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

from sklearn.tree import plot_tree
from sklearn import tree
from sklearn import metrics
from sklearn import svm
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
from sklearn.tree import DecisionTreeClassifier
from sklearn.tree import DecisionTreeClassifier, plot_tree
from sklearn.metrics import precision_score
from sklearn.metrics import recall_score
from sklearn.metrics import roc_auc_score
from sklearn.metrics import accuracy_score
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.neighbors import KNeighborsRegressor
from sklearn.model_selection import train_test_split

import warnings
warnings.filterwarnings('ignore')

df = pd.read_csv('titanic.csv')
df.head()
```

```
   PassengerId  Survived  Pclass  \
0            1         0       3
1            2         1       1
2            3         1       3
3            4         1       1
4            5         0       3

                                                 Name     Sex   Age
SibSp  \
0                             Braund, Mr. Owen Harris    male  22.0
1
1  Cumings, Mrs. John Bradley (Florence Briggs Th...  female  38.0
1
2                              Heikkinen, Miss. Laina  female  26.0
0
3       Futrelle, Mrs. Jacques Heath (Lily May Peel)  female  35.0
1
4                            Allen, Mr. William Henry    male  35.0
0
```

```
   Parch            Ticket     Fare Cabin Embarked
0      0         A/5 21171   7.2500   NaN        S
1      0          PC 17599  71.2833   C85        C
2      0  STON/O2. 3101282   7.9250   NaN        S
3      0            113803  53.1000  C123        S
4      0            373450   8.0500   NaN        S
```

```
df.size
```

```
10692
```

```
df.shape
```

```
(891, 12)
```

```
df.columns
```

```
Index(['PassengerId', 'Survived', 'Pclass', 'Name', 'Sex', 'Age',
'SibSp',
       'Parch', 'Ticket', 'Fare', 'Cabin', 'Embarked'],
      dtype='object')
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   PassengerId  891 non-null    int64
 1   Survived     891 non-null    int64
 2   Pclass       891 non-null    int64
 3   Name         891 non-null    object
 4   Sex          891 non-null    object
 5   Age          714 non-null    float64
 6   SibSp        891 non-null    int64
 7   Parch        891 non-null    int64
 8   Ticket       891 non-null    object
 9   Fare         891 non-null    float64
 10  Cabin        204 non-null    object
 11  Embarked     889 non-null    object
dtypes: float64(2), int64(5), object(5)
memory usage: 83.7+ KB
```

```
df.isnull().sum()
```

```
PassengerId      0
Survived         0
Pclass           0
Name             0
Sex              0
```

```
Age            177
SibSp            0
Parch            0
Ticket           0
Fare             0
Cabin          687
Embarked         2
dtype: int64
```

```
# excluding collums which is not required
df.drop(["PassengerId",
"Name","SibSp","Parch","Ticket","Fare","Cabin","Embarked"],
axis="columns",inplace=True)
df.head()
```

```
   Survived  Pclass     Sex   Age
0         0       3    male  22.0
1         1       1  female  38.0
2         1       3  female  26.0
3         1       1  female  35.0
4         0       3    male  35.0
```

```
X = df.drop(["Survived"],axis="columns")
Y = df["Survived"]
Y
```

```
0      0
1      1
2      1
3      1
4      0
      ..
886    0
887    1
888    0
889    1
890    0
Name: Survived, Length: 891, dtype: int64
```

```
X['Sex'] = X['Sex'].replace({"male": 0, "female": 1})
X.head()
```

```
   Pclass  Sex   Age
0       3    0  22.0
1       1    1  38.0
2       3    1  26.0
3       1    1  35.0
4       3    0  35.0
```

```
X.Age[0:10]
```

```
0    22.0
1    38.0
2    26.0
3    35.0
4    35.0
5     NaN
6    54.0
7     2.0
8    27.0
9    14.0
Name: Age, dtype: float64
```

```
X['Age'].fillna(X['Age'].mean(), inplace=True)
X['Age'].iloc[0:10]
```

```
0    22.000000
1    38.000000
2    26.000000
3    35.000000
4    35.000000
5    29.699118
6    54.000000
7     2.000000
8    27.000000
9    14.000000
Name: Age, dtype: float64
```

```
train_test_split(X,Y,train_size = 0.8)
```

```
[     Pclass  Sex        Age
 629       3    0  29.699118
 721       3    0  17.000000
 251       3    1  29.000000
 105       3    0  28.000000
 693       3    0  25.000000
 ..      ...  ...        ...
 471       3    0  38.000000
 476       2    0  34.000000
 691       3    1   4.000000
 767       3    1  30.500000
 11        1    1  58.000000

 [712 rows x 3 columns],
      Pclass  Sex        Age
 764       3    0  16.000000
 121       3    0  29.699118
 630       1    0  80.000000
 393       1    1  23.000000
 182       3    0   9.000000
 ..      ...  ...        ...
```

```
841       2    0  16.000000
36        3    0  29.699118
311       1    1  18.000000
572       1    0  36.000000
277       2    0  29.699118

