In [2]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.linear_model import LogisticRegression
from sklearn.preprocessing import StandardScaler
import re
from sklearn.datasets import load_digits
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import GridSearchCV
from sklearn.tree import plot_tree
```

In [3]:

```
df=pd.read_csv("C3_bot_detection_data - C3_bot_detection_data.csv")
df
```

Out[3]:

	User ID	Username	Tweet	Retweet Count	Mention Count	Follower Count	Verified	Bot Label	Location
0	132131	flong	Station activity person against natural majori...	85	1	2353	False	1	Adkinston
1	289683	hinesstephanie	Authority research natural life material staff...	55	5	9617	True	0	Sanderston
2	779715	roberttran	Manage whose quickly especially foot none to g...	6	2	4363	True	0	Harrisonfurt
3	696168	pmason	Just cover eight opportunity strong policy which.	54	5	2242	True	1	Martinezberg
4	704441	noah87	Animal sign six data good or.	26	3	8438	False	1	Camachoville
...	...	...	...	...	...	...	...	...	...
49995	491196	uberg	Want but put card direction know miss former h...	64	0	9911	True	1	Lake Kimberlyburgh
49996	739297	jessicamunoz	Provide whole maybe agree church respond most ...	18	5	9900	False	1	Greenbury
49997	674475	lynncunningham	Bring different everyone international capital...	43	3	6313	True	1	Deborahfort
49998	167081	richardthompson	Than about single generation itself seek sell ...	45	1	6343	False	0	Stephenside
49999	311204	daniel29	Here morning class various room human true bec...	91	4	4006	False	0	Novakberg

```
50000 rows × 11 columns
```

In [4]:

```
df1=df.fillna(value=0)
df1
```

Out[4]:

	User ID	Username	Tweet	Retweet Count	Mention Count	Follower Count	Verified	Bot Label	Location
0	132131	flong	Station activity person against natural majori...	85	1	2353	False	1	Adkinston
1	289683	hinesstephanie	Authority research natural life material staff...	55	5	9617	True	0	Sanderston
2	779715	roberttran	Manage whose quickly especially foot none to g...	6	2	4363	True	0	Harrisonfurt
3	696168	pmason	Just cover eight opportunity strong policy which.	54	5	2242	True	1	Martinezberg
4	704441	noah87	Animal sign six data good or.	26	3	8438	False	1	Camachoville
...	...	...	...	...	...	...	...	...	...
49995	491196	uberg	Want but put card direction know miss former h...	64	0	9911	True	1	Lake Kimberlyburgh
49996	739297	jessicamunoz	Provide whole maybe agree church respond most ...	18	5	9900	False	1	Greenbury
49997	674475	lynncunningham	Bring different everyone international capital...	43	3	6313	True	1	Deborahfort
49998	167081	richardthompson	Than about single generation itself seek sell ...	45	1	6343	False	0	Stephenside
49999	311204	daniel29	Here morning class various room human true bec...	91	4	4006	False	0	Novakberg

50000 rows × 11 columns

In [5]:
```
df1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 50000 entries, 0 to 49999
Data columns (total 11 columns):
 #   Column          Non-Null Count  Dtype 
---  ------          --------------  ----- 
 0   User ID         50000 non-null  int64 
 1   Username        50000 non-null  object
 2   Tweet           50000 non-null  object
 3   Retweet Count   50000 non-null  int64 
 4   Mention Count   50000 non-null  int64 
 5   Follower Count  50000 non-null  int64 
 6   Verified        50000 non-null  bool  
 7   Bot Label       50000 non-null  int64 
 8   Location        50000 non-null  object
 9   Created At      50000 non-null  object
 10  Hashtags        50000 non-null  object
dtypes: bool(1), int64(5), object(5)
memory usage: 3.9+ MB
```

In [6]:
```
df1.columns
```

Out[6]:
```
Index(['User ID', 'Username', 'Tweet', 'Retweet Count', 'Mention Count',
       'Follower Count', 'Verified', 'Bot Label', 'Location', 'Created At',
       'Hashtags'],
      dtype='object')
```

In [7]:
```
df2=df1[['User ID', 'Retweet Count', 'Mention Count', 'Follower Count', 'Bot Label
df2
```

Out[7]:

	User ID	Retweet Count	Mention Count	Follower Count	Bot Label
0	132131	85	1	2353	1
1	289683	55	5	9617	0
2	779715	6	2	4363	0
3	696168	54	5	2242	1
4	704441	26	3	8438	1
...	...	...	...	...	...
49995	491196	64	0	9911	1
49996	739297	18	5	9900	1
49997	674475	43	3	6313	1
49998	167081	45	1	6343	0
49999	311204	91	4	4006	0

50000 rows × 5 columns

