LAB 8
ADA BOOST:

In [2]:

```
#income
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.ensemble import AdaBoostClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score
import matplotlib.pyplot as plt
from google.colab import files

# Upload the CSV file
uploaded = files.upload()
# Read the CSV file into a pandas DataFrame
df = pd.read_csv(next(iter(uploaded)))  # Load the first uploaded file
print(df.head())

# Split features and target
X = df.drop("income_level", axis=1)
y = df["income_level"]

# Encode target if necessary (e.g., if it's strings)
y = y.astype('category').cat.codes  # Converts labels to numeric

# Train-test split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# 1. Train AdaBoost with default n_estimators = 10
ada_default = AdaBoostClassifier(
    estimator=DecisionTreeClassifier(max_depth=1),
    n_estimators=10,
    random_state=42
)
ada_default.fit(X_train, y_train)
y_pred_default = ada_default.predict(X_test)
default_score = accuracy_score(y_test, y_pred_default)
print(f"Accuracy with default n_estimators=10: {default_score:.4f}")
```

```
# 2. Fine-tune n_estimators
scores = {}
for n in range(10, 110, 10):  # Try 10 to 100 in steps of 10
    ada = AdaBoostClassifier(
        estimator=DecisionTreeClassifier(max_depth=1),
        n_estimators=n,
        random_state=42
    )
    ada.fit(X_train, y_train)
    y_pred = ada.predict(X_test)
    acc = accuracy_score(y_test, y_pred)
    scores[n] = acc

# Find best score and corresponding number of estimators
best_n = max(scores, key=scores.get)
best_score = scores[best_n]
print(f"Best accuracy: {best_score:.4f} with n_estimators={best_n}")

# Plot
plt.plot(list(scores.keys()), list(scores.values()), marker='o')
plt.xlabel("Number of Trees (n_estimators)")
plt.ylabel("Accuracy")
plt.title("AdaBoost Accuracy vs. Number of Trees")
plt.grid(True)
plt.show()
```

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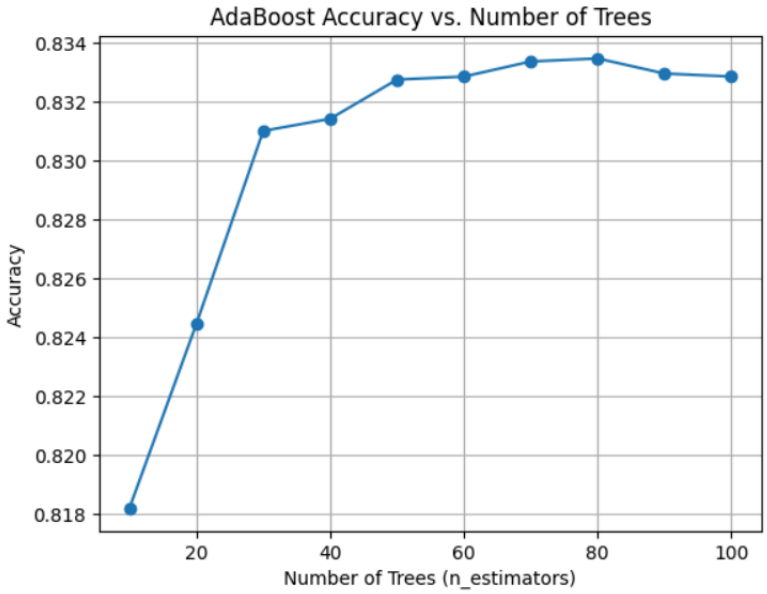
```
Saving income.csv to income (1).csv
   age  fnlwgt  education_num  capital_gain  capital_loss  hours_per_week  \
0   39   77516             13          2174             0              40
1   50   83311             13             0             0              13
2   38  215646              9             0             0              40
3   53  234721              7             0             0              40
4   28  338409             13             0             0              40
```

```
   income_level
0             0
1             0
2             0
3             0
4             0
Accuracy with default n_estimators=10: 0.8182
Best accuracy: 0.8335 with n_estimators=80
```



5/5/2025
Monday

Lab - 8

AdaBoost - tab

job profile yes → +1, Else −1

Index	CGPA	Job Profile	label
1	≥ 9	yes	+1
2	< 9	yes	+1
3	≥ 9	NO	−1
4	< 9	NO	−1
5	≥ 9	yes	+1
6	≥ 9	Yes	+1

Encode data :

Index	CGPA	True label	Prediction	
1	1	+1	+1	✓
2	0	+1	−1	x
3	1	−1	+1	x
4	0	−1	−1	✓
5	1	+1	+1	✓
6	1	+1	+1	✓

If CGPA ≥ 9 → Predict +1, Else −1

Each weight initially = 1/6 = 0.1667

Incorrect index → 2, 3

Error weight = $D_2 + D_3$ = 0.1667 + 0.1667
= 0.3333

$$\alpha = \frac{1}{2} \ln\left(\frac{1 - \text{error}}{\text{error}}\right) = \frac{1}{2} \ln\left(\frac{1 - 0.3333}{0.3333}\right) = 0.3466$$

If CGPA ≥ 9, predict job profile = yes,
else NO

Stump weight = 0.3466

Q2) For income dataset,
best accuracy score = 0.8335
number of trees = 80

Confusion matrix.

Actual	≤ 50K	7130	284
	> 50K	1343	1012
		≤ 50K	> 50K

predicted.

5/5/25