In [1]:

```python
import warnings
warnings.filterwarnings('ignore')
```

In [2]:

```python
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)

import matplotlib.pyplot as plt
import seaborn as sb

import xgboost as xgb
from xgboost import XGBClassifier



from sklearn.ensemble import IsolationForest
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import train_test_split

from sklearn.neighbors import LocalOutlierFactor
from sklearn.svm import OneClassSVM
from sklearn.metrics import accuracy_score,confusion_matrix,classification_repo

# Input data files are available in the read-only "../input/" directory
# For example, running this (by clicking run or pressing Shift+Enter) will list

import os
for dirname, _, filenames in os.walk('./'):
    for filename in filenames:
        print(os.path.join(dirname, filename))

# You can write up to 20GB to the current directory (/kaggle/working/) that get
# You can also write temporary files to /kaggle/temp/, but they won't be saved
```

```
./Submission.csv
./supervised-anomaly-detection.ipynb
./test.csv
./train.csv
./.ipynb_checkpoints\supervised-anomaly-detection-checkpoint.ipynb
```

In [3]:

```python
df_train = pd.read_csv('./train.csv')
df_train.head(2)
```

Out[3]:

	timestamp	value	is_anomaly	predicted
0	1425008573	42	False	44.07250
1	1425008873	41	False	50.70939

In [4]:

```python
df_train['is_anomaly'] = df_train['is_anomaly'].replace(False,0).replace(True,
df_train['is_anomaly'].value_counts()
```

Out[4]:

```
is_anomaly
0    15054
1      776
Name: count, dtype: int64
```

In [5]:

```python
df_train.isnull().sum()

```

Out[5]:

```
timestamp     0
value         0
is_anomaly    0
predicted     0
dtype: int64
```

In [6]:

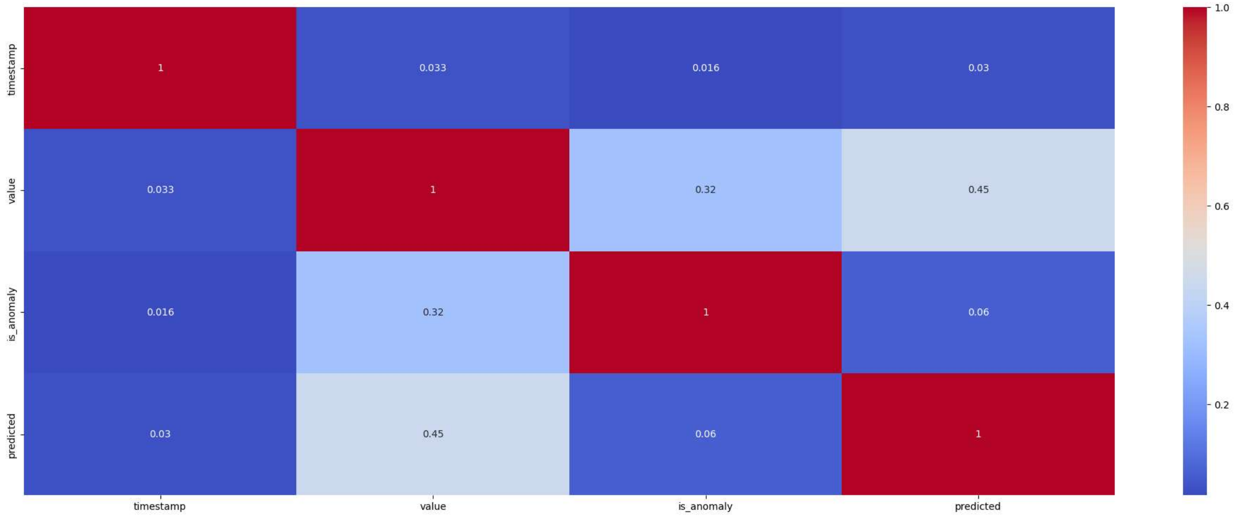
```python
df_train.describe()
```

Out[6]:

	timestamp	value	is_anomaly	predicted
count	1.583000e+04	15830.000000	15830.000000	15830.000000
mean	1.427383e+09	85.572205	0.049021	71.870715
std	1.370962e+06	321.760918	0.215918	92.450520
min	1.425009e+09	0.000000	0.000000	-281.389070
25%	1.426196e+09	29.000000	0.000000	32.919171
50%	1.427383e+09	47.000000	0.000000	49.771124
75%	1.428570e+09	76.000000	0.000000	75.948052
max	1.429757e+09	13479.000000	1.000000	2716.127200

