Importing Libraries

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
from sklearn.model_selection import KFold, StratifiedKFold, cross_val_score, train_test_split
from sklearn import linear_model, tree, ensemble
```

Reading the Data from CSV file

```
dataframe=pd.read_csv("/content/heart.csv")
dataframe.head(10)
```

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target
0	63	1	3	145	233	1	0	150	0	2.3	0	0	1	1
1	37	1	2	130	250	0	1	187	0	3.5	0	0	2	1
2	41	0	1	130	204	0	0	172	0	1.4	2	0	2	1
3	56	1	1	120	236	0	1	178	0	0.8	2	0	2	1
4	57	0	0	120	354	0	1	163	1	0.6	2	0	2	1
5	57	1	0	140	192	0	1	148	0	0.4	1	0	1	1
6	56	0	1	140	294	0	0	153	0	1.3	1	0	2	1
7	44	1	1	120	263	0	1	173	0	0.0	2	0	3	1
8	52	1	2	172	199	1	1	162	0	0.5	2	0	3	1
9	57	1	2	150	168	0	1	174	0	1.6	2	0	2	1

Next steps: Generate code with dataframe | View recommended plots | New interactive sheet

Data Analysis

```
dataframe.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 303 entries, 0 to 302
Data columns (total 14 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   age       303 non-null    int64
 1   sex       303 non-null    int64
 2   cp        303 non-null    int64
 3   trestbps  303 non-null    int64
 4   chol      303 non-null    int64
 5   fbs       303 non-null    int64
 6   restecg   303 non-null    int64
 7   thalach   303 non-null    int64
 8   exang     303 non-null    int64
 9   oldpeak   303 non-null    float64
 10  slope     303 non-null    int64
 11  ca        303 non-null    int64
 12  thal      303 non-null    int64
 13  target    303 non-null    int64
dtypes: float64(1), int64(13)
memory usage: 33.3 KB
```

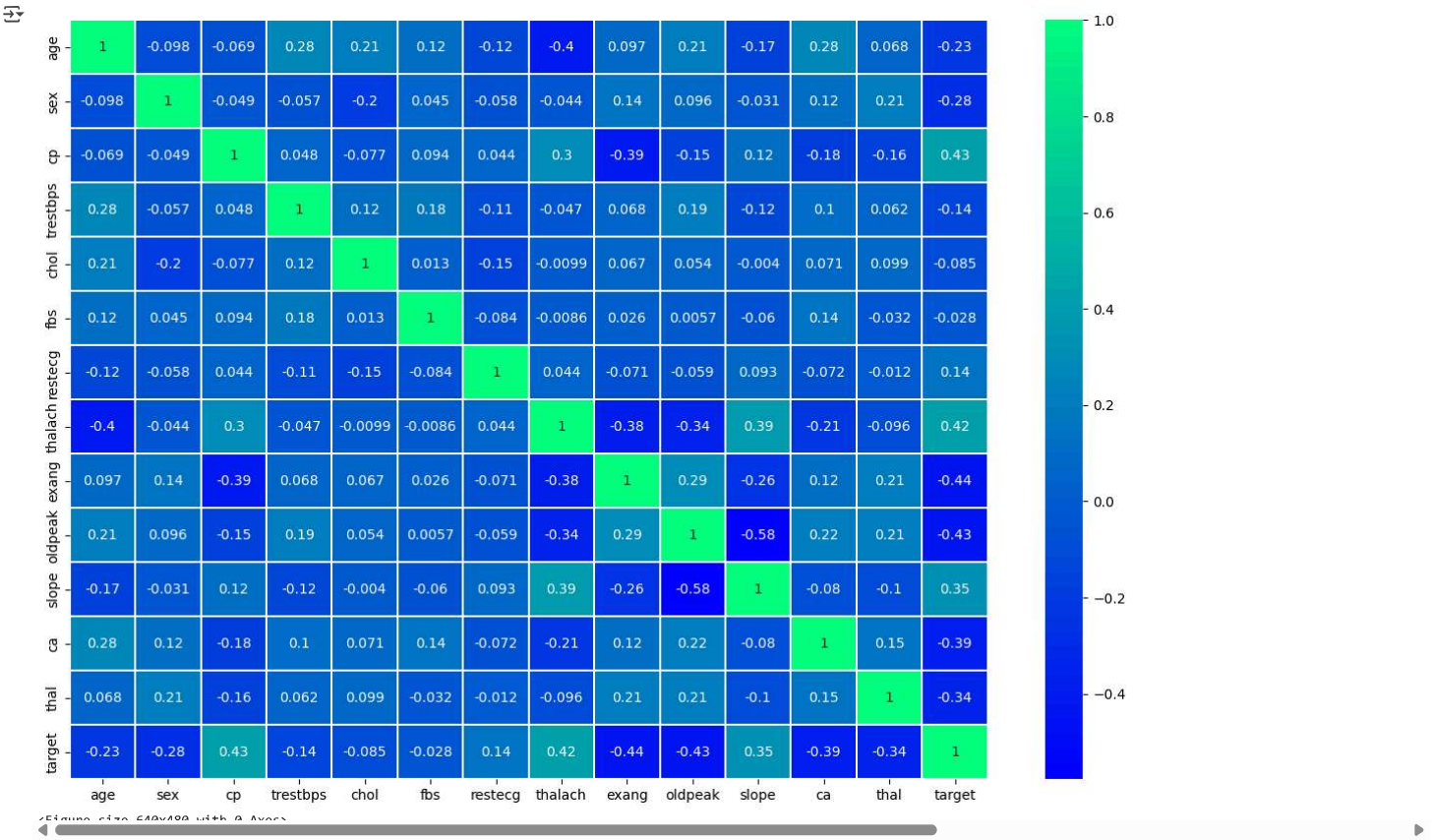
```
dataframe.isna().sum()
```

	0
age	0
sex	0
cp	0
trestbps	0
chol	0
fbs	0
restecg	0
thalach	0
exang	0
oldpeak	0
slope	0
ca	0
thal	0
target	0

dtype: int64

Correlation Matrix

