```
import numpy as np
import pandas as pd
from sklearn.preprocessing import StandardScaler, RobustScaler


df = pd.read_csv('/kaggle/input/creditcardfraud/creditcard.csv')

print(df.head())

class_0_data = df[df['Class'] == 0]
class_1_data = df[df['Class'] == 1]

print("Class 0 Data Shape:", class_0_data.shape)
print("Class 1 Data Shape:", class_1_data.shape)

print('No Frauds:', round(df['Class'].value_counts(normalize=True)[0] * 100, 2), '% of the dataset')
print('Frauds:', round(df['Class'].value_counts(normalize=True)[1] * 100, 2), '% of the dataset')


rob_scaler = RobustScaler()

df['scaled_amount'] = rob_scaler.fit_transform(df['Amount'].values.reshape(-1, 1))
df['scaled_time'] = rob_scaler.fit_transform(df['Time'].values.reshape(-1, 1))


df.drop(['Time', 'Amount'], axis=1, inplace=True)


scaled_amount = df['scaled_amount']
scaled_time = df['scaled_time']
df.drop(['scaled_amount', 'scaled_time'], axis=1, inplace=True)
df.insert(0, 'scaled_amount', scaled_amount)
df.insert(1, 'scaled_time', scaled_time)

print(df.head())
```

```
   Time        V1        V2        V3        V4        V5        V6        V7  \
0   0.0 -1.359807 -0.072781  2.536347  1.378155 -0.338321  0.462388  0.239599
1   0.0  1.191857  0.266151  0.166480  0.448154  0.060018 -0.082361 -0.078803
2   1.0 -1.358354 -1.340163  1.773209  0.379780 -0.503198  1.800499  0.791461
3   1.0 -0.966272 -0.185226  1.792993 -0.863291 -0.010309  1.247203  0.237609
4   2.0 -1.158233  0.877737  1.548718  0.403034 -0.407193  0.095921  0.592941

         V8        V9  ...       V21       V22       V23       V24       V25  \
0  0.098698  0.363787  ... -0.018307  0.277838 -0.110474  0.066928  0.128539
1  0.085102 -0.255425  ... -0.225775 -0.638672  0.101288 -0.339846  0.167170
2  0.247676 -1.514654  ...  0.247998  0.771679  0.909412 -0.689281 -0.327642
3  0.377436 -1.387024  ... -0.108300  0.005274 -0.190321 -1.175575  0.647376
4 -0.270533  0.817739  ... -0.009431  0.798278 -0.137458  0.141267 -0.206010

        V26       V27       V28  Amount  Class
0 -0.189115  0.133558 -0.021053  149.62      0
1  0.125895 -0.008983  0.014724    2.69      0
2 -0.139097 -0.055353 -0.059752  378.66      0
3 -0.221929  0.062723  0.061458  123.50      0
4  0.502292  0.219422  0.215153   69.99      0

[5 rows x 31 columns]
Class 0 Data Shape: (284315, 31)
Class 1 Data Shape: (492, 31)
No Frauds: 99.83 % of the dataset
Frauds: 0.17 % of the dataset
   scaled_amount  scaled_time        V1        V2        V3        V4  \
0       1.783274    -0.994983 -1.359807 -0.072781  2.536347  1.378155
1      -0.269825    -0.994983  1.191857  0.266151  0.166480  0.448154
2       4.983721    -0.994972 -1.358354 -1.340163  1.773209  0.379780
3       1.418291    -0.994972 -0.966272 -0.185226  1.792993 -0.863291
4       0.670579    -0.994960 -1.158233  0.877737  1.548718  0.403034

         V5        V6        V7        V8  ...       V20       V21       V22  \
0 -0.338321  0.462388  0.239599  0.098698  ...  0.251412 -0.018307  0.277838
1  0.060018 -0.082361 -0.078803  0.085102  ... -0.069083 -0.225775 -0.638672
2 -0.503198  1.800499  0.791461  0.247676  ...  0.524980  0.247998  0.771679
3 -0.010309  1.247203  0.237609  0.377436  ... -0.208038 -0.108300  0.005274
