cardio-disease-prediction

November 5, 2024

```python
[1]: # Import necessary libraries
     import pandas as pd
     import numpy as np
     import matplotlib.pyplot as plt
     import seaborn as sns
     from sklearn.model_selection import train_test_split, cross_val_score
     from sklearn.preprocessing import StandardScaler
     from sklearn.metrics import accuracy_score, classification_report,␣
      ↪confusion_matrix
     from sklearn.svm import SVC
     from sklearn.neighbors import KNeighborsClassifier


     from sklearn.tree import DecisionTreeClassifier
     from sklearn.linear_model import LogisticRegression
     from sklearn.ensemble import RandomForestClassifier

     # Load the dataset
     data = pd.read_csv('cardio_train.csv', sep=';')

     # Display basic information about the dataset
     print(data.head())
     print(data.info())
     print(data.describe())

     # Step 1: Data Preprocessing
     # Checking for missing values
     print("Missing values per column:\n", data.isnull().sum())

     # Dropping duplicates if any (optional)
     data = data.drop_duplicates()

     # Separating features and target
     X = data.drop(columns=['cardio'])  # Updated from 'target' to 'cardio'
     y = data['cardio']

     # Feature Scaling
```

```python
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)

# Step 2: Exploratory Data Analysis
# Plotting histograms for each feature
data.hist(bins=20, figsize=(15, 10))
plt.tight_layout()
plt.show()

# Pair Plot
sns.pairplot(data, hue='cardio')
plt.show()

# Correlation Matrix
plt.figure(figsize=(12, 8))
correlation_matrix = data.corr()
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm')
plt.title("Correlation Matrix")
plt.show()

# Step 3: Model Training and Evaluation
# Splitting data into train and test sets
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0.2,␣
 ↪random_state=42)

# Function to evaluate models
def evaluate_model(model):
    model.fit(X_train, y_train)
    y_pred = model.predict(X_test)
    accuracy = accuracy_score(y_test, y_pred)
    print(f"Model: {model.__class__.__name__}")
    print("Accuracy:", accuracy)
    print("Classification Report:\n", classification_report(y_test, y_pred))
    print("Confusion Matrix:\n", confusion_matrix(y_test, y_pred))
    print("\n")

# Initializing models
models = {
    'Support Vector Machine': SVC(),
    'K-Nearest Neighbors': KNeighborsClassifier(),
    'Decision Tree': DecisionTreeClassifier(),
    'Logistic Regression': LogisticRegression(max_iter=1000),
    'Random Forest': RandomForestClassifier()
}

# Evaluating each model
for model_name, model in models.items():
```

```
    print(f"Evaluating {model_name}")
    evaluate_model(model)

# Step 4: Cross-validation (Optional for more reliable results)
for model_name, model in models.items():
    scores = cross_val_score(model, X_scaled, y, cv=5)
    print(f"{model_name} Cross-Validation Accuracy: {np.mean(scores):.4f} ± {np.
 ↪std(scores):.4f}")
```

```
   id    age  gender  height  weight  ap_hi  ap_lo  cholesterol  gluc  smoke  \
0   0  18393       2     168    62.0    110     80            1     1      0
1   1  20228       1     156    85.0    140     90            3     1      0
2   2  18857       1     165    64.0    130     70            3     1      0
3   3  17623       2     169    82.0    150    100            1     1      0
4   4  17474       1     156    56.0    100     60            1     1      0

   alco  active  cardio
0     0       1       0
1     0       1       1
2     0       0       1
3     0       1       1
4     0       0       0
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 70000 entries, 0 to 69999
Data columns (total 13 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   id           70000 non-null  int64
 1   age          70000 non-null  int64
 2   gender       70000 non-null  int64
 3   height       70000 non-null  int64
 4   weight       70000 non-null  float64
 5   ap_hi        70000 non-null  int64
 6   ap_lo        70000 non-null  int64
 7   cholesterol  70000 non-null  int64
 8   gluc         70000 non-null  int64
 9   smoke        70000 non-null  int64
 10  alco         70000 non-null  int64
 11  active       70000 non-null  int64
 12  cardio       70000 non-null  int64
dtypes: float64(1), int64(12)
memory usage: 6.9 MB
None
                 id           age        gender        height        weight  \
count  70000.000000  70000.000000  70000.000000  70000.000000  70000.000000
mean   49972.419900  19468.865814      1.349571    164.359229     74.205690
std    28851.302323   2467.251667      0.476838      8.210126     14.395757
```

min	0.000000	10798.000000	1.000000	55.000000	10.000000
25%	25006.750000	17664.000000	1.000000	159.000000	65.000000
50%	50001.500000	19703.000000	1.000000	165.000000	72.000000
75%	74889.250000	21327.000000	2.000000	170.000000	82.000000
max	99999.000000	23713.000000	2.000000	250.000000	200.000000

	ap_hi	ap_lo	cholesterol	gluc	smoke \
count	70000.000000	70000.000000	70000.000000	70000.000000	70000.000000
mean	128.817286	96.630414	1.366871	1.226457	0.088129
std	154.011419	188.472530	0.680250	0.572270	0.283484
min	-150.000000	-70.000000	1.000000	1.000000	0.000000
25%	120.000000	80.000000	1.000000	1.000000	0.000000
50%	120.000000	80.000000	1.000000	1.000000	0.000000
75%	140.000000	90.000000	2.000000	1.000000	0.000000
max	16020.000000	11000.000000	3.000000	3.000000	1.000000

	alco	active	cardio
count	70000.000000	70000.000000	70000.000000
mean	0.053771	0.803729	0.499700
std	0.225568	0.397179	0.500003
min	0.000000	0.000000	0.000000
25%	0.000000	1.000000	0.000000
50%	0.000000	1.000000	0.000000
75%	0.000000	1.000000	1.000000
max	1.000000	1.000000	1.000000

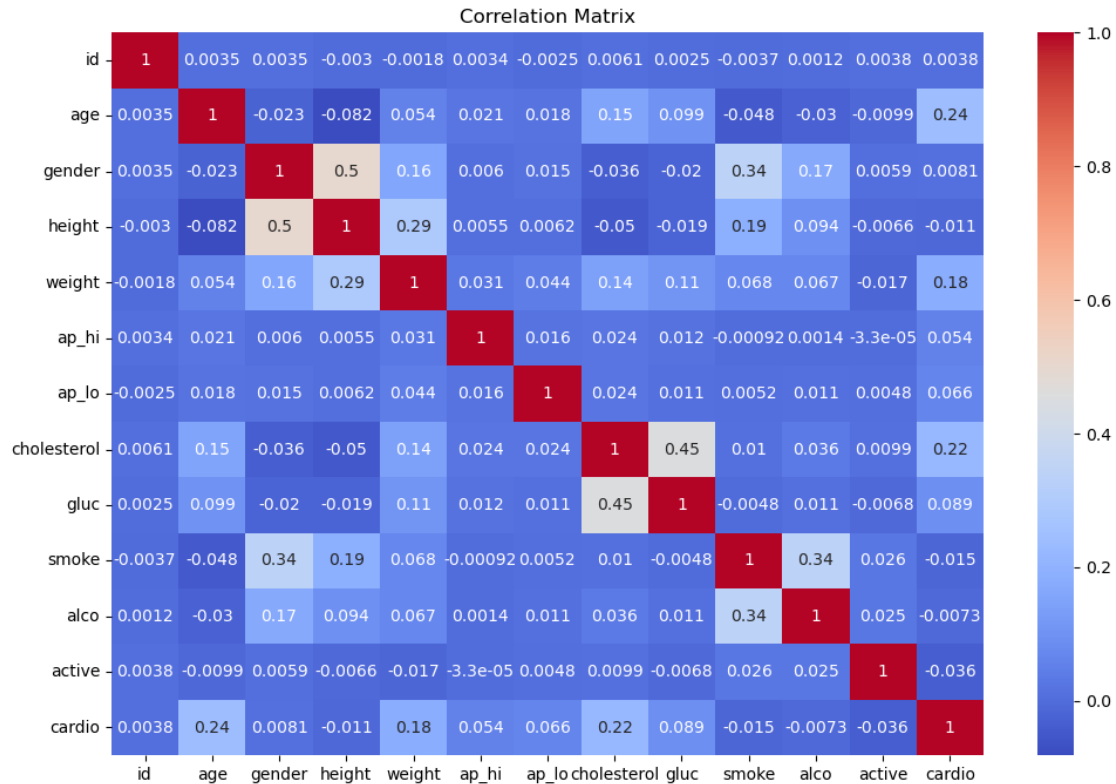Missing values per column:
```
 id           0
age           0
gender        0
height        0
weight        0
ap_hi         0
ap_lo         0
cholesterol   0
gluc          0
smoke         0
alco          0
active        0
cardio        0
dtype: int64
```