```
plt.figure(figsize=(15,10))
sns.heatmap(dataframe.corr(),linewidth=.01,annot=True,cmap="winter")
plt.show()
plt.savefig('correlationfigure')
```



Train-Test Split

```
X = dataframe.drop('target', axis=1)
y = dataframe['target']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.25, random_state=42)

print("Training set size:", X_train.shape, y_train.shape)
print("Test set size:", X_test.shape, y_test.shape)
```

```
Training set size: (227, 13) (227,)
Test set size: (76, 13) (76,)
```

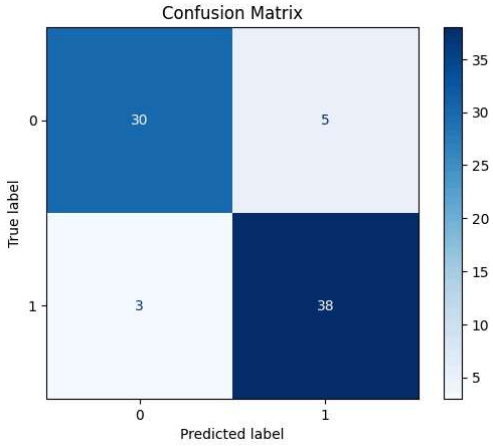
Algorithm Implementation

1. Logistic Regression

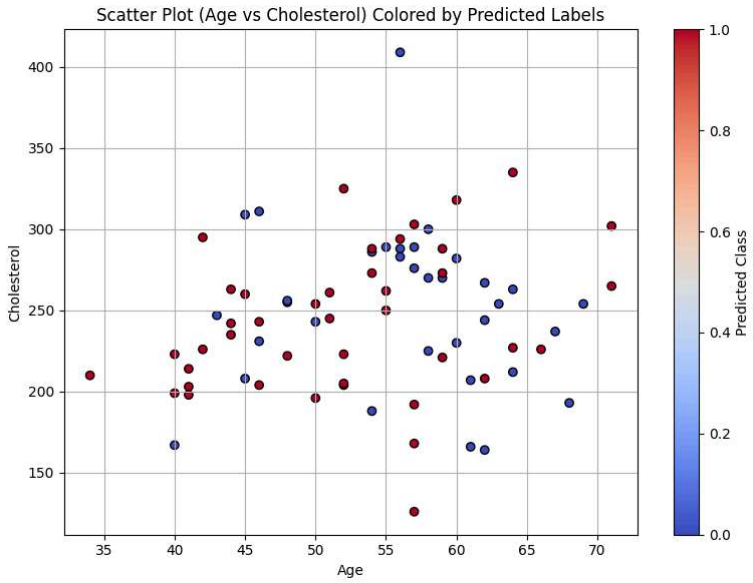
```
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import classification_report, confusion_matrix, ConfusionMatrixDisplay
from sklearn.metrics import accuracy_score

