Machine Learning Lab (PMCA507P)

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Exercise 9: Ensemble classifiers

Collab url : https://colab.research.google.com/drive/1pstRfqqvQFQfpBSjQ3MLnVt3xihmJ_pP?usp=sharing

Dataset url : https://www.kaggle.com/datasets/sudalairajkumar/indian-startup-funding/code?datasetId=1902&searchQuery=ens

Indian Startup Funding Dataset

Import necessary libraries

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
from pylab import rcParams
rcParams['figure.figsize'] = 25, 10
from datetime import datetime
from pandas.plotting import scatter_matrix
from sklearn.preprocessing import normalize
!pip install scikit-learn
from sklearn.model_selection import GridSearchCV
```

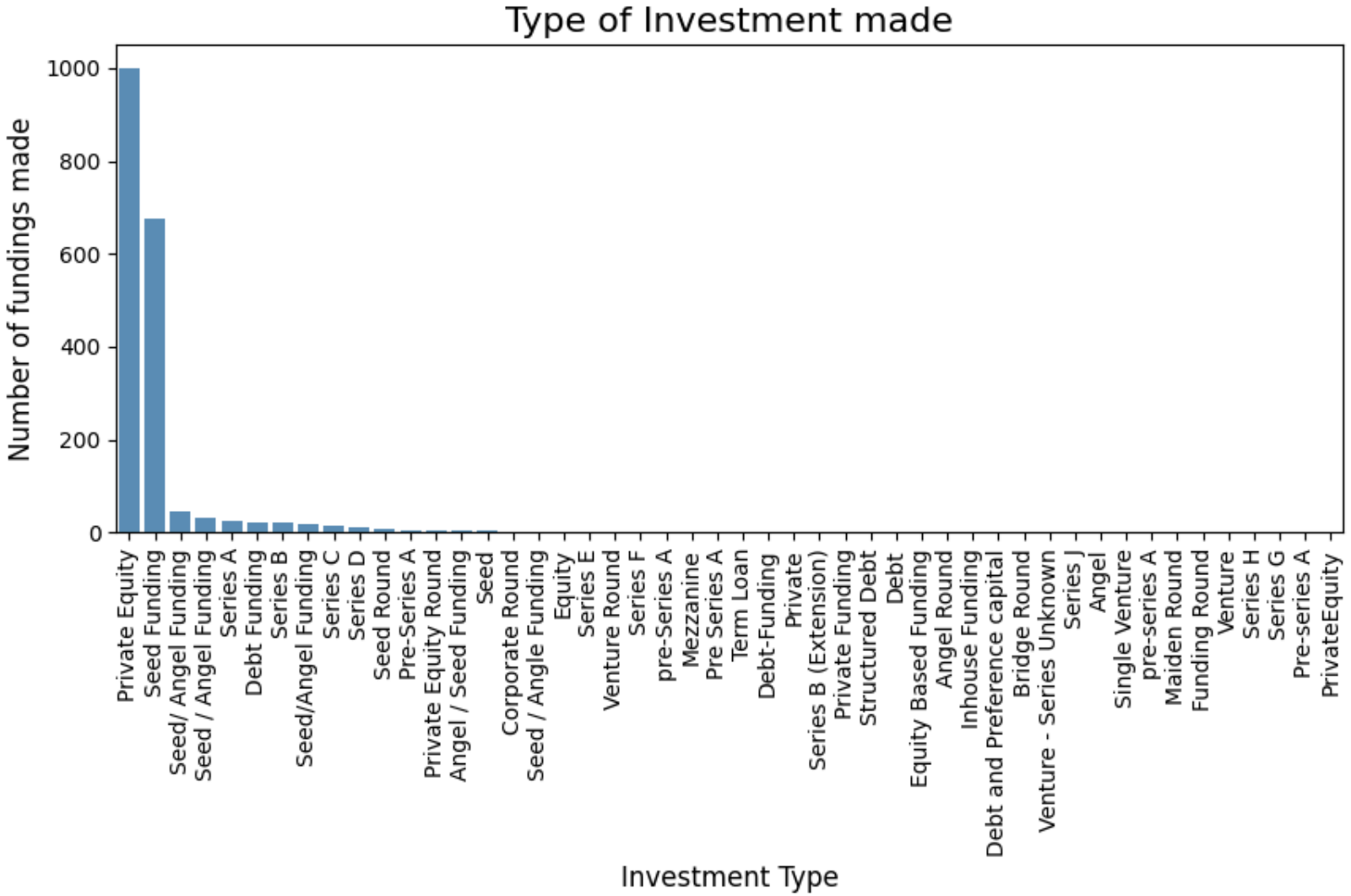
```
Requirement already satisfied: scikit-learn in /usr/local/lib/python3.10/dist-packages (1.2.2)
Requirement already satisfied: numpy>=1.17.3 in /usr/local/lib/python3.10/dist-packages (from scikit-learn) (1.25.2)
Requirement already satisfied: scipy>=1.3.2 in /usr/local/lib/python3.10/dist-packages (from scikit-learn) (1.11.4)
Requirement already satisfied: joblib>=1.1.1 in /usr/local/lib/python3.10/dist-packages (from scikit-learn) (1.3.2)
Requirement already satisfied: threadpoolctl>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from scikit-learn) (3.4.0)
```