[179 rows x 3 columns],
629    0
721    0
251    0
105    0
693    0
      ..
471    0
476    0
691    1
767    0
11     1
Name: Survived, Length: 712, dtype: int64,
764    0
121    0
630    1
393    1
182    0
      ..
841    0
36     1
311    1
572    1
277    0
Name: Survived, Length: 179, dtype: int64]
```

```
X_train,X_test,Y_train,Y_real=train_test_split(X,Y,train_size = 0.8)
len(X_train)
```

```
712
```

```
len(X_test)
```

```
179
```

```
X_test
```

```
     Pclass  Sex        Age
250       3    0  29.699118
507       1    0  29.699118
212       3    0  22.000000
344       2    0  36.000000
3         1    1  35.000000
..      ...  ...        ...
440       2    1  45.000000
```

```
38         3    1  18.000000
113        3    1  20.000000
237        2    1   8.000000
812        2    0  35.000000

[179 rows x 3 columns]
```

Model Building

1. Decision Tree

```
model_dt = tree.DecisionTreeClassifier(max_depth=3)
model_dt

DecisionTreeClassifier(max_depth=3)

model_dt = DecisionTreeClassifier()
model_dt.fit(X_train, Y_train)
predictions = model_dt.predict(X_test)

model_dt.predict(X_test)

array([0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 0,
0,
       0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1,
0,
       1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0,
1,
       0, 0, 0, 1, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1,
0,
       0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0,
0,
       0, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0,
0,
       0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0,
1,
       0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1,
0,
       0, 1, 0], dtype=int64)

Y_pred_dt = model_dt.predict(X_test)
Y_pred_dt

array([0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 0,
0,
       0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1,
0,
```

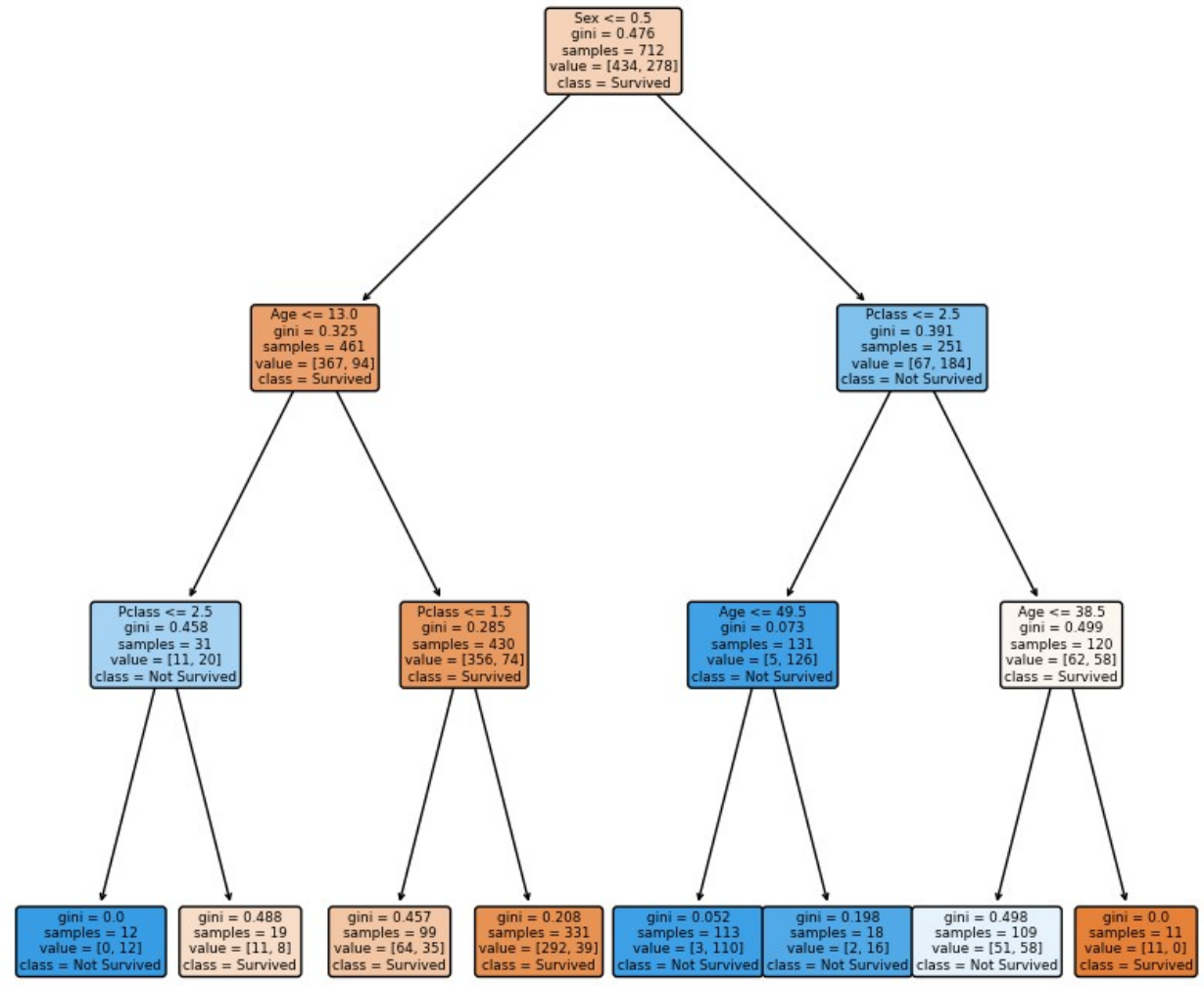
```
       1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0,
1,
       0, 0, 0, 1, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1,
0,
       0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0,
0,
       0, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0,
0,
       0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0,
1,
       0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1,
0,
       0, 1, 0], dtype=int64)
```