```
In [9]:  df2['Bot Label'].value_counts()
```

```
Out[9]:  1    25018
         0    24982
         Name: Bot Label, dtype: int64
```

```
In [10]: x=df2.drop('Bot Label',axis=1)
         y=df2['Bot Label']
```

```
In [11]: g1={'Bot Label':{'S':1,"C":2,"Q":3}}
         df2=df2.replace(g1)
         print(df2)
```

```
                User ID  Retweet Count  Mention Count  Follower Count  Bot Label
         0       132131             85              1            2353          1
         1       289683             55              5            9617          0
         2       779715              6              2            4363          0
         3       696168             54              5            2242          1
         4       704441             26              3            8438          1
         ...        ...            ...            ...             ...        ...
         49995   491196             64              0            9911          1
         49996   739297             18              5            9900          1
         49997   674475             43              3            6313          1
         49998   167081             45              1            6343          0
         49999   311204             91              4            4006          0

         [50000 rows x 5 columns]
```

```
In [12]: 
         x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.70)
```

```
In [13]: rfc=RandomForestClassifier()
         rfc.fit(x_train,y_train)
```

```
Out[13]: RandomForestClassifier()
```

```
In [14]: parameters = {'max_depth':[1,2,3,4,5],
                      'min_samples_leaf':[5,10,15,20,25],
                       'n_estimators':[10,20,30,40,50]}
```

```
In [15]: grid_search = GridSearchCV(estimator=rfc,param_grid=parameters,cv=2,scoring='accur
         grid_search.fit(x_train,y_train)
```

```
Out[15]: GridSearchCV(cv=2, estimator=RandomForestClassifier(),
                      param_grid={'max_depth': [1, 2, 3, 4, 5],
                                  'min_samples_leaf': [5, 10, 15, 20, 25],
                                  'n_estimators': [10, 20, 30, 40, 50]},
                      scoring='accuracy')
```

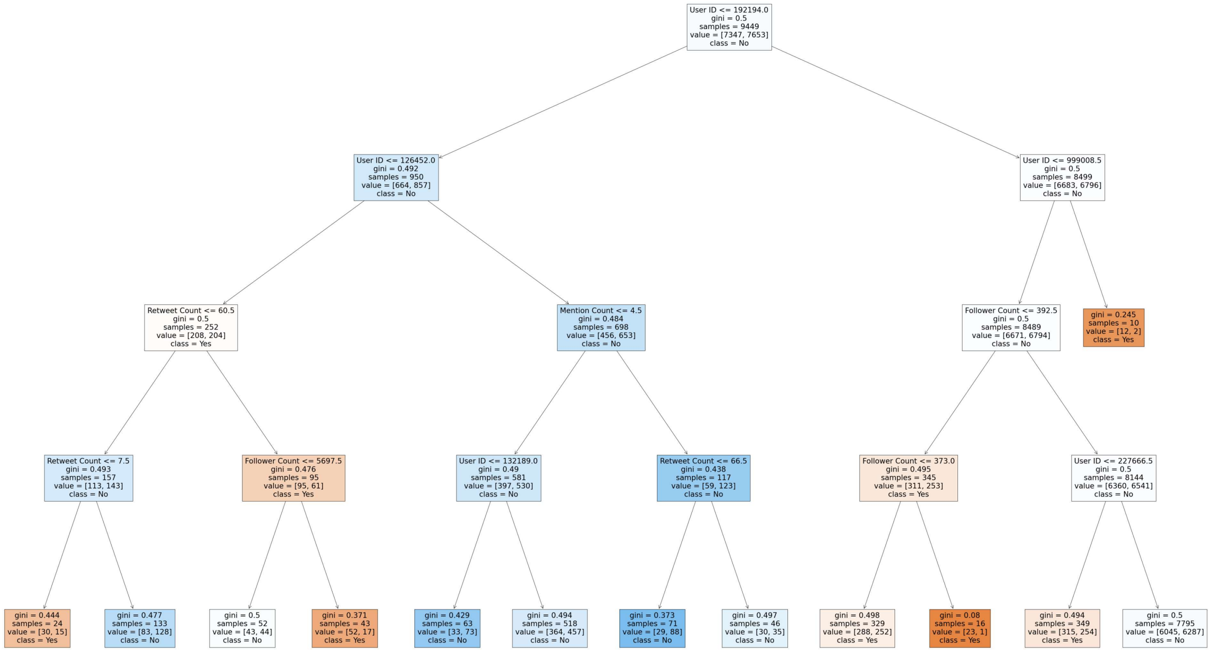
```
In [16]: grid_search.best_score_
```

```
Out[16]: 0.5100666666666667
```

```
In [21]: rfc_best =grid_search.best_estimator_
```

In [22]:
```
plt.figure(figsize=(80,50))
plot_tree(rfc_best.estimators_[5],feature_names=x.columns,class_names=['Yes','No']
```

Out[22]:
```
[Text(2697.0, 2446.2, 'User ID <= 192194.0\ngini = 0.5\nsamples = 9449\nvalue =
[7347, 7653]\nclass = No'),
 Text(1488.0, 1902.6, 'User ID <= 126452.0\ngini = 0.492\nsamples = 950\nvalue =
[664, 857]\nclass = No'),
 Text(744.0, 1359.0, 'Retweet Count <= 60.5\ngini = 0.5\nsamples = 252\nvalue =
[208, 204]\nclass = Yes'),
 Text(372.0, 815.3999999999999, 'Retweet Count <= 7.5\ngini = 0.493\nsamples = 15
7\nvalue = [113, 143]\nclass = No'),
 Text(186.0, 271.7999999999997, 'gini = 0.444\nsamples = 24\nvalue = [30, 15]\ncl
ass = Yes'),
 Text(558.0, 271.7999999999997, 'gini = 0.477\nsamples = 133\nvalue = [83, 128]\n
class = No'),
 Text(1116.0, 815.3999999999999, 'Follower Count <= 5697.5\ngini = 0.476\nsamples
= 95\nvalue = [95, 61]\nclass = Yes'),
 Text(930.0, 271.7999999999997, 'gini = 0.5\nsamples = 52\nvalue = [43, 44]\nclas
s = No'),
 Text(1302.0, 271.7999999999997, 'gini = 0.371\nsamples = 43\nvalue = [52, 17]\nc
lass = Yes'),
 Text(2232.0, 1359.0, 'Mention Count <= 4.5\ngini = 0.484\nsamples = 698\nvalue =
[456, 653]\nclass = No'),
 Text(1860.0, 815.3999999999999, 'User ID <= 132189.0\ngini = 0.49\nsamples = 581
\nvalue = [397, 530]\nclass = No'),
 Text(1674.0, 271.7999999999997, 'gini = 0.429\nsamples = 63\nvalue = [33, 73]\nc
lass = No'),
 Text(2046.0, 271.7999999999997, 'gini = 0.494\nsamples = 518\nvalue = [364, 457]
\nclass = No'),
 Text(2604.0, 815.3999999999999, 'Retweet Count <= 66.5\ngini = 0.438\nsamples =
117\nvalue = [59, 123]\nclass = No'),
 Text(2418.0, 271.7999999999997, 'gini = 0.373\nsamples = 71\nvalue = [29, 88]\nc
lass = No'),
 Text(2790.0, 271.7999999999997, 'gini = 0.497\nsamples = 46\nvalue = [30, 35]\nc
lass = No'),
 Text(3906.0, 1902.6, 'User ID <= 999008.5\ngini = 0.5\nsamples = 8499\nvalue =
[6683, 6796]\nclass = No'),
 Text(3720.0, 1359.0, 'Follower Count <= 392.5\ngini = 0.5\nsamples = 8489\nvalue
= [6671, 6794]\nclass = No'),
 Text(3348.0, 815.3999999999999, 'Follower Count <= 373.0\ngini = 0.495\nsamples
= 345\nvalue = [311, 253]\nclass = Yes'),
 Text(3162.0, 271.7999999999997, 'gini = 0.498\nsamples = 329\nvalue = [288, 252]
\nclass = Yes'),
 Text(3534.0, 271.7999999999997, 'gini = 0.08\nsamples = 16\nvalue = [23, 1]\ncla
ss = Yes'),
 Text(4092.0, 815.3999999999999, 'User ID <= 227666.5\ngini = 0.5\nsamples = 8144
\nvalue = [6360, 6541]\nclass = No'),
 Text(3906.0, 271.7999999999997, 'gini = 0.494\nsamples = 349\nvalue = [315, 254]
\nclass = Yes'),
 Text(4278.0, 271.7999999999997, 'gini = 0.5\nsamples = 7795\nvalue = [6045, 628
7]\nclass = No'),
 Text(4092.0, 1359.0, 'gini = 0.245\nsamples = 10\nvalue = [12, 2]\nclass = Ye
s')]
```


User ID <= 192194.0
gini = 0.5
samples = 9449
value = [7347, 7653]
class = No
User ID <= 126452.0
gini = 0.492
samples = 950
value = [664, 857]
class = No
User ID <= 999008.5
gini = 0.5
samples = 8499
value = [6683, 6796]
class = No
Retweet Count <= 60.5
gini = 0.5
samples = 252
value = [208, 204]
class = Yes
Mention Count <= 4.5
gini = 0.484
samples = 698
value = [456, 653]
class = No
Follower Count <= 392.5
gini = 0.5
samples = 8489
value = [6671, 6794]
class = No
gini = 0.245
samples = 10
value = [12, 2]
class = Yes
Retweet Count <= 7.5
gini = 0.493
samples = 157
value = [113, 143]
class = No
Follower Count <= 5697.5
gini = 0.476
samples = 95
value = [95, 61]
class = Yes
User ID <= 132189.0
gini = 0.49
samples = 581
value = [397, 530]
class = No
Retweet Count <= 66.5
gini = 0.438
samples = 117
value = [59, 123]
class = No
Follower Count <= 373.0
gini = 0.495
samples = 345
value = [311, 253]
class = Yes
User ID <= 227666.5
gini = 0.5
samples = 8144
value = [6360, 6541]
class = No
gini = 0.444
samples = 24
value = [30, 15]
class = Yes
gini = 0.477
samples = 133
value = [83, 128]
class = No
gini = 0.5
samples = 52
value = [43, 44]
class = No
gini = 0.371
samples = 43
value = [52, 17]
class = Yes
gini = 0.429
samples = 63
value = [33, 73]
class = No
gini = 0.494
samples = 518
value = [364, 457]
class = No
gini = 0.373
samples = 71
value = [29, 88]
class = No
gini = 0.497
samples = 46
value = [30, 35]
class = No
gini = 0.498
samples = 329
value = [288, 252]
class = Yes
gini = 0.08
samples = 16
value = [23, 1]
class = Yes
gini = 0.494
samples = 349
value = [315, 254]
class = Yes
gini = 0.5
samples = 7795
value = [6045, 6287]
class = No

In [ ]: