## Installing Dependencies

```
!pip install ucimlrepo
```

```
Requirement already satisfied: ucimlrepo in /usr/local/lib/python3.12/dist-packages (0.0.7)
Requirement already satisfied: pandas>=1.0.0 in /usr/local/lib/python3.12/dist-packages (from ucimlrepo) (2.2.2)
Requirement already satisfied: certifi>=2020.12.5 in /usr/local/lib/python3.12/dist-packages (from ucimlrepo) (20
Requirement already satisfied: numpy>=1.26.0 in /usr/local/lib/python3.12/dist-packages (from pandas>=1.0.0->ucim
Requirement already satisfied: python-dateutil>=2.8.2 in /usr/local/lib/python3.12/dist-packages (from pandas>=1.
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.12/dist-packages (from pandas>=1.0.0->uciml
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.12/dist-packages (from pandas>=1.0.0->uci
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.12/dist-packages (from python-dateutil>=2.8.2->
```

## Importing ucimlrepo library

```
from ucimlrepo import fetch_ucirepo
```

## Fetching datasets

```
HD_main = fetch_ucirepo(id=45)
W_main = fetch_ucirepo(id=109)
```

```
hddf = HD_main.data.original
wdf = W_main.data.original
```

```
hddf
```

| | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | num |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 63 | 1 | 1 | 145 | 233 | 1 | 2 | 150 | 0 | 2.3 | 3 | 0.0 | 6.0 | 0 |
| **1** | 67 | 1 | 4 | 160 | 286 | 0 | 2 | 108 | 1 | 1.5 | 2 | 3.0 | 3.0 | 2 |
| **2** | 67 | 1 | 4 | 120 | 229 | 0 | 2 | 129 | 1 | 2.6 | 2 | 2.0 | 7.0 | 1 |
| **3** | 37 | 1 | 3 | 130 | 250 | 0 | 0 | 187 | 0 | 3.5 | 3 | 0.0 | 3.0 | 0 |
| **4** | 41 | 0 | 2 | 130 | 204 | 0 | 2 | 172 | 0 | 1.4 | 1 | 0.0 | 3.0 | 0 |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| **298** | 45 | 1 | 1 | 110 | 264 | 0 | 0 | 132 | 0 | 1.2 | 2 | 0.0 | 7.0 | 1 |
| **299** | 68 | 1 | 4 | 144 | 193 | 1 | 0 | 141 | 0 | 3.4 | 2 | 2.0 | 7.0 | 2 |
| **300** | 57 | 1 | 4 | 130 | 131 | 0 | 0 | 115 | 1 | 1.2 | 2 | 1.0 | 7.0 | 3 |
| **301** | 57 | 0 | 2 | 130 | 236 | 0 | 2 | 174 | 0 | 0.0 | 2 | 1.0 | 3.0 | 1 |
| **302** | 38 | 1 | 3 | 138 | 175 | 0 | 0 | 173 | 0 | 0.0 | 1 | NaN | 3.0 | 0 |

303 rows × 14 columns

Next steps: Generate code with hddf New interactive sheet

```
wdf
```

| | Alcohol | Malicacid | Ash | Alcalinity_of_ash | Magnesium | Total_phenols | Flavanoids | Nonflavanoid_phenols | Proant |
|---|---|---|---|---|---|---|---|---|---|
| **0** | 14.23 | 1.71 | 2.43 | 15.6 | 127 | 2.80 | 3.06 | 0.28 | |
| **1** | 13.20 | 1.78 | 2.14 | 11.2 | 100 | 2.65 | 2.76 | 0.26 | |
| **2** | 13.16 | 2.36 | 2.67 | 18.6 | 101 | 2.80 | 3.24 | 0.30 | |
| **3** | 14.37 | 1.95 | 2.50 | 16.8 | 113 | 3.85 | 3.49 | 0.24 | |
| **4** | 13.24 | 2.59 | 2.87 | 21.0 | 118 | 2.80 | 2.69 | 0.39 | |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | |
| **173** | 13.71 | 5.65 | 2.45 | 20.5 | 95 | 1.68 | 0.61 | 0.52 | |
| **174** | 13.40 | 3.91 | 2.48 | 23.0 | 102 | 1.80 | 0.75 | 0.43 | |
| **175** | 13.27 | 4.28 | 2.26 | 20.0 | 120 | 1.59 | 0.69 | 0.43 | |
| **176** | 13.17 | 2.59 | 2.37 | 20.0 | 120 | 1.65 | 0.68 | 0.53 | |
| **177** | 14.13 | 4.10 | 2.74 | 24.5 | 96 | 2.05 | 0.76 | 0.56 | |