```
result = pd.DataFrame({"Survived REAL": Y_real, "Survived PREDICTION":
predictions})
result
```

```
     Survived REAL  Survived PREDICTION
250              0                    0
507              1                    0
212              0                    0
344              0                    0
3                1                    1
..             ...                  ...
440              1                    1
38               0                    0
113              0                    0
237              1                    1
812              0                    0

[179 rows x 2 columns]
```

Plotting Tree

```
model_dt = DecisionTreeClassifier(max_depth=3)
model_dt.fit(X_train, Y_train)
plt.figure(figsize=(10, 10))
plot_tree(model_dt, feature_names=['Pclass', 'Sex', 'Age'],
class_names=['Survived', 'Not Survived'], filled=True, rounded=True)
plt.show()
```



Performance Measurement

Accuracy

```
accuracy_dt = model_dt.score(X_test, Y_real)
accuracy_decimal = "{:.3f}".format(accuracy_dt)
print("Accuracy:", accuracy_decimal)

Accuracy: 0.832
```

Precision

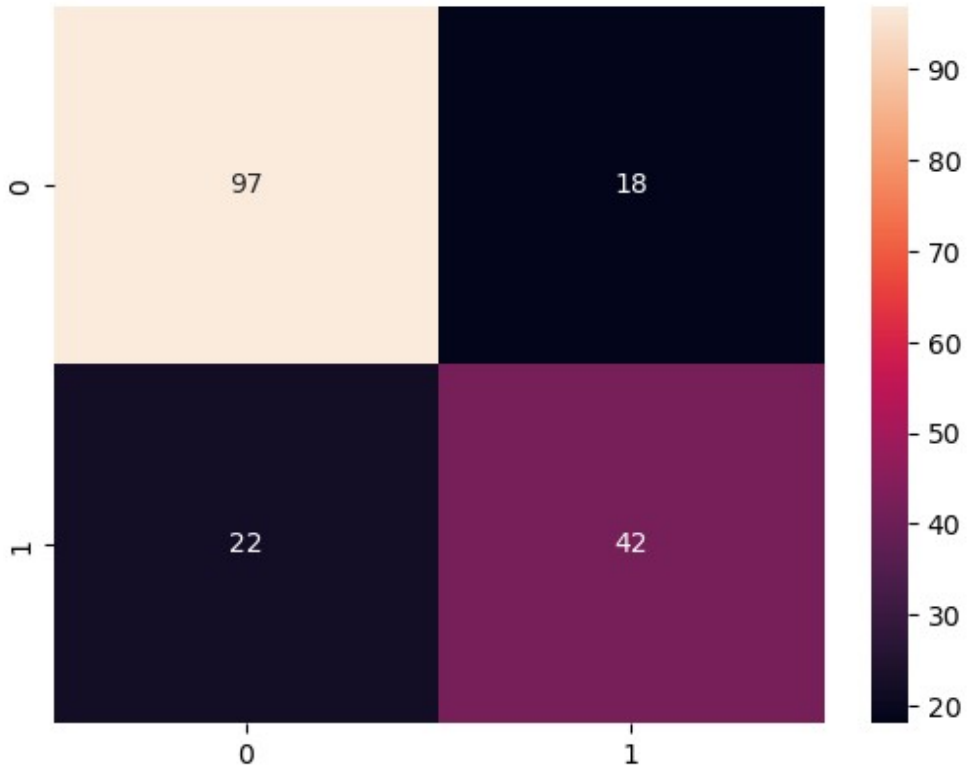
```
precision_dt = metrics.precision_score(Y_real, Y_pred_dt)
precision_decimal = "{:.3f}".format(precision_dt)
print("Precision:", precision_decimal)

Precision: 0.700
```

Recall

```
recall_dt = metrics.recall_score(Y_real, Y_pred_dt)
recall_decimal = "{:.3f}".format(recall_dt)
print("Recall:", recall_decimal)

Recall: 0.656
```

Confusion Matrix

```
confusion_matrix_dt = metrics.confusion_matrix(Y_real,Y_pred_dt)
confusion_matrix_dt

array([[97, 18],
       [22, 42]], dtype=int64)

sns.heatmap(confusion_matrix_dt, annot=True)

<Axes: >
```



AUC - ROC Curve

```
auc_dt = metrics.roc_auc_score(Y_real, Y_pred_dt)
auc_dt_formatted = f'{auc_dt:.3f}'
print("AUC Score:", auc_dt_formatted)
```

```
AUC Score: 0.750
```

DT K-Fold Cross Validation

```
kf_dt = KFold(n_splits=5, shuffle=True)
cv_dt = cross_val_score(model, X, Y, cv=kf_dt)
mean_cv_score = np.mean(cv_dt)
mean_cv_score_formatted = f'{mean_cv_score:.3f}'
print("Mean Cross-Validation Score:", mean_cv_score_formatted)
```