# Train logistic regression model
model = LogisticRegression(max_iter=1000)
model.fit(X_train, y_train)

# Make predictions
y_pred = model.predict(X_test)

print("Logistic Regression:")
# Print accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f"Accuracy: {accuracy:.2f}")

# Print classification report
print("Classification Report:\n")
print(classification_report(y_test, y_pred))

# Compute and plot confusion matrix
cm = confusion_matrix(y_test, y_pred)
```

```
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=model.classes_)
disp.plot(cmap=plt.cm.Blues)
plt.title("Confusion Matrix")
plt.show()

# Create a scatter plot of two features colored by predicted labels
print("Scatterplot:\n")
plt.figure(figsize=(8, 6))
scatter = plt.scatter(X_test['age'], X_test['chol'], c=y_pred, cmap='coolwarm', edgecolor='k')
plt.xlabel('Age')
plt.ylabel('Cholesterol')
plt.title('Scatter Plot (Age vs Cholesterol) Colored by Predicted Labels')
plt.colorbar(scatter, label='Predicted Class')
plt.grid(True)
plt.tight_layout()
plt.show()
```

```
Logistic Regression:
Accuracy: 0.89
Classification Report:

              precision    recall  f1-score   support

           0       0.91      0.86      0.88        35
           1       0.88      0.93      0.90        41

    accuracy                           0.89        76
   macro avg       0.90      0.89      0.89        76
weighted avg       0.90      0.89      0.89        76
```