178 rows × 14 columns

Next steps: Generate code with wdf New interactive sheet

## Cleaning dataset

```
hddf = hddf.dropna()
wdf = wdf.dropna()
```

```
hddf_target = hddf['num']
hddf_features = hddf.drop('num',axis=1)
wdf_target = wdf['class']
wdf_features = wdf.drop('class',axis=1)
```

## Importing libraries for model training

```
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier,plot_tree
from sklearn.metrics import accuracy_score,precision_score,recall_score,f1_score,confusion_matrix
import math
from matplotlib import pyplot as plt
```

```
modelHD = DecisionTreeClassifier(criterion="entropy")
modelW = DecisionTreeClassifier(criterion="entropy")
```

## Splitting datasets for training and testing

```
X_trainHD,X_testHD,y_trainHD,y_testHD = train_test_split(hddf_features,hddf_target,test_size=0.2,random_state=10
X_trainW,X_testW,y_trainW,y_testW = train_test_split(wdf_features,wdf_target,test_size=0.2,random_state=10)
```

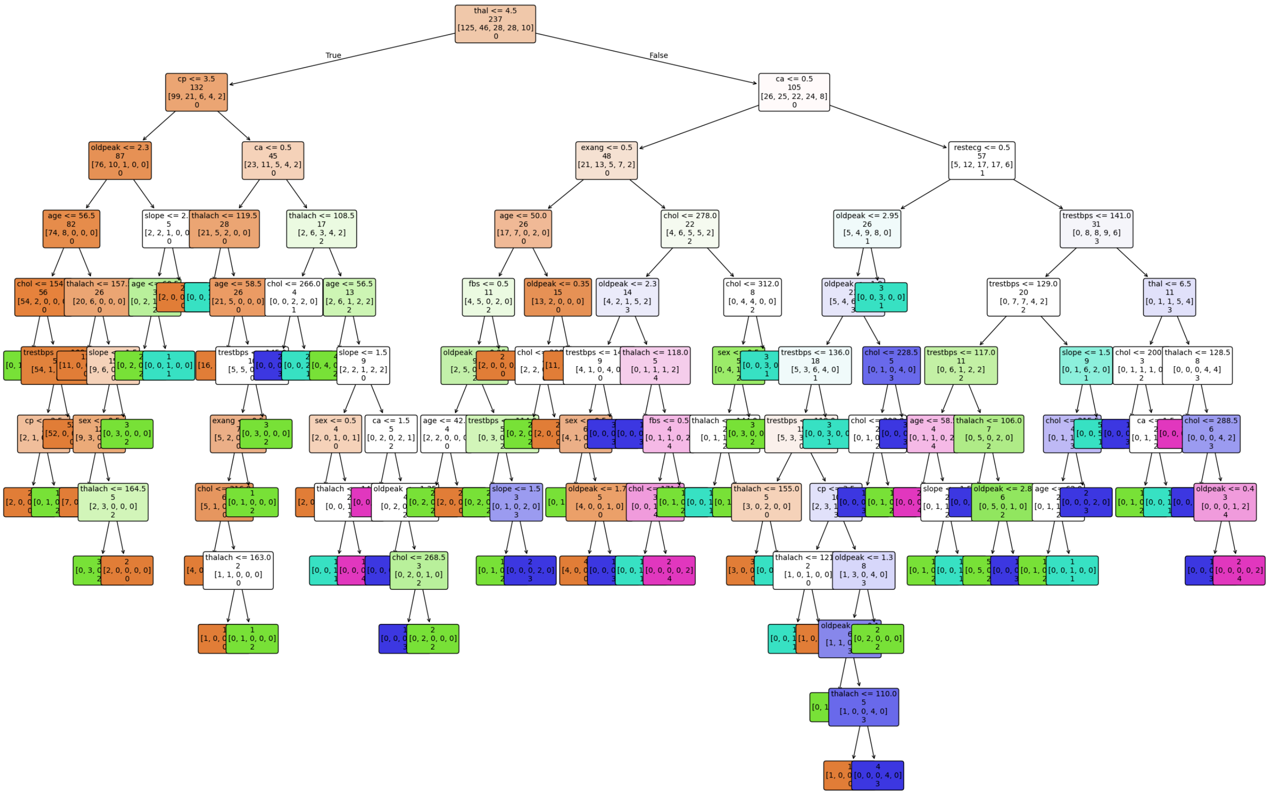
## Fitting Decision Tree Classifier model

```
modelHD.fit(X_trainHD,y_trainHD)
modelW.fit(X_trainW,y_trainW)
```