Correlation Matrix
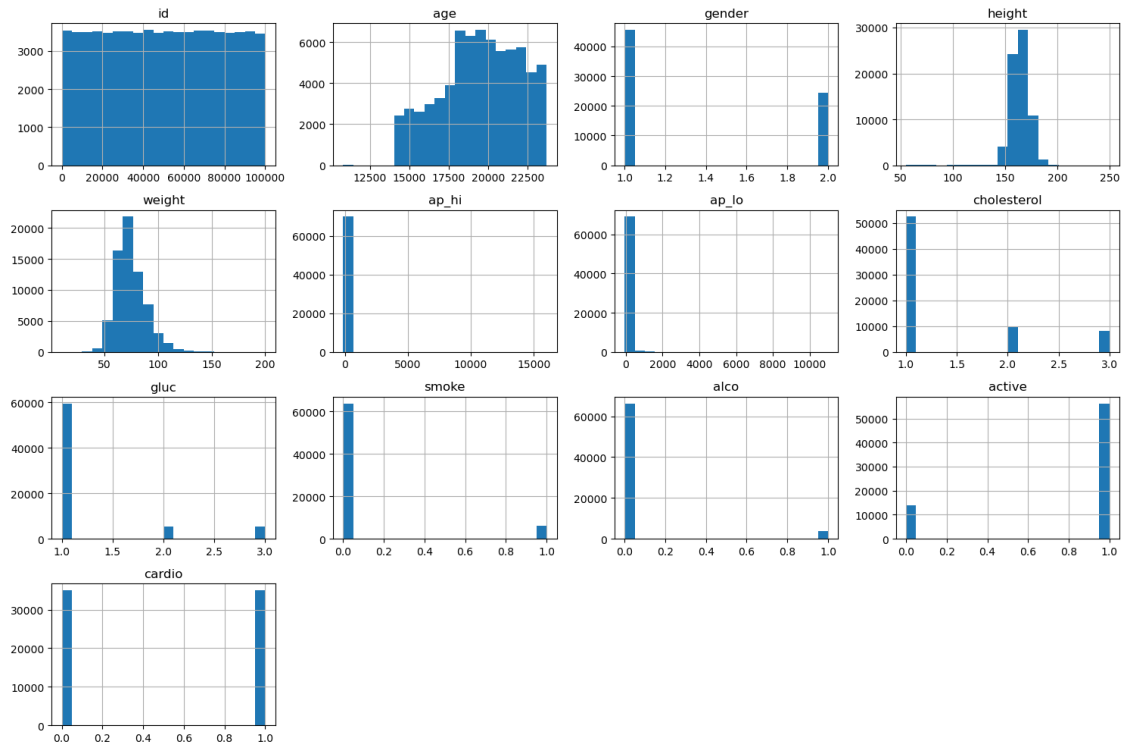
Evaluating Support Vector Machine
Model: SVC
Accuracy: 0.7298571428571429
Classification Report:

	precision	recall	f1-score	support
0	0.72	0.76	0.74	6988
1	0.75	0.70	0.72	7012
accuracy			0.73	14000
macro avg	0.73	0.73	0.73	14000
weighted avg	0.73	0.73	0.73	14000

Confusion Matrix:
 [[5324 1664]
 [2118 4894]]

Evaluating K-Nearest Neighbors
Model: KNeighborsClassifier
Accuracy: 0.626
Classification Report:

```
          precision    recall  f1-score   support

       0       0.62      0.64      0.63      6988
       1       0.63      0.61      0.62      7012

accuracy                           0.63     14000
macro avg       0.63      0.63      0.63     14000
weighted avg    0.63      0.63      0.63     14000
```

