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Duplicate Questions using RandomForestClassifier and XGBoostClassifier ¶

Dataset Description

The ground truth is the set of labels that have been supplied by human experts. The ground truth labels are inherently subjective, as the true meaning of sentences can never be known with certainty. Human labeling is also a 'noisy' process, and reasonable people will disagree. As a result, the ground truth labels on this dataset should be taken to be 'informed' but not 100% accurate, and may include incorrect labeling. We believe the labels, on the whole, to represent a reasonable consensus, but this may often not be true on a case by case basis for individual items in the dataset.

Please note: All of the questions in the training set are genuine examples from Quora.

Data fields

*** id -** the id of a training set question pair
*** qid1, qid2 -** - unique ids of each question (only available in train.csv)
*** question1, question2 -** - the full text of each question
*** is_duplicate -** the target variable, set to 1 if question1 and question2 have essentially the same meaning, and 0 otherwise.

Without Feature Engineering

In [1]:

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

import warnings
warnings.filterwarnings('ignore')
```

In [2]:

```
df = pd.read_csv("train.csv")
```

In [3]:

```
df
```

Out[3]:

	id	qid1	qid2	question1	question2	is_duplicate
0	0	1	2	What is the step by step guide to invest in sh...	What is the step by step guide to invest in sh...	0
1	1	3	4	What is the story of Kohinoor (Koh-i-Noor) Dia...	What would happen if the Indian government sto...	0
2	2	5	6	How can I increase the speed of my internet co...	How can Internet speed be increased by hacking...	0
3	3	7	8	Why am I mentally very lonely? How can I solve...	Find the remainder when [math]23^{24}[/math] i...	0
4	4	9	10	Which one dissolve in water quikly sugar, salt...	Which fish would survive in salt water?	0
...	...	...	...	...	...	...
404285	404285	433578	379845	How many keywords are there in the Racket prog...	How many keywords are there in PERL Programmin...	0
404286	404286	18840	155606	Do you believe there is life after death?	Is it true that there is life after death?	1
404287	404287	537928	537929	What is one coin?	What's this coin?	0
404288	404288	537930	537931	What is the approx annual cost of living while...	I am having little hairfall problem but I want...	0
404289	404289	537932	537933	What is like to have sex with cousin?	What is it like to have sex with your cousin?	0

404290 rows × 6 columns

In [4]:

```
df.shape
```

Out[4]:

```
(404290, 6)
```

In [5]:

```
df.head(10)
```

Out[5]:

	id	qid1	qid2	question1	question2	is_duplicate
0	0	1	2	What is the step by step guide to invest in sh...	What is the step by step guide to invest in sh...	0
1	1	3	4	What is the story of Kohinoor (Koh-i-Noor) Dia...	What would happen if the Indian government sto...	0
2	2	5	6	How can I increase the speed of my internet co...	How can Internet speed be increased by hacking...	0
3	3	7	8	Why am I mentally very lonely? How can I solve...	Find the remainder when [math]23^{24}[/math] i...	0
4	4	9	10	Which one dissolve in water quikly sugar, salt...	Which fish would survive in salt water?	0
5	5	11	12	Astrology: I am a Capricorn Sun Cap moon and c...	I'm a triple Capricorn (Sun, Moon and ascendan...	1
6	6	13	14	Should I buy tiago?	What keeps childern active and far from phone ...	0
7	7	15	16	How can I be a good geologist?	What should I do to be a great geologist?	1
8	8	17	18	When do you use シ instead of し?	When do you use "&" instead of "and"?	0
9	9	19	20	Motorola (company): Can I hack my Charter Moto...	How do I hack Motorola DCX3400 for free internet?	0

In [6]:

```
df.tail(10)
```

Out[6]:

	id	qid1	qid2	question1	question2	is_duplicate
404280	404280	537922	537923	What are some outfit ideas to wear to a frat p...	What are some outfit ideas wear to a frat them...	1
404281	404281	99131	81495	Why is Manaphy childish in Pokémon Ranger and ...	Why is Manaphy annoying in Pokemon ranger and ...	1
404282	404282	1931	16773	How does a long distance relationship work?	How are long distance relationships maintained?	1
404283	404283	537924	537925	What do you think of the removal of the MagSaf...	What will the CPU upgrade to the 2016 Apple Ma...	0
404284	404284	537926	537927	What does Jainism say about homosexuality?	What does Jainism say about Gays and Homosexua...	1
404285	404285	433578	379845	How many keywords are there in the Racket prog...	How many keywords are there in PERL Programmin...	0
404286	404286	18840	155606	Do you believe there is life after death?	Is it true that there is life after death?	1
404287	404287	537928	537929	What is one coin?	What's this coin?	0
404288	404288	537930	537931	What is the approx annual cost of living while...	I am having little hairfall problem but I want...	0
404289	404289	537932	537933	What is like to have sex with cousin?	What is it like to have sex with your cousin?	0

In [7]:

