LAB-2

Use an appropriate dataset for building the decision tree (ID3) and apply this knowledge to classify a new sample.

code:

```
import pandas as pd
import numpy as np

data = pd.read_csv('weatherdataset.csv')
df = pd.DataFrame(data)

def entropy(target):
    class_count = target.value_counts()
    probabilities = class_counts / len(target)
    return -np.sum(probabilities * np.log2(probabilities))

def information_gain(data, feature, target):
    entropy_before = entropy(target)
    feature_values = data[feature].unique()
    weighted_entropy = 0
    for value in feature_values:
        subset = target[data[feature] == value]
        weighted_entropy += (len(subset) / len(target)) * entropy(subset)
    return entropy_before - weighted_entropy

def print_entropy_and_gain(data, features, target):
    for feature in features:
        gain = information_gain(data, feature, target)
        ent = entropy(target)
        print(f"Feature: {feature} | Entropy: {ent:.4f} | Information
              Gain: {gain:.4f}")
```

```
def build_tree(data, target, features):
    if len(target.unique()) == 1:
        return target.iloc[0]
    if len(features) == 0:
        return target.mode()[0]

    gains = {feature: information_gain(data, feature, target) for feature
             in features}

    best_feature = max(gains, key=gains.get)

    tree = {best_feature: {}}

    feature_values = data[best_feature].unique()

    for value in feature_values:
        subset_data = data[data[best_feature] == value]
        subset_target = target[data[best_feature] == value]

        remaining_features = [f for f in features in f != best_feature]
        subtree = build_tree(subset_data, subset_target, remaining_features)

        tree[best_feature][value] = subtree

    return tree

def print_tree(tree, indent=""):
    if isinstance(tree, dict):
        for feature, branches in tree.items():
            print(f"{indent}{feature}:")
            for value, subtree in branches.items():
                print(f"{indent}  {value} ->", end=" ")
                print_tree(subtree, indent + "  ")
    else:
        print(f"{indent}{tree}")


target = df['Play tennis?']
features = ['Outlook', 'Temperature', 'Humidity', 'Windy']
print_entropy_and_gain(df, features, target)
tree = build_tree(df, target, features)
print("\nDecision Tree:")
print_tree(tree, indent="  ")
```

Output:

Entropy and Information Gain for each feature:

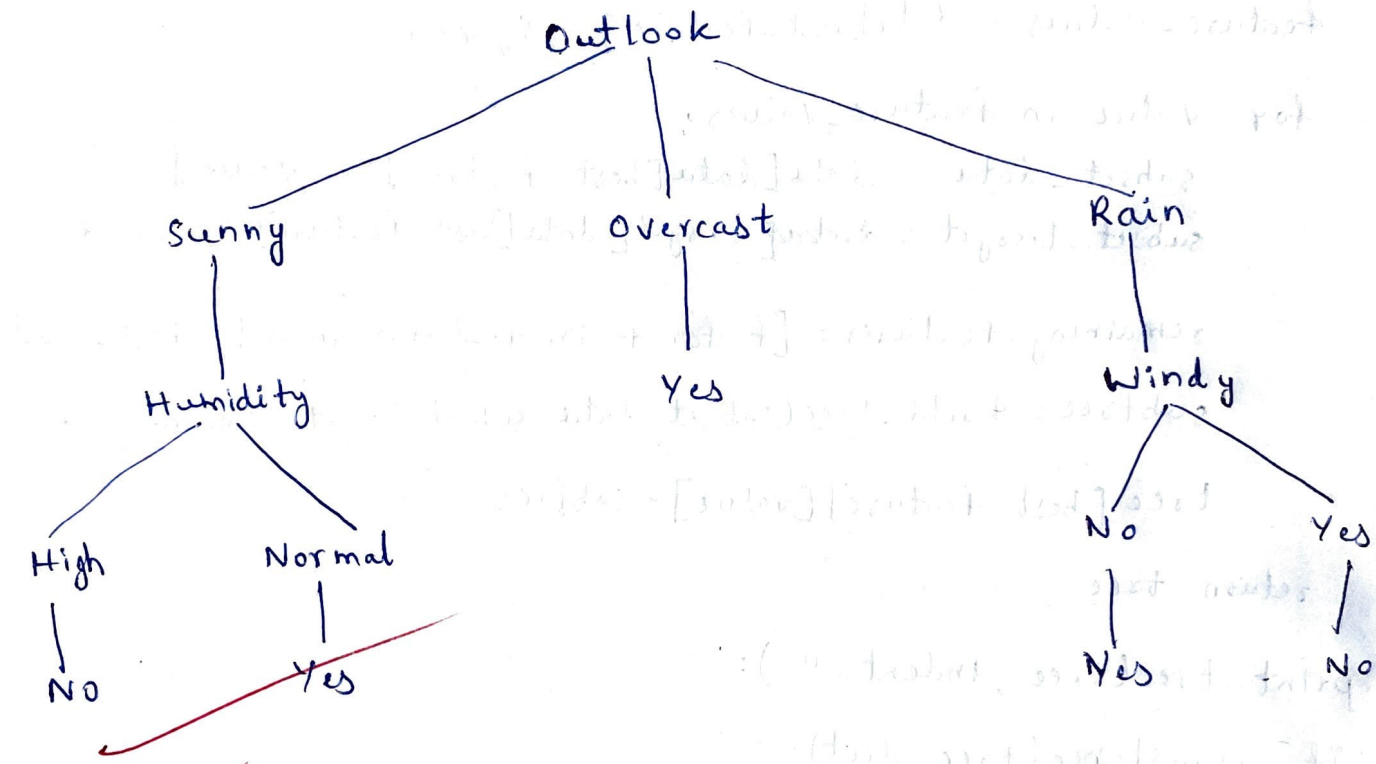
Feature : Outlook | Entropy : 0.9403 | Information Gain : 0.2467

Feature : Temperature | Entropy : 0.9403 | Information Gain : 0.0292

Feature : Humidity | Entropy : 0.9403 | Information Gain : 0.1518

Feature : Windy | Entropy : 0.9403 | Information Gain : 0.0481

Decision Tree:



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