Homework 2: Supervised Learning: Regression: Decision Tree

- Explain the problem
- Explain the AI Model & Data
- Explain/Analysis the results

Explain the problem:

The goal is to create a set of *human-interpretable* rules to tell wines apart*

Data Source:

The data will be retrieved from sklearn simple data sets (data is clean and tidy)

This is one project I build when studied at AI Academy (NCSU.edu)

1) Exploratory Data Analyst:

In [20]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.tree import DecisionTreeClassifier
from sklearn.tree import plot_tree
from sklearn import datasets # dataset for this report
from sklearn.preprocessing import MinMaxScaler
from sklearn.model_selection import train_test_split # For split the train and test set
from sklearn.metrics import accuracy_score

test_data_fraction = 0.2
```

In [5]:

```
wine_sk = datasets.load_wine()

# Make sure data is in the same range (normalization)
wine_sk.data = MinMaxScaler().fit_transform(wine_sk.data)

wine_sk.data
```

Out[5]:

```
array([[0.84210526, 0.1916996 , 0.57219251, ..., 0.45528455, 0.97069597,
        0.56134094],
       [0.57105263, 0.2055336 , 0.4171123 , ..., 0.46341463, 0.78021978,
        0.55064194],
       [0.56052632, 0.3201581 , 0.70053476, ..., 0.44715447, 0.6959707 ,
        0.64693295],
       ...,
       [0.58947368, 0.69960474, 0.48128342, ..., 0.08943089, 0.10622711,
        0.39728959],
       [0.56315789, 0.36561265, 0.54010695, ..., 0.09756098, 0.12820513,
        0.40085592],
       [0.81578947, 0.66403162, 0.73796791, ..., 0.10569106, 0.12087912,
        0.20114123]])
```

In [6]:

```
# Since this is supervised learning
# Note that the "target" attribute is species, represented as an integer
wine_data = pd.DataFrame(data= np.c_[wine_sk['data'], wine_sk['target']],columns= wine_
```

In [7]:

```
# Validate the transform data
wine_data.head()
```

Out[7]:

	alcohol	malic_acid	ash	alcalinity_of_ash	magnesium	total_phenols	flavanoids	nonflavanoid_
0	0.842105	0.191700	0.572193	0.257732	0.619565	0.627586	0.573840	
1	0.571053	0.205534	0.417112	0.030928	0.326087	0.575862	0.510549	
2	0.560526	0.320158	0.700535	0.412371	0.336957	0.627586	0.611814	
3	0.878947	0.239130	0.609626	0.319588	0.467391	0.989655	0.664557	
4	0.581579	0.365613	0.807487	0.536082	0.521739	0.627586	0.495781	

In [33]:

```
wine_sk["target"]
```

Out[33]:

```
array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2])
```

2) AI Model: Decision Tree

In [11]:

```
# Building the tree
# Grab all the columns except the last one
wine_features = wine_data.iloc[:,0:-1]

# Grab the last column
wine_labels = wine_data["target"]

# Then split the X and Y datasets into training and testing
X_train, X_test, Y_train, Y_test = train_test_split(wine_features, wine_labels, test_si
```

In [13]:

```
# Let validate the data again
print(f"Training Shape: X_train:{X_train.shape}, Y_train:{Y_train.shape}")
print(f"Testing Shape: X_test:{X_test.shape}, Y_test:{Y_test.shape}")
```

```
Training Shape: X_train:(142, 13), Y_train:(142,)
Testing Shape: X_test:(36, 13), Y_test:(36,)
```

In [24]:

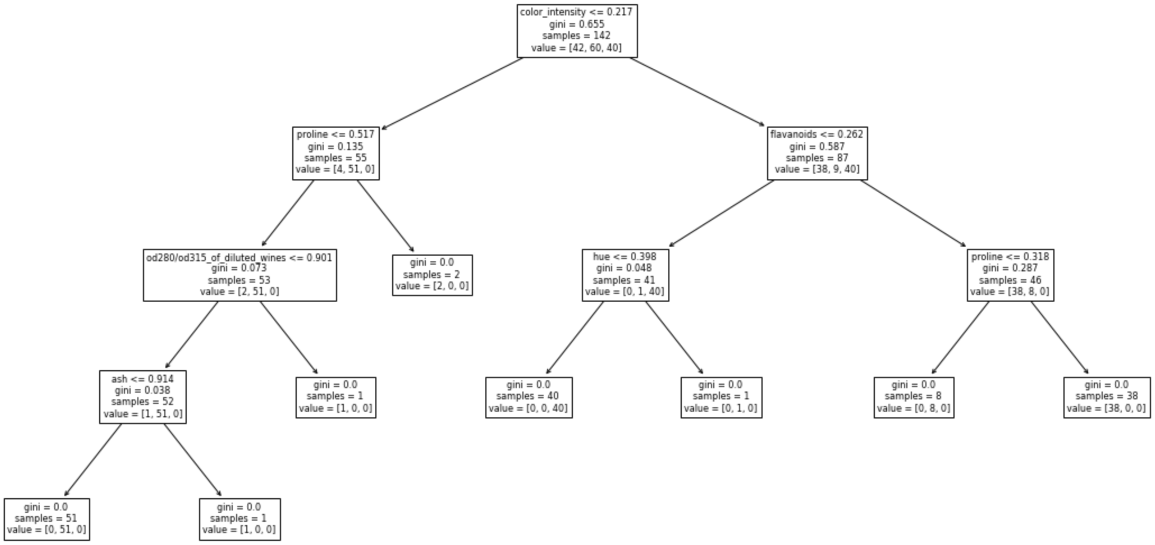
```
# Train a decision tree, plot it, and calculate its accuracy.
gini_tree = DecisionTreeClassifier (random_state=0)
gini_tree.fit(X_train, Y_train)
```

Out[24]:

```
DecisionTreeClassifier(random_state=0)
```

In [31]:

```
# We can plot the resulting tree using plot tree from sklearn
plt.figure(figsize=(20,10)) # create a figure size 20 and 10
_ = plot_tree(gini_tree, feature_names=wine_features.columns)
```



In [34]:

```
print(f'Train Accuracy: {accuracy_score(Y_train, gini_tree.predict(X_train))}')
print(f'Test Accuracy: {accuracy_score(Y_test, gini_tree.predict(X_test))}')
```

```
Train Accuracy: 1.0
Test Accuracy: 0.9722222222222222
```

3) Explain the Analyst

Result: Result show an accuracy score of 92% on the training test and 94% on the test set:

Explain: Go down the decison tree. The left side of the tree is yes, and the right side is no.

- Example 1: visit the root of the tree, then go left, then go left again: wine classify as 1. Explain: If a wine has a color_intensity less than 0.217 (root: choose yes) and proline less than 0.517 (first left: choose yes), it has more than 93% to be wine class 1 (at second left).
- Example 2: visit the root of the tree, then go right, another right, and another right: wine classify as type 0. Explain: If a wine has a color_intensity more than 0.217(root: choose no), and flavanoid more than 0.262 (first right: choose no) and proline more than 0.318 (second right: choose no). It has 100 % change to classify as wine type 0 (at third right).

Any one can look at the pics and do a quick classification base on the citeria