Confusion Matrix:
```
 [[4455 2533]
 [2703 4309]]
```

Evaluating Decision Tree
Model: DecisionTreeClassifier
Accuracy: 0.6329285714285714
Classification Report:
```
          precision    recall  f1-score   support

       0       0.63      0.63      0.63      6988
       1       0.63      0.64      0.64      7012

accuracy                           0.63     14000
macro avg       0.63      0.63      0.63     14000
weighted avg    0.63      0.63      0.63     14000
```

Confusion Matrix:
```
 [[4368 2620]
 [2519 4493]]
```

Evaluating Logistic Regression
Model: LogisticRegression
Accuracy: 0.7232857142857143
Classification Report:
```
          precision    recall  f1-score   support

       0       0.70      0.77      0.73      6988
       1       0.75      0.68      0.71      7012

accuracy                           0.72     14000
macro avg       0.73      0.72      0.72     14000
weighted avg    0.73      0.72      0.72     14000
```

Confusion Matrix:
```
 [[5362 1626]
 [2248 4764]]
```

```
Evaluating Random Forest
Model: RandomForestClassifier
Accuracy: 0.7247857142857143
Classification Report:
              precision    recall  f1-score   support

           0       0.71      0.75      0.73      6988
           1       0.74      0.70      0.72      7012

    accuracy                           0.72     14000
   macro avg       0.73      0.72      0.72     14000
weighted avg       0.73      0.72      0.72     14000


Confusion Matrix:
 [[5247 1741]
 [2112 4900]]


Support Vector Machine Cross-Validation Accuracy: 0.7265 ± 0.0064
K-Nearest Neighbors Cross-Validation Accuracy: 0.6180 ± 0.0025
Decision Tree Cross-Validation Accuracy: 0.5828 ± 0.0624
Logistic Regression Cross-Validation Accuracy: 0.7204 ± 0.0055
Random Forest Cross-Validation Accuracy: 0.6750 ± 0.0770
```

[2]:
```python
# Import necessary libraries
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score, classification_report,␣
 ↪confusion_matrix
import joblib  # for saving the model

# Load and prepare the data
data = pd.read_csv('cardio_train.csv', sep=';')

# Separate features and target
X = data.drop(columns=['cardio'])
y = data['cardio']

# Feature Scaling
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)

# Split the data into training and testing sets
```

```python
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0.2,
    random_state=42)

# Build the final model with SVM
final_model = SVC(kernel='rbf')  # You can experiment with other kernels like
    'linear', 'poly', etc.
final_model.fit(X_train, y_train)

# Make predictions on the test set
y_pred = final_model.predict(X_test)

# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy of the SVM model:", accuracy)
print("Classification Report:\n", classification_report(y_test, y_pred))
print("Confusion Matrix:\n", confusion_matrix(y_test, y_pred))

# Save the trained model for future use
joblib.dump(final_model, 'heart_disease_svm_model.pkl')
print("Model saved as 'heart_disease_svm_model.pkl'")

# Save the scaler as well for future data preprocessing
joblib.dump(scaler, 'scaler.pkl')
print("Scaler saved as 'scaler.pkl'")
```

```
Accuracy of the SVM model: 0.7298571428571429
Classification Report:
               precision    recall  f1-score   support

           0       0.72      0.76      0.74      6988
           1       0.75      0.70      0.72      7012

    accuracy                           0.73     14000
   macro avg       0.73      0.73      0.73     14000
weighted avg       0.73      0.73      0.73     14000

Confusion Matrix:
 [[5324 1664]
 [2118 4894]]
Model saved as 'heart_disease_svm_model.pkl'
Scaler saved as 'scaler.pkl'
```

[9]:
```
!pip install voila
```

```
Requirement already satisfied: voila in d:\python ide\lib\site-packages (0.5.8)


[notice] A new release of pip is available: 24.2 -> 24.3.1
```

[notice] To update, run: python.exe -m pip install --upgrade pip

Requirement already satisfied: jupyter-client<9,>=7.4.4 in d:\python
ide\lib\site-packages (from voila) (8.6.3)
Requirement already satisfied: jupyter-core>=4.11.0 in d:\python ide\lib\site-
packages (from voila) (5.7.2)
Requirement already satisfied: jupyter-server<3,>=1.18 in d:\python
ide\lib\site-packages (from voila) (2.14.2)
Requirement already satisfied: jupyterlab-server<3,>=2.3.0 in d:\python
ide\lib\site-packages (from voila) (2.27.3)
Requirement already satisfied: nbclient>=0.4.0 in d:\python ide\lib\site-
packages (from voila) (0.10.0)
Requirement already satisfied: nbconvert<8,>=6.4.5 in d:\python ide\lib\site-
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Requirement already satisfied: traitlets<6,>=5.0.3 in d:\python ide\lib\site-
packages (from voila) (5.14.3)
Requirement already satisfied: websockets>=9.0 in d:\python ide\lib\site-
packages (from voila) (13.1)
Requirement already satisfied: python-dateutil>=2.8.2 in d:\python ide\lib\site-
packages (from jupyter-client<9,>=7.4.4->voila) (2.9.0.post0)
Requirement already satisfied: pyzmq>=23.0 in d:\python ide\lib\site-packages
(from jupyter-client<9,>=7.4.4->voila) (26.2.0)
Requirement already satisfied: tornado>=6.2 in d:\python ide\lib\site-packages
(from jupyter-client<9,>=7.4.4->voila) (6.4.1)
Requirement already satisfied: platformdirs>=2.5 in d:\python ide\lib\site-
packages (from jupyter-core>=4.11.0->voila) (4.3.6)
Requirement already satisfied: pywin32>=300 in d:\python ide\lib\site-packages
(from jupyter-core>=4.11.0->voila) (308)
Requirement already satisfied: anyio>=3.1.0 in d:\python ide\lib\site-packages
(from jupyter-server<3,>=1.18->voila) (4.6.2.post1)
Requirement already satisfied: argon2-cffi>=21.1 in d:\python ide\lib\site-
packages (from jupyter-server<3,>=1.18->voila) (23.1.0)
Requirement already satisfied: jinja2>=3.0.3 in d:\python ide\lib\site-packages
(from jupyter-server<3,>=1.18->voila) (3.1.4)
Requirement already satisfied: jupyter-events>=0.9.0 in d:\python ide\lib\site-
packages (from jupyter-server<3,>=1.18->voila) (0.10.0)
Requirement already satisfied: jupyter-server-terminals>=0.4.4 in d:\python
ide\lib\site-packages (from jupyter-server<3,>=1.18->voila) (0.5.3)
Requirement already satisfied: nbformat>=5.3.0 in d:\python ide\lib\site-
packages (from jupyter-server<3,>=1.18->voila) (5.10.4)
Requirement already satisfied: overrides>=5.0 in d:\python ide\lib\site-packages
(from jupyter-server<3,>=1.18->voila) (7.7.0)
Requirement already satisfied: packaging>=22.0 in d:\python ide\lib\site-
packages (from jupyter-server<3,>=1.18->voila) (24.1)
Requirement already satisfied: prometheus-client>=0.9 in d:\python ide\lib\site-
packages (from jupyter-server<3,>=1.18->voila) (0.21.0)
Requirement already satisfied: pywinpty>=2.0.1 in d:\python ide\lib\site-

packages (from jupyter-server<3,>=1.18->voila) (2.0.14)
Requirement already satisfied: send2trash>=1.8.2 in d:\python ide\lib\site-packages (from jupyter-server<3,>=1.18->voila) (1.8.3)
Requirement already satisfied: terminado>=0.8.3 in d:\python ide\lib\site-packages (from jupyter-server<3,>=1.18->voila) (0.18.1)
Requirement already satisfied: websocket-client>=1.7 in d:\python ide\lib\site-packages (from jupyter-server<3,>=1.18->voila) (1.8.0)
Requirement already satisfied: babel>=2.10 in d:\python ide\lib\site-packages (from jupyterlab-server<3,>=2.3.0->voila) (2.16.0)
Requirement already satisfied: json5>=0.9.0 in d:\python ide\lib\site-packages (from jupyterlab-server<3,>=2.3.0->voila) (0.9.25)
Requirement already satisfied: jsonschema>=4.18.0 in d:\python ide\lib\site-packages (from jupyterlab-server<3,>=2.3.0->voila) (4.23.0)
Requirement already satisfied: requests>=2.31 in d:\python ide\lib\site-packages (from jupyterlab-server<3,>=2.3.0->voila) (2.32.3)
Requirement already satisfied: beautifulsoup4 in d:\python ide\lib\site-packages (from nbconvert<8,>=6.4.5->voila) (4.12.3)
Requirement already satisfied: bleach!=5.0.0 in d:\python ide\lib\site-packages (from nbconvert<8,>=6.4.5->voila) (6.2.0)
Requirement already satisfied: defusedxml in d:\python ide\lib\site-packages (from nbconvert<8,>=6.4.5->voila) (0.7.1)
Requirement already satisfied: jupyterlab-pygments in d:\python ide\lib\site-packages (from nbconvert<8,>=6.4.5->voila) (0.3.0)
Requirement already satisfied: markupsafe>=2.0 in d:\python ide\lib\site-packages (from nbconvert<8,>=6.4.5->voila) (2.1.5)
Requirement already satisfied: mistune<4,>=2.0.3 in d:\python ide\lib\site-packages (from nbconvert<8,>=6.4.5->voila) (3.0.2)
Requirement already satisfied: pandocfilters>=1.4.1 in d:\python ide\lib\site-packages (from nbconvert<8,>=6.4.5->voila) (1.5.1)
Requirement already satisfied: pygments>=2.4.1 in d:\python ide\lib\site-packages (from nbconvert<8,>=6.4.5->voila) (2.18.0)
Requirement already satisfied: tinycss2 in d:\python ide\lib\site-packages (from nbconvert<8,>=6.4.5->voila) (1.4.0)
Requirement already satisfied: idna>=2.8 in d:\python ide\lib\site-packages (from anyio>=3.1.0->jupyter-server<3,>=1.18->voila) (3.10)
Requirement already satisfied: sniffio>=1.1 in d:\python ide\lib\site-packages (from anyio>=3.1.0->jupyter-server<3,>=1.18->voila) (1.3.1)
Requirement already satisfied: argon2-cffi-bindings in d:\python ide\lib\site-packages (from argon2-cffi>=21.1->jupyter-server<3,>=1.18->voila) (21.2.0)
Requirement already satisfied: webencodings in d:\python ide\lib\site-packages (from bleach!=5.0.0->nbconvert<8,>=6.4.5->voila) (0.5.1)
Requirement already satisfied: attrs>=22.2.0 in d:\python ide\lib\site-packages (from jsonschema>=4.18.0->jupyterlab-server<3,>=2.3.0->voila) (24.2.0)
Requirement already satisfied: jsonschema-specifications>=2023.03.6 in d:\python ide\lib\site-packages (from jsonschema>=4.18.0->jupyterlab-server<3,>=2.3.0->voila) (2024.10.1)
Requirement already satisfied: referencing>=0.28.4 in d:\python ide\lib\site-packages (from jsonschema>=4.18.0->jupyterlab-server<3,>=2.3.0->voila) (0.35.1)

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Requirement already satisfied: rpds-py>=0.7.1 in d:\python ide\lib\site-packages
(from jsonschema>=4.18.0->jupyterlab-server<3,>=2.3.0->voila) (0.20.1)
Requirement already satisfied: python-json-logger>=2.0.4 in d:\python
ide\lib\site-packages (from jupyter-events>=0.9.0->jupyter-
server<3,>=1.18->voila) (2.0.7)
Requirement already satisfied: pyyaml>=5.3 in d:\python ide\lib\site-packages
(from jupyter-events>=0.9.0->jupyter-server<3,>=1.18->voila) (6.0.2)
Requirement already satisfied: rfc3339-validator in d:\python ide\lib\site-
packages (from jupyter-events>=0.9.0->jupyter-server<3,>=1.18->voila) (0.1.4)
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server<3,>=1.18->voila) (0.1.1)
Requirement already satisfied: fastjsonschema>=2.15 in d:\python ide\lib\site-
packages (from nbformat>=5.3.0->jupyter-server<3,>=1.18->voila) (2.20.0)
Requirement already satisfied: six>=1.5 in d:\python ide\lib\site-packages (from
python-dateutil>=2.8.2->jupyter-client<9,>=7.4.4->voila) (1.16.0)
Requirement already satisfied: charset-normalizer<4,>=2 in d:\python
ide\lib\site-packages (from requests>=2.31->jupyterlab-server<3,>=2.3.0->voila)
(3.4.0)
Requirement already satisfied: urllib3<3,>=1.21.1 in d:\python ide\lib\site-
packages (from requests>=2.31->jupyterlab-server<3,>=2.3.0->voila) (2.2.3)
Requirement already satisfied: certifi>=2017.4.17 in d:\python ide\lib\site-
packages (from requests>=2.31->jupyterlab-server<3,>=2.3.0->voila) (2024.8.30)
Requirement already satisfied: soupsieve>1.2 in d:\python ide\lib\site-packages
(from beautifulsoup4->nbconvert<8,>=6.4.5->voila) (2.6)
Requirement already satisfied: fqdn in d:\python ide\lib\site-packages (from
jsonschema[format-nongpl]>=4.18.0->jupyter-events>=0.9.0->jupyter-
server<3,>=1.18->voila) (1.5.1)
Requirement already satisfied: isoduration in d:\python ide\lib\site-packages
(from jsonschema[format-nongpl]>=4.18.0->jupyter-events>=0.9.0->jupyter-
server<3,>=1.18->voila) (20.11.0)
Requirement already satisfied: jsonpointer>1.13 in d:\python ide\lib\site-
packages (from jsonschema[format-nongpl]>=4.18.0->jupyter-
events>=0.9.0->jupyter-server<3,>=1.18->voila) (3.0.0)
Requirement already satisfied: uri-template in d:\python ide\lib\site-packages
(from jsonschema[format-nongpl]>=4.18.0->jupyter-events>=0.9.0->jupyter-
server<3,>=1.18->voila) (1.3.0)
Requirement already satisfied: webcolors>=24.6.0 in d:\python ide\lib\site-
packages (from jsonschema[format-nongpl]>=4.18.0->jupyter-
events>=0.9.0->jupyter-server<3,>=1.18->voila) (24.8.0)
Requirement already satisfied: cffi>=1.0.1 in d:\python ide\lib\site-packages
(from argon2-cffi-bindings->argon2-cffi>=21.1->jupyter-server<3,>=1.18->voila)
(1.17.1)
Requirement already satisfied: pycparser in d:\python ide\lib\site-packages
(from cffi>=1.0.1->argon2-cffi-bindings->argon2-cffi>=21.1->jupyter-
server<3,>=1.18->voila) (2.22)
Requirement already satisfied: arrow>=0.15.0 in d:\python ide\lib\site-packages
(from isoduration->jsonschema[format-nongpl]>=4.18.0->jupyter-
```

```
events>=0.9.0->jupyter-server<3,>=1.18->voila) (1.3.0)
Requirement already satisfied: types-python-dateutil>=2.8.10 in d:\python
ide\lib\site-packages (from arrow>=0.15.0->isoduration->jsonschema[format-
nongpl]>=4.18.0->jupyter-events>=0.9.0->jupyter-server<3,>=1.18->voila)
(2.9.0.20241003)
```

[13]: `!pip install ipywidgets voila`

```
Requirement already satisfied: ipywidgets in d:\python ide\lib\site-packages
(8.1.5)


[notice] A new release of pip is available: 24.2 -> 24.3.1
[notice] To update, run: python.exe -m pip install --upgrade pip


Requirement already satisfied: voila in d:\python ide\lib\site-packages (0.5.8)
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Requirement already satisfied: prompt-toolkit<3.1.0,>=3.0.41 in d:\python
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Requirement already satisfied: webcolors>=24.6.0 in d:\python ide\lib\site-packages (from jsonschema[format-nongpl]>=4.18.0->jupyter-events>=0.9.0->jupyter-server<3,>=1.18->voila) (24.8.0)
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Requirement already satisfied: pycparser in d:\python ide\lib\site-packages (from cffi>=1.0.1->argon2-cffi-bindings->argon2-cffi>=21.1->jupyter-server<3,>=1.18->voila) (2.22)
Requirement already satisfied: arrow>=0.15.0 in d:\python ide\lib\site-packages (from isoduration->jsonschema[format-nongpl]>=4.18.0->jupyter-events>=0.9.0->jupyter-server<3,>=1.18->voila) (1.3.0)
Requirement already satisfied: types-python-dateutil>=2.8.10 in d:\python ide\lib\site-packages (from arrow>=0.15.0->isoduration->jsonschema[format-nongpl]>=4.18.0->jupyter-events>=0.9.0->jupyter-server<3,>=1.18->voila) (2.9.0.20241003)

17

```python
[41]: # Import necessary libraries
      import pandas as pd
      import joblib
      import numpy as np

      # Load the trained model and scaler
      model = joblib.load('heart_disease_svm_model.pkl')
      scaler = joblib.load('scaler.pkl')

      # Load the dataset to find features by ID
      data = pd.read_csv('cardio_train.csv', sep=';')

      # Function to get user ID input and make a prediction
      def get_user_id_and_predict():
          # Get user input for ID
          user_id = int(input("Enter ID number: "))

          # Retrieve the record corresponding to the ID
          user_data = data[data['id'] == user_id]

          if user_data.empty:
              print("No data found for the given ID.")
              return

          # List of exact features the model expects, including ID if necessary
          required_features = ['age', 'gender', 'height', 'weight', 'ap_hi', 'ap_lo',
                               'cholesterol', 'gluc', 'smoke', 'alco', 'active']  #␣
       ↪Adjust this list as per output from Step 1

          # Ensure we have the correct columns for prediction
          features = user_data[required_features].values

          # Convert gender to numerical (1 for Male, 0 for Female) if applicable
          features[0, 1] = 1 if features[0, 1] == 'Male' else 0

          # Scale the input data
          features_scaled = scaler.transform(features)

          # Make prediction
          prediction = model.predict(features_scaled)

          # Show prediction result
          if prediction[0] == 1:
              print("The model predicts: Heart Disease Detected!")
          else:
              print("The model predicts: No Heart Disease Detected!")
```

```
# Call the function
get_user_id_and_predict()
```

Enter ID number: 6002

D:\anaconda\Lib\site-packages\sklearn\base.py:493: UserWarning: X does not have valid feature names, but StandardScaler was fitted with feature names
  warnings.warn(

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[41], line 48
     45          print("The model predicts: No Heart Disease Detected!")
     47 # Call the function
---> 48 get_user_id_and_predict()

Cell In[41], line 36, in get_user_id_and_predict()
     33 features[0, 1] = 1 if features[0, 1] == 'Male' else 0
     35 # Scale the input data
---> 36 features_scaled = scaler.transform(features)
     38 # Make prediction
     39 prediction = model.predict(features_scaled)

File D:\anaconda\Lib\site-packages\sklearn\utils\_set_output.py:295, in
 ↪_wrap_method_output.<locals>.wrapped(self, X, *args, **kwargs)
    293 @wraps(f)
    294 def wrapped(self, X, *args, **kwargs):
--> 295     data_to_wrap = f(self, X, *args, **kwargs)
    296     if isinstance(data_to_wrap, tuple):
    297         # only wrap the first output for cross decomposition
    298         return_tuple = (
    299             _wrap_data_with_container(method, data_to_wrap[0], X, self)
    300             *data_to_wrap[1:],
    301         )

File D:\anaconda\Lib\site-packages\sklearn\preprocessing\_data.py:1043, in
 ↪StandardScaler.transform(self, X, copy)
   1040 check_is_fitted(self)
   1042 copy = copy if copy is not None else self.copy
-> 1043 X = self._validate_data(
   1044     X,
   1045     reset=False,
   1046     accept_sparse="csr",
   1047     copy=copy,
   1048     dtype=FLOAT_DTYPES,
   1049     force_all_finite="allow-nan",
   1050 )
   1052 if sparse.issparse(X):
```

```
   1053        if self.with_mean:

File D:\anaconda\Lib\site-packages\sklearn\base.py:654, in BaseEstimator.
 ↪_validate_data(self, X, y, reset, validate_separately, cast_to_ndarray,␣
 ↪**check_params)
    651        out = X, y
    653 if not no_val_X and check_params.get("ensure_2d", True):
--> 654        self._check_n_features(X, reset=reset)
    656 return out

File D:\anaconda\Lib\site-packages\sklearn\base.py:443, in BaseEstimator.
 ↪_check_n_features(self, X, reset)
    440        return
    442 if n_features != self.n_features_in_:
--> 443        raise ValueError(
    444            f"X has {n_features} features, but {self.__class__.__name__} "
    445            f"is expecting {self.n_features_in_} features as input."
    446        )

ValueError: X has 11 features, but StandardScaler is expecting 12 features as␣
 ↪input.
```

[ ]: