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(6) PRODIGY_DS_03-Intern-Pins

Decision Tree Classifier Tutorial

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CommandsCodeTextRun all

RAMDisk

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[4] import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier, plot_tree
from sklearn.metrics import classification_report, accuracy_score, confusion_matrix

[11] from google.colab import files
files.upload()

collar,married,secondary,no,2548,yes,no,cellular,11,may,577,1,368,1,other,no\n31,services,single,secondary,no,3,yes,no,cellular,5,may,41,1,-1,0,unknown,no\n40,admin.,married,secondary,no,139
collar,married,primary,no,-196,no,no,cellular,7,jul,209,1,-1,0,unknown,no\n42,blue-collar,married,primary,no,205,yes,no,cellular,17,apr,582,1,-1,0,unknown,no\n53,blue-
collar,single,secondary,no,1442,no,no,telephone,9,dec,137,8,188,2,other,no\n33,admin.,married,secondary,no,393,yes,no,unknown,28,may,383,1,-1,0,unknown,no\n28,blue-
collar,married,secondary,no,-185,yes,yes,unknown,13,may,170,1,-1,0,unknown,no\n50,housemaid,single,primary,no,1158,yes,no,cellular,3,feb,116,3,265,3,failure,no\n30,blue-
collar,single,secondary,no,1165,yes,no,cellular,18,may,365,2,-1,0,unknown,no\n37,blue-
collar,married,secondary,no,10721,yes,no,unknown,18,jun,394,3,-1,0,unknown,no\n39,technician,divorced,secondary,no,1270,yes,no,unknown,29,may,245,4,-1,0,unknown,no\n29,management,married,ter-
collar,married,primary,no,328,yes,no,cellular,7,may,58,1,-1,0,unknown,no\n57,management,married,secondary,no,0,no,no,cellular,28,jan,132,1,-1,0,unknown,no\n32,technician,married,secondary,no
employed,single,tertiary,no,4574,no,no,cellular,12,aug,187,2,-1,0,unknown,no\n39,housemaid,single,primary,no,109,yes,no,unknown,6,may,699,3,-1,0,unknown,no\n41,blue-
collar,married,secondary,no,140,yes,no,cellular,3,jun,96,1,125,2,failure,no\n56,management,married,tertiary,no,-45,yes,no,unknown,30,may,116,6,-1,0,unknown,no\n54,technician,married,tertiary
collar,married,primary,no,1291,yes,no,cellular,14,may,142,3,259,17,failure,no\n35,management,married,tertiary,yes,-10,yes,no,cellular,15,may,168,2,364,1,other,no\n41,admin.,single,secondary,
collar,married,primary,no,-20,yes,no,unknown,7,may,353,3,-1,0,unknown,no\n37,admin.,single,secondary,no,309,yes,no,cellular,15,may,58,3,-1,0,unknown,no\n28,technician,single,secondary,no,250
collar,single,secondary,no,75,no,no,unknown,1,jun,7,1,-1,0,unknown,no\n42,admin.,married,secondary,no,12,yes,no,cellular,16,apr,466,4,-1,0,unknown,no\n32,admin.,married,secondary,no,3540,yes
collar,married,primary,no,3297,yes,yes,telephone,30,apr,96,1,-1,0,unknown,no\n41,management,married,tertiary,no,9,yes,no,cellular,22,jul,82,3,-1,0,unknown,no\n33,management,married,tertiary,
collar,married,secondary,no,381,no,no,cellular,11,nov,79,4,-1,0,unknown,no\n32,blue-collar,single,secondary,no,760,yes,no,cellular,16,apr,445,1,148,2,other,no\n36,blue-
collar,married,unknown,no,722,yes,no,unknown,20,may,268,2,-1,0,unknown,no\n31,technician,single,tertiary,yes,24,no,no,cellular,21,aug,246,2,-1,0,unknown,no\n33,management,married,tertiary,no
collar,married,primary,no,6691,no,no,cellular,13,aug,211,2,-1,0,unknown,no\n40,housemaid,married,primary,no,0,no,no,cellular,28,aug,16,20,-1,0,unknown,no\n29,blue-
collar,married,primary,no,787,yes,no,cellular,24,jul,257,2,-1,0,unknown,no\n53,self-
employed,married,primary,no,4576,no,no,telephone,30,jul,82,2,-1,0,unknown,no\n53,technician,divorced,unknown,no,629,yes,no,cellular,8,may,298,1,-1,0,unknown,no\n35,management,married,tertiar-
collar,married,primary,no,-132,yes,yes,cellular,18,may,170,6,-1,0,unknown,no\n38,entrepreneur,married,tertiary,no,1438,no,no,cellular,13,nov,122,5,-1,0,unknown,no\n31,blue-
collar,single,secondary,no,-159,no,yes,telephone,21,nov,49,1,-1,0,unknown,no\n48,admin.,married,secondary,no,2235,yes,yes,unknown,15,may,755,2,-1,0,unknown,no\n25,services,married,secondary,
collar,married,primary,no,-79,no,yes,unknown,27,jun,293,3,-1,0,unknown,no\n31,blue-
collar,married,secondary,no,1664,yes,no,cellular,7,may
collar,married,unknown,no,1154,yes,no,cellular,16,apr,-
collar,married,secondary,yes,-238,yes,no,unknown,27,may,427,1,-1,0,unknown,no\n38,technician,single,secondary,no,1685,yes,no,unknown,5,may,185,1,-1,0,unknown,no\n37,self-