```
Mean Cross-Validation Score: 0.818
```

Logistic Regression

```
model_lr = LogisticRegression(solver='liblinear')
```

```
model_lr.fit(X_train,Y_train)

LogisticRegression(solver='liblinear')

y_pred_lg = model_lr.predict(X_test)
y_pred_lg

array([0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 1, 1, 0, 1, 1, 1, 0, 0, 0,
0,
       0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 1,
0,
       1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0,
1,
       0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1,
0,
       1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0,
0,
       0, 1, 1, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
1,
       0, 0, 1, 0, 0, 1, 1, 1, 1, 0, 1, 1, 0, 0, 1, 1, 0, 1, 0, 1, 0,
0,
       0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1,
1,
       1, 1, 0], dtype=int64)
```

Performance Measurement

Accuracy

```
accuracy_lg = model_lr.score(X_test, Y_real)
accuracy_lg_formatted = f'{accuracy_lg:.3f}'
print("Accuracy:", accuracy_lg_formatted)

Accuracy: 0.838
```

Precision

```
precision_lg = metrics.precision_score(Y_real, y_pred_lg)
precision_lg_percentage = "{:.3f}%".format(precision_lg * 100)
print("Precision:", precision_lg_percentage)

Precision: 76.923%
```

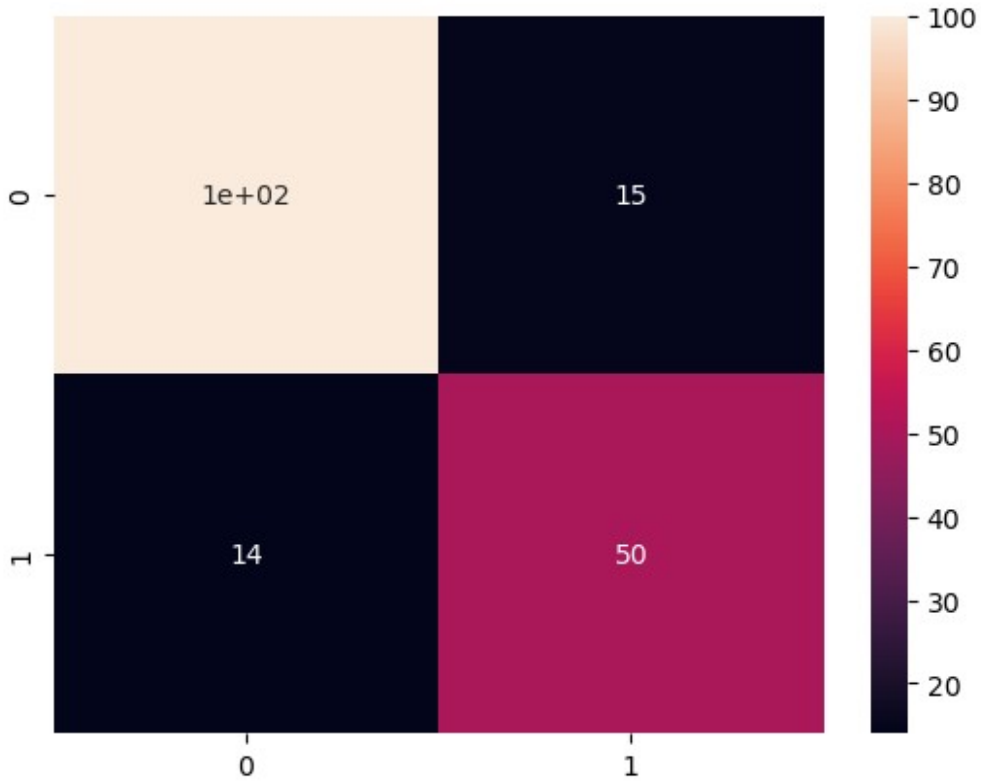
Recall

```
rec_lg = metrics.recall_score(Y_real, y_pred_lg)
rec_lg_percentage = "{:.3f}%".format(rec_lg * 100)
print("Recall:", rec_lg_percentage)
```

```
Recall: 78.125%
```

Confusion Matrix

```
cm_lg = metrics.confusion_matrix(Y_real,y_pred_lg)
cm_lg

array([[100,  15],
       [ 14,  50]], dtype=int64)

sns.heatmap(cm_lg, annot=True)

<Axes: >
```



AUC - ROC Curve

```
auc_lg = metrics.roc_auc_score(Y_real, y_pred_lg)
auc_lg_percentage = "{:.3f}%".format(auc_lg * 100)
print("AUC Score:", auc_lg_percentage)

AUC Score: 82.541%
```

LR K-Fold Cross Validation

```
kf_lg = KFold(n_splits=5,shuffle=True)
```

```
cv_lg = cross_val_score(model_lr, X, Y, cv=kf_lg)
mean_cv_accuracy = np.mean(cv_lg)
mean_cv_accuracy_percentage = "{:.3f}%".format(mean_cv_accuracy * 100)
print("Cross Validation Accuracy:", mean_cv_accuracy_percentage)
```

