
```python
from sklearn.model_selection import GridSearchCV


# defining parameter range

param_grid = {'C': [0.1, 1],

              'gamma': [1, 0.1],

              'kernel': ['rbf']}



grid = GridSearchCV(SVC(probability = True), param_grid, refit = True, verbose = 3)


# fitting the model for grid search
grid.fit(train_df, ydata)
```

Apply Model

In [35]:
```python
from sklearn.neighbors import KNeighborsClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.tree import DecisionTreeClassifier
```

Train Model

In [ ]:
```python
ydata
```

In [ ]:
```python
model2 = RandomForestClassifier(n_estimators = 100)


model2.fit(X, ydata)
```

In [40]:
```python
from sklearn.svm import SVC
```

In [ ]:
```python
svclassifier = SVC(kernel='rbf',probability = True)
svclassifier.fit(X, ydata)
```

In [ ]:
```python
from sklearn.calibration import CalibratedClassifierCV
```

In [ ]:
```python
 svm = LinearSVC()
 clf = CalibratedClassifierCV(svm)
 clf.fit(train_df, ydata)
```

In [ ]:
```python
logisticRegr = LogisticRegression()

model = LogisticRegression()

model.fit(train_df, ydata)
```

Column to predict :

In [ ]:
```python
Y = vectorizer.transform(test_d["page_description"])
```

Word2Vec Implementation

In [22]:
```python
import gensim
from gensim.models import Word2Vec,KeyedVectors
i=0
sentances_to_train = []
sentances_to_test=[]
for sentances in train_d['page_description']:
    sentances_to_train.append(sentances.split())
for sentances in test_d['page_description']:
    sentances_to_train.append(sentances.split())
```

In [23]:
```python
w2v_model = Word2Vec(sentances_to_train, min_count=2, vector_size=200, workers=4)
#w2v_model=KeyedVectors.load_word2vec_format('GoogleNews-vectors-negative300.bin', binary=True)
```

In [24]:
```python
text = train_d['page_description'].apply(gensim.utils.simple_preprocess)
test = test_d['page_description'].apply(gensim.utils.simple_preprocess)
train_d['web'] = text
#test_d['web']
test_d['web']=test
```

In [25]:
```python
make_vector = []
def avg_word2_vec(df):
    sc = np.zeros(200)
    i=0
    for text1 in df:
        if text1 not in w2v_model.wv.key_to_index:
            continue
        scq = w2v_model.wv.get_vector(text1)
        sc += scq
        i+=1
    sc = sc/i
    sc = np.array(sc)
    make_vector.append(sc)
    return sc
```

In [26]:
```python
make_test=[]
def avg_word2_test(df):
    sc = np.zeros(200)
    i=0
    for text1 in df:
        if text1 not in w2v_model.wv.key_to_index:
            continue
        scq = w2v_model.wv.get_vector(text1)
        sc += scq
        i+=1
    sc = sc/i
    sc = np.array(sc)
    make_test.append(sc)
    return sc
```

In [27]:
```python
vectorized = train_d['web'].apply(lambda x:avg_word2_vec(x))
vectorizedtest = test_d['web'].apply(lambda x:avg_word2_test(x))
```

In [28]:
```python
make_vector = np.array(make_vector)
make_test = np.array(make_test)
make_vector.shape
```

Out[28]:
```
(4437, 200)
```

In [40]:
```python
from sklearn.model_selection import GridSearchCV
from sklearn.svm import SVC,NuSVC
param_grid = {'C': [0.1,1, 10, 100], 'gamma': [1,0.1,0.01,0.001]}
grid = GridSearchCV(SVC(probability=True),param_grid,refit=True,verbose=2)
grid.fit(np.array(make_vector),train_d['label'])
```

```
Fitting 5 folds for each of 16 candidates, totalling 80 fits
[CV] END ....................................C=0.1, gamma=1; total time=   9.6s
[CV] END ....................................C=0.1, gamma=1; total time=   9.5s
[CV] END ....................................C=0.1, gamma=1; total time=   9.4s
[CV] END ....................................C=0.1, gamma=1; total time=   9.8s
[CV] END ....................................C=0.1, gamma=1; total time=   9.3s
[CV] END ..................................C=0.1, gamma=0.1; total time=   6.5s
[CV] END ..................................C=0.1, gamma=0.1; total time=   6.4s
[CV] END ..................................C=0.1, gamma=0.1; total time=   6.6s
[CV] END ..................................C=0.1, gamma=0.1; total time=   6.5s
[CV] END ..................................C=0.1, gamma=0.1; total time=   6.3s
[CV] END .................................C=0.1, gamma=0.01; total time=   7.1s
[CV] END .................................C=0.1, gamma=0.01; total time=   7.3s
[CV] END .................................C=0.1, gamma=0.01; total time=   7.7s
[CV] END .................................C=0.1, gamma=0.01; total time=   7.5s
[CV] END .................................C=0.1, gamma=0.01; total time=   7.4s
[CV] END ................................C=0.1, gamma=0.001; total time=  11.2s
[CV] END ................................C=0.1, gamma=0.001; total time=  10.8s
[CV] END ................................C=0.1, gamma=0.001; total time=  11.1s
[CV] END ................................C=0.1, gamma=0.001; total time=  10.7s
[CV] END ................................C=0.1, gamma=0.001; total time=  10.6s
[CV] END ......................................C=1, gamma=1; total time=  10.5s
[CV] END ......................................C=1, gamma=1; total time=  10.5s
[CV] END ......................................C=1, gamma=1; total time=  10.6s
[CV] END ......................................C=1, gamma=1; total time=  10.4s
[CV] END ......................................C=1, gamma=1; total time=  10.5s
[CV] END ....................................C=1, gamma=0.1; total time=   6.6s
[CV] END ....................................C=1, gamma=0.1; total time=   6.6s
[CV] END ....................................C=1, gamma=0.1; total time=   6.5s
[CV] END ....................................C=1, gamma=0.1; total time=   6.3s
[CV] END ....................................C=1, gamma=0.1; total time=   6.1s
[CV] END ...................................C=1, gamma=0.01; total time=   6.2s
[CV] END ...................................C=1, gamma=0.01; total time=   6.3s
[CV] END ...................................C=1, gamma=0.01; total time=   6.5s
[CV] END ...................................C=1, gamma=0.01; total time=   6.1s
[CV] END ...................................C=1, gamma=0.01; total time=   5.9s
[CV] END ..................................C=1, gamma=0.001; total time=   7.1s
[CV] END ..................................C=1, gamma=0.001; total time=   7.1s
[CV] END ..................................C=1, gamma=0.001; total time=   7.2s
[CV] END ..................................C=1, gamma=0.001; total time=   7.3s
[CV] END ..................................C=1, gamma=0.001; total time=   7.1s
[CV] END .....................................C=10, gamma=1; total time=  11.0s
[CV] END .....................................C=10, gamma=1; total time=  11.2s
[CV] END .....................................C=10, gamma=1; total time=  11.4s
[CV] END .....................................C=10, gamma=1; total time=  11.0s
[CV] END .....................................C=10, gamma=1; total time=  11.3s
[CV] END ...................................C=10, gamma=0.1; total time=   7.4s
[CV] END ...................................C=10, gamma=0.1; total time=   7.3s
[CV] END ...................................C=10, gamma=0.1; total time=   7.4s
[CV] END ...................................C=10, gamma=0.1; total time=   7.3s
[CV] END ...................................C=10, gamma=0.1; total time=   7.3s
[CV] END ..................................C=10, gamma=0.01; total time=   5.9s
[CV] END ..................................C=10, gamma=0.01; total time=   6.9s
[CV] END ..................................C=10, gamma=0.01; total time=   5.9s
[CV] END ..................................C=10, gamma=0.01; total time=   5.9s
[CV] END ..................................C=10, gamma=0.01; total time=   6.0s
[CV] END .................................C=10, gamma=0.001; total time=   6.2s
[CV] END .................................C=10, gamma=0.001; total time=   6.3s
[CV] END .................................C=10, gamma=0.001; total time=   6.3s
[CV] END .................................C=10, gamma=0.001; total time=   6.2s
[CV] END .................................C=10, gamma=0.001; total time=   6.0s
[CV] END ....................................C=100, gamma=1; total time=  10.9s
[CV] END ....................................C=100, gamma=1; total time=  11.0s
[CV] END ....................................C=100, gamma=1; total time=  11.1s
[CV] END ....................................C=100, gamma=1; total time=  11.0s
[CV] END ....................................C=100, gamma=1; total time=  10.8s
[CV] END ..................................C=100, gamma=0.1; total time=   9.7s
[CV] END ..................................C=100, gamma=0.1; total time=   9.9s
[CV] END ..................................C=100, gamma=0.1; total time=  10.3s
[CV] END ..................................C=100, gamma=0.1; total time=   9.7s
[CV] END ..................................C=100, gamma=0.1; total time=   9.9s
[CV] END .................................C=100, gamma=0.01; total time=   7.0s
[CV] END .................................C=100, gamma=0.01; total time=   7.3s
[CV] END .................................C=100, gamma=0.01; total time=   7.2s
[CV] END .................................C=100, gamma=0.01; total time=   7.1s
[CV] END .................................C=100, gamma=0.01; total time=   7.2s
[CV] END ................................C=100, gamma=0.001; total time=   5.8s
[CV] END ................................C=100, gamma=0.001; total time=   5.9s
[CV] END ................................C=100, gamma=0.001; total time=   5.9s
[CV] END ................................C=100, gamma=0.001; total time=   5.8s
[CV] END ................................C=100, gamma=0.001; total time=   5.9s
```

Out[40]:
```
GridSearchCV(estimator=SVC(probability=True),
             param_grid={'C': [0.1, 1, 10, 100],
                         'gamma': [1, 0.1, 0.01, 0.001]},
             verbose=2)
```

In [41]:
```python
print(grid.best_estimator_)
```

```
SVC(C=100, gamma=0.001, probability=True)
```

In [39]:
```python
model9=SVC(C=100, gamma=0.001,probability=True)
model9.fit(np.array(make_vector),train_d['label'])
```

Out[39]:
```
SVC(C=1, gamma=0.1, probability=True)
```

In [ ]:
```python
ypred = model9.predict_proba(np.array(make_test))
```

Slacking :

In [ ]:
```python
ypred1 = model1.predict_proba(Y).T[1]
ypred2  = svclassifier.predict_proba(Y).T[1]
ypred3 = model2.predict_proba(Y).T[1]
ypred = (ypred1+ypred2+ypred3)/3
```

Vooting :

In [36]:
```python
from sklearn.ensemble import VotingClassifier
from sklearn.tree import DecisionTreeClassifier
```

create a voting classifier with hard voting

In [41]:
```python
voting_classifier_hard = VotingClassifier(
    estimators = [('dtc',DecisionTreeClassifier(random_state=42)),
                  ('lr', LogisticRegression()),
                  ('gnb', SVC())],
    voting='hard')
```

create a voting classifier with soft voting

In [42]:
```python
voting_classifier_soft = VotingClassifier(
    estimators = [('dtc',DecisionTreeClassifier(random_state=42)),
                  ('lr', LogisticRegression()),
                  ('gnb', SVC())],
    voting='soft')
```

Make prediction using hard and soft vooting :

In [ ]:
```python
voting_classifier_hard.fit(train_df, ydata)
y_pred_vch = voting_classifier_hard.predict(Y)


voting_classifier_soft.fit(train_df, ydata)
y_pred_vcs = voting_classifier_soft.predict(Y)
```

In [ ]:

In [ ]:
```python
ypred.shape
```

In [ ]:
```python
ypred = ypred.T[1]
ypred = ypred.T
ypred
```

In [ ]:
```python
ypred.shape
```

In [ ]:
```python
ypred
```

In [ ]:
```python
sub = pd.read_csv("../input/aid-escalating-internet-coverage/sample_submission.csv")
sub.head()
```

if model after suffling dataframe based on alchemy category is used uncomment line 2

In [ ]:
```python
sub["label"] = ypred
#sub['link_id']=testdf1['link_id']       #if model after suffling dataframe based on alchemy category is used
sub.head()
```

Expoting the output file:

In [ ]:
```python
sub.to_csv('./submission14.csv',index = False)
```

In [44]:
```python
from sklearn.model_selection import StratifiedKFold
from sklearn.metrics import roc_auc_score as rac
```

Checking Accuracy using ROC Curve and AUC:

In [ ]:
```python
skf = StratifiedKFold(n_splits = 4,shuffle = True)
ydata = train_d['label']
skf.get_n_splits(train_df, ydata)
print(skf)
model = KNeighborsClassifier(n_neighbors=50,leaf_size = 20)
#StratifiedKFold(n_splits=4, random_state=None, shuffle=True)
racs = []
for train_index, test_index in skf.split(train_df, ydata):

    #print("TRAIN:", train_index, "TEST:", test_index)
    X_train, X_test = train_df[train_index], train_df[test_index]
    y_train, y_test = ydata[train_index], ydata[test_index]
    model.fit(X_train,y_train)
    ypred = model.predict_proba(X_test)
    ypred = ypred.T[1]
    racs.append(rac(y_test,ypred))
print(np.mean(racs))
```

In [ ]:

In [ ]: