Batch: HO-ML 1 **Experiment Number: 05**

Roll Number: 16010422234 **Name: Chandana Galgali**

Aim of the Experiment: Classify the Iris dataset using the Decision tree classifier. Follow the steps given on the Kaggle website.

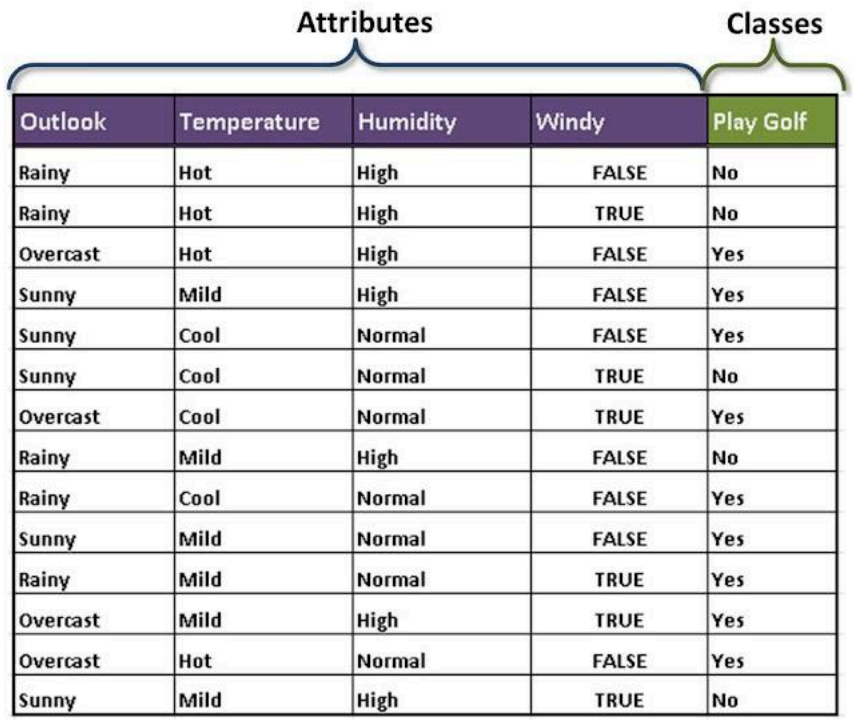
Program/ Steps:

Part 1:

1) Open this website https://www.kaggle.com/code/shikhnu/decision-tree-iris-dataset.
2) Follow the steps to classify the Iris dataset and display the results.

Part 2:

1) Use the same steps as Part 1 to classify the data in the following table.
2) Calculate the efficiency also.

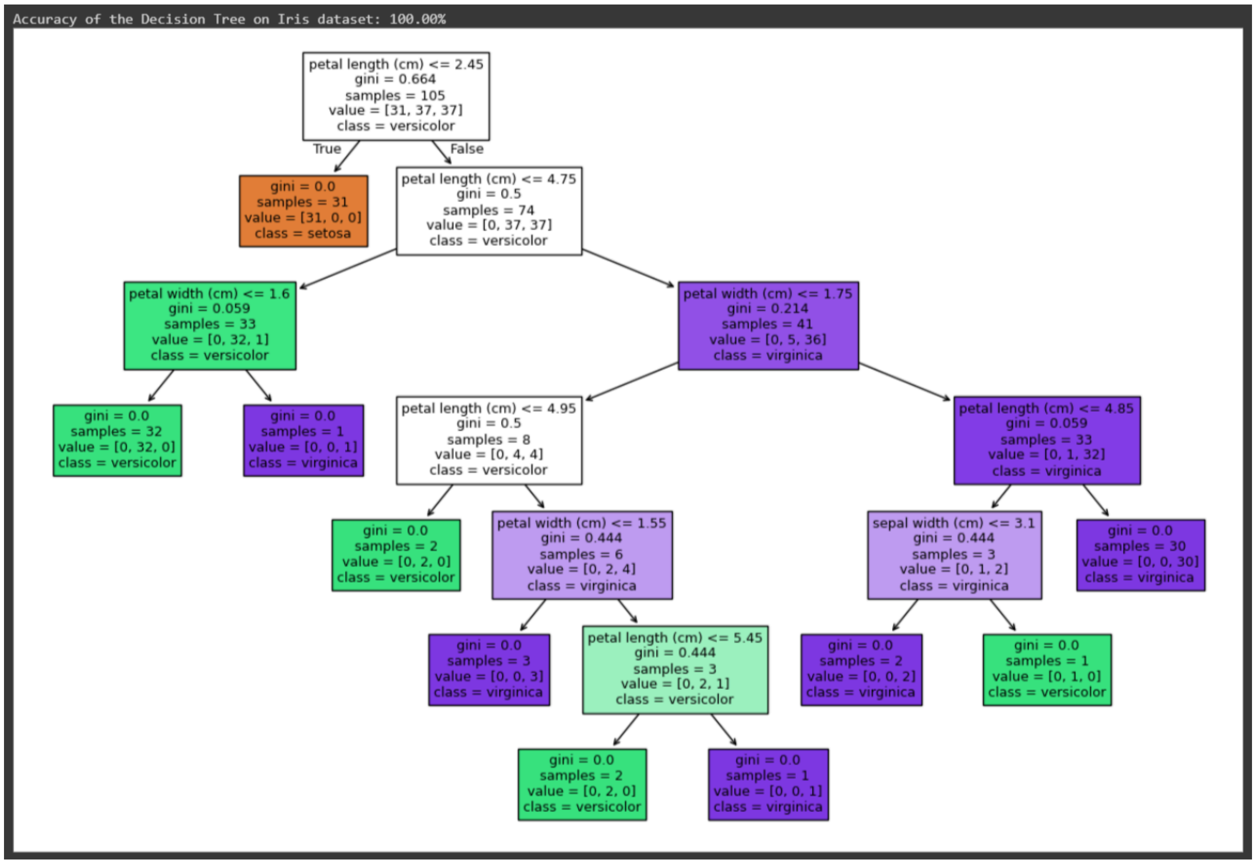

Attributes
Classes

Outlook	Temperature	Humidity	Windy	Play Golf
Rainy	Hot	High	FALSE	No
Rainy	Hot	High	TRUE	No
Overcast	Hot	High	FALSE	Yes
Sunny	Mild	High	FALSE	Yes
Sunny	Cool	Normal	FALSE	Yes
Sunny	Cool	Normal	TRUE	No
Overcast	Cool	Normal	TRUE	Yes
Rainy	Mild	High	FALSE	No
Rainy	Cool	Normal	FALSE	Yes
Sunny	Mild	Normal	FALSE	Yes
Rainy	Mild	Normal	TRUE	Yes
Overcast	Mild	High	TRUE	Yes
Overcast	Hot	Normal	FALSE	Yes
Sunny	Mild	High	TRUE	No

Output/Result:

Part 1:

```
# Part 1: Classifying the Iris dataset using a Decision Tree
import pandas as pd
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score
from sklearn import tree
import matplotlib.pyplot as plt

# Load Iris dataset
iris = load_iris()
X = iris.data
y = iris.target

# Split dataset into training and testing sets (70% train, 30% test)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,
random_state=42)

# Create Decision Tree Classifier
clf = DecisionTreeClassifier(criterion='gini', random_state=42)

# Train the classifier
clf.fit(X_train, y_train)

# Predict the test data
y_pred = clf.predict(X_test)

# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy of the Decision Tree on Iris dataset: {accuracy *
100:.2f}%')

# Plot the decision tree
plt.figure(figsize=(15,10))
tree.plot_tree(clf, feature_names=iris.feature_names,
class_names=iris.target_names, filled=True)
plt.show()
```

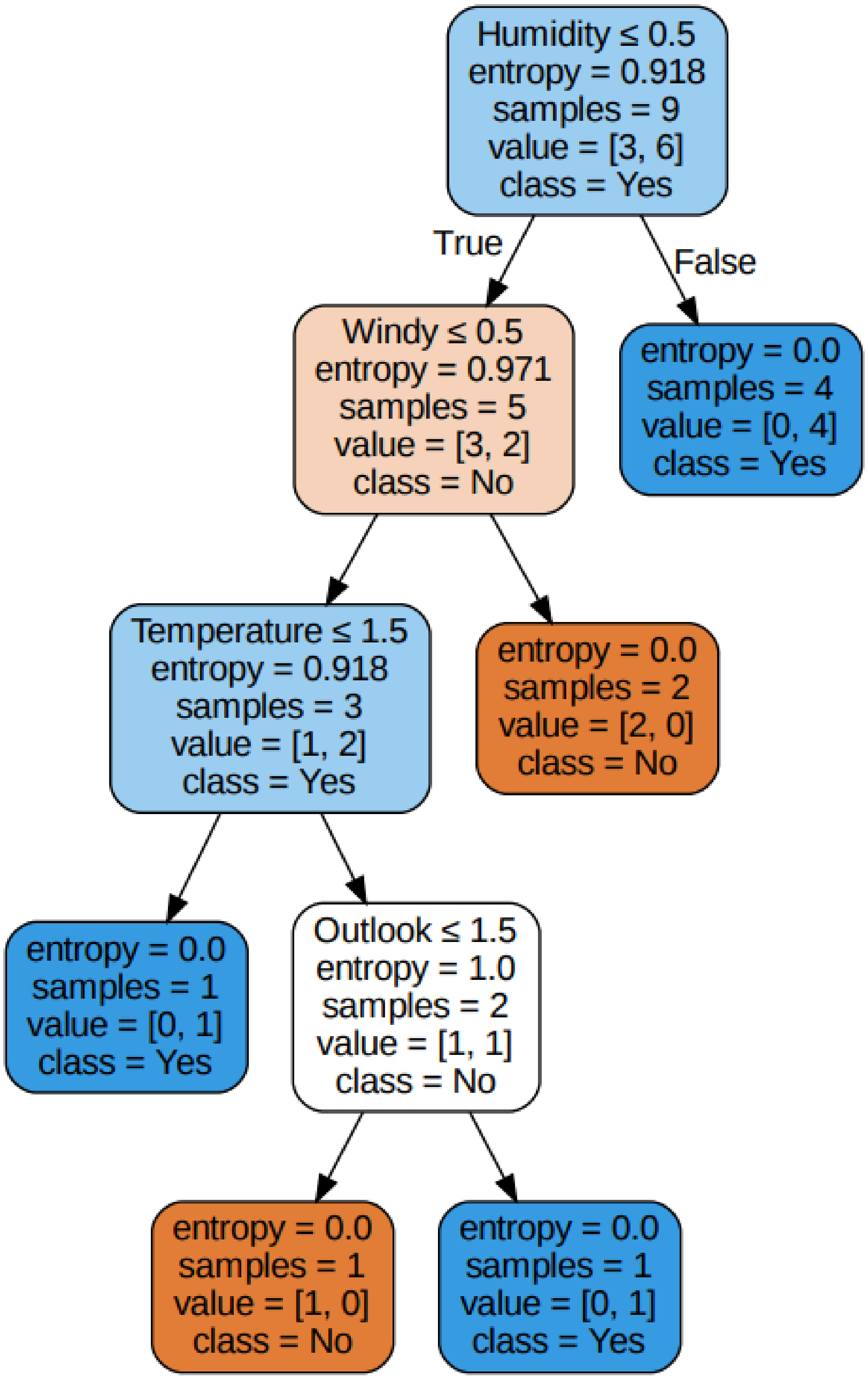


```
Accuracy of the Decision Tree on Iris dataset: 100.00%
```

Part 2:

```
# Import necessary libraries
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score
from sklearn.preprocessing import LabelEncoder
from sklearn.tree import export_graphviz
import graphviz

# Create the dataset as shown in the image
data = {
    'Outlook': ['Rainy', 'Rainy', 'Overcast', 'Sunny', 'Sunny', 'Sunny',
'Overcast', 'Rainy',
                'Rainy', 'Sunny', 'Rainy', 'Overcast', 'Overcast',
'Sunny'],
    'Temperature': ['Hot', 'Hot', 'Hot', 'Mild', 'Cool', 'Cool', 'Cool',
'Mild',
                    'Cool', 'Mild', 'Mild', 'Mild', 'Hot', 'Mild'],
    'Humidity': ['High', 'High', 'High', 'High', 'Normal', 'Normal',
'Normal', 'High',
                 'Normal', 'Normal', 'Normal', 'High', 'Normal', 'High'],
    'Windy': [False, True, False, False, False, True, True, False, False,
False, True, True, False, True],
    'Play Golf': ['No', 'No', 'Yes', 'Yes', 'Yes', 'No', 'Yes', 'No',
                  'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'No']
}

# Convert the dictionary into a DataFrame
df = pd.DataFrame(data)

# Initialize the LabelEncoder
le = LabelEncoder()

# Encode categorical features (Outlook, Temperature, Humidity, Windy, Play
Golf)
df['Outlook'] = le.fit_transform(df['Outlook'])
df['Temperature'] = le.fit_transform(df['Temperature'])
df['Humidity'] = le.fit_transform(df['Humidity'])
df['Windy'] = le.fit_transform(df['Windy'])
df['Play Golf'] = le.fit_transform(df['Play Golf'])

# Separate features and target variable
X = df.drop(columns=['Play Golf'])
y = df['Play Golf']

# Split the dataset into training and testing sets (70% train, 30% test)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,
random_state=42)

# Create Decision Tree Classifier with entropy (to achieve better splits)
clf = DecisionTreeClassifier(criterion='entropy', random_state=42)
```

```
# Train the classifier on the training data
clf.fit(X_train, y_train)

# Predict the test data
y_pred = clf.predict(X_test)

# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy of the Decision Tree on Play Golf dataset: {accuracy *
100:.2f}%')

# Visualize the tree using graphviz
dot_data = export_graphviz(clf, out_file=None,
                           feature_names=X.columns,
                           class_names=['No', 'Yes'],
                           filled=True, rounded=True,
                           special_characters=True)

# Create a Graphviz source object and render it
graph = graphviz.Source(dot_data)
graph.render("play_golf_decision_tree")  # Saves the tree as a PDF

# Show the tree inline (optional, depending on the environment)
graph.view()
```


Humidity ≤ 0.5
entropy = 0.918
samples = 9
value = [3, 6]
class = Yes
True
False
Windy ≤ 0.5
entropy = 0.971
samples = 5
value = [3, 2]
class = No
entropy = 0.0
samples = 4
value = [0, 4]
class = Yes
Temperature ≤ 1.5
entropy = 0.918
samples = 3
value = [1, 2]
class = Yes
entropy = 0.0
samples = 2
value = [2, 0]
class = No
entropy = 0.0
samples = 1
value = [0, 1]
class = Yes
Outlook ≤ 1.5
entropy = 1.0
samples = 2
value = [1, 1]
class = No
entropy = 0.0
samples = 1
value = [1, 0]
class = No
entropy = 0.0
samples = 1
value = [0, 1]
class = Yes

Post Lab Question-Answers:

1. What are the four commonly used ways to generate decision trees from a given dataset?

1) Gini Index: Measures the impurity or impurity reduction at each node. It selects the feature that maximizes this reduction.

2) Information Gain (Entropy): Measures the amount of information gained when a feature is selected. A higher information gain indicates a better feature for splitting.

3) Gain Ratio: Modifies the Information Gain to deal with issues of bias towards features with a larger number of distinct values.

4) Chi-Square: Evaluates the statistical significance of the relationship between a feature and the target class, choosing the feature with the most significant relation.

Outcomes: Apply concepts of different types of Learning and Neural Network

---

Conclusion (based on the Results and outcomes achieved):
The Decision Tree algorithm effectively classifies the Iris dataset into its respective species using feature selection methods such as Gini Index or Information Gain. Through recursive partitioning, the data is divided into smaller subsets based on the most important features, resulting in a model that can predict the class labels with high accuracy. This process demonstrates the power of decision trees for classification problems, as it achieves clear decision boundaries and interpretable results. The performance of the model can be evaluated by calculating the efficiency (accuracy) of the predictions.

References:

Books/ Journals/ Websites:

1. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3nd Edition

---