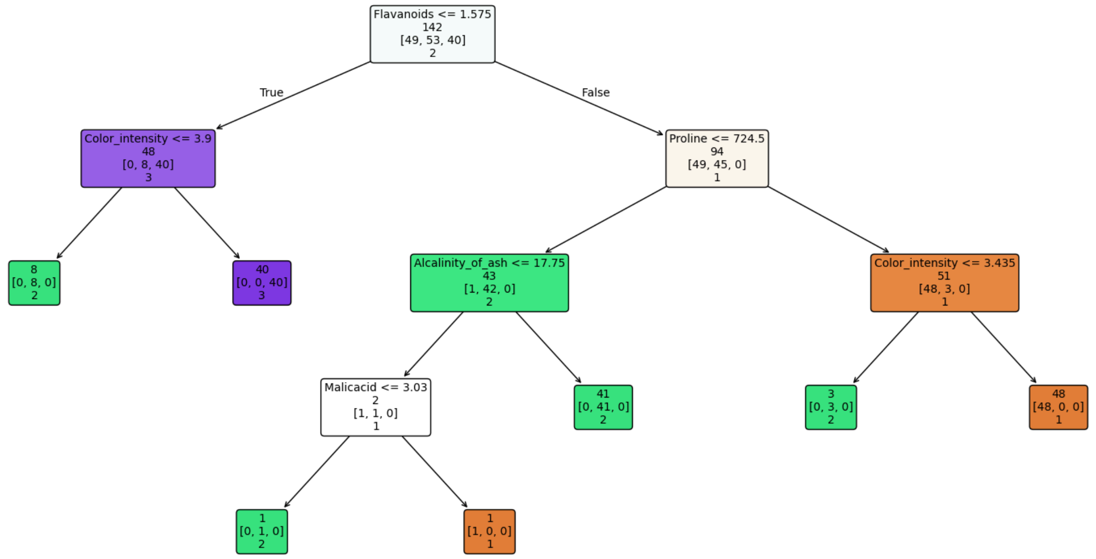
```
▾       DecisionTreeClassifier         i ?
DecisionTreeClassifier(criterion='entropy')
```

## Plotting made Decision Trees

```
plt.figure(figsize=(30,20))
plot_tree(
    modelHD,
    filled=True,
    rounded=True,
    class_names=[str(x) for x in hddf_target.unique()],
    feature_names=hddf_features.columns,
    proportion=False,
    impurity=False,
    label="none",
    fontsize=10
  )
plt.show()
```



```
plt.figure(figsize=(20,10))
plot_tree(
    modelW,
    filled=True,
    rounded=True,
    class_names=[str(x) for x in wdf_target.unique()],
    feature_names=wdf_features.columns,
    proportion=False,
    label="none",
    impurity=False,
    fontsize=10
  )
plt.show()
```



## Showing calculated metrics

```
HD_accu = accuracy_score(y_testHD,modelHD.predict(X_testHD))
W_accu = accuracy_score(y_testW,modelW.predict(X_testW))
print("Heart Disease data DT model accuracy",round(HD_accu*100,2),"%")
print("Wine data DT model accuracy",round(W_accu*100,2),"%")
```

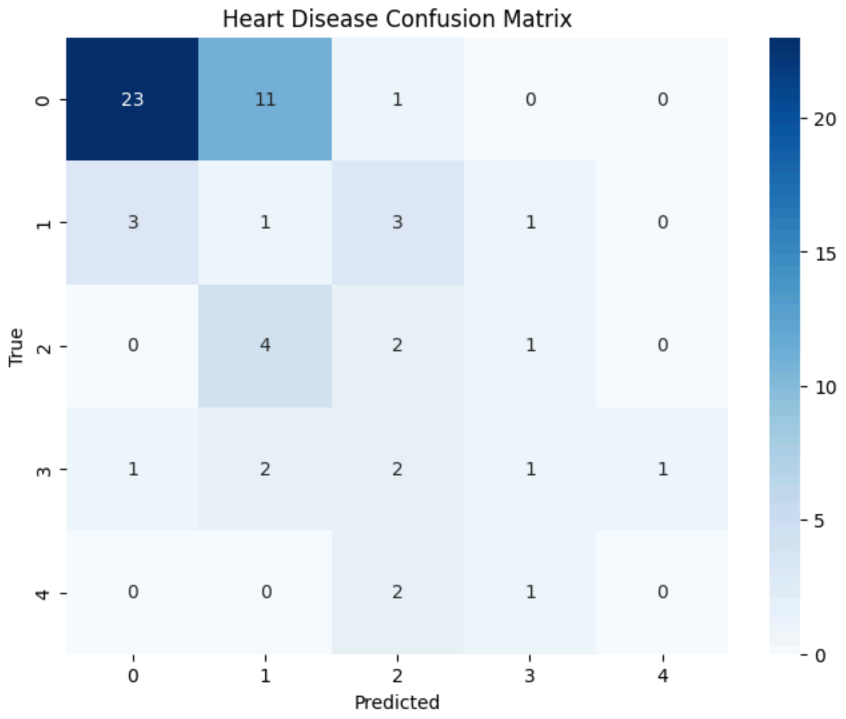
```
Heart Disease data DT model accuracy 45.0 %
Wine data DT model accuracy 94.44 %
```

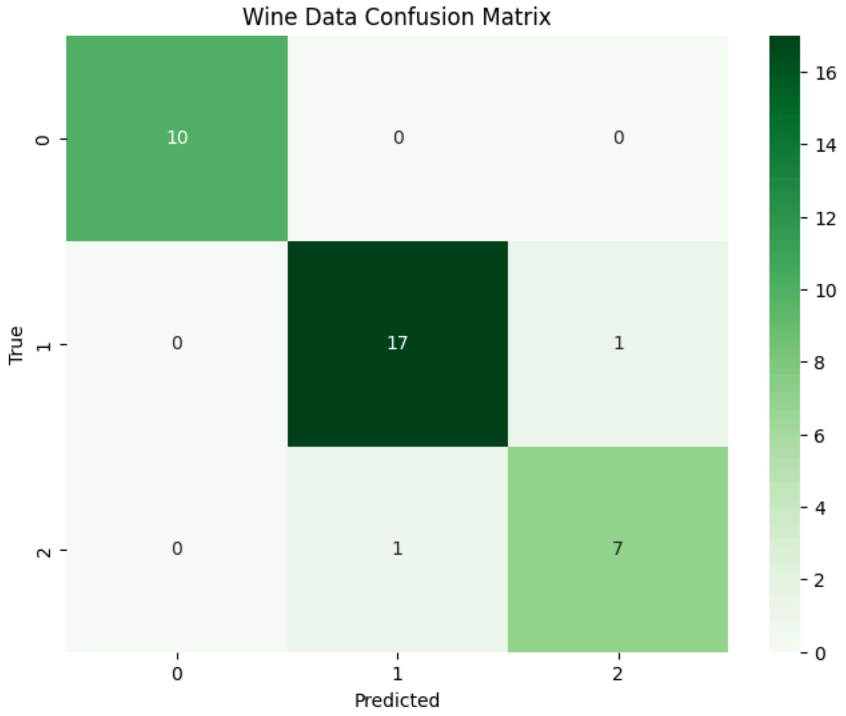
```
HD_pred = modelHD.predict(X_testHD)
W_pred = modelW.predict(X_testW)

print("Heart Disease Data Metrics:")
print(f"  Accuracy: {accuracy_score(y_testHD, HD_pred)*100:.2f}%")
print(f"  Precision: {precision_score(y_testHD, HD_pred, average='weighted', zero_division=0):.4f}")
print(f"  F1-Score: {f1_score(y_testHD, HD_pred, average='weighted', zero_division=0):.4f}")
print("\nWine Data Metrics:")
print(f"  Accuracy: {accuracy_score(y_testW, W_pred)*100:.2f}%")
print(f"  Precision: {precision_score(y_testW, W_pred, average='weighted', zero_division=0):.4f}")
print(f"  F1-Score: {f1_score(y_testW, W_pred, average='weighted', zero_division=0):.4f}")
```

```
Heart Disease Data Metrics:
  Accuracy: 45.00%
  Precision: 0.5568
  F1-Score: 0.4917

Wine Data Metrics:
  Accuracy: 94.44%
  Precision: 0.9444
  F1-Score: 0.9444
```

```
import seaborn as sns
import matplotlib.pyplot as plt

HD_cm = confusion_matrix(y_testHD, HD_pred)
```

```
    plt.figure(figsize=(8, 6))
    sns.heatmap(HD_cm, annot=True, fmt='d', cmap='Blues')
    plt.title('Heart Disease Confusion Matrix')
    plt.xlabel('Predicted')
    plt.ylabel('True')
    plt.show()

    W_cm = confusion_matrix(y_testW, W_pred)
    plt.figure(figsize=(8, 6))
    sns.heatmap(W_cm, annot=True, fmt='d', cmap='Greens')
    plt.title('Wine Data Confusion Matrix')
    plt.xlabel('Predicted')
    plt.ylabel('True')
    plt.show()
```