```
Scatterplot:
```

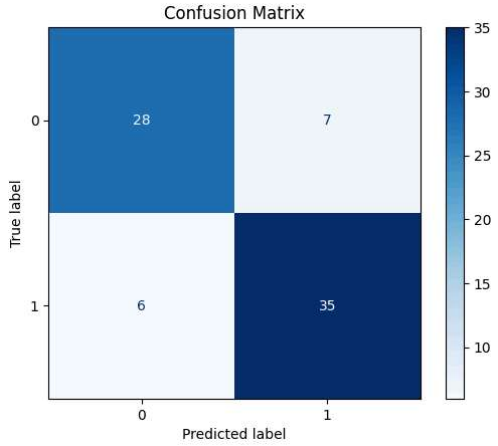


2. Decision Tree

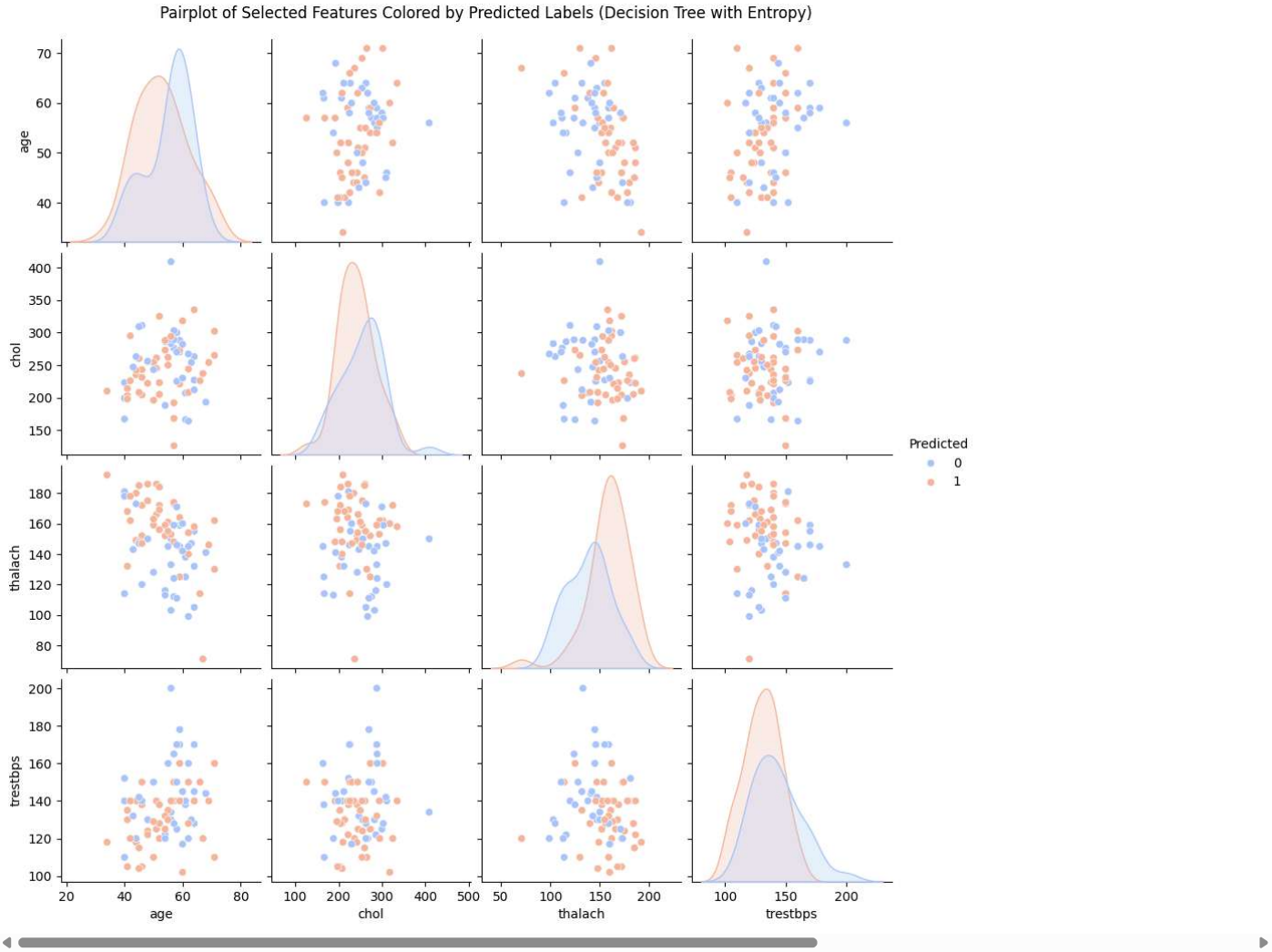
```
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import classification_report, confusion_matrix, ConfusionMatrixDisplay, accuracy_score

# Train Decision Tree model
model = DecisionTreeClassifier(max_depth=2,criterion='entropy',random_state=42)
model.fit(X_train, y_train)

# Make predictions
y_pred = model.predict(X_test)
```

```
print("Decision Tree:")