4 -0.407193  0.095921  0.592941 -0.270533  ...  0.408542 -0.009431  0.798278

        V23       V24       V25       V26       V27       V28  Class
0 -0.110474  0.066928  0.128539 -0.189115  0.133558 -0.021053      0
1  0.101288 -0.339846  0.167170  0.125895 -0.008983  0.014724      0
2  0.909412 -0.689281 -0.327642 -0.139097 -0.055353 -0.059752      0
3 -0.190321 -1.175575  0.647376 -0.221929  0.062723  0.061458      0
4 -0.137458  0.141267 -0.206010  0.502292  0.219422  0.215153      0

[5 rows x 31 columns]
```

```
from sklearn.model_selection import StratifiedKFold

print('No Frauds:', round(df['Class'].value_counts(normalize=True)[0] * 100, 2), '% of the dataset')
print('Frauds:', round(df['Class'].value_counts(normalize=True)[1] * 100, 2), '% of the dataset')

X = df.drop('Class', axis=1)
y = df['Class']

sss = StratifiedKFold(n_splits=5, random_state=None, shuffle=False)


for train_index, test_index in sss.split(X, y):
    print("Train:", train_index, "Test:", test_index)
    original_Xtrain, original_Xtest = X.iloc[train_index], X.iloc[test_index]
    original_ytrain, original_ytest = y.iloc[train_index], y.iloc[test_index]

original_Xtrain = original_Xtrain.values
original_Xtest = original_Xtest.values
original_ytrain = original_ytrain.values
original_ytest = original_ytest.values

train_label_distribution = np.bincount(original_ytrain) / len(original_ytrain)
test_label_distribution = np.bincount(original_ytest) / len(original_ytest)

print('-' * 100)
print('Label Distributions: \n')
print("Train set:", train_label_distribution)
print("Test set:", test_label_distribution)
```

```
No Frauds: 99.83 % of the dataset
Frauds: 0.17 % of the dataset
Train: [ 30473  30496  31002 ... 284804 284805 284806] Test: [    0     1     2 ... 57017 57018 57019]
Train: [     0      1      2 ... 284804 284805 284806] Test: [ 30473  30496  31002 ... 113964 113965 113966]
Train: [     0      1      2 ... 284804 284805 284806] Test: [ 81609  82400  83053 ... 170946 170947 170948]
Train: [     0      1      2 ... 284804 284805 284806] Test: [150654 150660 150661 ... 227866 227867 227868]
Train: [     0      1      2 ... 227866 227867 227868] Test: [212516 212644 213092 ... 284804 284805 284806]
----------------------------------------------------------------------------------------------------
Label Distributions:

Train set: [0.99827076 0.00172924]
Test set: [0.99827952 0.00172048]
```

```
#Subsampling
df = df.sample(frac=1)
fraud_df = df.loc[df['Class'] == 1]
non_fraud_df = df.loc[df['Class'] == 0][:492]

normal_distributed_df = pd.concat([fraud_df, non_fraud_df])
new_df = normal_distributed_df.sample(frac=1, random_state=42)

print('Distribution of the Classes in the subsample dataset')
print(new_df['Class'].value_counts()/len(new_df))
```

```
Distribution of the Classes in the subsample dataset
Class
0    0.5
1    0.5
Name: count, dtype: float64
```

```
# Code taken from kaggle removing the outliers in the data
v14_fraud = new_df['V14'].loc[new_df['Class'] == 1].values
q25, q75 = np.percentile(v14_fraud, 25), np.percentile(v14_fraud, 75)
print('Quartile 25: {} | Quartile 75: {}'.format(q25, q75))
v14_iqr = q75 - q25
print('iqr: {}'.format(v14_iqr))

v14_cut_off = v14_iqr * 1.5
v14_lower, v14_upper = q25 - v14_cut_off, q75 + v14_cut_off
print('Cut Off: {}'.format(v14_cut_off))
print('V14 Lower: {}'.format(v14_lower))
print('V14 Upper: {}'.format(v14_upper))

outliers = [x for x in v14_fraud if x < v14_lower or x > v14_upper]
print('Feature V14 Outliers for Fraud Cases: {}'.format(len(outliers)))
print('V10 outliers:{}'.format(outliers))

new_df = new_df.drop(new_df[(new_df['V14'] > v14_upper) | (new_df['V14'] < v14_lower)].index)
print('----' * 44)

v12_fraud = new_df['V12'].loc[new_df['Class'] == 1].values
q25, q75 = np.percentile(v12_fraud, 25), np.percentile(v12_fraud, 75)
v12_iqr = q75 - q25

v12_cut_off = v12_iqr * 1.5
v12_lower, v12_upper = q25 - v12_cut_off, q75 + v12_cut_off
print('V12 Lower: {}'.format(v12_lower))
print('V12 Upper: {}'.format(v12_upper))
outliers = [x for x in v12_fraud if x < v12_lower or x > v12_upper]
print('V12 outliers: {}'.format(outliers))
print('Feature V12 Outliers for Fraud Cases: {}'.format(len(outliers)))
new_df = new_df.drop(new_df[(new_df['V12'] > v12_upper) | (new_df['V12'] < v12_lower)].index)
print('Number of Instances after outliers removal: {}'.format(len(new_df)))
print('----' * 44)


v10_fraud = new_df['V10'].loc[new_df['Class'] == 1].values
q25, q75 = np.percentile(v10_fraud, 25), np.percentile(v10_fraud, 75)
v10_iqr = q75 - q25

v10_cut_off = v10_iqr * 1.5
v10_lower, v10_upper = q25 - v10_cut_off, q75 + v10_cut_off
print('V10 Lower: {}'.format(v10_lower))
print('V10 Upper: {}'.format(v10_upper))
outliers = [x for x in v10_fraud if x < v10_lower or x > v10_upper]
print('V10 outliers: {}'.format(outliers))
print('Feature V10 Outliers for Fraud Cases: {}'.format(len(outliers)))
new_df = new_df.drop(new_df[(new_df['V10'] > v10_upper) | (new_df['V10'] < v10_lower)].index)
print('Number of Instances after outliers removal: {}'.format(len(new_df)))
```

```
Quartile 25: -9.692722964972386 | Quartile 75: -4.282820849486865
iqr: 5.409902115485521
Cut Off: 8.114853173228282
V14 Lower: -17.807576138200666
V14 Upper: 3.8320323237414167
Feature V14 Outliers for Fraud Cases: 4
V10 outliers:[-18.0499976898594, -19.2143254902614, -18.4937733551053, -18.8220867423816]
------------------------------------------------------------------------------------------------------------------------------
V12 Lower: -17.3430371579634
V12 Upper: 5.776973384895937
V12 outliers: [-18.6837146333443, -18.0475965708216, -18.5536970096458, -18.4311310279993]
Feature V12 Outliers for Fraud Cases: 4
Number of Instances after outliers removal: 975
------------------------------------------------------------------------------------------------------------------------------
V10 Lower: -14.89885463232024
V10 Upper: 4.92033495834214
V10 outliers: [-22.1870885620007, -14.9246547735487, -15.2399619587112, -16.6496281595399, -22.1870885620007, -24.4031849699728, -2
Feature V10 Outliers for Fraud Cases: 27
Number of Instances after outliers removal: 947
```

```
X = new_df.drop('Class', axis=1)
y = new_df['Class']
```

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

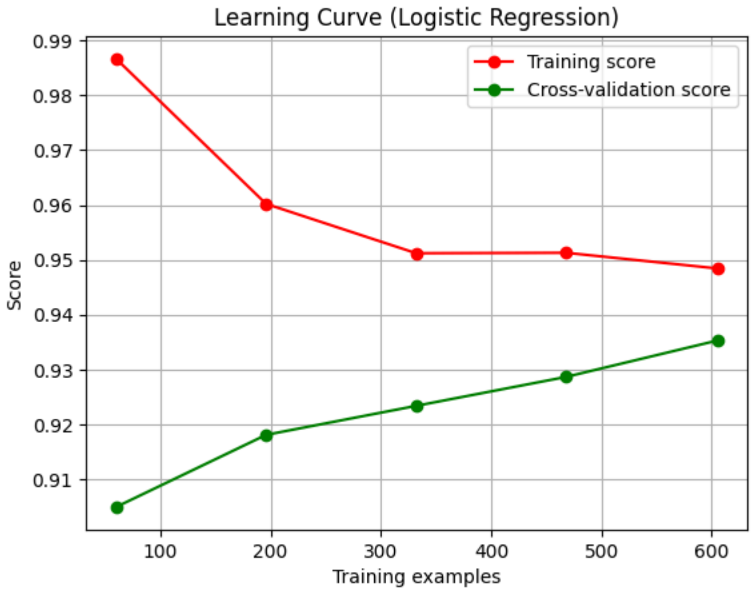
```
X_train = X_train.values
X_test = X_test.values
y_train = y_train.values
y_test = y_test.values
```

```
from sklearn.model_selection import cross_val_score
from sklearn.linear_model import LogisticRegression
import xgboost as xgb
from sklearn.neural_network import MLPClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC
import numpy as np
import warnings
warnings.filterwarnings("ignore")

# Define models
models = {
    "Logistic Regression": LogisticRegression(),
    "XGBoost": xgb.XGBClassifier(),
    "MLP": MLPClassifier(),
    "KNN": KNeighborsClassifier(),
    "SVM": SVC()
}

# Perform cross-validation for each model
for name, model in models.items():
    scores = cross_val_score(model, X_train, y_train, cv=5)  # 5-fold cross-validation
    print(f"{name} Cross-Validation Mean Accuracy:", np.mean(scores))
```

```
Logistic Regression Cross-Validation Mean Accuracy: 0.9352823283373999
XGBoost Cross-Validation Mean Accuracy: 0.9326420355524572
MLP Cross-Validation Mean Accuracy: 0.9379400487974904
KNN Cross-Validation Mean Accuracy: 0.9194057162774486
SVM Cross-Validation Mean Accuracy: 0.9259933774834437
```

```
from sklearn.model_selection import GridSearchCV
warnings.filterwarnings("ignore")
param_grids = {
    "Logistic Regression": {'C': [0.001, 0.01, 0.1, 1, 10, 100]},
    "XGBoost": {'max_depth': [3, 5, 7], 'n_estimators': [50, 100, 200]},
    "MLP": {'hidden_layer_sizes': [(50,), (100,), (50, 50)]},
    "KNN": {'n_neighbors': [3, 5, 7, 9]},
    "SVM": {'C': [0.1, 1, 10], 'gamma': [0.1, 1, 10]}
}

for name, model in models.items():
    grid_search = GridSearchCV(model, param_grids[name], cv=5, scoring='accuracy', n_jobs=-1)
    grid_search.fit(X_train, y_train)
    print(f"Best parameters for {name}: {grid_search.best_params_}")
    print(f"Best cross-validation accuracy for {name}: {grid_search.best_score_}")

    best_model = grid_search.best_estimator_

    scores = cross_val_score(best_model, X_train, y_train, cv=5)
    print(f"{name} Cross-Validation Mean Accuracy with Best Parameters:", np.mean(scores))
```

```
import matplotlib.pyplot as plt
from sklearn.model_selection import learning_curve

def plot_learning_curve(model, title, X, y, cv=5, train_sizes=np.linspace(.1, 1.0, 5)):
    train_sizes, train_scores, test_scores = learning_curve(model, X, y, cv=cv, train_sizes=train_sizes, scoring='accuracy', n_jobs=-1)
    train_scores_mean = np.mean(train_scores, axis=1)
    test_scores_mean = np.mean(test_scores, axis=1)

    plt.figure()
    plt.title(title)
    plt.xlabel("Training examples")
    plt.ylabel("Score")
    plt.grid()

    plt.plot(train_sizes, train_scores_mean, 'o-', color="r", label="Training score")
    plt.plot(train_sizes, test_scores_mean, 'o-', color="g", label="Cross-validation score")

    plt.legend(loc="best")

    return plt

models = {
    "Logistic Regression": LogisticRegression(C=1),  # Use best parameters found from grid search
    "XGBoost": xgb.XGBClassifier(max_depth=3, n_estimators=100),
    "MLP": MLPClassifier(hidden_layer_sizes=(50,)),  # Use best parameters found from grid search
    "KNN": KNeighborsClassifier(n_neighbors=5),  # Use best parameters found from grid search
    "SVM": SVC(C=1, gamma=0.1)  # Use best parameters found from grid search
}

for name, model in models.items():
    plot_learning_curve(model, f"Learning Curve ({name})", X_train, y_train)
    plt.show()
```

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