```
df = pd.read_csv("/content/startup_funding.csv")
df = df.drop(['Sr No','Remarks','SubVertical'],axis = 1)
df = df.dropna()
df = df.reset_index(drop=True)
```

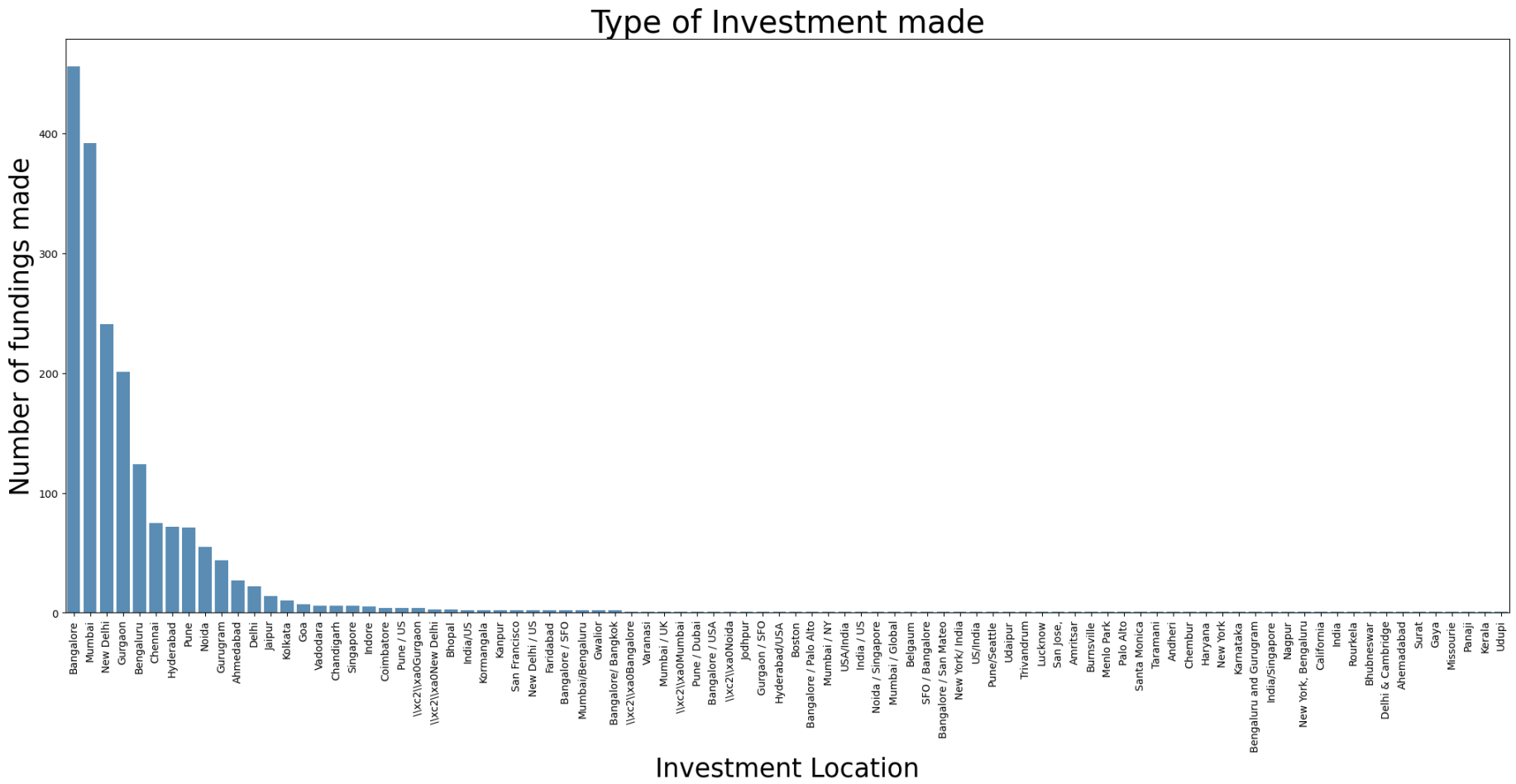
```
count = df['Industry Vertical'].value_counts()
count.head(10)
```