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lular,24,jul,229,2,-1,0,unknown,no\n31,admin.,single,secondary,n
,13,may,151,2,351,1,failure,no\n34,admin.,married,secondary,no,1-

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[13] df = pd.read_csv('bank.csv', sep=';')
df.head()

age,job,marital,education,default,balance,housing,loan,contact,day,month,duration,campaign,pdays,previous,poutcome,deposit
0 59,admin.,married,secondary,no,2343,yes,no,unk...
1 56,admin.,married,secondary,no,45,no,no,unknow...
2 41,technician,married,secondary,no,1270,yes,no...
3 55,services,married,secondary,no,2476,yes,no,u...
4 54,admin.,married,tertiary,no,184,no,no,unknow...

Next steps:

Generate code with df

View recommended plots

New interactive sheet

[14] print(df.columns)

Index(['age,job,marital,education,default,balance,housing,loan,contact,day,month,duration,campaign,pdays,previous,poutcome,deposit'], dtype='object')

[16] print(df.head())
print(df.columns)

age,job,marital,education,default,balance,housing,loan,contact,day,month,duration,campaign,pdays,previous,poutcome,deposit
0 59,admin.,married,secondary,no,2343,yes,no,unk...
1 56,admin.,married,secondary,no,45,no,no,unknow...
2 41,technician,married,secondary,no,1270,yes,no...
3 55,services,married,secondary,no,2476,yes,no,u...
4 54,admin.,married,tertiary,no,184,no,no,unknow...
Index(['age,job,marital,education,default,balance,housing,loan,contact,day,month,duration,campaign,pdays,previous,poutcome,deposit'], dtype='object')

[17] df = pd.read_csv('/content/bank.csv', sep=';')

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[17] df = pd.read_csv('/content/bank.csv', sep=';')

[19] import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report

[20] df = pd.read_csv('/content/bank.csv', sep=';')
print(df.head())
print(df.columns)

age, job, marital, education, default, balance, housing, loan, contact, day, month, duration, campaign, pdays, previous, poutcome, deposit
0 59, admin., married, secondary, no, 2343, yes, no, unk...
1 56, admin., married, secondary, no, 45, no, no, unknow...
2 41, technician, married, secondary, no, 1270, yes, no...
3 55, services, married, secondary, no, 2476, yes, no, u...
4 54, admin., married, tertiary, no, 184, no, no, unknow...
Index(['age, job, marital, education, default, balance, housing, loan, contact, day, month, duration, campaign, pdays, previous, poutcome, deposit'], dtype='object')

[21] print(df.columns)

Index(['age, job, marital, education, default, balance, housing, loan, contact, day, month, duration, campaign, pdays, previous, poutcome, deposit'], dtype='object')

[22] import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier, plot_tree
from sklearn.metrics import classification_report, accuracy_score, confusion_matrix

[23] df.describe()

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```
[23] df.describe()
df.isnull().sum()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 11162 entries, 0 to 11161
Data columns (total 1 columns):
#   Column
---  ---
0    age,job,marital,education,default,balance,housing,loan,contact,day,month,duration,campaign,pdays,previous,poutcome,deposit
dtypes: object(1)
memory usage: 87.3+ KB

Non-Null Count  Dtype
-----
11162 non-null  object

0

age,job,marital,education,default,balance,housing,loan,contact,day,month,duration,campaign,pdays,previous,poutcome,deposit 0

dtype: int64

[29] df_encoded = pd.get_dummies(df, drop_first=True)
df_encoded.head()

age,job,marital,education,default,balance,housing,loan,contact,day,month,duration,campaign,pdays,previous,poutcome,deposit_18,student,single,primary,no,608,no,no,cellular,13,nov,210,1,93,1
0
1
2
3
4
5 rows x 11161 columns

