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# PART A: Data Preprocessing

# Install necessary libraries (only if needed in some Colab environments)
# !pip install pandas scikit-learn matplotlib

import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.tree import DecisionTreeClassifier, plot_tree
from sklearn.metrics import accuracy_score

# Load dataset
url = "https://archive.ics.uci.edu/ml/machine-learning-databases/car/car.data"
column_names = ['buying', 'maint', 'doors', 'persons', 'lug_boot', 'safety', 'class']
df = pd.read_csv(url, names=column_names)

# Encode categorical features
le = LabelEncoder()
for col in df.columns:
    df[col] = le.fit_transform(df[col])

# Split dataset into train and test sets
X = df.drop('class', axis=1)
y = df['class']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# PART B: Decision Tree using Gini Index
clf_gini = DecisionTreeClassifier(criterion='gini', random_state=42)
clf_gini.fit(X_train, y_train)
y_pred_gini = clf_gini.predict(X_test)
accuracy_gini = accuracy_score(y_test, y_pred_gini)
print("Accuracy using Gini Index:", accuracy_gini)

# Plot Gini Tree
plt.figure(figsize=(20,10))
plot_tree(clf_gini, feature_names=X.columns, class_names=le.classes_, filled=True)
plt.title("Decision Tree (Gini Index)")
plt.show()

# PART C: Decision Tree using Entropy
clf_entropy = DecisionTreeClassifier(criterion='entropy', random_state=42)
clf_entropy.fit(X_train, y_train)
y_pred_entropy = clf_entropy.predict(X_test)
accuracy_entropy = accuracy_score(y_test, y_pred_entropy)
print("Accuracy using Entropy:", accuracy_entropy)

# Plot Entropy Tree
plt.figure(figsize=(20,10))
plot_tree(clf_entropy, feature_names=X.columns, class_names=le.classes_, filled=True)
plt.title("Decision Tree (Entropy)")
plt.show()

# PART D: Analysis
print("\n--- Comparison Report ---")
print(f"Accuracy (Gini): {accuracy_gini:.4f}")
print(f"Accuracy (Entropy):{accuracy_entropy:.4f}")

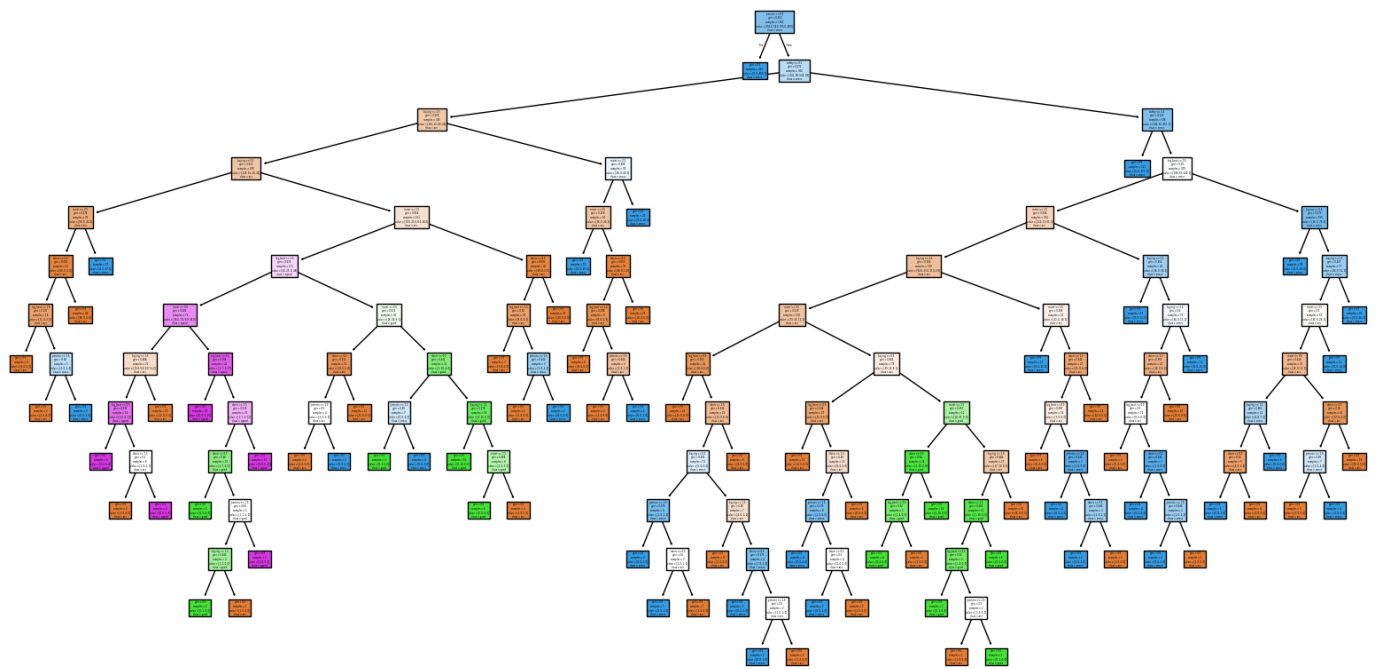
if accuracy_gini > accuracy_entropy:
    print("Gini-based tree performed slightly better.")
elif accuracy_entropy > accuracy_gini:
    print("Entropy-based tree performed slightly better.")
else:
    print("Both trees performed equally well.")

print(f"Gini Tree Depth: {clf_gini.get_depth()} | Nodes: {clf_gini.tree_.node_count}")
print(f"Entropy Tree Depth: {clf_entropy.get_depth()} | Nodes: {clf_entropy.tree_.node_count}")

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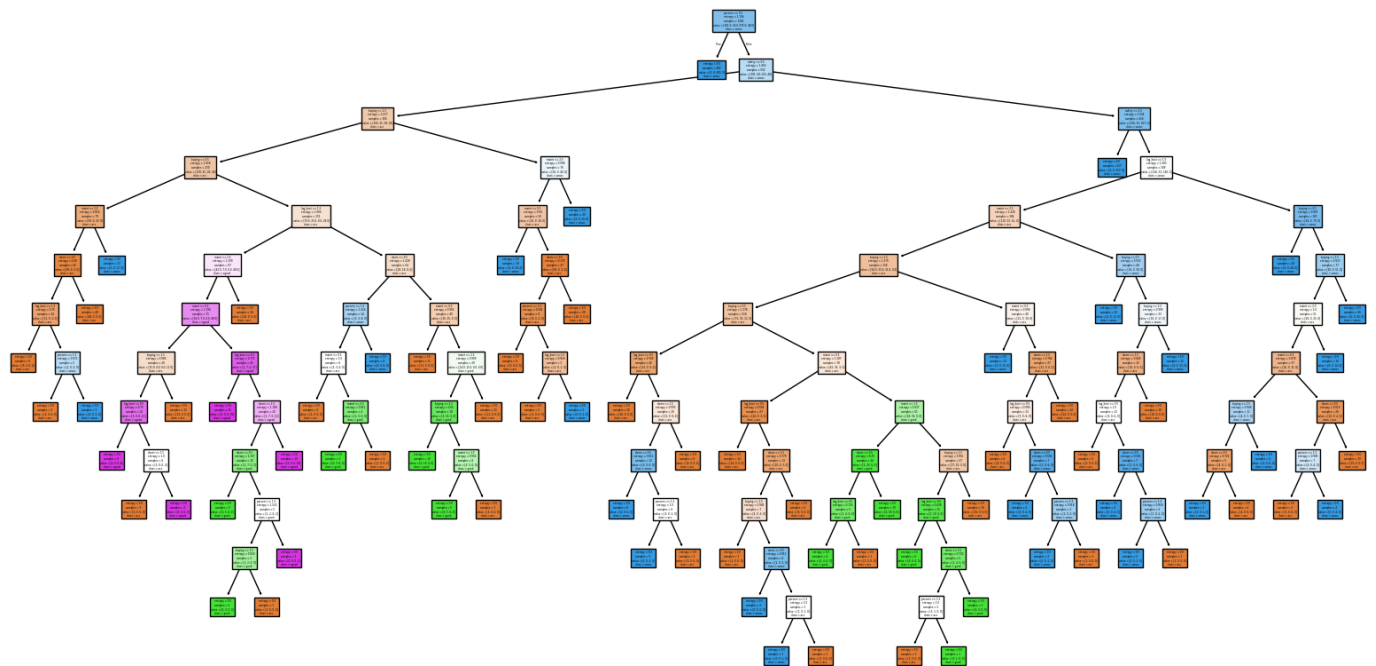
↻ Accuracy using Gini Index: 0.9739884393063584

Decision Tree (Gini Index)



Accuracy using Entropy: 0.9739884393063584

Decision Tree (Entropy)



--- Comparison Report ---  
Accuracy (Gini): 0.9740  
Accuracy (Entropy): 0.9740  
Both trees performed equally well.  
Gini Tree Depth: 13 | Nodes: 157  
Entropy Tree Depth: 13 | Nodes: 147