```
df.sample(10)
```

Out[7]:

	id	qid1	qid2	question1	question2	is_duplicate
200467	200467	302231	302232	What are some movies bearing best names/titles?	What is the best name for a movie?	0
333464	333464	460536	460537	Can I not apply for gre 2016 without passport?	What are the four fundamental forces in physic...	0
292283	292283	413851	385953	On OkCupid, in the messages it says this user ...	I don't want my ex to see that I re-activated ...	0
222609	222609	330212	330213	What are the standard markings for classified ...	What marking elements are required for classif...	0
316999	316999	265052	442123	I want to be a billionaire, how do I accomplis...	I want to become a billionaire through creatin...	1
221858	221858	73296	329295	What are the secrets behind the Gold Rush TV s...	How many camera men are killed annually filmin...	0
209123	209123	313317	313318	What type business is we should to be start?	What type of business should I start?	1
229696	229696	339069	339070	Would you be angry if your teenage son had sex...	How do I show compassion to my teenage son?	0
103113	103113	170504	170505	What is better for retirement, Miami or Marbel...	Is blinking controlled by the medulla oblongata?	0
107591	107591	176972	176973	Are Armenians generally considered white or Eu...	Which Europeans are not considered white?	0

In [8]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 404290 entries, 0 to 404289
Data columns (total 6 columns):
 #   Column        Non-Null Count   Dtype 
---  ------        --------------   ----- 
 0   id            404290 non-null  int64 
 1   qid1          404290 non-null  int64 
 2   qid2          404290 non-null  int64 
 3   question1     404289 non-null  object
 4   question2     404288 non-null  object
 5   is_duplicate  404290 non-null  int64 
dtypes: int64(4), object(2)
memory usage: 18.5+ MB
```

In [9]:

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

Out[9]:

```
id              0
qid1            0
qid2            0
question1       1
question2       2
is_duplicate    0
dtype: int64
```

In [10]:

```
df = df.dropna()
```

In [11]:

```
df.shape
```

Out[11]:

```
(404287, 6)
```

In [12]:

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

Out[12]:

```
id              0
qid1            0
qid2            0
question1       0
question2       0
is_duplicate    0
dtype: int64
```

In [13]:

```
df.duplicated().sum()
```

Out[13]:

```
0
```

In [14]:

```
print(df["is_duplicate"].value_counts())
print((df["is_duplicate"].value_counts()/df["is_duplicate"].count())*100)
```

