```
import numpy as np # for numeric calculation
import pandas as pd # for data analysis and manupulation
import matplotlib.pyplot as plt # for data visualization
import seaborn as sns # for data visualization
from dateutil import parser # convert time in date time data type
```

```
fineTech_appData = pd.read_csv("FineTech_appData.csv")
```

```
fineTech_appData.shape # get shape of dataset
```

```
(50000, 12)
```

```
fineTech_appData.head(6) # show fisrt 6 rows of fineTech_appData DataFram
```

	user	first_open	dayofweek	hour	age	screen_l
0	235136	2012-12-27 02:14:51.273	3	02:00:00	23	idscreen,joinscreen,Cycle,product_review,Scar
1	333588	2012-12-02 01:16:00.905	6	01:00:00	24	joinscreen,product_review,product_review2,Sca
2	254414	2013-03-19 19:19:09.157	1	19:00:00	23	Splash,Cycle,Lo
3	234192	2013-07-05 16:08:46.354	4	16:00:00	28	product_review,Home,product_review,Loan3,Fina
4	51549	2013-02-26 18:50:48.661	1	18:00:00	31	idscreen,joinscreen,Cycle,Credit3Container,Sc
5	56480	2013-04-03 09:58:15.752	2	09:00:00	20	idscreen,Cycle,Home,ScanPreview,VerifyPhone,V

```
fineTech_appData.tail(6) # show last 6 rows of fineTech_appData DataFrame
```

	user	first_open	dayofweek	hour	age	scre
49994	90813	2013-02-25 19:35:12.691	0	19:00:00	36	idscreen,joinscreen,Cycle,product_reviev
49995	222774	2013-05-09 13:46:17.871	3	13:00:00	32	Splash,Home,ScanPreview,VerifyPhone,Veri
49996	169179	2013-04-09 00:05:17.823	1	00:00:00	35	Cycle,Splash,Home,RewardsC
49997	302367	2013-02-20 22:41:51.165	2	22:00:00	39	joinscreen,product_review,product_review
49998	324905	2013-04-28 12:33:04.288	6	12:00:00	27	Cycle,Home,product_review,product_reviev
49999	27047	2012-12-14 01:22:44.638	4	01:00:00	25	product_review,ScanPreview,VerifyDateOf

```
for i in [1,2,3,4,5]:
    print(fineTech_appData.loc[i,'screen_list'],'\n')
```

```
joinscreen,product_review,product_review2,ScanPreview,VerifyDateOfBirth,location,VerifyCountry,VerifyPhone,VerifyToken,Institutions,Loar

Splash,Cycle,Loan

product_review,Home,product_review,Loan3,Finances,Credit3,ReferralContainer,Leaderboard,Rewards,RewardDetail,ScanPreview,location,Verify

idscreen,joinscreen,Cycle,Credit3Container,ScanPreview,VerifyPhone,VerifySSN,Credit1,Loan2,Home,Institutions,SelectInstitution,BankVerif

idscreen,Cycle,Home,ScanPreview,VerifyPhone,VerifySSN,Credit1,Credit3Dashboard,Loan2,Institutions,product_review,product_review,product_
```

```
fineTech_appData.isnull().sum() # take summation of null values
```

```
user                        0
first_open                  0
dayofweek                   0
hour                        0
age                         0
screen_list                 0
numscreens                  0
minigame                    0
used_premium_feature        0
enrolled                    0
enrolled_date           18926
liked                       0
dtype: int64
```

```
fineTech_appData.info() # brief inforamtion about Dataset
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 50000 entries, 0 to 49999
Data columns (total 12 columns):
 #   Column                Non-Null Count  Dtype 
---  ------                --------------  ----- 
 0   user                  50000 non-null  int64 
 1   first_open            50000 non-null  object
 2   dayofweek             50000 non-null  int64 
 3   hour                  50000 non-null  object
 4   age                   50000 non-null  int64 
 5   screen_list           50000 non-null  object
 6   numscreens            50000 non-null  int64 
 7   minigame              50000 non-null  int64 
 8   used_premium_feature  50000 non-null  int64 
 9   enrolled              50000 non-null  int64 
 10  enrolled_date         31074 non-null  object
 11  liked                 50000 non-null  int64 
dtypes: int64(8), object(4)
memory usage: 4.6+ MB
```

```
fineTech_appData.describe() # give the distribution of numerical variables
```

	user	dayofweek	age	numscreens	minigame	used_premium_
count	50000.000000	50000.000000	50000.00000	50000.000000	50000.000000	5000
mean	186889.729900	3.029860	31.72436	21.095900	0.107820	
std	107768.520361	2.031997	10.80331	15.728812	0.310156	
min	13.000000	0.000000	16.00000	1.000000	0.000000	
25%	93526.750000	1.000000	24.00000	10.000000	0.000000	
50%	187193.500000	3.000000	29.00000	18.000000	0.000000	
75%	279984.250000	5.000000	37.00000	28.000000	0.000000	
max	373662.000000	6.000000	101.00000	325.000000	1.000000	

```
# Get the unique value of each columns and it's length
features = fineTech_appData.columns
for i in features:
    print("""Unique value of {}\n{}\nlen is {} \n.........................\n
          """.format(i, fineTech_appData[i].unique(), len(fineTech_appData[i].unique())))
```

```
 189 153 243 103 101 118 325 141 129 133 126 120 123 134 121 105 113 117
 200 247 179 132 144 130 148]
len is 151
.......................


Unique value of minigame
[0 1]
len is 2
.......................


Unique value of used_premium_feature
[0 1]
len is 2
.......................


Unique value of enrolled
[0 1]
len is 2
.......................


Unique value of enrolled_date
[nan '2013-07-05 16:11:49.513' '2013-02-26 18:56:37.841' ...
 '2013-02-25 19:36:56.082' '2013-05-09 13:47:52.875'
 '2013-04-28 12:35:38.709']
len is 31002
.......................


Unique value of liked
[0 1]
len is 2
.......................
```

```
#  hour data convert string to int
fineTech_appData['hour'] = fineTech_appData.hour.str.slice(1,3).astype(int)

# get data type of each columns
fineTech_appData.dtypes
