In [27]:
```
# imports
import warnings
warnings.simplefilter('ignore')

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

import re
from time import time
from scipy import stats
import json

from sklearn.base import BaseEstimator, TransformerMixin
from sklearn.model_selection import train_test_split
from sklearn.pipeline import Pipeline
from sklearn.impute import SimpleImputer
from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import OneHotEncoder

from sklearn.model_selection import ShuffleSplit
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import GridSearchCV

from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.svm import SVC
from sklearn.linear_model import SGDClassifier
from sklearn.ensemble import RandomForestClassifier

from sklearn.pipeline import Pipeline, FeatureUnion
from sklearn.metrics import make_scorer, roc_auc_score, log_loss, accuracy_score
from sklearn.preprocessing import LabelEncoder

from sklearn.metrics import confusion_matrix

from IPython.display import display, Math, Latex
```

In [2]:
```
df = pd.read_csv('./application_train.csv')
df.head()
```

Out[2]:

	SK_ID_CURR	TARGET	NAME_CONTRACT_TYPE	CODE_GENDER	FLAG_OWN_CAR	FLAG_OWN_REAL
0	100002	1	Cash loans	M	N	
1	100003	0	Cash loans	F	N	
2	100004	0	Revolving loans	M	Y	
3	100006	0	Cash loans	F	N	
4	100007	0	Cash loans	M	N	

5 rows × 122 columns

In [3]:
```
y = df['TARGET']
```

```
x = df.drop(columns='TARGET')
```

Building Logistic Regression baseline pipeline

In [4]:

```
results = pd.DataFrame(columns=["ExpID", "Cross fold train accuracy", "Test Accuracy

def pct(x):
    return round(100*x,1)


class DataFrameSelector(BaseEstimator, TransformerMixin):
    def __init__(self, attribute_names):
        self.attribute_names = attribute_names
    def fit(self, X, y=None):
        return self
    def transform(self, X):
        return X[self.attribute_names].values


def returnModel(x,y,results,description_text):
    num_attribs = []
    cat_attribs = []

    for col in x.columns.tolist():
        if x[col].dtype in (['int','float']):
            num_attribs.append(col)
        else:
            cat_attribs.append(col)

    le_dict = {}
    for col in x.columns.tolist():
        if df[col].dtype == 'object':
            le = LabelEncoder()
            x[col] = x[col].fillna("NULL")
            x[col] = le.fit_transform(x[col])
            le_dict['le_{}'.format(col)] = le

    num_pipeline =Pipeline([('selector',DataFrameSelector(num_attribs)),
                            ('scaler', StandardScaler()),
                           ('imputer', SimpleImputer(strategy = 'median'))
                            ])


    cat_pipeline = Pipeline([
        ('selector', DataFrameSelector(cat_attribs)),
        ('imputer', SimpleImputer(strategy='most_frequent'))
    ])


    full_pipeline = FeatureUnion(transformer_list=[
        ("num_pipeline", num_pipeline),
        ("cat_pipeline", cat_pipeline),
    ])

    np.random.seed(42)
    full_pipeline_with_predictor = Pipeline([
            ("preparation", num_pipeline),
            ("linear", LogisticRegression(random_state=42))
        ])

    # split 20% test data with random seed set to 42 for correct results
    x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.20, random
    x_train, x_valid, y_train, y_valid = train_test_split(x_train, y_train, test_siz
```

```
    print("train data set: ")
    print(x_train.shape,y_train.shape)
    print("test data set: ")
    print(x_test.shape,y_test.shape)
    print("validation data set: ")
    print(x_valid.shape,y_valid.shape)


    start = time()
    full_pipeline_with_predictor.fit(x_train, y_train)
    np.random.seed(42)

    cv30Splits = ShuffleSplit(n_splits = 30, test_size = 0.3, random_state = 0)
    logit_scores = cross_val_score(full_pipeline_with_predictor, x_train, y_train, c
    logit_score_train = logit_scores.mean()
    train_time = np.round(time() - start, 4)

    # Time and score test predictions
    start = time()
    logit_score_test  = full_pipeline_with_predictor.score(x_test, y_test)
    test_time = np.round(time() - start, 4)

    start = time()
    logit_score_valid  = full_pipeline_with_predictor.score(x_valid, y_valid)
    valid_time = np.round(time() - start, 4)

    AUC = roc_auc_score(y_test,full_pipeline_with_predictor.predict(x_test))
    print("AUC is {}".format(AUC))
    print("\n.............\n")
    print("Confusion Matrix: {}".format(confusion_matrix(y_test, full_pipeline_with_

    no_of_inputs = x.shape[1]

    temp_df = pd.DataFrame()
    temp_df = temp_df.append(pd.Series(["Baseline with {} inputs".format(no_of_input
                  AUC, train_time, test_time, valid_time, "{} - Untuned LogisticRegr
    temp_df.columns = results.columns

    results = results.append(temp_df,ignore_index=True)

    return le_dict, full_pipeline_with_predictor, results
```

Loss function used (data loss and regularization parts) in latex

source: https://tex.stackexchange.com/questions/517834/how-to-define-loss-function-in-latex

In [28]:
```
display(Math(r'[L_\varepsilon(y,f(x,w))=\max\{0, |y-f(x,w)|-\varepsilon\}]'))
```

$$[L_{\varepsilon}(y, f(x, w)) = \max\{0, |y - f(x, w)| - \varepsilon\}]$$

In [5]:
```
le_dict, full_pipeline_with_predictor, results = returnModel(x,y,results,"Unbalanced
```

```
train data set:
(196806, 121) (196806,)
test data set:
(61503, 121) (61503,)
validation data set:
(49202, 121) (49202,)
AUC is 0.5025370977627421

.............
```

```
Confusion Matrix: [[56521    33]
 [ 4921    28]]
```

In [6]:
```
results
```

Out[6]:

	ExpID	Cross fold train accuracy	Test Accuracy	Validation Accuracy	AUC	Train Time(s)	Test Time(s)	Validation Time(s)	Experimen description
0	Baseline with 121 inputs	92.0	91.9	91.8	0.502537	146.9194	0.1387	0.1223	Unbalance Dataset - Untune LogisticRegressio

In [ ]:
```

```

Submission 1

Checking across test dataset

In [7]:
```
test_data_set = pd.read_csv('./application_test.csv')
test_data_set.head()
```

Out[7]:

	SK_ID_CURR	NAME_CONTRACT_TYPE	CODE_GENDER	FLAG_OWN_CAR	FLAG_OWN_REALTY	CNT
0	100001	Cash loans	F	N	Y	
1	100005	Cash loans	M	N	Y	
2	100013	Cash loans	M	Y	Y	
3	100028	Cash loans	F	N	Y	
4	100038	Cash loans	M	Y	N	

5 rows × 121 columns

In [8]:
```
for col in test_data_set.columns.tolist():
    for le in le_dict:
        if col in le:
            test_data_set[col] = le_dict[le].fit_transform(test_data_set[col])
```

In [9]:
```
output_data = test_data_set[['SK_ID_CURR']]
output_data['TARGET'] = pd.Series(full_pipeline_with_predictor.predict(test_data_set
```

In [10]:
```
output_data['TARGET'].value_counts()
```

Out[10]:
```
0    48687
1       57
Name: TARGET, dtype: int64
```

In [11]:
```
output_data.to_csv('./output.csv', index=False)
```

In [ ]:
```

```

Improving the AUC

Balancing the dataset and running the same baseline model

Approach 1

In [12]:
```
df['TARGET'].value_counts()
```

Out[12]:
```
0    282686
1     24825
Name: TARGET, dtype: int64
```

In [13]:
```
final_data = df[df['TARGET']==1]
final_data = final_data.append(df[df['TARGET']==0].reset_index(drop=True).sample(n =
print(final_data.shape)
final_data.head()
```

```
(74825, 122)
```

Out[13]:

	SK_ID_CURR	TARGET	NAME_CONTRACT_TYPE	CODE_GENDER	FLAG_OWN_CAR	FLAG_OWN_REA
0	100002	1	Cash loans	M	N	
26	100031	1	Cash loans	F	N	
40	100047	1	Cash loans	M	N	
42	100049	1	Cash loans	F	N	
81	100096	1	Cash loans	F	N	

5 rows × 122 columns

In [14]:
```
x = final_data.drop(columns='TARGET')
y = final_data['TARGET']
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=.2, shuffle=True
print(x_train.shape,y_train.shape)
```

```
(59860, 121) (59860,)
```

In [15]:
```
le_dict, full_pipeline_with_predictor, results = returnModel(x,y,results,"50000 non-
```

```
train data set:
(47888, 121) (47888,)
test data set:
(14965, 121) (14965,)
validation data set:
(11972, 121) (11972,)
AUC is 0.6232512922394526

............
```

```
Confusion Matrix: [[8941 1110]
 [3160 1754]]
```

In [16]:
```
results
```

Out[16]:

	ExpID	Cross fold train accuracy	Test Accuracy	Validation Accuracy	AUC	Train Time(s)	Test Time(s)	Validation Time(s)	Experimen description
0	Baseline with 121 inputs	92.0	91.9	91.8	0.502537	146.9194	0.1387	0.1223	Unbalance Dataset - Untune LogisticRegressio
1	Baseline with 121 inputs	71.2	71.5	71.9	0.623251	26.9970	0.0328	0.0408	50000 non defaulter Balanced Datase - Untune.

Submission 2

Checking across test dataset

In [17]:
```
output_data = test_data_set[['SK_ID_CURR']]
output_data['TARGET'] = pd.Series(full_pipeline_with_predictor.predict(test_data_set
```

In [18]:
```
output_data['TARGET'].value_counts()
```

Out[18]:
```
0    42160
1     6584
Name: TARGET, dtype: int64
```

In [19]:
```
output_data.to_csv('./output_submission_1.csv', index=False)
```

In [ ]:
```

```

Approach 2

In [20]:
```
final_data = df[df['TARGET']==1]
final_data = final_data.append(df[df['TARGET']==0].reset_index(drop=True).sample(n =
print(final_data.shape)
final_data.head()
```

```
(99825, 122)
```

Out[20]:

	SK_ID_CURR	TARGET	NAME_CONTRACT_TYPE	CODE_GENDER	FLAG_OWN_CAR	FLAG_OWN_REA
0	100002	1	Cash loans	M	N	
26	100031	1	Cash loans	F	N	
40	100047	1	Cash loans	M	N	
42	100049	1	Cash loans	F	N	

	SK_ID_CURR	TARGET	NAME_CONTRACT_TYPE	CODE_GENDER	FLAG_OWN_CAR	FLAG_OWN_REA
81	100096	1	Cash loans	F	N	

5 rows × 122 columns

In [21]:
```
x = final_data.drop(columns='TARGET')
y = final_data['TARGET']
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=.2, shuffle=True
print(x_train.shape,y_train.shape)
```

```
(79860, 121) (79860,)
```

In [22]:
```
le_dict, full_pipeline_with_predictor, results = returnModel(x,y,results,"75000 non-
```

```
train data set:
(63888, 121) (63888,)
test data set:
(19965, 121) (19965,)
validation data set:
(15972, 121) (15972,)
AUC is 0.5695009389246085

............

Confusion Matrix: [[14242   734]
 [ 4051   938]]
```

In [23]:
```
results
```

Out[23]:

	ExpID	Cross fold train accuracy	Test Accuracy	Validation Accuracy	AUC	Train Time(s)	Test Time(s)	Validation Time(s)	Experimen description
0	Baseline with 121 inputs	92.0	91.9	91.8	0.502537	146.9194	0.1387	0.1223	Unbalance Dataset - Untune LogisticRegressio
1	Baseline with 121 inputs	71.2	71.5	71.9	0.623251	26.9970	0.0328	0.0408	50000 non defaulter Balanced Datase - Untune.
2	Baseline with 121 inputs	76.7	76.0	76.8	0.569501	36.4743	0.0408	0.0325	75000 non defaulter Balanced Datase - Untune.