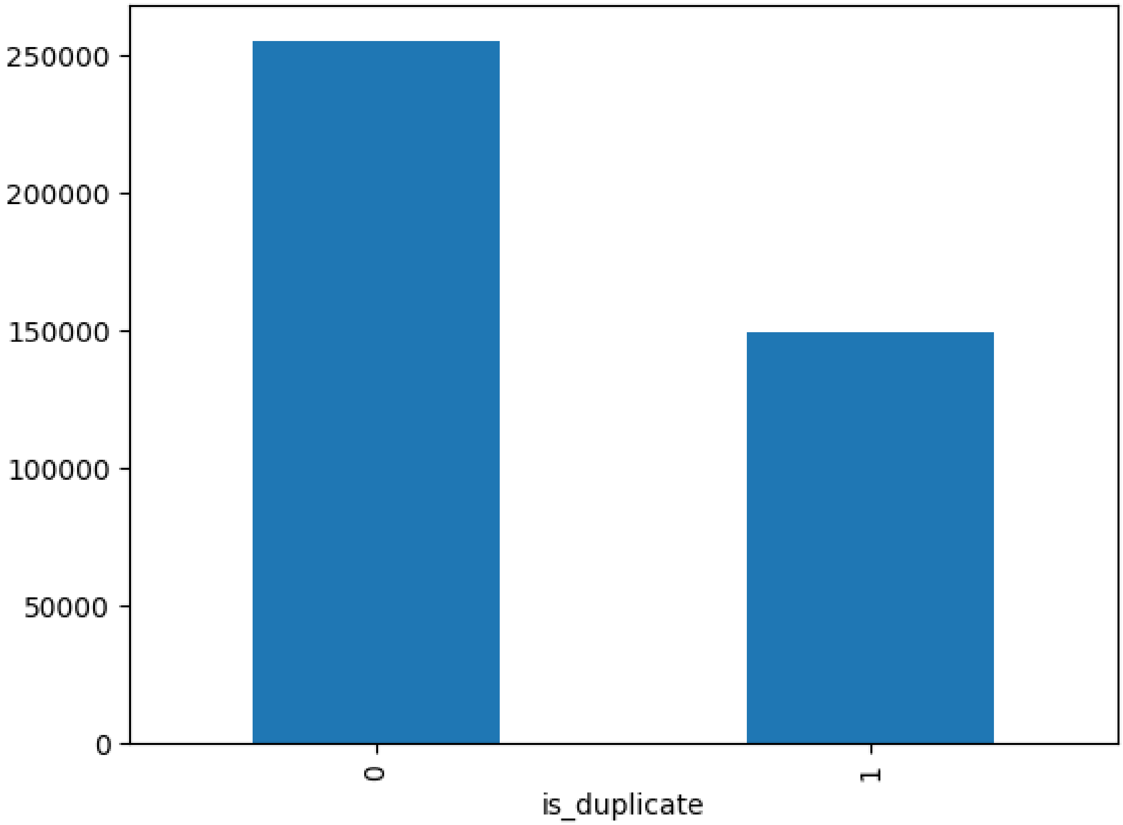
```
is_duplicate
0    255024
1    149263
Name: count, dtype: int64
is_duplicate
0    63.079941
1    36.920059
Name: count, dtype: float64
```

In [15]:

```
df["is_duplicate"].value_counts().plot(kind="bar")
```

Out[15]:

```
<Axes: xlabel='is_duplicate'>
```

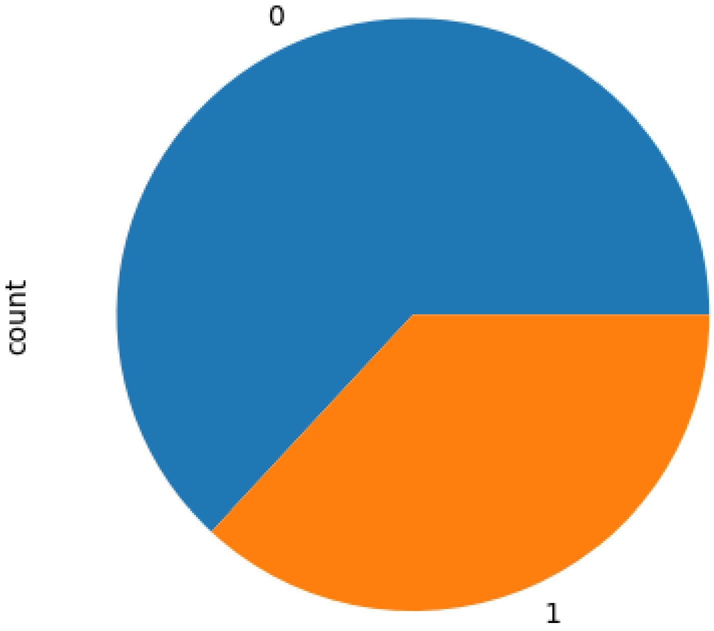


In [16]:

```
df["is_duplicate"].value_counts().plot(kind="pie")
```

Out[16]:

```
<Axes: ylabel='count'>
```



In [17]:

```
qid = pd.Series(df["qid1"].tolist() + df["qid2"].tolist())
print("# of Unique Questions",np.unique(qid).shape[0])
```

```
# of Unique Questions 537929
```