# Print accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f"Accuracy: {accuracy:.2f}")

# Print classification report
print("Classification Report:\n")
print(classification_report(y_test, y_pred))

# Compute and plot confusion matrix
cm = confusion_matrix(y_test, y_pred)
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=model.classes_)
disp.plot(cmap=plt.cm.Blues)
plt.title("Confusion Matrix")
plt.show()

# Create a pairplot with predicted labels
print("Pairplot:\n")
pairplot_df = X_test.copy()
pairplot_df['Predicted'] = y_pred

# Select a few features for pairplot to avoid clutter
features_to_plot = ['age', 'chol', 'thalach', 'trestbps', 'Predicted']
sns.pairplot(pairplot_df[features_to_plot], hue='Predicted', palette='coolwarm', diag_kind='kde')
plt.suptitle('Pairplot of Selected Features Colored by Predicted Labels (Decision Tree with Entropy)', y=1.02)
plt.show()
```

```
Decision Tree:
Accuracy: 0.83
Classification Report:

              precision    recall  f1-score   support

           0       0.82      0.80      0.81        35
           1       0.83      0.85      0.84        41

    accuracy                           0.83        76
   macro avg       0.83      0.83      0.83        76
weighted avg       0.83      0.83      0.83        76
```



Pairplot:

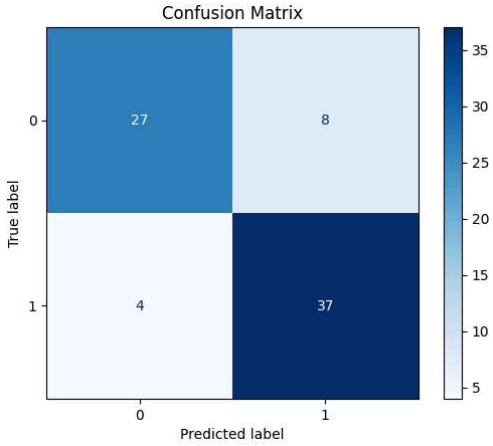


3. Random Forest Classifier

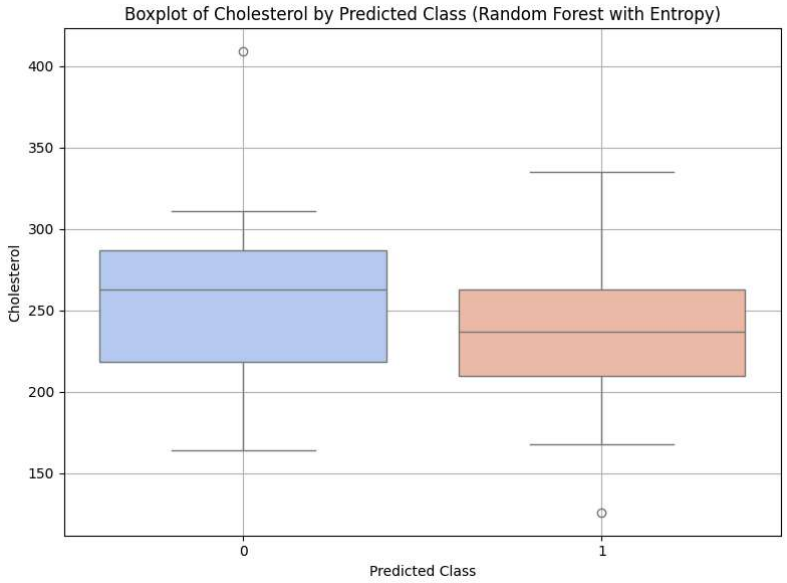
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import classification_report, confusion_matrix, ConfusionMatrixDisplay, accuracy_score
```

```
# Train Random Forest model with entropy criterion
model = RandomForestClassifier(criterion='entropy', random_state=42)
model.fit(X_train, y_train)

# Make predictions
y_pred = model.predict(X_test)

print("Random Forest:")

# Print accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f"Accuracy: {accuracy:.2f}")

# Print classification report
print("Classification Report:\n")
print(classification_report(y_test, y_pred))

# Compute and plot confusion matrix
cm = confusion_matrix(y_test, y_pred)
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=model.classes_)
disp.plot(cmap=plt.cm.Blues)
plt.title("Confusion Matrix")
plt.show()

# Create a boxplot of cholesterol across predicted classes
print("Boxplot:\n")
plot_df = X_test.copy()
plot_df['Predicted'] = y_pred

plt.figure(figsize=(8, 6))
sns.boxplot(x='Predicted', y='chol', data=plot_df, palette='coolwarm')
plt.xlabel('Predicted Class')
plt.ylabel('Cholesterol')
plt.title('Boxplot of Cholesterol by Predicted Class (Random Forest with Entropy)')
plt.grid(True)
plt.tight_layout()
plt.show()
```

```
Random Forest:
Accuracy: 0.84
Classification Report:

              precision    recall  f1-score   support

           0       0.87      0.77      0.82        35
           1       0.82      0.90      0.86        41

    accuracy                           0.84        76
   macro avg       0.85      0.84      0.84        76
weighted avg       0.84      0.84      0.84        76
```




```
Boxplot:

<ipython-input-13-9d2d40e77fea>:38: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

  sns.boxplot(x='Predicted', y='chol', data=plot_df, palette='coolwarm')
```

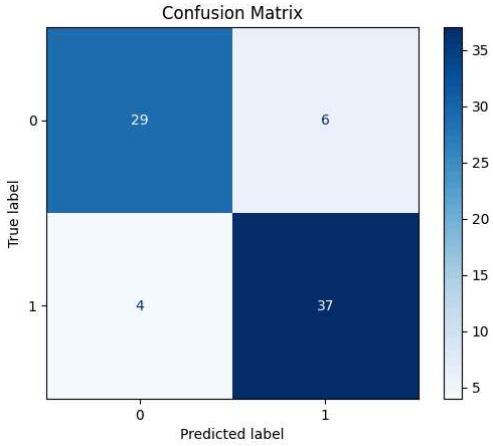


4. Support Vector Machines(SVM)

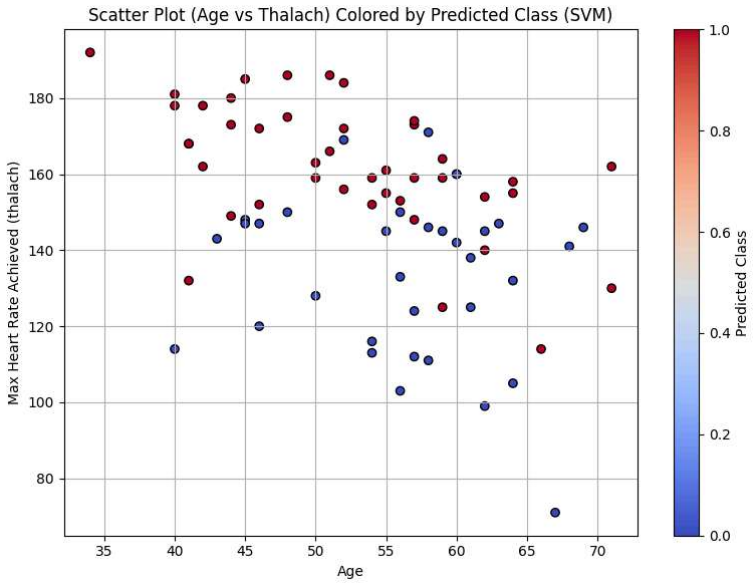
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.svm import SVC
from sklearn.metrics import classification_report, confusion_matrix, ConfusionMatrixDisplay, accuracy_score

# Train SVM model
model = SVC(kernel='linear')
model.fit(X_train, y_train)

# Make predictions
y_pred = model.predict(X_test)

print("SVM:")