```
Consumer Internet    582
Technology           309
eCommerce            126
Finance               53
Healthcare            43
ECommerce             37
E-Commerce            24
Logistics             23
Education             18
Food & Beverage       15
Name: Industry Vertical, dtype: int64
```

```
count = df['InvestmentnType'].value_counts()
plt.figure(figsize=(10,4))
sns.barplot(x = count.index, y = count.values, alpha=0.8)
plt.xticks(rotation='vertical')
plt.xlabel('Investment Type', fontsize=12)
plt.ylabel('Number of fundings made', fontsize=12)
plt.title("Type of Investment made", fontsize=16)
plt.show()
```


Type of Investment made
Number of fundings made
0
200
400
600
800
1000
Private Equity
Seed Funding
Seed/ Angel Funding
Seed / Angel Funding
Series A
Debt Funding
Series B
Seed/Angel Funding
Series C
Series D
Seed Round
Pre-Series A
Private Equity Round
Angel / Seed Funding
Seed
Corporate Round
Seed / Angle Funding
Equity
Series E
Venture Round
Series F
pre-Series A
Mezzanine
Pre Series A
Term Loan
Debt-Funding
Private
Series B (Extension)
Private Funding
Structured Debt
Debt
Equity Based Funding
Angel Round
Inhouse Funding
Debt and Preference capital
Bridge Round
Venture - Series Unknown
Series J
Angel
Single Venture
pre-series A
Maiden Round
Funding Round
Venture
Series H
Series G
Pre-series A
PrivateEquity
Investment Type

```
count = df['City  Location'].value_counts()
plt.figure(figsize=(25,10))
sns.barplot(x = count.index, y = count.values, alpha=0.8)
plt.xticks(rotation='vertical')
plt.xlabel('Investment Location', fontsize=25)
plt.ylabel('Number of fundings made', fontsize=25)
plt.title("Type of Investment made", fontsize=30)
plt.show()
```



Random Forest

```
from sklearn.ensemble import RandomForestRegressor
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split

df.head()
```

	Date dd/mm/yyyy	Startup Name	Industry Vertical	City Location	Investors Name	InvestmentnType	Amount in USD
0	09/01/2020	BYJU'S	E-Tech	Bengaluru	Tiger Global Management	Private Equity Round	200000000.0
1	13/01/2020	Shuttl	Transportation	Gurgaon	Susquehanna Growth Equity	Series C	8048394.0
2	09/01/2020	Mamaearth	E-commerce	Bengaluru	Sequoia Capital India	Series B	18358860.0
3	02/01/2020	https://www.wealthbucket.in/	FinTech	New Delhi	Vinod Khatumal	Pre-series A	3000000.0

Next steps: Generate code with df View recommended plots

```
df = df[~df['Amount in USD'].isnull()]
```

```
train,test= train_test_split(df,test_size=0.2,random_state =10)
train_x = train.drop(['Amount in USD'],axis = 1)
train_y = train['Amount in USD']
test_x = test.drop(['Amount in USD'],axis = 1)
test_y = test['Amount in USD']
print(train_y)
```

```
3         3000000.0
18        1500000.0
13        2000000.0
2        18358860.0
14       50000000.0
8        70000000.0
17         486000.0
16     150000000.0
237      4200000.0
12      30000000.0
11      12000000.0
1        8048394.0
0      200000000.0
15     231000000.0
4        1800000.0
9       50000000.0
Name: Amount in USD, dtype: float64
```

```
from sklearn.preprocessing import LabelEncoder
le1, le2, le3, le4, le5, le6 = LabelEncoder(), LabelEncoder(), LabelEncoder(), LabelEncoder(), LabelEncoder(), LabelEncoder()
le1.fit(df['InvestmentnType'])
le2.fit(df['Investors Name'])
le3.fit(df['Industry Vertical'].values)
le4.fit(df['Startup Name'].values)
le5.fit(df['City  Location'].values)
le6.fit(df['Date dd/mm/yyyy'].values)
```

▾ LabelEncoder

LabelEncoder()

```
train_df = pd.DataFrame(
    {
        'InvestmentType': le1.transform(train_x['InvestmentnType']),
        'InvestorsName': le2.transform(train_x['Investors Name']),
        'IndustryVertical': le3.transform(train_x['Industry Vertical']),
        'StartupName': le4.transform(train_x['Startup Name']),
        'CityLocation': le5.transform(train_x['City  Location']),
        'month': le6.transform(train_x['Date dd/mm/yyyy'])
    })
test_df = pd.DataFrame(
    {
        'InvestmentType': le1.transform(test_x['InvestmentnType']),
        'InvestorsName': le2.transform(test_x['Investors Name']),
        'IndustryVertical': le3.transform(test_x['Industry Vertical']),
        'StartupName': le4.transform(test_x['Startup Name']),
        'CityLocation': le5.transform(test_x['City  Location']),
        'month': le6.transform(test_x['Date dd/mm/yyyy'])
    })
```

```
test_df.head()
```

	InvestmentType	InvestorsName	IndustryVertical	StartupName	CityLocation	month
0	5	10	14	3	7	6
1	10	9	14	13	3	9
2	5	1	12	11	1	7
3	2	0	11	17	3	4

Next steps: Generate code with `test_df` View recommended plots

```
clf = GradientBoostingRegressor(learning_rate =0.1,max_depth = 11,min_samples_split =100,min_samples_leaf =20,n_estimators =40,
                                max_features =3,random_state =43)
clf.fit(train_df,train_y)
```

```
GradientBoostingRegressor
GradientBoostingRegressor(max_depth=11, max_features=3, min_samples_leaf=20,
                          min_samples_split=100, n_estimators=40,
                          random_state=43)
```

```
from sklearn.ensemble import RandomForestClassifier
rf_clf = RandomForestClassifier()
```

```
rf_clf.fit(train_df, train_y)
```

```
RandomForestClassifier
RandomForestClassifier()
```

```
evaluate(rf_clf, train_df, train_y, test_df, test_y)
```

```
Train Results:
Mean Squared Error: 0.0
R2 Score: 1.0
Mean Absolute Error: 0.0

Test Results:
Mean Squared Error: 2960370221494809.0
R2 Score: 0.18112954819222815
Mean Absolute Error: 39287901.5
Train Results:
Mean Squared Error: 0.0
R2 Score: 1.0
Mean Absolute Error: 0.0

Test Results:
Mean Squared Error: 2960370221494809.0
R2 Score: 0.18112954819222815
Mean Absolute Error: 39287901.5
```

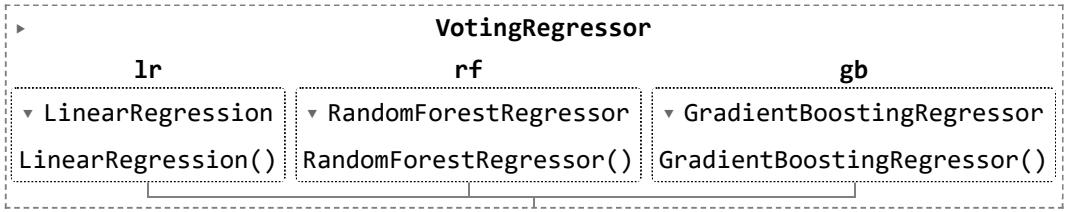
Voting Regressor ensemble

```
from sklearn.ensemble import VotingRegressor
from sklearn.linear_model import LinearRegression
from sklearn.tree import DecisionTreeRegressor
```

```
lr = LinearRegression()
rf = RandomForestRegressor()
gb = GradientBoostingRegressor()
```

```
voting_reg = VotingRegressor(estimators=[('lr', lr), ('rf', rf), ('gb', gb)])
```

```
voting_reg.fit(train_df, train_y)
```




```
evaluate(voting_reg, train_df, train_y, test_df, test_y)
```

```
Train Results:
Mean Squared Error: 620569682990373.2
R2 Score: 0.8817093389093895
Mean Absolute Error: 17939311.084098116

Test Results:
Mean Squared Error: 6814934148937292.0
R2 Score: -0.885084563093143
Mean Absolute Error: 57982655.935594216
```

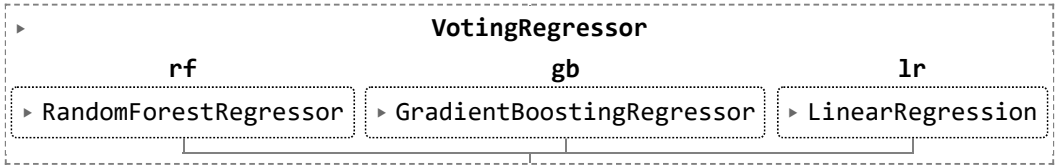
Model Comparison

```
from sklearn.ensemble import RandomForestRegressor, GradientBoostingRegressor
from sklearn.linear_model import LinearRegression

rf_reg = RandomForestRegressor()
gb_reg = GradientBoostingRegressor(learning_rate=0.1, max_depth=11, min_samples_split=100, max_features=3, random_state=43)
lr_reg = LinearRegression()
```

Instance of the Voting Regressor:

```
from sklearn.ensemble import VotingRegressor

voting_reg = VotingRegressor(estimators=[('rf', rf_reg), ('gb', gb_reg), ('lr', lr_reg)])
```

```
rf_reg.fit(train_df, train_y)
gb_reg.fit(train_df, train_y)
lr_reg.fit(train_df, train_y)
voting_reg.fit(train_df, train_y)
```



Evaluate the performance of each model on the test data using the evaluate function

```
print("Random Forest Regressor:")
evaluate(rf_reg, train_df, train_y, test_df, test_y)
print("\nGradient Boosting Regressor:")
evaluate(gb_reg, train_df, train_y, test_df, test_y)
print("\nLinear Regression:")
evaluate(lr_reg, train_df, train_y, test_df, test_y)
print("\nVoting Regressor:")
evaluate(voting_reg, train_df, train_y, test_df, test_y)
```

```
Random Forest Regressor:
Train Results:
Mean Squared Error: 589633423818955.0
R2 Score: 0.8876062923851433
Mean Absolute Error: 15931191.34875

Test Results:
Mean Squared Error: 3789714440126361.0
R2 Score: -0.04827604104250782
Mean Absolute Error: 50434138.644999996

Gradient Boosting Regressor:
Train Results:
Mean Squared Error: 5246142656308409.0
R2 Score: 0.0
Mean Absolute Error: 55362710.8125

Test Results:
Mean Squared Error: 3648533255409018.0
R2 Score: -0.009223796942487317
Mean Absolute Error: 54762289.1875

Linear Regression:
Train Results:
Mean Squared Error: 2668272215043784.0
R2 Score: 0.49138397679002765
```