```
Cross Validation Accuracy: 79.682%
```

Support Vector Machines (SVM)

```
model_svc = svm.SVC(kernel="linear")
model_svc
```

```
SVC(kernel='linear')
```

```
model_svc.fit(X_train,Y_train)
```

```
SVC(kernel='linear')
```

```
Y_pred_svm = model_svc.predict(X_test)
Y_pred_svm
```

```
array([0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 1, 1, 0, 1, 1, 1, 0, 0, 0,
0,
       0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1,
0,
       1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0,
1,
       0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1,
0,
       1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0,
0,
       0, 1, 1, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
1,
       0, 0, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 1, 0, 1, 0,
0,
       0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1,
1,
       1, 1, 0], dtype=int64)
```

Performance Measurement

Accuracy

```
accuracy_svc = model_svc.score(X_test, Y_real)
accuracy_svc_formatted = f'{accuracy_svc:.3f}'
print("Accuracy:", accuracy_svc_formatted)
```

```
Accuracy: 0.838
```

Precision

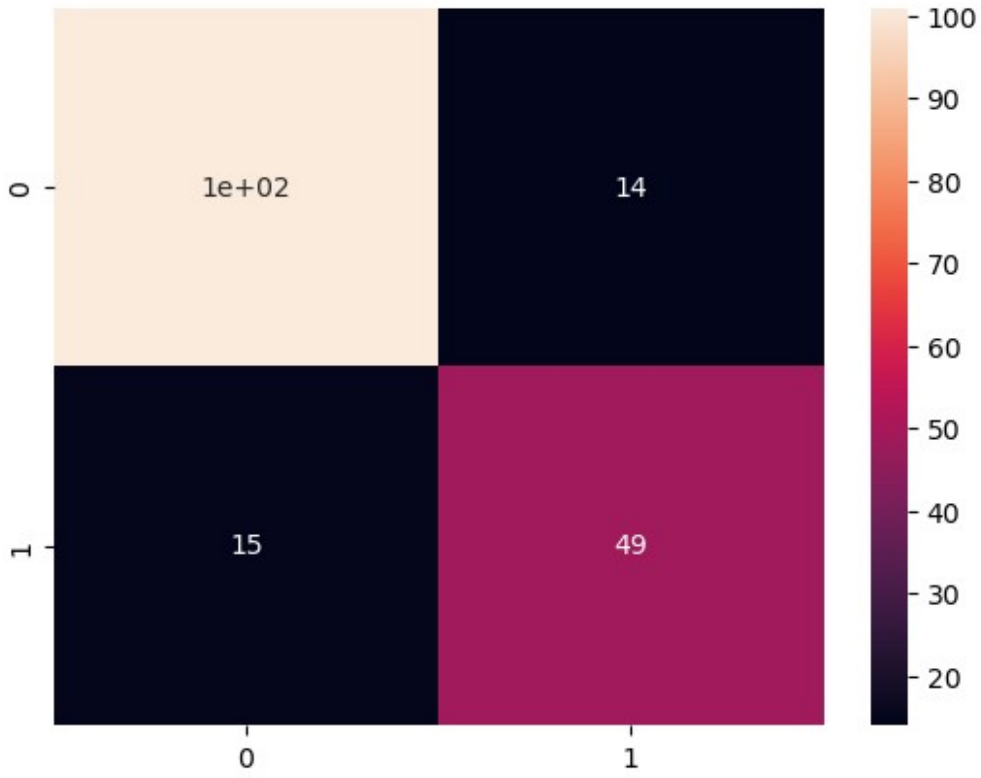
```
precision_svc = precision_score(Y_real, Y_pred_svm)
precision_svc_percentage = "{:.3f}%".format(precision_svc * 100)
print("Precision:", precision_svc_percentage)

Precision: 77.778%
```

Recall

```
rec_svc = recall_score(Y_real, Y_pred_svm)
rec_svc_percentage = "{:.3f}%".format(rec_svc * 100)
print("Recall:", rec_svc_percentage)

Recall: 76.562%
```

Confusion Matrix

```
cm_svc = metrics.confusion_matrix(Y_real,Y_pred_svm)
cm_svc

array([[101,  14],
       [ 15,  49]], dtype=int64)

sns.heatmap(cm_svc, annot=True)

<Axes: >
```



AUC - ROC Curve

```
auc_svc = roc_auc_score(Y_real, Y_pred_svm)
auc_svc_percentage = "{:.3f}%".format(auc_svc * 100)
print("AUC:", auc_svc_percentage)
```

```
AUC: 82.194%
```

SVM K-Fold Cross Validation

```
kf_svc = KFold(n_splits=5,shuffle=True)

cv_svc = cross_val_score(model_svc, X, Y, cv=kf_svc)
mean_cv_svc = np.mean(cv_svc)
mean_cv_svc_percentage = "{:.3f}%".format(mean_cv_svc * 100)
print("Cross-validated Accuracy:", mean_cv_svc_percentage)
```

```
Cross-validated Accuracy: 78.678%
```

Random Forest

```
model_rf = RandomForestClassifier().fit(X_train,Y_train)
```

```
y_pred_forest = model_rf.predict(X_test)
y_pred_forest
```

```
array([0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 0,
0,
       0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1,
0,
       1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0,
1,
       0, 0, 0, 1, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1,
0,
       0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0,
0,
       0, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0,
1,
       0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0,
1,
       0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1,
0,
       0, 1, 0], dtype=int64)
```

Performance Measurement

Accuracy

```
accuracy_forest = model_rf.score(X_test, Y_real)
accuracy_forest_formatted = f'{accuracy_forest:.3f}'
print("Accuracy:", accuracy_forest_formatted)
```

```
Accuracy: 0.793
```

Precision

```
precision_forest = precision_score(Y_real, y_pred_forest)
precision_forest_percentage = "{:.3f}%".format(precision_forest * 100)
print("Precision:", precision_forest_percentage)
```

```
Precision: 71.429%
```

Recall

```
recall_forest = recall_score(Y_real, y_pred_forest)
recall_forest_percentage = "{:.3f}%".format(recall_forest * 100)
print("Recall:", recall_forest_percentage)
```

```
Recall: 70.312%
```

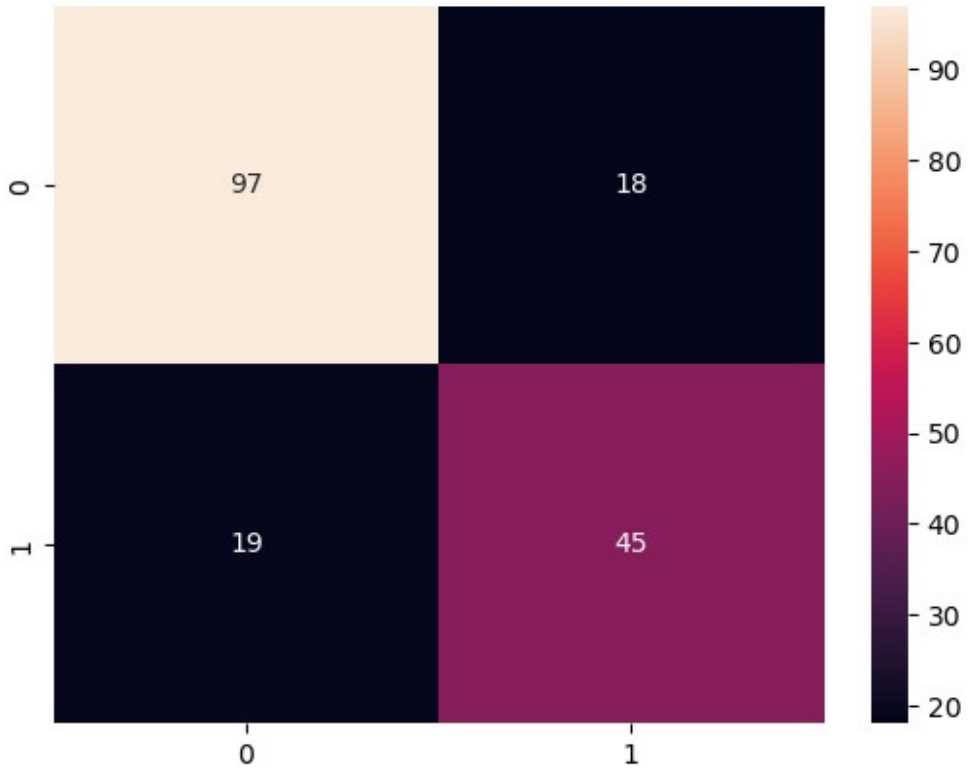
Confusion Matrix

```
cm_forest = metrics.confusion_matrix(Y_real,y_pred_forest)
cm_forest
```

```
array([[97, 18],
       [19, 45]], dtype=int64)
```

```
sns.heatmap(cm_forest, annot=True)
```

```
<Axes: >
```



AUC - ROC Curve

```
auc_forest = roc_auc_score(Y_real, y_pred_forest)
auc_forest_percentage = "{:.3f}%".format(auc_forest * 100)
print("AUC:", auc_forest_percentage)
```

```
AUC: 77.330%
```

RF K-Fold Cross-Validation

```
kf_forest = KFold(n_splits=5,shuffle=True)

cv_forest = cross_val_score(model_rf, X, Y, cv=kf_forest)
mean_accuracy_forest = np.mean(cv_forest)
```

```
mean_accuracy_forest_percentage = "{:.3f}
%".format(mean_accuracy_forest * 100)
print("Cross Validation Accuracy:", mean_accuracy_forest_percentage)
```

```
Cross Validation Accuracy: 80.358%
```

K-Nearest Neighbors

```
knn_model = KNeighborsRegressor()
knn_model
```

```
KNeighborsRegressor()
```

```
knn_model.fit(X_train, Y_train)
```

```
KNeighborsRegressor()
```

```
y_pred_knn = knn_model.predict(X_test)
y_pred_knn
```

```
array([0. , 0. , 0.2, 0.2, 1. , 0. , 0.8, 0. , 0.2, 0.4, 0.2, 1. ,
0.4,
       1. , 0.2, 1. , 1. , 1. , 0. , 0.2, 0.4, 0. , 0. , 0.2, 0.4,
0.6,
       0. , 0.4, 0.4, 0. , 1. , 1. , 0. , 1. , 0.6, 0. , 0.8, 0.4,
0.6,
       0.2, 0. , 0. , 0.4, 0.4, 0.6, 0.2, 0. , 0.4, 0.4, 0. , 0. ,
0.6,
       0.6, 0.4, 0.6, 0. , 1. , 1. , 1. , 0.6, 0.2, 0.2, 1. , 0.2,
0.2,
       0.4, 0.4, 0. , 0. , 0.2, 0.6, 0.2, 0.6, 0.8, 0.6, 0.2, 0. ,
0. ,
       0.6, 0.2, 0.6, 0.4, 0. , 0.2, 0.4, 0. , 0.4, 0.4, 0. , 0. ,
0. ,
       0.6, 0.4, 0. , 0. , 0. , 0.8, 0. , 0.8, 0.2, 0.8, 0.2, 0.8,
0. ,
       0.2, 0.6, 0.4, 0.8, 0.2, 0. , 0.2, 1. , 1. , 0.4, 0.8, 0.4,
0.2,
       0. , 0.8, 0. , 1. , 0. , 0.2, 0. , 0. , 0. , 0.2, 0. , 0. ,
0.8,
       0.2, 0.6, 0.2, 0.2, 0.2, 0.6, 0. , 0.4, 1. , 0.6, 0.6, 0. ,
0.6,
       0.4, 0.4, 0.4, 0.2, 0.8, 0. , 0.6, 0.6, 1. , 0.4, 0.6, 0.2,
0.2,
       0.4, 1. , 0. , 0.2, 1. , 0.2, 0.6, 0.4, 0.4, 0.2, 0. , 0.2,
0.4,
       0. , 0.6, 0. , 0. , 0.2, 0.4, 0.4, 0.8, 0.4, 0.2])
```

Performance Measurement

Accuracy

```
rounding = np.round(y_pred_knn)

acc_knn = metrics.accuracy_score(Y_real, rounding)
acc_knn_formatted = f'{acc_knn:.3f}'
print("Accuracy:", acc_knn_formatted)

Accuracy: 0.765
```

Precision

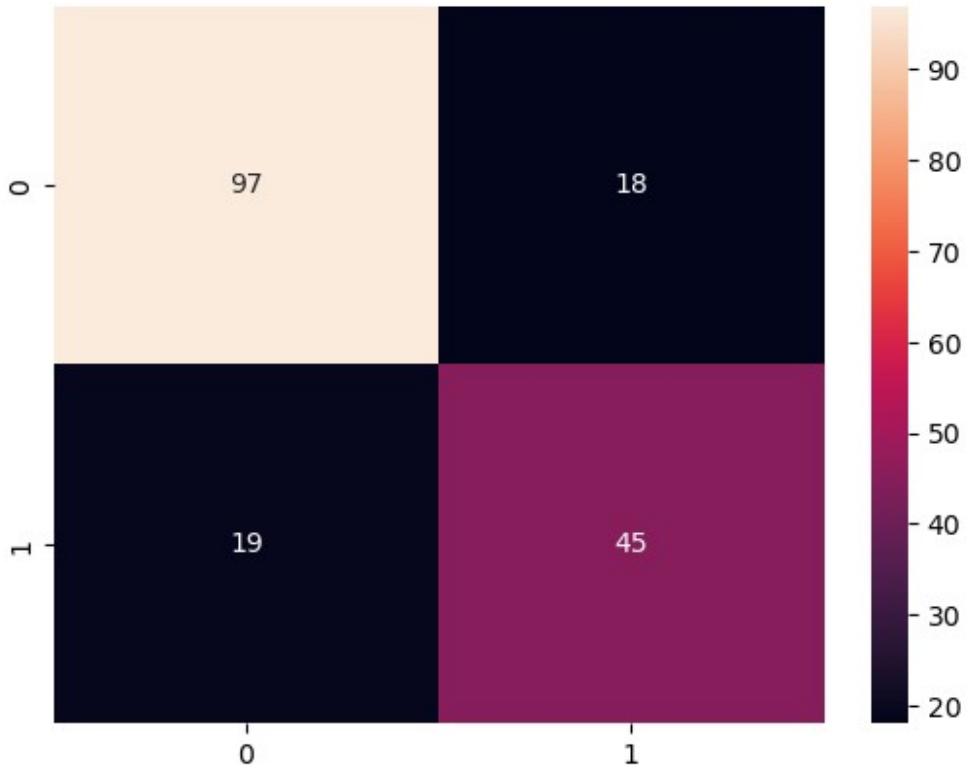
```
precision_knn_percentage = precision_score(Y_real, rounding) * 100
print("Precision:", "{:.3f}%".format(precision_knn_percentage))

Precision: 68.966%
```

Recall

```
recall_knn_percentage = recall_score(Y_real, rounding) * 100
print("Recall:", "{:.3f}%".format(recall_knn_percentage))

Recall: 62.500%
```

Confusion Matrix

```
cm_knn = metrics.confusion_matrix(Y_real, rounding)
cm_knn

array([[97, 18],
       [24, 40]], dtype=int64)

sns.heatmap(cm_forest, annot=True)