Submission 3

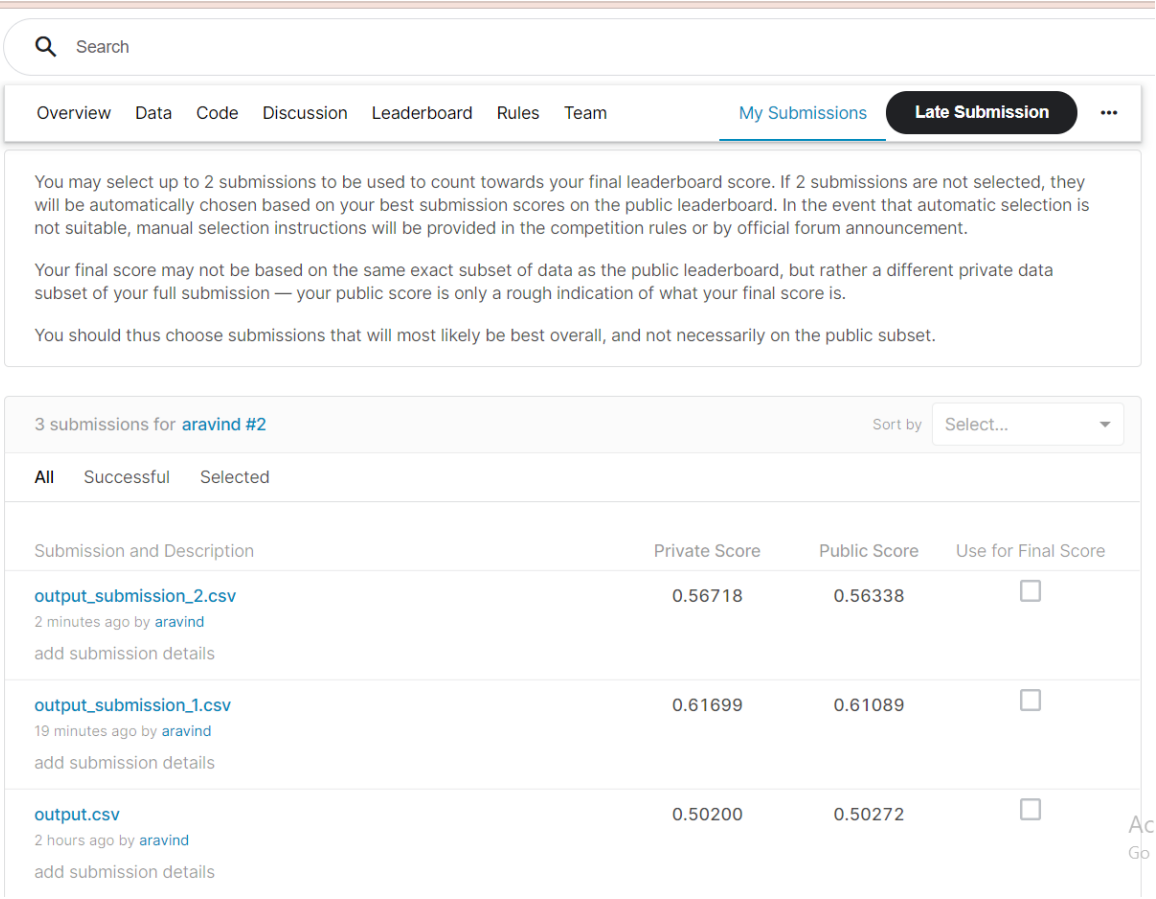
Checking across test dataset

In [24]:
```
output_data = test_data_set[['SK_ID_CURR']]
output_data['TARGET'] = pd.Series(full_pipeline_with_predictor.predict(test_data_set
```

In [25]:
```
output_data['TARGET'].value_counts()
```

Out[25]:
```
0    45649
1     3095
Name: TARGET, dtype: int64
```

In [26]:
```
output_data.to_csv('./output_submission_2.csv', index=False)
```



In [ ]:
```
```