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

from sklearn.metrics import accuracy_score, precision_score,
recall_score, f1_score

df=pd.read_csv("./User_Data.csv")
df.head()
```

```
   Gender  Age  EstimatedSalary  Purchased
0    Male   19            19000          0
1    Male   35            20000          0
2  Female   26            43000          0
3  Female   27            57000          0
4    Male   19            76000          0
```

EDA and Handling Null Values

```
data_info = df.info()

data_summary = df.describe()

missing_values = df.isnull().sum()

data_info, data_summary, missing_values
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 400 entries, 0 to 399
Data columns (total 4 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   Gender           400 non-null    object
 1   Age              400 non-null    int64
 2   EstimatedSalary  400 non-null    int64
 3   Purchased        400 non-null    int64
dtypes: int64(3), object(1)
memory usage: 12.6+ KB

(None,
                Age  EstimatedSalary   Purchased
 count  400.000000       400.000000  400.000000
 mean    37.655000     69742.500000    0.357500
 std     10.482877     34096.960282    0.479864
 min     18.000000     15000.000000    0.000000
 25%     29.750000     43000.000000    0.000000
 50%     37.000000     70000.000000    0.000000
 75%     46.000000     88000.000000    1.000000
```

```
max     60.000000    150000.000000    1.000000,
Gender              0
Age                 0
EstimatedSalary     0
Purchased           0
dtype: int64)
```

Pre-processing

```
from sklearn.preprocessing import LabelEncoder, StandardScaler

label_encoder = LabelEncoder()
df['Gender'] = label_encoder.fit_transform(df['Gender'])

scaler = StandardScaler()
df[['Age', 'EstimatedSalary']] = scaler.fit_transform(df[['Age',
'EstimatedSalary']])

df.head()
```

	Gender	Age	EstimatedSalary	Purchased
0	1	-1.781797	-1.490046	0
1	1	-0.253587	-1.460681	0
2	0	-1.113206	-0.785290	0
3	0	-1.017692	-0.374182	0
4	1	-1.781797	0.183751	0

Train-test split

```
from sklearn.model_selection import train_test_split

X = df[['Gender', 'Age', 'EstimatedSalary']]
y = df['Purchased']

X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.3, random_state=42, stratify=y)

X_train.shape, X_test.shape, y_train.shape, y_test.shape
```

```
((280, 3), (120, 3), (280,), (120,))
```

```
import pandas as pd
from sklearn.model_selection import train_test_split, GridSearchCV
from sklearn.svm import SVC
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import classification_report, confusion_matrix
import joblib
```

```
param_grid = {
    'C': [0.1, 1, 10, 100],                 # Regularization parameter
    'gamma': [1, 0.1, 0.01, 0.001],        # Kernel coefficient for RBF
and polynomial
    'kernel': ['linear', 'poly', 'rbf']   # Kernel options
}

svc = SVC()

grid_search = GridSearchCV(estimator=svc, param_grid=param_grid,
scoring='accuracy', cv=5, verbose=2)
grid_search.fit(X_train, y_train)

best_params = grid_search.best_params_
best_model = grid_search.best_estimator_

print("Best Parameters:", best_params)

best_model.fit(X_train, y_train)
```

```
Fitting 5 folds for each of 48 candidates, totalling 240 fits
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[CV] END ....................C=100, gamma=0.1, kernel=rbf; total
time=   0.0s
[CV] END ....................C=100, gamma=0.1, kernel=rbf; total
time=   0.0s
```

```
[CV] END .....................C=100, gamma=0.1, kernel=rbf; total
time=   0.0s
[CV] END ..................C=100, gamma=0.01, kernel=linear; total
time=   0.0s
[CV] END ..................C=100, gamma=0.01, kernel=linear; total
time=   0.0s
[CV] END ..................C=100, gamma=0.01, kernel=linear; total
time=   0.0s
[CV] END ..................C=100, gamma=0.01, kernel=linear; total
time=   0.0s
[CV] END ..................C=100, gamma=0.01, kernel=linear; total
time=   0.0s
[CV] END .....................C=100, gamma=0.01, kernel=poly; total
time=   0.0s
[CV] END .....................C=100, gamma=0.01, kernel=poly; total
time=   0.0s
[CV] END .....................C=100, gamma=0.01, kernel=poly; total
time=   0.0s
[CV] END .....................C=100, gamma=0.01, kernel=poly; total
time=   0.0s
[CV] END .....................C=100, gamma=0.01, kernel=poly; total
time=   0.0s
[CV] END ......................C=100, gamma=0.01, kernel=rbf; total
time=   0.0s
[CV] END ......................C=100, gamma=0.01, kernel=rbf; total
time=   0.0s
[CV] END ......................C=100, gamma=0.01, kernel=rbf; total
time=   0.0s
[CV] END ......................C=100, gamma=0.01, kernel=rbf; total
time=   0.0s
[CV] END ......................C=100, gamma=0.01, kernel=rbf; total
time=   0.0s
[CV] END ..................C=100, gamma=0.001, kernel=linear; total
time=   0.0s
[CV] END ..................C=100, gamma=0.001, kernel=linear; total
time=   0.0s
[CV] END ..................C=100, gamma=0.001, kernel=linear; total
time=   0.0s

[CV] END ..................C=100, gamma=0.001, kernel=linear; total
time=   0.0s
[CV] END ..................C=100, gamma=0.001, kernel=linear; total
time=   0.0s
[CV] END .....................C=100, gamma=0.001, kernel=poly; total
time=   0.0s
[CV] END .....................C=100, gamma=0.001, kernel=poly; total
time=   0.0s
[CV] END .....................C=100, gamma=0.001, kernel=poly; total
time=   0.0s
[CV] END .....................C=100, gamma=0.001, kernel=poly; total
```

```
time=   0.0s
[CV] END .....................C=100, gamma=0.001, kernel=poly; total
time=   0.0s
[CV] END .....................C=100, gamma=0.001, kernel=rbf; total
time=   0.0s
[CV] END .....................C=100, gamma=0.001, kernel=rbf; total
time=   0.0s
[CV] END .....................C=100, gamma=0.001, kernel=rbf; total
time=   0.0s
[CV] END .....................C=100, gamma=0.001, kernel=rbf; total
time=   0.0s
[CV] END .....................C=100, gamma=0.001, kernel=rbf; total
time=   0.0s
Best Parameters: {'C': 0.1, 'gamma': 1, 'kernel': 'rbf'}

SVC(C=0.1, gamma=1)

y_pred = best_model.predict(X_test)

print("\nClassification Report:")
print(classification_report(y_test, y_pred))

print("\nConfusion Matrix:")
print(confusion_matrix(y_test, y_pred))



Classification Report:
              precision    recall  f1-score   support

           0       0.93      0.92      0.93        77
           1       0.86      0.88      0.87        43

    accuracy                           0.91       120
   macro avg       0.90      0.90      0.90       120
weighted avg       0.91      0.91      0.91       120


Confusion Matrix:
[[71  6]
 [ 5 38]]

# Save the trained model
joblib.dump(best_model, 'svm_model_assignment4.pkl')
print("\nModel saved as 'svm_model_assignment4.pkl'")


Model saved as 'svm_model_assignment4.pkl'
```