<Axes: >
```



AUC - ROC Curve

```
auc_knn_percentage = roc_auc_score(Y_real, rounding) * 100
print("AUC:", "{:.3f}%".format(auc_knn_percentage))
```

```
AUC: 73.424%
```

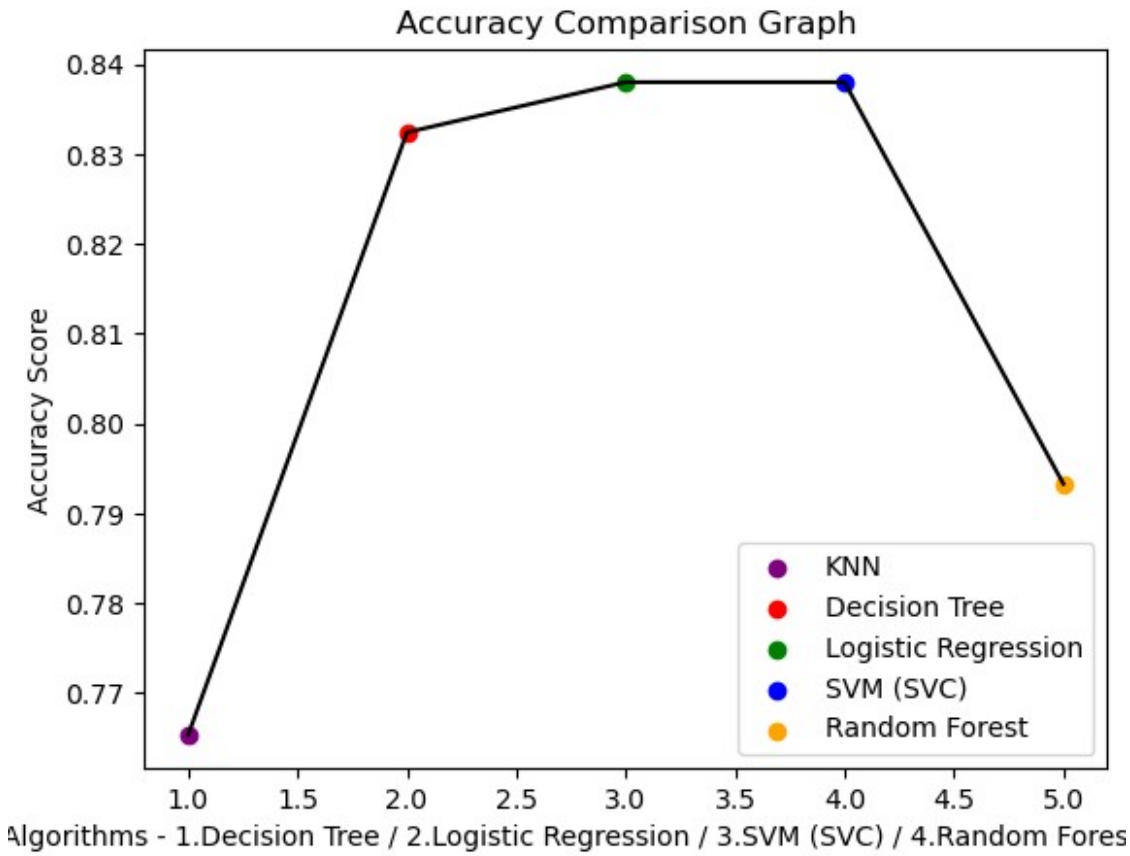
KNN K-Fold Cross Validation

```
kf_neighbors = KFold(n_splits=5,shuffle=True)

cv_accuracy_neighbors = cross_val_score(knn_model, X, Y,
cv=kf_neighbors)
mean_cv_accuracy_neighbors = np.mean(cv_accuracy_neighbors) * 100
print("Cross Validation Accuracy:", "{:.3f}
%".format(mean_cv_accuracy_neighbors))
```

```
Cross Validation Accuracy: 23.822%
```

Valuation Analysis

```
plt.title("Accuracy Comparison Graph")
plt.ylabel("Accuracy Score")

plt.xlabel("Algorithms - 1.Decision Tree / 2.Logistic Regression /
3.SVM (SVC) / 4.Random Forest / 5.KNN")

y = [acc_knn,accuracy_dt,accuracy_lg,accuracy_svc,accuracy_forest]

plt.plot([1,2,3,4,5],y, color = "black")


plt.scatter(1,acc_knn, marker="o", color = "purple",label = "KNN")

plt.scatter(2,accuracy_dt, marker="o", color="red", label="Decision
Tree")

plt.scatter(3,accuracy_lg, marker="o", color="green", label="Logistic
Regression")

plt.scatter(4,accuracy_svc, marker="o", color="blue", label="SVM
(SVC)")

plt.scatter(5,accuracy_forest, marker="o", color = "orange",label =
"Random Forest")


plt.legend()
plt.show()
```


Accuracy Comparison Graph
Accuracy Score
0.84
0.83
0.82
0.81
0.80
0.79
0.78
0.77
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Algorithms - 1.Decision Tree / 2.Logistic Regression / 3.SVM (SVC) / 4.Random Fores
KNN
Decision Tree
Logistic Regression
SVM (SVC)
Random Forest