In [7]:

```python
plt.figure(figsize=(25, 9))
sb.heatmap(df_train.corr(),annot=True,cmap='coolwarm')
plt.show()
```

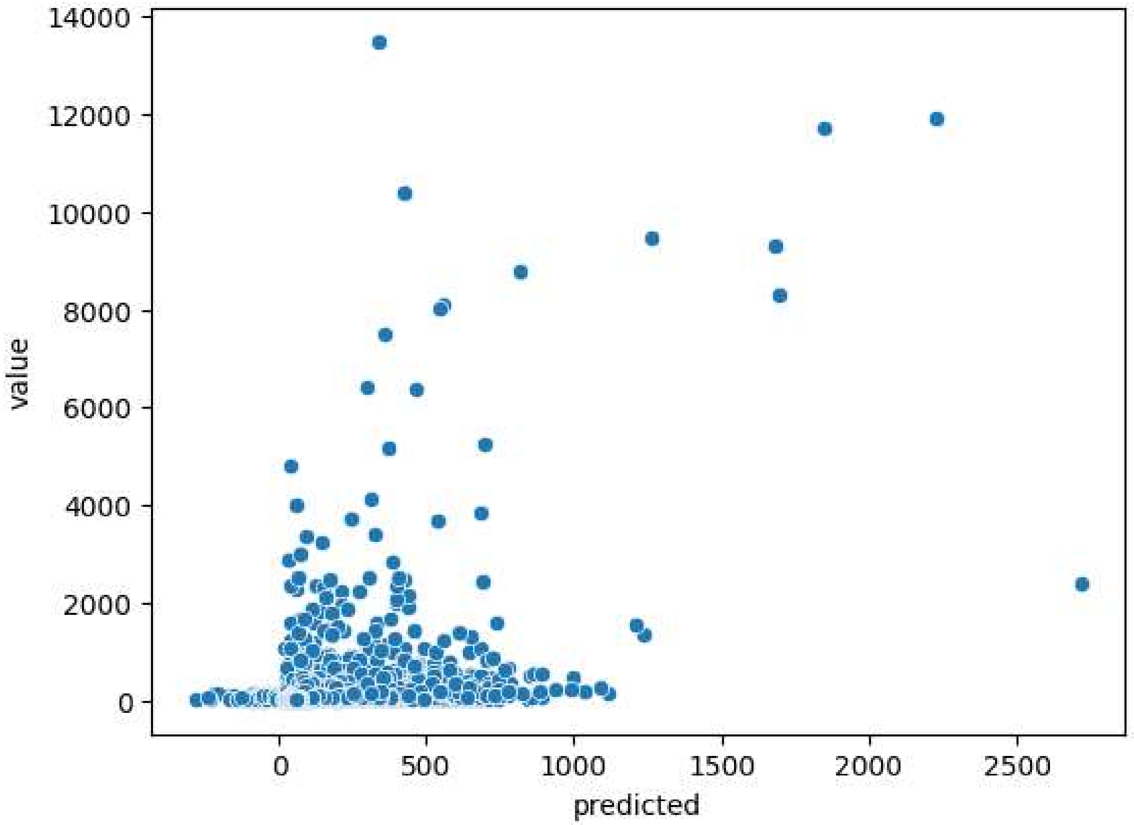


In [8]:

```
sb.scatterplot(x=df_train['predicted'], y=df_train['value'])
```

Out[8]:

```
<Axes: xlabel='predicted', ylabel='value'>
```



In [9]:

```
print("Total No of Transactions:",df_train.size)

Fraud_df = df_train[df_train['is_anomaly']==True]
print("No of Anomalous Transactions:",len(Fraud_df))

Valid_df = df_train[df_train['is_anomaly']==False]
print("No of Valid Transactions:",len(Valid_df))

outlier_fraction = len(Fraud_df)/float(len(df_train))
valid_fraction = len(Valid_df)/float(len(df_train))
print("Percentage of Anomalous Transactions:",round((outlier_fraction*100),3))
print("Percentage of Valid Transactions:",round((valid_fraction*100),3))
```

```
Total No of Transactions: 63320
No of Anomalous Transactions: 776
No of Valid Transactions: 15054
Percentage of Anomalous Transactions: 4.902
Percentage of Valid Transactions: 95.098
```

In [10]:

```python
X = df_train.drop(columns=['is_anomaly'],inplace=False,axis=1)
X.head(2)
```

Out[10]:

	timestamp	value	predicted
0	1425008573	42	44.07250
1	1425008873	41	50.70939

In [11]:

```python
y = df_train['is_anomaly']
y.head(3)
```

Out[11]:

```
0    0
1    0
2    0
Name: is_anomaly, dtype: int64
```

In [12]:

```python
X.shape
X_train = X.copy(deep=True)
y_train  = y.copy(deep=True)
```

In [13]:

```python
state = np.random.RandomState(42)
X_outliers = state.uniform(low=0, high=1, size=(X_train.shape[0], X_train.shap
```

In [14]:

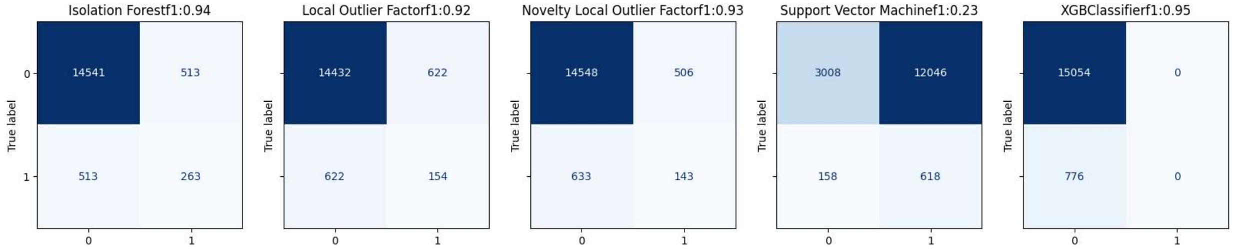
```python
classifiers = {
    "Isolation Forest":IsolationForest(n_estimators=100,
                                       max_samples=len(X_train),
                                       contamination=outlier_fraction,
                                       random_state=state,
                                       verbose=0),
    "Local Outlier Factor":LocalOutlierFactor(n_neighbors=20,
                                              algorithm='auto',
                                              leaf_size=30,
                                              metric='minkowski',
                                              novelty=False,
                                              p=2, metric_params=None,
                                              contamination=outlier_fraction),
    "Novelty Local Outlier Factor":LocalOutlierFactor(n_neighbors=20, algorith
                                              leaf_size=30, metric='minkowski'
                                                      novelty=True,p=2, metric_
                                                      contamination=outlier_fra
    "Support Vector Machine":OneClassSVM(kernel='rbf', degree=3, gamma=0.1,nu=
                                         max_iter=-1),
    "XGBClassifier":XGBClassifier(objective="binary:logistic", random_state=42
}
```

