Ember Data Preprocessing To get the Features

In [1]:

```
import os
import re
import json
import lief
import hashlib
import tqdm
import numpy as np
import pandas as pd
import multiprocessing
from sklearn.feature_extraction import FeatureHasher
import seaborn as sns
```

Make sure these file are present in the same directory

extract_binary_features.py is a customized script to extract features given a executables directory

ember_dataset.py is a customized script to extract ember features from ember dataset.

i have tweaked the original ember codes sligtly to get these scripts as per my requirement

In [2]:

```
!ls *.py
```

```
ember_dataset.py  extract_binary_features.py
```

In [13]:

```
from extract_binary_features import extract_features
from ember_dataset import create_data,read_metadata,read_vectorized_features
```

Made a custom script to generate features given a directory of PE files

The executables Dir contains 24 PE files

In [14]:

```
executables_dir ="../executables"
!ls ../executables
```

```
CheckNetIsolation.exe  cipher.exe    icacls.exe
chglogon.exe           find.exe      IcsEntitlementHost.exe
chgport.exe            findstr.exe   icsunattend.exe
chgusr.exe             finger.exe    InfDefaultInstall.exe
chkdsk.exe             fixmapi.exe   iscsicpl.exe
chkntfs.exe            fltMC.exe     ktmutil.exe
choice.exe             help.exe      label.exe
CIDiag.exe             HOSTNAME.EXE  Locator.exe
```

Ember feature_version=1 gives 2351 features per PE file

In [5]:

```
features =extract_features(executables_dir,feature_version=1)
features.shape
```

Out[5]:

```
(24, 2351)
```

Ember feature_version=2 gives 2381 features per PE file

In [6]:

```
features =extract_features(executables_dir,feature_version=2)
features.shape
```

Out[6]:

```
(24, 2381)
```

In [7]:

```
features
```

```
Out[7]: array([[0.46194774, 0.00855334, 0.00404095, ..., 0.        , 0.        ,
                 0.        ],
                [0.39925656, 0.0108997 , 0.00321321, ..., 0.        , 0.        ,
                 0.        ],
                [0.35704628, 0.00661058, 0.00424429, ..., 0.        , 0.        ,
                 0.        ],
                ...,
                [0.39425224, 0.01004464, 0.00507812, ..., 0.        , 0.        ,
                 0.        ],
                [0.39185473, 0.01005498, 0.00426794, ..., 0.        , 0.        ,
                 0.        ],
                [0.31587839, 0.01332876, 0.004091  , ..., 0.        , 0.        ,
                 0.        ]])
```

Ember provides 3 datasets I have used ember2018 Dataet

```
In [8]: ember2018 = '../Dataset/ember_zip/ember2018'
```

Which initially contains *.jsonl files and a pretrained lightgbm trained model file ember_model_2018.txt The dataset size is almost 10GB

```
In [9]: !ls '../Dataset/ember_zip/ember2018'
```

```
ember2018_test_data.npz   test_metadata.csv       train_features_5.jsonl
ember2018_train_data.npz  train_features_0.jsonl  train_metadata.csv
ember_model_2018.txt      train_features_1.jsonl  X_test.dat
metadata.csv              train_features_2.jsonl  X_train.dat
model2018.txt             train_features_3.jsonl  y_test.dat
test_features.jsonl       train_features_4.jsonl  y_train.dat
```

If the .dat files are not present execute below command, which creates numpy dat files which can be used for training"

```
In [10]: create_data(ember2018,feature_version=2)
```

```
In [11]: !ls '../Dataset/ember_zip/ember2018'
```

```
ember2018_test_data.npz   test_metadata.csv       train_features_5.jsonl
ember2018_train_data.npz  train_features_0.jsonl  train_metadata.csv
ember_model_2018.txt      train_features_1.jsonl  X_test.dat
metadata.csv              train_features_2.jsonl  X_train.dat
model2018.txt             train_features_3.jsonl  y_test.dat
test_features.jsonl       train_features_4.jsonl  y_train.dat
```

metadata.csv file contains info about the pefiles which can be seen as below

label =0 represents benign, label=1 reprsents malware

```
In [12]: meta_data = read_metadata(ember2018)
         meta_data
```

Out[12]:

	sha256	appeared	label	avclass	subset
0	0abb4fda7d5b13801d63bee53e5e256be43e141faa077a...	2006-12	0	NaN	train
1	c9cafff8a596ba8a80bafb4ba8ae6f2ef3329d95b85f15...	2007-01	0	NaN	train
2	eac8ddb4970f8af985742973d6f0e06902d42a3684d791...	2007-02	0	NaN	train
3	7f513818bcc276c531af2e641c597744da807e21cc1160...	2007-02	0	NaN	train
4	ca65e1c387a4cc9e7d8a8ce12bf1bcf9f534c9032b9d95...	2007-02	0	NaN	train
...	...	...	...	...	...
999995	e033bc4967ce64bbb5cafdb234372099395185a6e0280c...	2018-12	1	zbot	test

	sha256	appeared	label	avclass	subset
999996	c7d16736fd905f5fbe4530670b1fe787eb12ee86536380...	2018-12	1	flystudio	test
999997	0020077cb673729209d88b603bddf56b925b18e682892a...	2018-12	0	NaN	test
999998	1b7e7c8febabf70d1c17fe3c7abf80f33003581c380f28...	2018-12	0	NaN	test
999999	836063f2312b597632bca1f738e68e4d23f672d587a7fc...	2018-12	1	emotet	test

1000000 rows × 5 columns

More frequent malware classes in the Dataset

In [13]:

```
A = meta_data['avclass'].value_counts()
A[A>11000]
```

Out[13]:

```
xtrat             41564
zbot              27656
ramnit            23999
installmonster    22199
sality            21750
zusy              18766
vtflooder         16164
emotet            15624
fareit            14382
adposhel          11756
Name: avclass, dtype: int64
```

Loading the Dataset

In [14]:

```
( X_train, y_train, X_test, y_test) = read_vectorized_features(ember2018, subset=Non
```

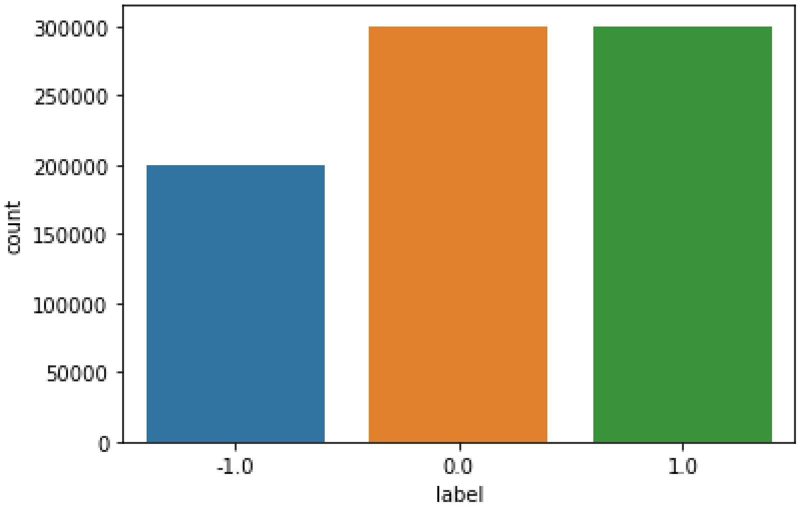
```
WARNING: EMBER feature version 2 were computed using lief version 0.9.0-
WARNING:   lief version 0.10.1- found instead. There may be slight inconsistencies
WARNING:   in the feature calculations.
```

Train Dataset Contains 300000 benign,300000 Malware samples and 200000 unlabeled samples

In [15]:

```
values, counts = np.unique(y_train, return_counts=True)
print (values,counts)
df = pd.DataFrame(data=y_train, columns=["label"])
sns.countplot(x = 'label', data=df);
```

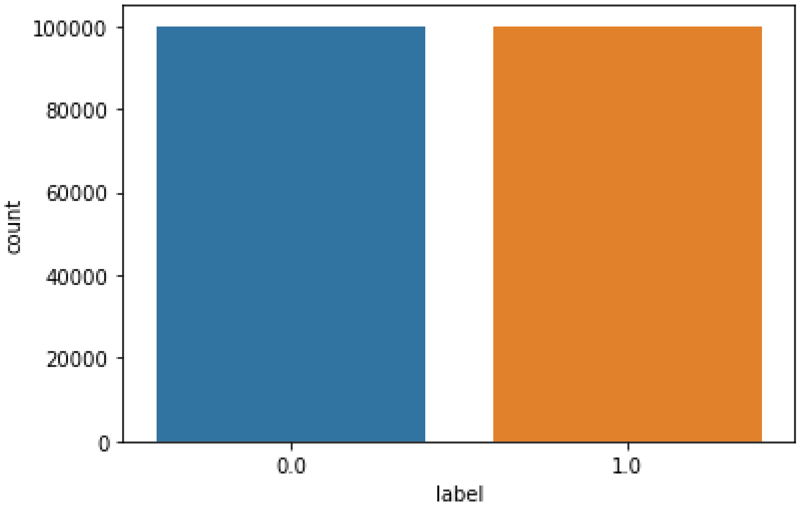
```
[-1.  0.  1.] [200000 300000 300000]
```



Test Dataset Contains 100000 benign and 100000 Malware samples

In [16]:
```
values, counts = np.unique(y_test, return_counts=True)
print (values,counts)
df = pd.DataFrame(data=y_test, columns=["label"])
sns.countplot(x = 'label', data=df);
```

```
[0. 1.] [100000 100000]
```



Removed unlabel samples and saved the train and test datset in the files ember2018_train_data.npz,ember2018_test_data.npz for future use

In [17]:
```
train = np.column_stack((X_train,y_train))
test = np.column_stack((X_test,y_test))
```

In [18]:
```
rows = np.where(train[:,-1]!=-1)
train[rows].shape
```

Out[18]:
```
(600000, 2382)
```

In [19]:
```
np.savez(os.path.join(ember2018,'ember2018_train_data.npz'),train[rows][:,:2381],tra
```

In [20]:
```
np.savez(os.path.join(ember2018,'ember2018_test_data.npz'),test[:,:2381],test[:,2381
```

In [21]:
```
npzfile = np.load(os.path.join(ember2018,'ember2018_train_data.npz'),allow_pickle=Tr
```

In [22]:
```
npzfile['arr_0'].shape
```

Out[22]:
```
(600000, 2381)
```

In [23]:
```
npzfile['arr_1'].shape
```

Out[23]:
```
(600000,)
```

In [24]:
```
npzfile = np.load(os.path.join(ember2018,'ember2018_test_data.npz'),allow_pickle=Tru
```

In [25]:
```
npzfile['arr_0'].shape,npzfile['arr_1'].shape
```

Out[25]:
```
((200000, 2381), (200000,))
```

In [26]:
```
!ls -l ../Dataset/ember_zip/ember2018/*.npz
```

```
-rw-r--r-- 1 mcs192792 mcs19 1905600486 May 14 23:28 ../Dataset/ember_zip/ember2018/
ember2018_test_data.npz
-rw-r--r-- 1 mcs192792 mcs19 5716800594 May 14 23:28 ../Dataset/ember_zip/ember2018/
ember2018_train_data.npz
```