# Print accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f"Accuracy: {accuracy:.2f}")

# Print classification report
print("Classification Report:\n")
print(classification_report(y_test, y_pred))
```

```
# Compute and plot confusion matrix
cm = confusion_matrix(y_test, y_pred)
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=model.classes_)
disp.plot(cmap=plt.cm.Blues)
plt.title("Confusion Matrix")
plt.show()

# Create a scatter plot of two features colored by predicted labels
print("Scatter Plot:\n")
plot_df = X_test.copy()
plot_df['Predicted'] = y_pred

plt.figure(figsize=(8, 6))
scatter = plt.scatter(plot_df['age'], plot_df['thalach'], c=plot_df['Predicted'], cmap='coolwarm', edgecolor='k')
plt.xlabel('Age')
plt.ylabel('Max Heart Rate Achieved (thalach)')
plt.title('Scatter Plot (Age vs Thalach) Colored by Predicted Class (SVM)')
plt.colorbar(scatter, label='Predicted Class')
plt.grid(True)
plt.tight_layout()
plt.show()
```

```
SVM:
Accuracy: 0.87
Classification Report:

              precision    recall  f1-score   support

           0       0.88      0.83      0.85        35
           1       0.86      0.90      0.88        41

    accuracy                           0.87        76
   macro avg       0.87      0.87      0.87        76
weighted avg       0.87      0.87      0.87        76
```




```
Scatter Plot:
```



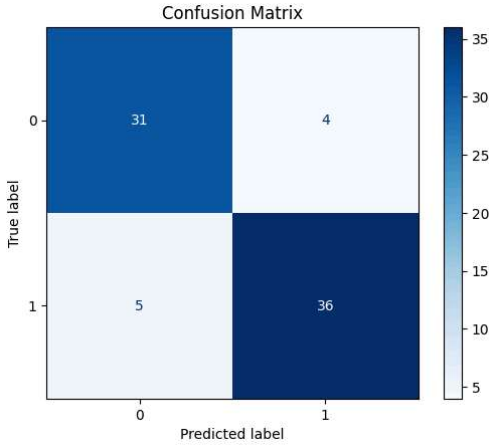
5. Naive Bayes

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import classification_report, confusion_matrix, ConfusionMatrixDisplay, accuracy_score
```

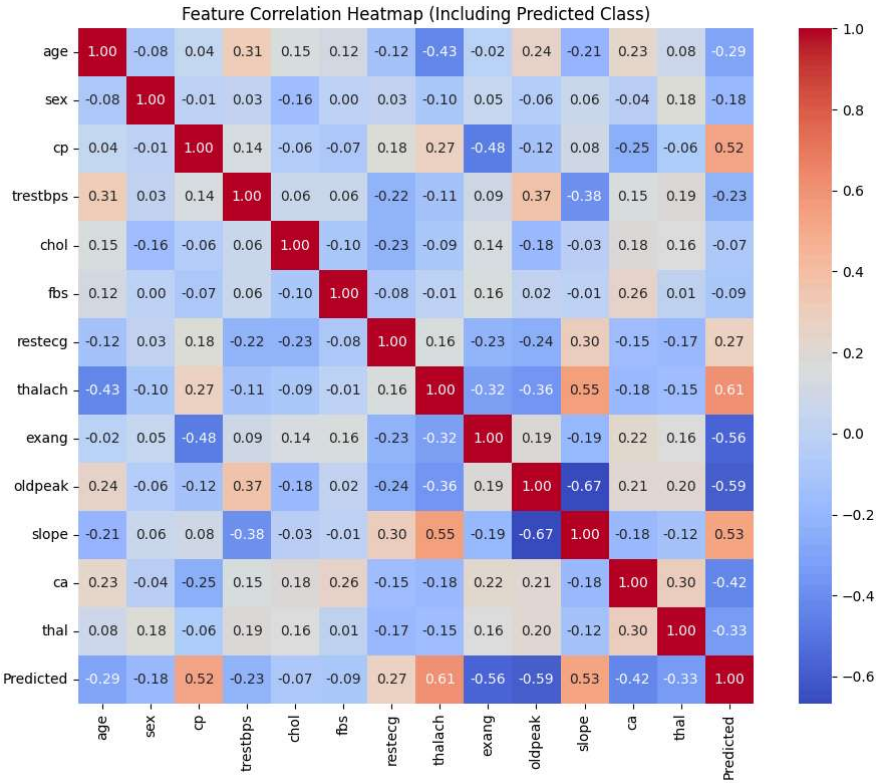
```
# Train Naive Bayes model
model = GaussianNB()
model.fit(X_train, y_train)

# Predictions
y_pred = model.predict(X_test)

print("Naive Bayes:")

# Accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f"Accuracy: {accuracy:.2f}")

# Classification report
print("Classification Report:\n")
print(classification_report(y_test, y_pred))

# Confusion matrix
cm = confusion_matrix(y_test, y_pred)
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=model.classes_)
disp.plot(cmap=plt.cm.Blues)
plt.title("Confusion Matrix")
plt.show()

# Heatmap of feature correlations by predicted class
print("Heatmap:\n")
plot_df = X_test.copy()
plot_df['Predicted'] = y_pred

# Compute correlation matrix
corr = plot_df.corr(numeric_only=True)

plt.figure(figsize=(10, 8))
sns.heatmap(corr, annot=True, cmap='coolwarm', fmt=".2f", square=True, cbar=True)
plt.title("Feature Correlation Heatmap (Including Predicted Class)")
plt.tight_layout()
plt.show()
```

```
Naive Bayes:
Accuracy: 0.88
Classification Report:
```

	precision	recall	f1-score	support
0	0.86	0.89	0.87	35
1	0.90	0.88	0.89	41
accuracy			0.88	76
macro avg	0.88	0.88	0.88	76
weighted avg	0.88	0.88	0.88	76



Heatmap:



Final Model Implementation

CASE 1 – For Heart Disease data

```
import warnings
warnings.filterwarnings("ignore")
from sklearn.linear_model import LogisticRegression
import pandas as pd

# Initialize and train Logistic Regression model
model = LogisticRegression(max_iter=1000)
model.fit(X_train, y_train)

# Define input values (sample patient data)
input_values = (63, 1, 145, 233, 150, 2.3, 0, 0, 1, 0, 2.3, 0, 1)

# Create a DataFrame using the same columns as training data
input_columns = X.columns  # X is the training feature set
```

```
input_df = pd.DataFrame([input_values], columns=input_columns)

# Predict using the trained Logistic Regression model
pre1 = model.predict(input_df)

# Interpret the prediction
if pre1[0] == 1:
    print("The patient seems to have heart disease :(")
else:
    print("The patient seems to be Normal :)")
```

```
The patient seems to have heart disease :(
```

CASE 2 – For Normal Data

```
import warnings
warnings.filterwarnings("ignore")
from sklearn.linear_model import LogisticRegression
import pandas as pd

# Initialize and train Logistic Regression model
model = LogisticRegression(max_iter=1000)
model.fit(X_train, y_train)

# Define the input patient data
input_values = (60, 0, 0, 150, 258, 0, 0, 157, 0, 2.6, 1, 2, 2)

# Create a DataFrame using the same columns as training data
input_columns = X.columns  # X is the training feature set
input_df = pd.DataFrame([input_values], columns=input_columns)

# Predict using the trained Naive Bayes model
pre1 = model.predict(input_df)

# Print prediction result
if pre1[0] == 1:
    print("The patient seems to have heart disease :(")
else:
    print("The patient seems to be Normal :)")
```

```
The patient seems to be Normal :)
```

```
Start coding or generate with AI.
```

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