In [15]:

```python
f, axes = plt.subplots(1, 5, figsize=(20, 10), sharey='row')
for i, (clf_name,clf) in enumerate(classifiers.items()):
    #Fit the data and tag outliers
    print("###"*32)
    if clf_name == "Local Outlier Factor":
        y_pred = clf.fit_predict(X_train)
        scores_prediction = clf.negative_outlier_factor_
    elif clf_name == "Support Vector Machine":
        clf.fit(X_train)
        y_pred = clf.predict(X_train)
    elif clf_name == "Novelty Local Outlier Factor":
        clf.fit(X_train)
        y_pred = clf.predict(X_train)
        scores_prediction = clf.negative_outlier_factor_
    elif clf_name == "XGBClassifier":
        clf.fit(X_train,y_train)
        y_pred = clf.predict(X_train)
    else:
        clf.fit(X_train)
        scores_prediction = clf.decision_function(X_train)
        y_pred = clf.predict(X_train)
#     Reshape the prediction values to 0 for Valid transactions , 1 for Fraud t
    y_pred[y_pred == 1] = 0
    y_pred[y_pred == -1] = 1
    n_errors = (y_pred != y_train).sum()
    # Run Classification Metrics
    print("{}: {}".format(clf_name,n_errors))
    ac_score = accuracy_score(y_train,y_pred)

    print(f"Accuracy Score :{round(ac_score,2)}")
    print("Classification Report :")
    print(classification_report(y_train,y_pred))
    cf_matrix = confusion_matrix(y_train, y_pred)
    disp = ConfusionMatrixDisplay(cf_matrix)
    disp.plot(ax=axes[i], values_format='.0f',cmap = "Blues")
    axes[i].set_title(clf_name+"f1:"+str(round(ac_score,2)))
    disp.im_.colorbar.remove()
    disp.ax_.set_xlabel('')
```

```
#################################################################################
###############
Isolation Forest: 1026
Accuracy Score :0.94
Classification Report :
              precision    recall  f1-score   support

           0       0.97      0.97      0.97     15054
           1       0.34      0.34      0.34       776

    accuracy                           0.94     15830
   macro avg       0.65      0.65      0.65     15830
weighted avg       0.94      0.94      0.94     15830

#################################################################################
###############
Local Outlier Factor: 1244
Accuracy Score :0.92
Classification Report :
              precision    recall  f1-score   support

           0       0.96      0.96      0.96     15054
           1       0.20      0.20      0.20       776

    accuracy                           0.92     15830
   macro avg       0.58      0.58      0.58     15830
weighted avg       0.92      0.92      0.92     15830

#################################################################################
###############
Novelty Local Outlier Factor: 1139
Accuracy Score :0.93
Classification Report :
              precision    recall  f1-score   support

           0       0.96      0.97      0.96     15054
           1       0.22      0.18      0.20       776

    accuracy                           0.93     15830
   macro avg       0.59      0.58      0.58     15830
weighted avg       0.92      0.93      0.92     15830

#################################################################################
###############
Support Vector Machine: 12204
Accuracy Score :0.23
Classification Report :
              precision    recall  f1-score   support

           0       0.95      0.20      0.33     15054
           1       0.05      0.80      0.09       776

    accuracy                           0.23     15830
   macro avg       0.50      0.50      0.21     15830
weighted avg       0.91      0.23      0.32     15830

#################################################################################
###############
```

```
XGBClassifier: 776
Accuracy Score :0.95
Classification Report :
              precision    recall  f1-score   support

           0       0.95      1.00      0.97     15054
           1       0.00      0.00      0.00       776

    accuracy                           0.95     15830
   macro avg       0.48      0.50      0.49     15830
weighted avg       0.90      0.95      0.93     15830
```



In [16]:

```
X_test=pd.read_csv('./test.csv')
```

In [17]:

```
clf  = XGBClassifier(objective="binary:logistic", random_state=42)
clf.fit(X_train,y_train)
y_test_pred = clf.predict(X_test)
```

In [18]:

```
data={"timestamp":[],"is_anomaly":[]}
for id,pred in zip(X["timestamp"].unique(),y_test_pred):
    data["timestamp"].append(id)
    data["is_anomaly"].append(pred)
```

In [19]:

```
output=pd.DataFrame(data,columns=["timestamp","is_anomaly"])
output.head(2)
```

Out[19]:

	timestamp	is_anomaly
0	1425008573	0
1	1425008873	0

In [20]:

```
output['is_anomaly'].value_counts()
```

Out[20]:

```
is_anomaly
0    3948
1      12
Name: count, dtype: int64
```

In [21]:

```python
output.to_csv('submission.csv', index=False)
print("Your submission was successfully saved!")
output['is_anomaly'].value_counts()
```

```
Your submission was successfully saved!
```

Out[21]:

```
is_anomaly
0    3948
1      12
Name: count, dtype: int64
```

In [23]:

```python

```

```
{'Isolation Forest': IsolationForest(contamination=0.04902084649399874, max_sampl
es=15830,
                random_state=RandomState(MT19937) at 0x25B7C42DB40), 'Local Outli
er Factor': LocalOutlierFactor(contamination=0.04902084649399874), 'Novelty Local
Outlier Factor': LocalOutlierFactor(contamination=0.04902084649399874, novelty=Tr
ue), 'Support Vector Machine': OneClassSVM(gamma=0.1, nu=0.05), 'XGBClassifier':
XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
              colsample_bytree=None, device=None, early_stopping_rounds=None,
              enable_categorical=False, eval_metric=None, feature_types=None,
              gamma=None, grow_policy=None, importance_type=None,
              interaction_constraints=None, learning_rate=None, max_bin=None,
              max_cat_threshold=None, max_cat_to_onehot=None,
              max_delta_step=None, max_depth=None, max_leaves=None,
              min_child_weight=None, missing=nan, monotone_constraints=None,
              multi_strategy=None, n_estimators=None, n_jobs=None,
              num_parallel_tree=None, random_state=42, ...)}
```

In [ ]:

```python

```