## WEKA data

## Wine Dataset

# Weka Classification Report: J48 Decision Tree

**Dataset:** Wine

## 1. Run Information

- **Scheme:** `weka.classifiers.trees.J48 -C 0.25 -M 2`
- **Instances:** 178
- **Attributes:** 14
- **Test Mode:** 10-fold cross-validation

## 2. Classifier Model (J48 Pruned Tree)

*Tree Size: 9 | Number of Leaves: 5*

```
Flavanoids <= 1.57
|   Color intensity <= 3.8: class2 (13.0)
|   Color intensity > 3.8: class3 (49.0/1.0)
Flavanoids > 1.57
|   Proline <= 720: class2 (54.0/1.0)
|   Proline > 720
|   |   Color intensity <= 3.4: class2 (4.0)
|   |   Color intensity > 3.4: class1 (58.0)
```

## 3. Stratified Cross-Validation Summary

| Metric | Value |
|---|---|
| Correctly Classified Instances | 167 (93.8202 %) |
| Incorrectly Classified Instances | 11 (6.1798 %) |
| Kappa statistic | 0.9058 |
| Mean absolute error | 0.0486 |
| Root mean squared error | 0.2019 |
| Relative absolute error | 11.0723 % |
| Root relative squared error | 43.0865 % |

## 4. Detailed Accuracy By Cla

| Class | TP Rate | FP Rate | Precision | Recall | F-Measure | MCC | ROC Area | PRC Area |
|---|---|---|---|---|---|---|---|---|
| class1 | 0.983 | 0.034 | 0.935 | 0.983 | 0.959 | 0.938 | 0.977 | 0.942 |
| class2 | 0.944 | 0.056 | 0.918 | 0.944 | 0.931 | 0.884 | 0.937 | 0.884 |
| class3 | 0.875 | 0.008 | 0.977 | 0.875 | 0.923 | 0.899 | 0.946 | 0.901 |
| Weighted Avg. | 0.938 | 0.036 | 0.940 | 0.938 | 0.938 | 0.906 | 0.953 | 0.908 |

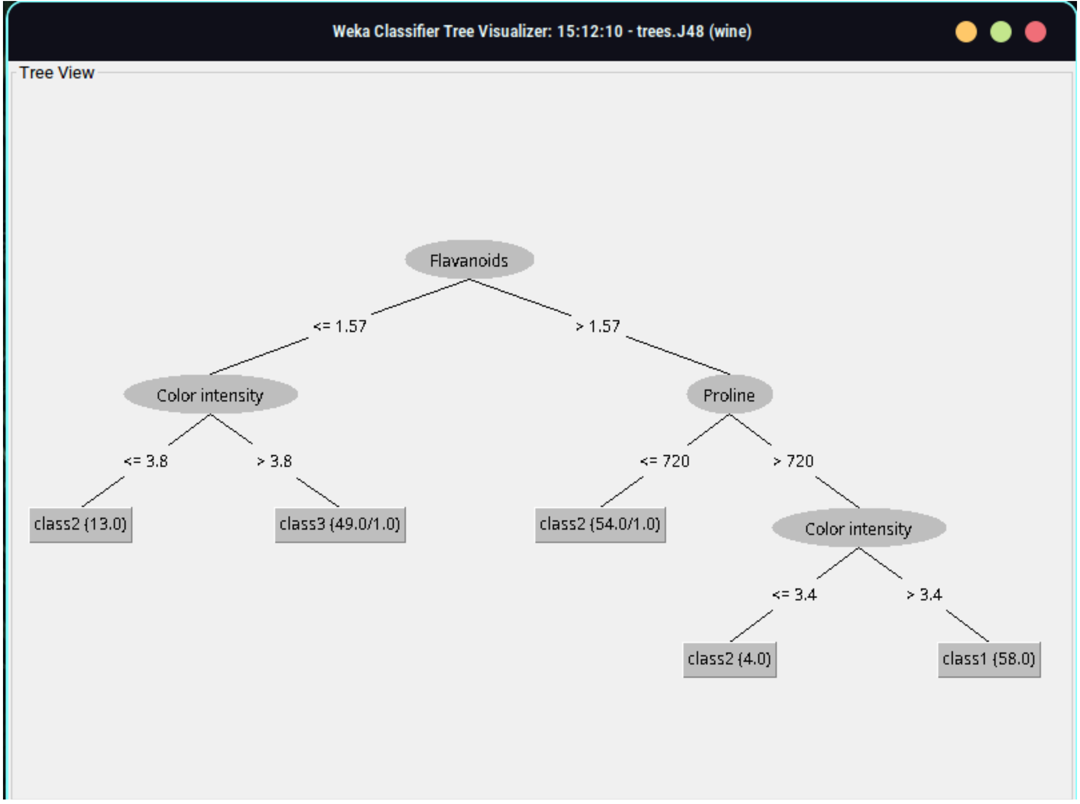
## 5. Confusion Matrix

Vertical axis: Actual Class | Horizontal axis: Predicted Class

| Actual \ Predicted | class1 (a) | class2 (b) | class3 (c) |
|---|---|---|---|
| class1 (a) | 58 | 1 | 0 |
| class2 (b) | 3 | 67 | 1 |
| class3 (c) | 1 | 5 | 42 |

```
from google.colab import drive
from IPython.display import Image
drive.mount('/content/drive')

Image('/content/drive/MyDrive/Colab Notebooks/dm/wine.png')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force
```



## Heart Disease

## Weka Classification Report: J48 Decision Tree

**Dataset:** Cleveland Heart Disease (`processed.cleveland`)

---

### 1. Run Information

- **Scheme:** `weka.classifiers.trees.J48 -C 0.25 -M 2`
- **Instances:** 303
- **Attributes:** 14
- **Test Mode:** 10-fold cross-validation

---

### 2. Classifier Model (J48 Pruned Tree)

*Tree Size: 67 | Number of Leaves: 34*

```
thal <= 3
|   thalach <= 117
|   |   cp <= 3: class 0 (4.55)
|   |   cp > 3
|   |   |   exang <= 0: class 2 (3.0/1.0)
|   |   |   exang > 0
|   |   |   |   trestbps <= 140: class 3 (3.0)
|   |   |   |   trestbps > 140: class 2 (2.0)
|   thalach > 117
|   |   ca <= 0: class 0 (110.99/11.55)
|   |   ca > 0
|   |   |   oldpeak <= 2.3
|   |   |   |   cp <= 3: class 0 (28.56/6.0)
|   |   |   |   cp > 3
|   |   |   |   |   sex <= 0: class 0 (4.0/1.0)
|   |   |   |   |   sex > 0
|   |   |   |   |   |   ca <= 1: class 1 (6.0/2.0)
|   |   |   |   |   |   ca > 1: class 3 (2.0/1.0)
|   |   |   oldpeak > 2.3: class 2 (3.0/2.0)
thal > 3
|   cp <= 3
|   |   oldpeak <= 1.9
|   |   |   thal <= 6
|   |   |   |   exang <= 0: class 0 (2.05)
|   |   |   |   exang > 0: class 2 (2.0)
|   |   |   thal > 6
|   |   |   |   thalach <= 109: class 2 (2.0/1.0)
|   |   |   |   thalach > 109: class 0 (30.4/10.0)
|   |   oldpeak > 1.9
|   |   |   slope <= 2
|   |   |   |   age <= 58
|   |   |   |   |   chol <= 227: class 3 (2.0)
|   |   |   |   |   chol > 227: class 4 (2.0)
|   |   |   |   age > 58: class 2 (3.0/1.0)
|   |   |   slope > 2: class 0 (2.0)
|   cp > 3
|   |   ca <= 2
|   |   |   oldpeak <= 0.7
|   |   |   |   fbs <= 0
|   |   |   |   |   restecg <= 1
|   |   |   |   |   |   ca <= 0
|   |   |   |   |   |   |   trestbps <= 136: class 0 (4.0)
|   |   |   |   |   |   |   trestbps > 136: class 1 (3.0/1.0)
|   |   |   |   |   |   ca > 0
|   |   |   |   |   |   |   chol <= 244: class 2 (3.0)
|   |   |   |   |   |   |   chol > 244: class 0 (2.0/1.0)
|   |   |   |   |   restecg > 1: class 1 (7.0/2.0)
|   |   |   |   fbs > 0: class 3 (2.89/0.89)
|   |   |   oldpeak > 0.7
|   |   |   |   thal <= 6
|   |   |   |   |   exang <= 0: class 0 (3.0/2.0)
|   |   |   |   |   exang > 0: class 2 (5.06/2.0)
|   |   |   |   thal > 6
|   |   |   |   |   age <= 58
|   |   |   |   |   |   chol <= 302: class 3 (24.39/11.39)
|   |   |   |   |   |   chol > 302: class 2 (6.0/1.0)
|   |   |   |   |   age > 58
|   |   |   |   |   |   sex <= 0: class 3 (3.0/1.0)
|   |   |   |   |   |   sex > 0
|   |   |   |   |   |   |   thalach <= 139
|   |   |   |   |   |   |   |   chol <= 206: class 4 (2.0)
|   |   |   |   |   |   |   |   chol > 206: class 1 (4.0/1.0)
|   |   |   |   |   |   |   thalach > 139: class 2 (11.0/2.0)
|   |   ca > 2
|   |   |   exang <= 0: class 4 (6.0/2.0)
|   |   |   exang > 0: class 3 (4.11/1.11)
```

## 3. Stratified Cross-Validation Summary

| Metric | Value |
|---|---|
| Correctly Classified Instances | 159 (52.4752 %) |
| Incorrectly Classified Instances | 144 (47.5248 %) |
| Kappa statistic | 0.223 |
| Mean absolute error | 0.2105 |
| Root mean squared error | 0.4011 |
| Relative absolute error | 81.2618 % |
| Root relative squared error | 111.6521 % |

## 4. Detailed Accuracy By Class

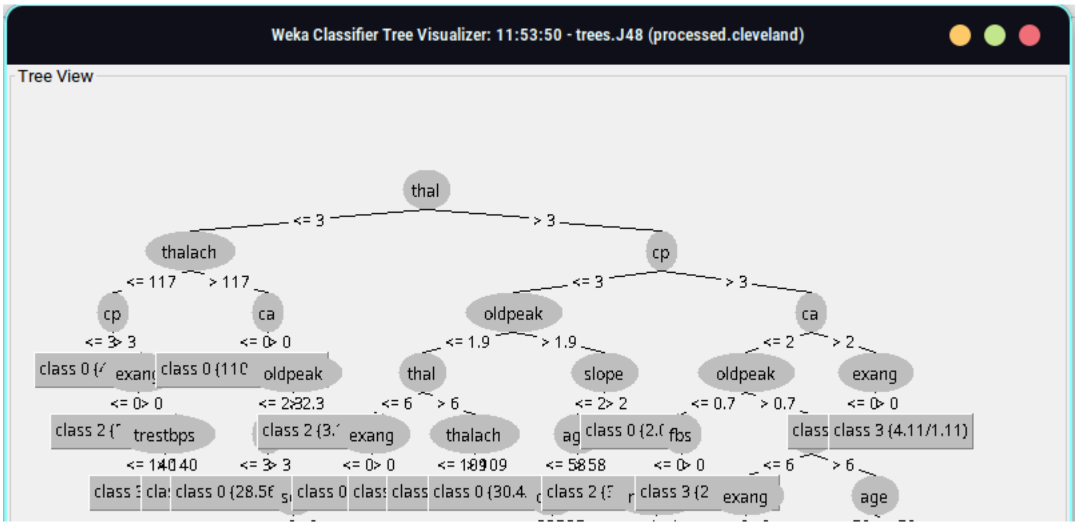
| Class | TP Rate | FP Rate | Precision | Recall | F-Measure | MCC | ROC Area | PRC Area |
|---|---|---|---|---|---|---|---|---|
| Class 0 | 0.860 | 0.345 | 0.746 | 0.860 | 0.799 | 0.529 | 0.756 | 0.710 |
| Class 2 | 0.194 | 0.097 | 0.212 | 0.194 | 0.203 | 0.101 | 0.454 | 0.143 |
| Class 1 | 0.145 | 0.149 | 0.178 | 0.145 | 0.160 | -0.004 | 0.500 | 0.195 |
| Class 3 | 0.057 | 0.082 | 0.083 | 0.057 | 0.068 | -0.030 | 0.374 | 0.115 |
| Class 4 | 0.077 | 0.038 | 0.083 | 0.077 | 0.080 | 0.041 | 0.548 | 0.050 |
| Weighted Avg. | 0.525 | 0.237 | 0.474 | 0.525 | 0.497 | 0.296 | 0.621 | 0.452 |

## 5. Confusion Matrix

Vertical axis: Actual Class | Horizontal axis: Predicted Class

| Actual \ Predicted | Class 0 (a) | Class 2 (b) | Class 1 (c) | Class 3 (d) | Class 4 (e) |
|---|---|---|---|---|---|
| Class 0 (a) | 141 | 3 | 14 | 4 | 2 |
| Class 2 (b) | 10 | 7 | 10 | 8 | 1 |
| Class 1 (c) | 29 | 9 | 8 | 5 | 4 |
| Class 3 (d) | 8 | 11 | 10 | 2 | 4 |
| Class 4 (e) | 1 | 3 | 3 | 5 | 1 |

```
Image("/content/drive/MyDrive/Colab Notebooks/dm/heartdisease.png")
```


Weka Classifier Tree Visualizer: 11:53:50 - trees.J48 (processed.cleveland)
Tree View
thal
<= 3
> 3
thalach
cp
<= 117
> 117
<= 3
> 3
cp
ca
oldpeak
ca
<= 3> 3
<= 0> 0
<= 1.9
> 1.9
<= 2
> 2
class 0 (
exang
class 0 (110
oldpeak
thal
slope
oldpeak
exang
<= 0> 0
<= 2.32.3
<= 6
> 6
<= 2> 2
<= 0.7
> 0.7
<= 0> 0
class 2 (
trestbps
class 2 (3.
exang
thalach
ag
class 0 (2.
fbs
class
class 3 (4.11/1.11)
<= 140 40
<= 3> 3
<= 0> 0
<= 109 09
<= 58 58
<= 0> 0
<= 6
> 6
class
cla
class 0 (28.5
class 0
class
class
class 0 (30.4
class 2 (
class 3 (2
exang
age