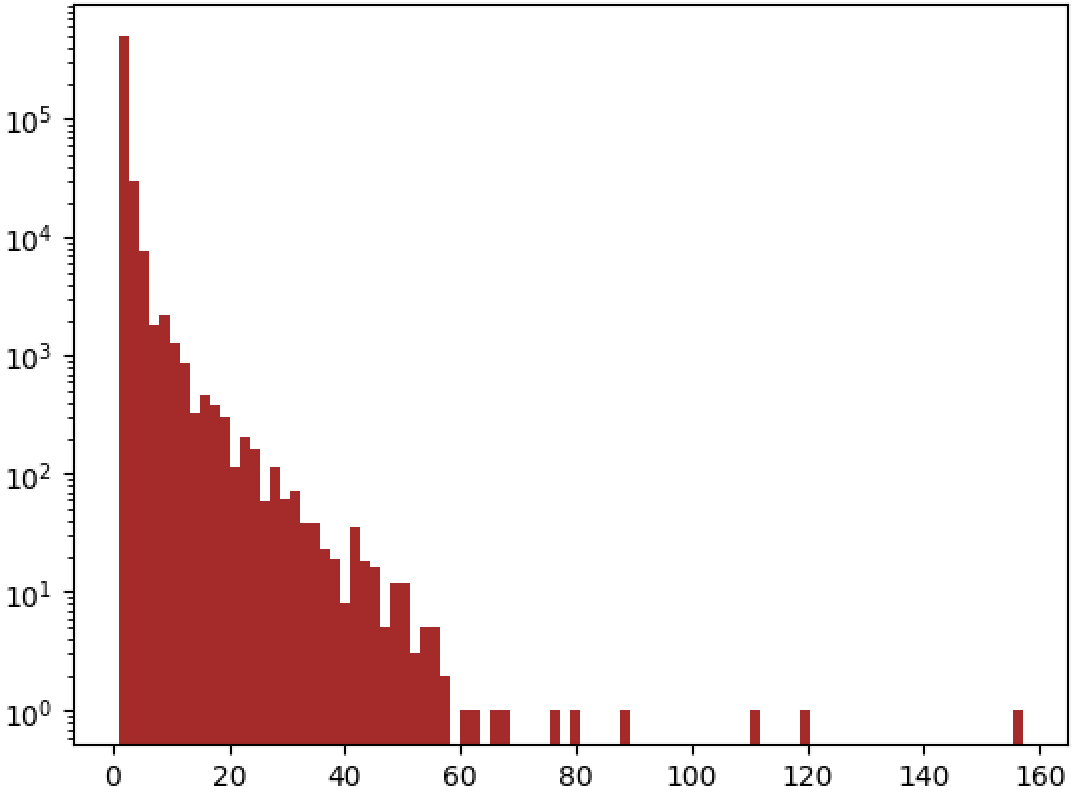
In [18]:

```
x = qid.value_counts()>1
print("# of Questions Qepeated",x[x].shape[0])
```

```
# of Questions Qepeated 111778
```

In [19]:

```
plt.hist(qid.value_counts().values,bins=90,color="brown")
plt.yscale("log")
plt.show()
```



In [20]:

```
new_df = df
```

In [21]:

```
new_df.shape
```

Out[21]:

```
(404287, 6)
```

In [22]:

```
new_df.isnull().sum()
```

Out[22]:

```
id              0
qid1            0
qid2            0
question1       0
question2       0
is_duplicate    0
dtype: int64
```

In [23]:

```
new_df = new_df.dropna()
```

Im using just 20000 rows to reduce time and computation consumption bcz to load whole data need 18GB+ Memory required

```
File ~/Documents/MachineLearning/lib/python3.10/site-packages/scipy/sparse/_base.py:1267, in _spbase.
ray_args(self, order, out)
   1265     return out
   1266 else:
-> 1267     return np.zeros(self.shape, dtype=self.dtype, order=order)

MemoryError: Unable to allocate 18.1 GiB for an array with shape (808574, 3000) and data type int64
```

In [24]:

```
new_df = df.sample(20000)
```

In [25]:

```
new_df.shape
```

Out[25]:

```
(20000, 6)
```

In [26]:

```
new_df.isnull().sum()
```

Out[26]:

```
id              0
qid1            0
qid2            0
question1       0
question2       0
is_duplicate    0
dtype: int64
```

In [27]:

```
new_df.duplicated().sum()
```

Out[27]:

```
0
```

In [28]:

```
new_df.shape
```

Out[28]:

```
(20000, 6)
```

In [29]:

```
ques_df = new_df[['question1','question2']]
ques_df.head()
```

Out[29]:

	question1	question2
34117	What is the Sahara, and how do the average tem...	What is the Sahara, and how do the average tem...
88707	What is muscle memory?	Does muscle memory exist?
369992	If a woman rapes a man, then she gets pregnant...	If a woman rapes a man and gets pregnant, what...
242119	What is a vector file?	What is a vector?
240859	What is the melting point of crustal rocks?	What is the melting point of rocks?

In [30]:

```
from sklearn.feature_extraction.text import CountVectorizer
# merge texts of questions asked
questions = list(ques_df['question1']) + list(ques_df['question2'])

# if You have Good laptop increase No. of max_features
cv = CountVectorizer(max_features=3000)#creating 3000 here for Question1 7 3000 f
q1_array, q2_array = np.vsplit(cv.fit_transform(questions).toarray(),2)
```

In [31]:

```
temp_data1 = pd.DataFrame(q1_array, index= ques_df.index) # here q1_array back to
temp_data2 = pd.DataFrame(q2_array, index= ques_df.index) # here q2_array back to
temp_data = pd.concat([temp_data1, temp_data2], axis=1) # concating data frames h
temp_data.shape
```

Out[31]:

```
(20000, 6000)
```

In [32]:

```
temp_data.head()
```

Out[32]:

	0	1	2	3	4	5	6	7	8	9	...	2990	2991	2992	2993	2994	2995	2996	2997	2
34117	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
88707	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
369992	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
242119	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
240859	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	

5 rows × 6000 columns

In [33]:

```
temp_data['is_duplicate'] = new_df['is_duplicate']
```

In [34]:

```
temp_data.shape
```

Out[34]:

```
(20000, 6001)
```

In [35]:

```
temp_data.head(10)
```

Out[35]:

	0	1	2	3	4	5	6	7	8	9	...	2991	2992	2993	2994	2995	2996	2997	2998
34117	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0
88707	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0
369992	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0
242119	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0
240859	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0
86587	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0
25994	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0
115238	0	0	0	0	0	0	0	0	0	0	...	1	0	0	0	0	0	0	0
289549	0	0	0	0	0	0	0	0	0	0	...	1	0	0	0	0	0	0	0
20960	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0

10 rows × 6001 columns

In [36]:

```
temp_data.sample(10)
```

Out[36]:

	0	1	2	3	4	5	6	7	8	9	...	2991	2992	2993	2994	2995	2996	2997	2998	2
13516	0	0	0	0	0	0	0	0	0	0	...	1	0	0	1	0	0	0	0	
263769	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
67244	0	0	0	0	0	0	0	0	0	0	...	2	0	0	0	0	0	0	0	
94819	0	0	0	0	0	0	0	0	0	0	...	1	0	0	0	0	0	0	0	
67979	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
49799	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
83708	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
59671	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
206951	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
236875	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	

10 rows × 6001 columns

In [37]:

```
temp_data.tail(10)
```

Out[37]:

	0	1	2	3	4	5	6	7	8	9	...	2991	2992	2993	2994	2995	2996	2997	2998	2
200778	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
258720	0	0	0	0	0	0	0	0	0	0	...	1	0	0	0	0	0	0	0	
294027	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
11705	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
242937	0	0	0	0	0	0	0	0	0	0	...	1	0	0	0	0	1	0	0	
287891	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
144533	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
249463	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
247383	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	
335973	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	

10 rows × 6001 columns

In [38]:

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(temp_data.iloc[:,0:-1].values
                                                      test_size=0.2,random_state= 4
```

In [39]:

```
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score
rfc = RandomForestClassifier()
rfc.fit(X_train, y_train)
y_pred = rfc.predict(X_test)
print("Accuracy of Random Forest",accuracy_score(y_test,y_pred) * 100)
```

```
Accuracy of Random Forest 73.3
```

In [40]:

```
from xgboost import XGBClassifier
from sklearn.metrics import accuracy_score
rf = XGBClassifier()
rf.fit(X_train, y_train)
y_pred = rf.predict(X_test)
print("Accuracy of Random Forest",accuracy_score(y_test,y_pred) * 100)
```

```
Accuracy of Random Forest 72.82499999999999
```

In [ ]:

In [ ]:

In [ ]: