Predict the Criminal with Ensemble

Ensemble modeling is a powerful way to improve the performance of your model. It usually pays off to apply ensemble learning over and above various models you might be building.

Import Libraries

In [25]:
```
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
import seaborn as sns
from tqdm import tqdm_notebook
%matplotlib inline
```

Get the Data

In [26]:
```
train = pd.read_csv('criminal_train.csv')
test = pd.read_csv('criminal_test.csv')
```

In [27]:
```
train.head()
```

Out[27]:

	PERID	IFATHER	NRCH17_2	IRHHSIZ2	IIHHSIZ2	IRKI17_2	IIKI17_2	IRHH65_2	I
0	25095143	4	2	4	1	3	1	1	1
1	13005143	4	1	3	1	2	1	1	1
2	67415143	4	1	2	1	2	1	1	1
3	70925143	4	0	2	1	1	1	1	1
4	75235143	1	0	6	1	4	1	1	1

5 rows × 72 columns

In [28]:
```
test.head()
```

Out[28]:

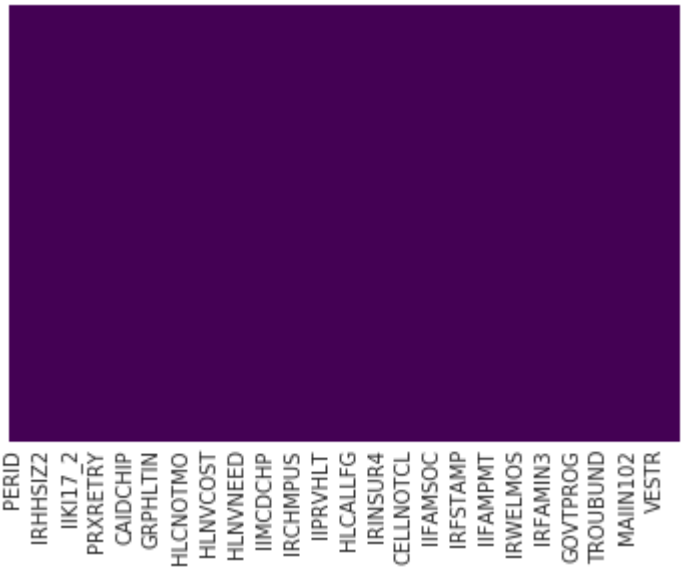
	PERID	IFATHER	NRCH17_2	IRHHSIZ2	IIHHSIZ2	IRKI17_2	IIKI17_2	IRHH65_2	I
0	66583679	4	0	4	1	2	1	1	1
1	35494679	4	0	4	1	1	1	1	1
2	79424679	2	0	3	1	2	1	1	1
3	11744679	4	0	6	1	2	1	1	1
4	31554679	1	0	4	1	3	1	1	1

5 rows × 71 columns

Exploratory Data Analysis

In [29]:
```
sns.heatmap(train.isnull(),yticklabels=False,cbar=False,cmap='viridis')
```

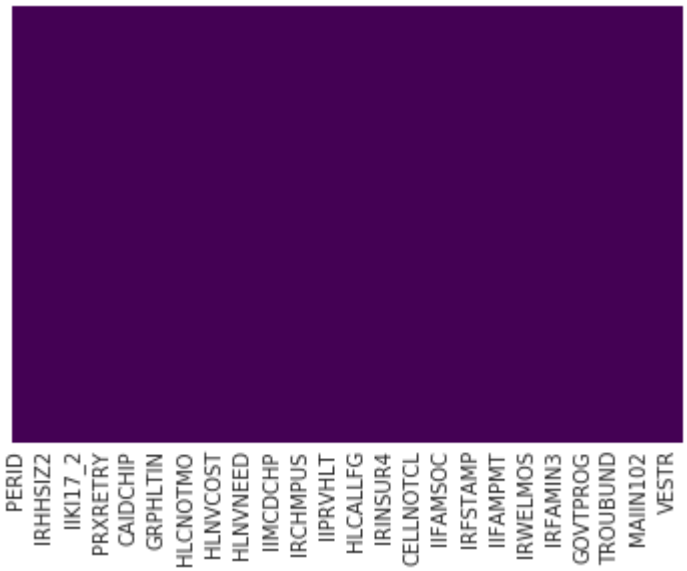
Out[29]: <matplotlib.axes._subplots.AxesSubplot at 0x7fc669b07978>



Train data do not have any Null values

In [30]:
```
sns.heatmap(test.isnull(),yticklabels=False,cbar=False,cmap='viridis'
)
```

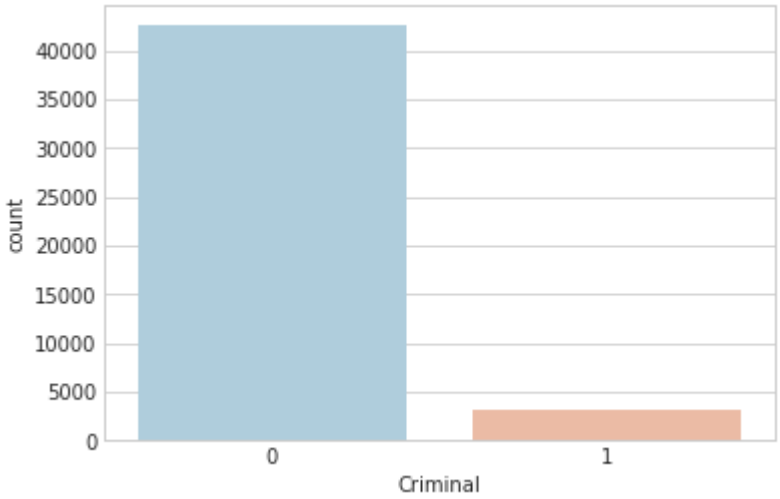
Out[30]: <matplotlib.axes._subplots.AxesSubplot at 0x7fc669a78390>



Test data do not have any Null values

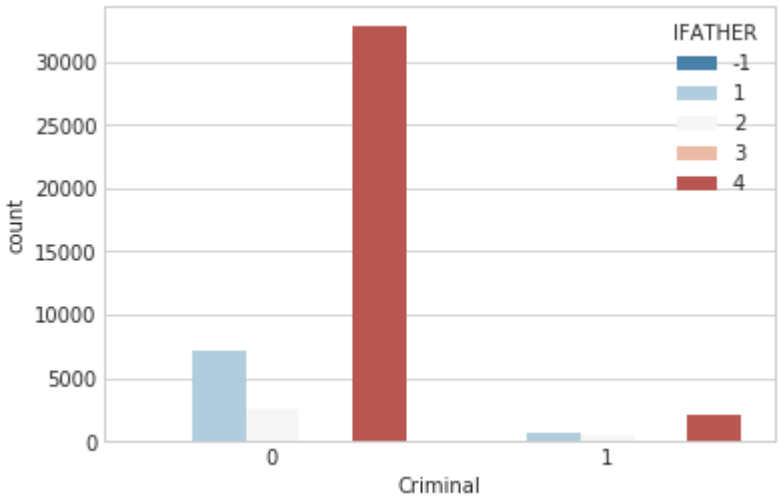
In [31]:
```
sns.set_style('whitegrid')
sns.countplot(x='Criminal',data=train,palette='RdBu_r')
```

Out[31]: <matplotlib.axes._subplots.AxesSubplot at 0x7fc6641d5780>



In [32]:
```
sns.set_style('whitegrid')
sns.countplot(x='Criminal',hue='IFATHER',data=train,palette='RdBu_r')
```

Out[32]: <matplotlib.axes._subplots.AxesSubplot at 0x7fc669ae46d8>



Count Unique features

In [33]:
```
feats_counts = train.nunique(dropna=False)
```

In [34]:
```
feats_counts.sort_values()[:10]
```

Out[34]:
```
Criminal    2
IRFAMSSI    3
IIFAMSOC    3
IRFAMSOC    3
OTHINS      3
IIINSUR4    3
IRMCDCHP    3
IIMCDCHP    3
IRMEDICR    3
IIMEDICR    3
dtype: int64
```

Data Cleaning

For Duplicate Columns

In [35]:
```
train_enc = pd.DataFrame(index= train.index)
```

In [36]:
```
for col in tqdm_notebook(train.columns):
    train_enc[col] = train[col].factorize()[0]
```

In [37]:
```
dup_col = {}

for i, c1 in enumerate(tqdm_notebook(train_enc.columns)):
    for c2 in train_enc.columns[i+1 :]:
        if c2 not in dup_col and np.all(train_enc[c1] == train_enc[c2
]):
            dup_col[c2]=c1
```

In [38]:
```
dup_col
```

Out[38]:
```
{'HLCALL99': 'HLCALLFG'}
```

In [39]:
```
train.head()
```

Out[39]:

	PERID	IFATHER	NRCH17_2	IRHHSIZ2	IIHHSIZ2	IRKI17_2	IIKI17_2	IRHH65_2	I
0	25095143	4	2	4	1	3	1	1	1
1	13005143	4	1	3	1	2	1	1	1
2	67415143	4	1	2	1	2	1	1	1
3	70925143	4	0	2	1	1	1	1	1
4	75235143	1	0	6	1	4	1	1	1

5 rows × 72 columns

Drop Duplicte Columns

In [40]:
```
train.drop('PERID', axis=1,inplace=True)
```

In [41]:
```
train.drop("HLCALL99",axis=1,inplace=True)
test.drop("HLCALL99",axis=1, inplace=True)
```

In [42]:
```
train.shape
```

Out[42]:
```
(45718, 70)
```

In [43]:
```
test.shape
```

Out[43]:
```
(11430, 70)
```

In [44]:
```
nunique = train.nunique()
```

Building a Model

Train-Test Split

Split the data into Training testing set

In [50]:
```
from sklearn.model_selection import train_test_split
```

In [51]:
```
X = train.drop('Criminal', axis=1)
y = train['Criminal']
training, valid, ytraning, yvalid = train_test_split(X, y, test_size=
0.5)
```

In [52]:
```
from sklearn.ensemble import AdaBoostClassifier
from xgboost import XGBClassifier
from sklearn.ensemble import RandomForestClassifier, RandomForestRegr
essor
from sklearn.linear_model import LinearRegression
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.ensemble import BaggingClassifier, BaggingRegressor
```

Useing Random Forest and XGBClassifier

In [53]:
```
model1 = RandomForestClassifier(n_estimators=100)
model2 = XGBClassifier()
```

Training both the models

In [54]:
```
model1.fit(training, ytraning)
model2.fit(training, ytraning)
```

Out[54]:
```
XGBClassifier(base_score=0.5, booster='gbtree', colsample_bylevel=1,
       colsample_bytree=1, gamma=0, learning_rate=0.1, max_delta_step
=0,
       max_depth=3, min_child_weight=1, missing=None, n_estimators=10
0,
       n_jobs=1, nthread=None, objective='binary:logistic', random_st
ate=0,
       reg_alpha=0, reg_lambda=1, scale_pos_weight=1, seed=None,
       silent=True, subsample=1)
```

In [55]:
```
pred1 = model1.predict(valid)
pred2 = model2.predict(valid)
```

In [56]:
```
X_test = test.drop('PERID', axis=1)
```

In [57]:
```
test_pred1 = model1.predict(X_test)
```

In [58]:
```
test_pred2 = model2.predict(X_test)
```

Stacking both the predictions

In [59]:
```
stacked_pred = np.column_stack((pred1, pred2))
stacked_pred_test = np.column_stack((test_pred1, test_pred2))
```

Use of meta model Random Forest for final prediction

In [60]:
```
meta_model = RandomForestClassifier(n_estimators=100, max_depth=3)
```

In [61]:
```
meta_model.fit(stacked_pred, yvalid)
```

Out[61]:
```
RandomForestClassifier(bootstrap=True, class_weight=None, criterion
='gini',
            max_depth=3, max_features='auto', max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, n_estimators=100, n_jobs=1,
            oob_score=False, random_state=None, verbose=0,
            warm_start=False)
```

In [62]:
```
final_prediction = meta_model.predict(stacked_pred_test)
```

Metamodel Score

In [63]:
```
meta_model.score(stacked_pred, yvalid)
```

Out[63]:
```
0.95389124633623523
```

Result file into .csv

In [ ]:
```
submission = pd.DataFrame({
    "PERID": test["PERID"],
    "Criminal": bagged_predictions,
    })
submission.to_csv('Result4.csv', index=False, columns=['PERID', 'Crim
inal'])
```

In [ ]:
```
bagged_predictions
```

In [ ]:
```

```