Credit Card Fraud Detection

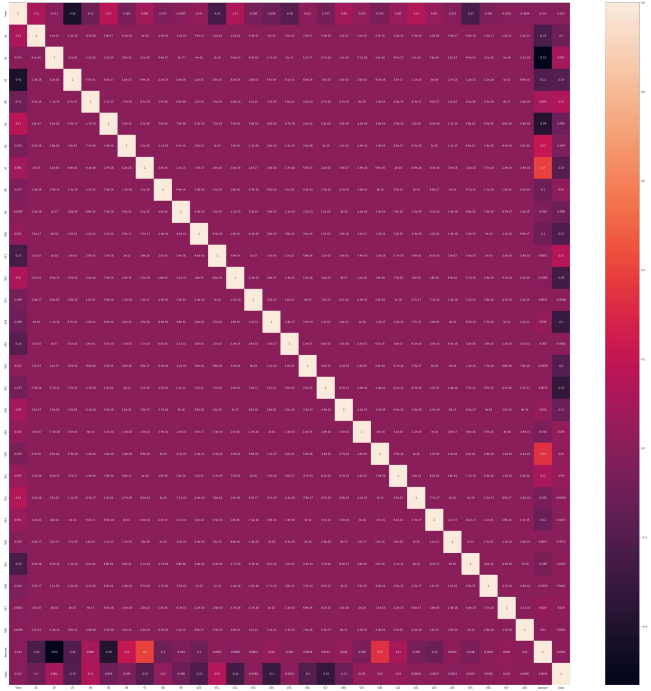
Using Unsupervised ML Techniques

Dataset

- September 2013
- European Cardholders
- 284,807 Transactions
- PCA already performed
  - Protect anonymity of cardholders with Variable names
- 400,000 cases in 2020 alone
- Comparing to Supervised

Cleaning and Visualization

- PCA already performed
- No missing values
  - Also checked outside default pandas NA values
- 31 variables
  - 30 predictor, 1 response
- Look at correlation Matrix
- Only 492 fraudulent transactions
  - Heavily Skewed Data



Splitting Data

- Undersampling
  - Change proportion of positive cases to negative cases
  - Identify all the legitimate and fraudulent cases
  - Select all fraudulent and three times that many legitimate cases
  - Check for duplicates
- Split use train_test_split
- Check train data set

```
X = df.iloc[:, df.columns != 'Class']
y = df.iloc[:, df.columns == 'Class']
len(y[y.Class ==1])
```

```
492
```

```
number_fraud = len(df[df['Class']==1]) * 3
fraud_index = np.array(df[df['Class']==1].index)
legit_index = np.array(df[df['Class']==0].index)

random_legit_index = np.random.choice(legit_index, number_fraud, replace = False )
under_sample_index = np.concatenate([fraud_index, random_legit_index])
```

```
#Make sure they don't overlap
np.intersect1d(fraud_index , legit_index)
```

```
array([], dtype=int64)
```

```
under_sample = df.iloc[under_sample_index,:]
x_undersample = under_sample.iloc[:, under_sample.columns != 'Class'];
y_undersample = under_sample.iloc[:, under_sample.columns == 'Class'];
```

```
from sklearn.model_selection import train_test_split
X_train_under, X_test_under, y_train_under, y_test_under = train_test_split (x_undersample,y_undersample, test_size = 0.3, random_state = 42)
```

```
y_train_under['Class'].value_counts()
```

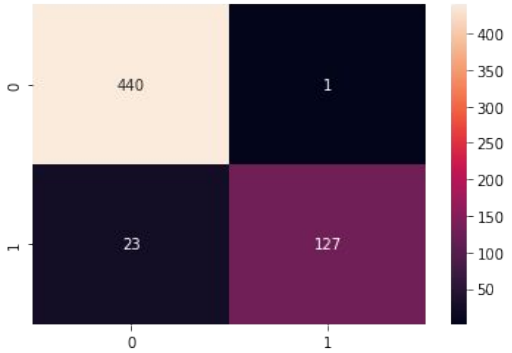
```
0    1035
1     342
Name: Class, dtype: int64
```

Modelling Data

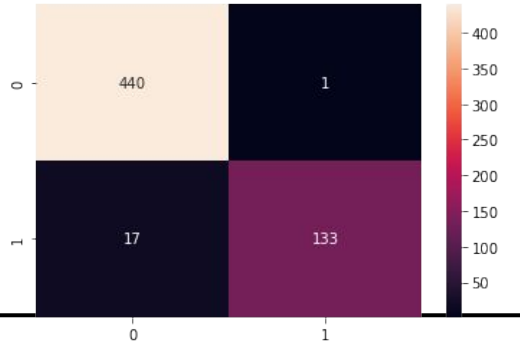
- Large number of Variables
- Cannot assume linearity
- Best Supervised Model
  - Random Forest
- Look at Recall Score and Execution Time

Random Forest

- Max_depth: 2
  - Duration: 0:00:00.233200
  - Recall Score: 0.8466666666666667



- Max-depth: 10
  - Duration: 0:00:00.476433
  - Recall Score: 0.88

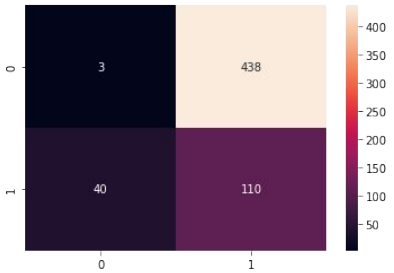


Agglomerative Clustering

- Commonly used for Similarity/Dissimilarity
- Loop through combinations of parameters
- Duration: 0:00:00.060055
- Recall Score: 0.526315789473684 2

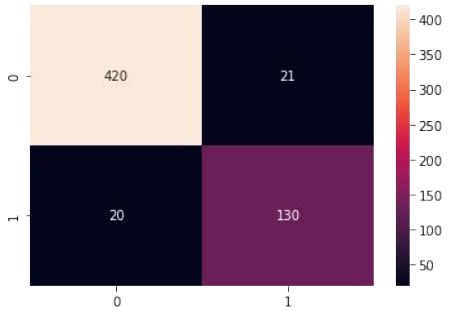
Isolation Forests

- Anomaly detection algorithm and detects anomalies using isolation
  - How far a data point is from the rest of the data
- Duration: 0:00:01.324203
- Recall Score: 0.7333333333333333



Gaussian Mixture

- Uses several Gaussians
  - Each Gaussian has unique mean, covariance, and mixing probability
- Duration: 0:00:00.021019
- Recall Score: 0.8666666666666667



Conclusion

- Use three unsupervised ML techniques to identify credit card fraud
- Initially used Agglomerative Clustering
  - Saw improvement in execution time but very bad recall
- Isolation Forests
  - Twice as long with a significantly worse score
- Gaussian Mixture
  - 20x Speed while retaining similar score