```

```
user                     int64
first_open              object
dayofweek                int64
hour                     int64
age                      int64
screen_list             object
numscreens               int64
minigame                 int64
used_premium_feature     int64
enrolled                 int64
enrolled_date           object
liked                    int64
dtype: object
```

```
# drop object dtype columns
fineTech_appData2 = fineTech_appData.drop(['user', 'first_open', 'screen_list', 'enrolled_date'], axis = 1)
```

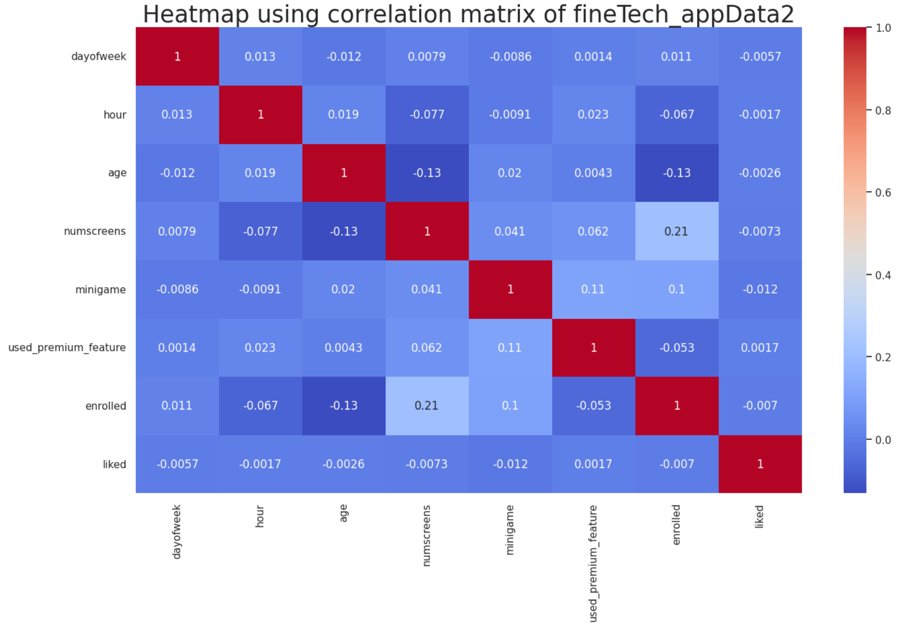
```
fineTech_appData2.head(6) # head of numeric dataFrame
```

	dayofweek	hour	age	numscreens	minigame	used_premium_feature	enrolled	liked
0	3	2	23	15	0	0	0	0
1	6	1	24	13	0	0	0	0
2	1	19	23	3	0	1	0	1
3	4	16	28	40	0	0	1	0
4	1	18	31	32	0	0	1	1
5	2	9	20	14	0	0	1	0

```
# Heatmap
plt.figure(figsize=(16,9)) # heatmap size in ratio 16:9
```

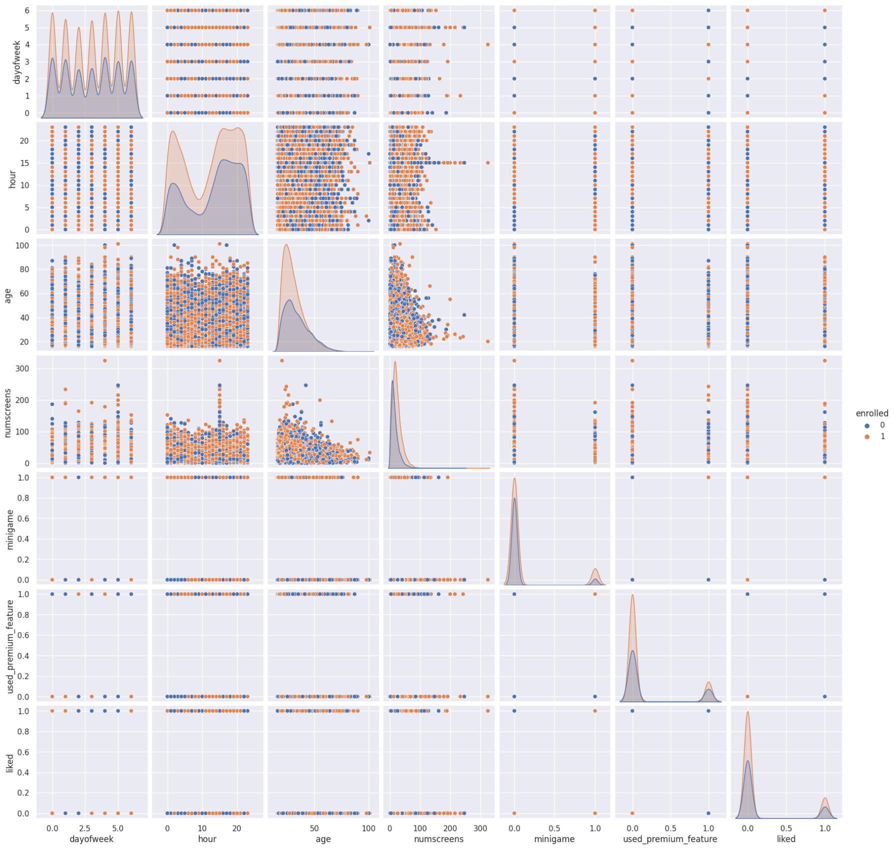
```
sns.heatmap(fineTech_appData2.corr(), annot = True, cmap ='coolwarm') # show heatmap

plt.title("Heatmap using correlation matrix of fineTech_appData2", fontsize = 25) # title of heatmap
```

```
    Text(0.5, 1.0, 'Heatmap using correlation matrix of fineTech_appData2')
```



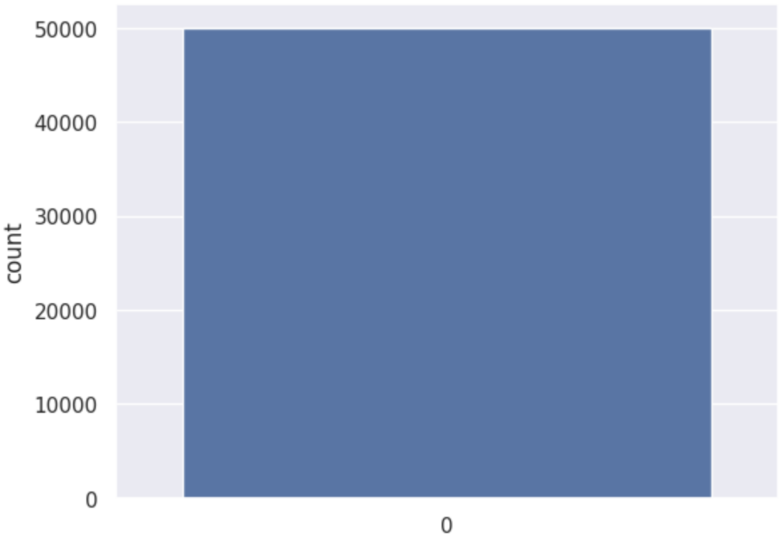
```
# Pailplot of fineTech_appData2 Dataset

#%matplotlib qt5 # for show graph in seperate window
sns.pairplot(fineTech_appData2, hue  = 'enrolled')
```

```
<seaborn.axisgrid.PairGrid at 0x7fbd6ad661a0>
```



```
# Show counterplot of 'enrolled' feature
sns.countplot(fineTech_appData.enrolled)
```

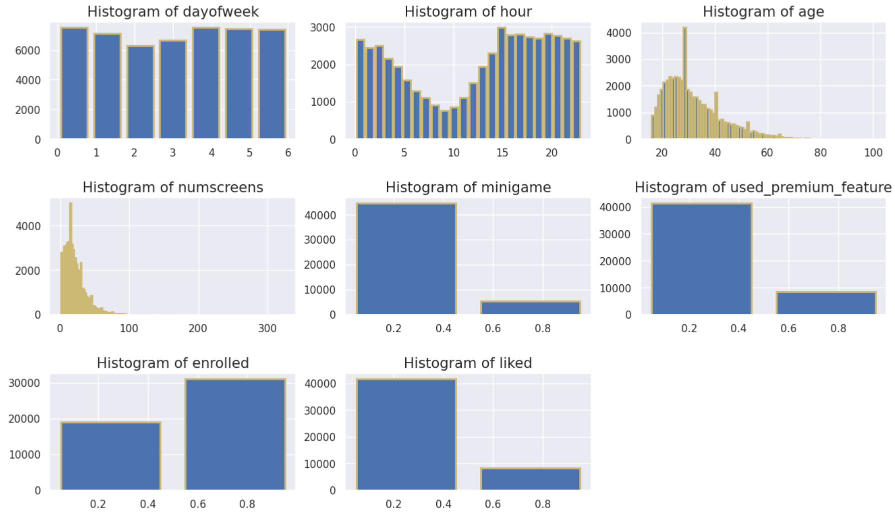
```
<Axes: ylabel='count'>
```



```
# value enrolled and not enrolled customers
print("Not enrolled user = ", (fineTech_appData.enrolled < 1).sum(), "out of 50000")
print("Enrolled user = ",50000-(fineTech_appData.enrolled < 1).sum(),  "out of 50000")
```

```
Not enrolled user =  18926 out of 50000
Enrolled user =  31074 out of 50000
```

```
# plot histogram

plt.figure(figsize = (16,9)) # figure size in ratio 16:9
features = fineTech_appData2.columns # list of columns name
for i,j in enumerate(features):
    plt.subplot(3,3,i+1) # create subplot for histogram
    plt.title("Histogram of {}".format(j), fontsize = 15) # title of histogram

    bins = len(fineTech_appData2[j].unique()) # bins for histogram
    plt.hist(fineTech_appData2[j], bins = bins, rwidth = 0.8, edgecolor = "y", linewidth = 2, ) # plot histogram

plt.subplots_adjust(hspace=0.5) # space between horixontal axes (subplots)
```



```
# show corelation barplot

sns.set() # set background dark grid
plt.figure(figsize = (14,5))
plt.title("Correlation all features with 'enrolled' ", fontsize = 20)
fineTech_appData3 = fineTech_appData2.drop(['enrolled'], axis = 1) # drop 'enrolled' feature
ax =sns.barplot(fineTech_appData3.columns,fineTech_appData3.corrwith(fineTech_appData2.enrolled)) # plot barplot
ax.tick_params(labelsize=15, labelrotation = 20, color ="k") # decorate x & y ticks font
```

```
# parsinf object data into data time format

fineTech_appData['first_open'] =[parser.parse(i) for i in fineTech_appData['first_open']]

fineTech_appData['enrolled_date'] =[parser.parse(i) if isinstance(i, str) else i for i in fineTech_appData['enrolled_date']]

fineTech_appData.dtypes
```

```
user                             int64
first_open              datetime64[ns]
```

```
dayofweek                         int64
hour                              int64
age                               int64
screen_list                      object
numscreens                        int64
minigame                          int64
used_premium_feature              int64
enrolled                          int64
enrolled_date            datetime64[ns]
liked                             int64
dtype: object
```

```
# Select columns with numerical data types
num_cols = fineTech_appData2.select_dtypes(include=['int64', 'float64']).columns

# Subtract the mean of each column from that column
fineTech_appData2[num_cols] = fineTech_appData2[num_cols] - fineTech_appData2[num_cols].mean()
```

```
fineTech_appData['time_to_enrolled']  = (fineTech_appData.enrolled_date - fineTech_appData.first_open).astype('timedelta64[h]')
```

```
# Plot histogram
plt.hist(fineTech_appData['time_to_enrolled'].dropna(), range = (0,100))
```

```
# Feature selection:
```

```
# Those customers have enrolled after 48 hours set as 0
fineTech_appData.loc[fineTech_appData.time_to_enrolled > 48, 'enrolled'] = 0
```

```
fineTech_appData.drop(columns = ['time_to_enrolled', 'enrolled_date', 'first_open'], inplace=True)
```

```
# read csv file and convert it into numpy array
fineTech_app_screen_Data = pd.read_csv("top_screens.csv").top_screens.values

fineTech_app_screen_Data
```

```
fineTech_appData['screen_list'] = fineTech_appData.screen_list.astype(str) + ','
```

```
# string into to number

for screen_name in fineTech_app_screen_Data:
    fineTech_appData[screen_name] = fineTech_appData.screen_list.str.contains(screen_name).astype(int)
    fineTech_appData['screen_list'] = fineTech_appData.screen_list.str.replace(screen_name+",", "")
```

```
# get shape
fineTech_appData.shape
```

```
# head of DataFrame
fineTech_appData.head(6)
```

```
# remain screen in 'screen_list'
fineTech_appData.loc[0,'screen_list']
```

```
# count remain screen list and store counted number in 'remain_screen_list'

fineTech_appData['remain_screen_list'] = fineTech_appData.screen_list.str.count(",")
```

```
# Drop the 'screen_list'
fineTech_appData.drop(columns = ['screen_list'], inplace=True)
```

```
# total columns
fineTech_appData.columns
```

```
# take sum of all saving screen in one place
saving_screens = ['Saving1',
                  'Saving2',
                  'Saving2Amount',
                  'Saving4',
                  'Saving5',
                  'Saving6',
                  'Saving7',
                  'Saving8',
                  'Saving9',
                  'Saving10',
                 ]
fineTech_appData['saving_screens_count'] = fineTech_appData[saving_screens].sum(axis = 1)
fineTech_appData.drop(columns = saving_screens, inplace = True)


credit_screens = ['Credit1',
                  'Credit2',
                  'Credit3',
                  'Credit3Container',
                  'Credit3Dashboard',
                 ]
fineTech_appData['credit_screens_count'] = fineTech_appData[credit_screens].sum(axis = 1)
fineTech_appData.drop(columns = credit_screens, axis = 1, inplace = True)


cc_screens = ['CC1',
              'CC1Category',
              'CC3',
             ]
fineTech_appData['cc_screens_count'] = fineTech_appData[cc_screens].sum(axis = 1)
fineTech_appData.drop(columns = cc_screens, inplace = True)


loan_screens = ['Loan',
                'Loan2',
                'Loan3',
                'Loan4',
               ]
fineTech_appData['loan_screens_count'] = fineTech_appData[loan_screens].sum(axis = 1)
fineTech_appData.drop(columns = loan_screens, inplace = True)


fineTech_appData.shape


fineTech_appData.info()


# Numerical distribution of fineTech_appData
fineTech_appData.describe()


# Heatmap with correlation matrix of new fineTech_appData

plt.figure(figsize = (25,16))
sns.heatmap(fineTech_appData.corr(), annot = True, linewidth =2)


# Data preprocessing:


clean_fineTech_appData = fineTech_appData
target = fineTech_appData['enrolled']
fineTech_appData.drop(columns = 'enrolled', inplace = True)
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(fineTech_appData, target, test_size = 0.2, random_state = 0)


print('Shape of X_train = ', X_train.shape)
print('Shape of X_test = ', X_test.shape)
print('Shape of y_train = ', y_train.shape)
print('Shape of y_test = ', y_test.shape)


# take User ID in another variable
train_userID = X_train['user']
X_train.drop(columns= 'user', inplace =True)
test_userID = X_test['user']
X_test.drop(columns= 'user', inplace =True)
```

```
print('Shape of X_train = ', X_train.shape)
print('Shape of X_test = ', X_test.shape)
print('Shape of train_userID = ', train_userID.shape)
print('Shape of test_userID = ', test_userID.shape)


# Feature Scaling


from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train_sc = sc.fit_transform(X_train)
X_test_sc = sc.transform(X_test)


# impoer required packages
from sklearn.metrics import confusion_matrix, classification_report, accuracy_score


# Decision Tree Classifier
from sklearn.tree import DecisionTreeClassifier
dt_model = DecisionTreeClassifier(criterion= 'entropy', random_state=0)
dt_model.fit(X_train, y_train)
y_pred_dt = dt_model.predict(X_test)
accuracy_score(y_test, y_pred_dt)


# train with Standert Scaling dataset
dt_model2 = DecisionTreeClassifier(criterion= 'entropy', random_state=0)
dt_model2.fit(X_train_sc, y_train)
y_pred_dt_sc = dt_model2.predict(X_test_sc)
accuracy_score(y_test, y_pred_dt_sc)


# K - Nearest Neighbor Classifier
from sklearn.neighbors import KNeighborsClassifier
knn_model = KNeighborsClassifier(n_neighbors=5, metric='minkowski', p=2,)
knn_model.fit(X_train, y_train)
y_pred_knn = knn_model.predict(X_test)

accuracy_score(y_test, y_pred_knn)


# train with Standert Scaling dataset
knn_model2 = KNeighborsClassifier(n_neighbors=5, metric='minkowski', p=2,)
knn_model2.fit(X_train_sc, y_train)
y_pred_knn_sc = knn_model2.predict(X_test_sc)

accuracy_score(y_test, y_pred_knn_sc)


# Naive Bayes
from sklearn.naive_bayes import GaussianNB
nb_model = GaussianNB()
nb_model.fit(X_train, y_train)
y_pred_nb = nb_model.predict(X_test)

accuracy_score(y_test, y_pred_nb)


# train with Standert Scaling dataset
nb_model2 = GaussianNB()
nb_model2.fit(X_train_sc, y_train)
y_pred_nb_sc = nb_model2.predict(X_test_sc)

accuracy_score(y_test, y_pred_nb_sc)


# Random Forest Classifier
from sklearn.ensemble import RandomForestClassifier
rf_model = RandomForestClassifier(n_estimators=10, criterion='entropy', random_state=0)
rf_model.fit(X_train, y_train)
y_pred_rf = rf_model.predict(X_test)

accuracy_score(y_test, y_pred_rf)


# train with Standert Scaling dataset
rf_model2 = RandomForestClassifier(n_estimators=10, criterion='entropy', random_state=0)
rf_model2.fit(X_train_sc, y_train)
```

```
y_pred_rf_sc = rf_model2.predict(X_test_sc)

accuracy_score(y_test, y_pred_rf_sc)
```

```
# Logistic Regression
from sklearn.linear_model import LogisticRegression
lr_model = LogisticRegression(random_state = 0, penalty = 'l2')
lr_model.fit(X_train, y_train)
y_pred_lr = lr_model.predict(X_test)

accuracy_score(y_test, y_pred_lr)
```

```
# train with Standert Scaling dataset
lr_model2 = LogisticRegression(random_state = 0, penalty = 'l2')
lr_model2.fit(X_train_sc, y_train)
y_pred_lr_sc = lr_model2.predict(X_test_sc)

accuracy_score(y_test, y_pred_lr_sc)
```

```
# Support Vector Machine
from sklearn.svm import SVC
svc_model = SVC()
svc_model.fit(X_train, y_train)
y_pred_svc = svc_model.predict(X_test)

accuracy_score(y_test, y_pred_svc)
```

```
# train with Standert Scaling dataset
svc_model2 = SVC()
svc_model2.fit(X_train_sc, y_train)
y_pred_svc_sc = svc_model2.predict(X_test_sc)

accuracy_score(y_test, y_pred_svc_sc)
```

```
# XGBoost Classifier
from xgboost import XGBClassifier
xgb_model = XGBClassifier()
xgb_model.fit(X_train, y_train)
y_pred_xgb = xgb_model.predict(X_test)
accuracy_score(y_test, y_pred_xgb)
```

```
# train with Standert Scaling dataset
xgb_model2 = XGBClassifier()
xgb_model2.fit(X_train_sc, y_train)
y_pred_xgb_sc = xgb_model2.predict(X_test_sc)

accuracy_score(y_test, y_pred_xgb_sc)
```

```
# XGB classifier with parameter tuning
xgb_model_pt1 = XGBClassifier(
 learning_rate =0.01,
 n_estimators=5000,
 max_depth=4,
 min_child_weight=6,
 gamma=0,
 subsample=0.8,
 colsample_bytree=0.8,
 reg_alpha=0.005,
 objective= 'binary:logistic',
 nthread=4,
 scale_pos_weight=1,
 seed=27)

xgb_model_pt1.fit(X_train, y_train)
y_pred_xgb_pt1 = xgb_model_pt1.predict(X_test)

accuracy_score(y_test, y_pred_xgb_pt1)
```

```
# XGB classifier with parameter tuning
# train with Stander Scaling dataset
xgb_model_pt2 = XGBClassifier(
 learning_rate =0.01,
 n_estimators=5000,
 max_depth=4,
 min_child_weight=6,
 gamma=0,
 subsample=0.8,
 colsample_bytree=0.8,
 reg_alpha=0.005,
 objective= 'binary:logistic',
 nthread=4,
 scale_pos_weight=1,
 seed=27)

xgb_model_pt2.fit(X_train_sc, y_train)
y_pred_xgb_sc_pt2 = xgb_model_pt2.predict(X_test_sc)

accuracy_score(y_test, y_pred_xgb_sc_pt2)

# confussion matrix
cm_xgb_pt2 = confusion_matrix(y_test, y_pred_xgb_sc_pt2)
sns.heatmap(cm_xgb_pt2, annot = True, fmt = 'g')
plt.title("Confussion Matrix", fontsize = 20)


# Clasification Report
cr_xgb_pt2 = classification_report(y_test, y_pred_xgb_sc_pt2)

print("Classification report >>> \n", cr_xgb_pt2)


from sklearn.metrics import roc_curve
import matplotlib.pyplot as plt

# y_test: true labels of test data
# y_pred_prob: predicted probabilities of test data
fpr, tpr, thresholds = roc_curve(y_test, y_pred_xgb_sc_pt2)

# plot ROC curve
plt.plot(fpr, tpr, label='ROC Curve')
plt.plot([0, 1], [0, 1], linestyle='--', label='Random Guess')
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('ROC Curve')
plt.legend()
plt.show()


# Cross validation
from sklearn.model_selection import cross_val_score
cross_validation = cross_val_score(estimator = xgb_model_pt2, X = X_train_sc, y = y_train, cv = 10)
print("Cross validation of XGBoost model = ",cross_validation)
print("Cross validation of XGBoost model (in mean) = ",cross_validation.mean())


final_result = pd.concat([test_userID, y_test], axis = 1)
final_result['predicted result'] = y_pred_xgb_sc_pt2

print(final_result)
```