[33] df_encoded = pd.get_dummies(df, drop_first=True)
```

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5 rows x 11161 columns

[33] df_encoded = pd.get_dummies(df, drop_first=True)
df_encoded.columns

Index(['age', 'job', 'marital', 'education', 'default', 'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'deposit_18', 'student', 'single', 'primary', 'no', 608, 'no', 'no', 'cellular', 13, 'nov', 210, 1, 'age', 'job', 'marital', 'education', 'default', 'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'deposit_18', 'student', 'single', 'secondary', 'no', 5, 'no', 'no', 'cellular', 24, 'aug', 143, 2, -1, 0, ur 'age', 'job', 'marital', 'education', 'default', 'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'deposit_18', 'student', 'single', 'unknown', 'no', 108, 'no', 'no', 'cellular', 10, 'aug', 167, 1, -1, 0, ur 'age', 'job', 'marital', 'education', 'default', 'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'deposit_18', 'student', 'single', 'unknown', 'no', 108, 'no', 'no', 'cellular', 8, 'sep', 169, 1, -1, 0, unk 'age', 'job', 'marital', 'education', 'default', 'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'deposit_18', 'student', 'single', 'unknown', 'no', 108, 'no', 'no', 'cellular', 9, 'feb', 92, 1, 183, 1, suc 'age', 'job', 'marital', 'education', 'default', 'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'deposit_18', 'student', 'single', 'unknown', 'no', 3, 'no', 'no', 'cellular', 25, 'aug', 130, 2, -1, 0, unkr 'age', 'job', 'marital', 'education', 'default', 'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'deposit_18', 'student', 'single', 'unknown', 'no', 348, 'no', 'no', 'cellular', 5, 'may', 443, 4, -1, 0, unk 'age', 'job', 'marital', 'education', 'default', 'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'deposit_19', 'student', 'single', 'primary', 'no', 103, 'no', 'no', 'cellular', 10, 'jul', 104, 2, -1, 0, ur 'age', 'job', 'marital', 'education', 'default', 'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'deposit_19', 'student', 'single', 'primary', 'no', 134, 'no', 'no', 'cellular', 27, 'mar', 271, 2, -1, 0, ur 'age', 'job', 'marital', 'education', 'default', 'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'deposit_19', 'student', 'single', 'primary', 'no', 608, 'no', 'no', 'cellular', 12, 'may', 236, 1, 180, 2, s ... 'age', 'job', 'marital', 'education', 'default', 'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'deposit_88', 'retired', 'married', 'primary', 'no', 648, 'no', 'no', 'telephone', 3, 'sep', 318, 1, -1, 0, u 'age', 'job', 'marital', 'education', 'default', 'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'deposit_88', 'retired', 'married', 'secondary', 'no', 433, 'no', 'no', 'telephone', 15, 'sep', 161, 1, 274 'age', 'job', 'marital', 'education', 'default', 'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'deposit_89', 'retired', 'married', 'tertiary', 'no', 553, 'no', 'no', 'telephone', 19, 'aug', 2027, 5, -1, 'age', 'job', 'marital', 'education', 'default', 'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'deposit_90', 'retired', 'divorced', 'primary', 'no', 712, 'no', 'no', 'telephone', 3, 'mar', 557, 1, -1, 0, 'age', 'job', 'marital', 'education', 'default', 'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome', 'deposit_90', 'retired', 'divorced', 'secondary', 'no', 1, 'no', 'no', 'cellular', 13, 'feb', 152, 3, -1, 0, 'age', 'job', 'marital', 'education', 'default', 'balance', 'housing', loa

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age, job, marital, education, default, balance, housing, loan, contact, day, month, duration, campaign, pdays, previous, poutcome, deposit

0	59,admin.,married,secondary,no,2343,yes,no,unk...
1	56,admin.,married,secondary,no,45,no,no,unknow...
2	41,technician,married,secondary,no,1270,yes,no...
3	55,services,married,secondary,no,2476,yes,no,u...
4	54,admin.,married,tertiary,no,184,no,no,unknow...

```
✓ [35] df = pd.read_csv('bank.csv')
0s df.head()
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	deposit
0	59	admin.	married	secondary	no	2343	yes	no	unknown	5	may	1042	1	-1	0	unknown	yes
1	56	admin.	married	secondary	no	45	no	no	unknown	5	may	1467	1	-1	0	unknown	yes
2	41	technician	married	secondary	no	1270	yes	no	unknown	5	may	1389	1	-1	0	unknown	yes
3	55	services	married	secondary	no	2476	yes	no	unknown	5	may	579	1	-1	0	unknown	yes
4	54	admin.	married	tertiary	no	184	no	no	unknown	5	may	673	2	-1	0	unknown	yes

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454admin.marriedtertiaryno184nonounknown5may6732-10unknownyes

Next steps:Generate code with dfView recommended plotsNew interactive sheet

[36] print(df.columns)
Index(['age', 'job', 'marital', 'education', 'default', 'balance', 'housing',
 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays',
 'previous', 'poutcome', 'deposit'],
 dtype='object')

[38] import pandas as pd

df = pd.read_csv('bank.csv')
df.head()

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	deposit
0	59	admin.	married	secondary	no	2343	yes	no	unknown	5	may	1042	1	-1	0	unknown	yes
1	56	admin.	married	secondary	no	45	no	no	unknown	5	may	1467	1	-1	0	unknown	yes
2	41	technician	married	secondary	no	1270	yes	no	unknown	5	may	1389	1	-1	0	unknown	yes
3	55	services	married	secondary	no	2476	yes	no	unknown	5	may	579	1	-1	0	unknown	yes
4	54	admin.	married	tertiary	no	184	no	no	unknown	5	may	673	2	-1	0	unknown	yes

Next steps:Generate code with dfView recommended plotsNew interactive sheet

[39] df['deposit'] = df['deposit'].map({'yes': 1, 'no': 0})

[40] df_encoded = pd.get_dummies(df, drop_first=True)
df_encoded.columns

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```
[39] df['deposit'] = df['deposit'].map({'yes': 1, 'no': 0})
```

```
[40] df_encoded = pd.get_dummies(df, drop_first=True)
df_encoded.columns
```

```
Index(['age', 'balance', 'day', 'duration', 'campaign', 'pdays', 'previous',
       'deposit', 'job_blue-collar', 'job_entrepreneur', 'job_housemaid',
       'job_management', 'job_retired', 'job_self-employed', 'job_services',
       'job_student', 'job_technician', 'job_unemployed', 'job_unknown',
       'marital_married', 'marital_single', 'education_secondary',
       'education_tertiary', 'education_unknown', 'default_yes', 'housing_yes',
       'loan_yes', 'contact_telephone', 'contact_unknown', 'month_aug',
       'month_dec', 'month_feb', 'month_jan', 'month_jul', 'month_jun',
       'month_mar', 'month_may', 'month_nov', 'month_oct', 'month_sep',
       'poutcome_other', 'poutcome_success', 'poutcome_unknown'],
      dtype='object')
```

```
[41] df = pd.read_csv('bank.csv', sep=';')
df.head()
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	deposit
0	59	admin.	married	secondary	no	2343	yes	no	unk...								
1	56	admin.	married	secondary	no	45	no	no	unknow...								
2	41	technician	married	secondary	no	1270	yes	no									
3	55	services	married	secondary	no	2476	yes	no	u...								
4	54	admin.	married	tertiary	no	184	no	no	unknow...								

Next steps: [Generate code with df](#) [View recommended plots](#) What can I help you build? + ▶

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54,admin.,married,tertiary,no,184,no,no,unknow...

Next steps: [Generate code with df](#) [View recommended plots](#) [New interactive sheet](#)

[42] from sklearn.model_selection import train_test_split

X = df_encoded.drop('deposit', axis=1)

y = df_encoded['deposit']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

[43] from sklearn.tree import DecisionTreeClassifier

clf = DecisionTreeClassifier(random_state=42)

clf.fit(X_train,y_train)

DecisionTreeClassifier

DecisionTreeClassifier(random_state=42)

[44] from sklearn.metrics import accuracy_score, classification_report, confusion_matrix

import seaborn as sns

import matplotlib.pyplot as plt

y_pred = clf.predict(X_test)

print("Accuracy:", accuracy_score(y_test, y_pred))

print("Classification Report:\n", classification_report(y_test, y_pred))

Confusion Matrix

cm = confusion_matrix(y_test, y_pred)

sns.heatmap(cm, annot=True, fmt='d', cmap='Blues')

plt.title('Confusion Matrix')

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[44]

plt.title('Confusion Matrix')
plt.xlabel('Predicted')
plt.ylabel('Actual')
plt.show()

Accuracy: 0.7895208240035826
Classification Report:

	precision	recall	f1-score	support
0	0.79	0.80	0.80	1166
1	0.78	0.77	0.78	1067
accuracy			0.79	2233
macro avg	0.79	0.79	0.79	2233
weighted avg	0.79	0.79	0.79	2233

Confusion Matrix

	Predicted 0	Predicted 1
Actual 0	938	228
Actual 1	242	825

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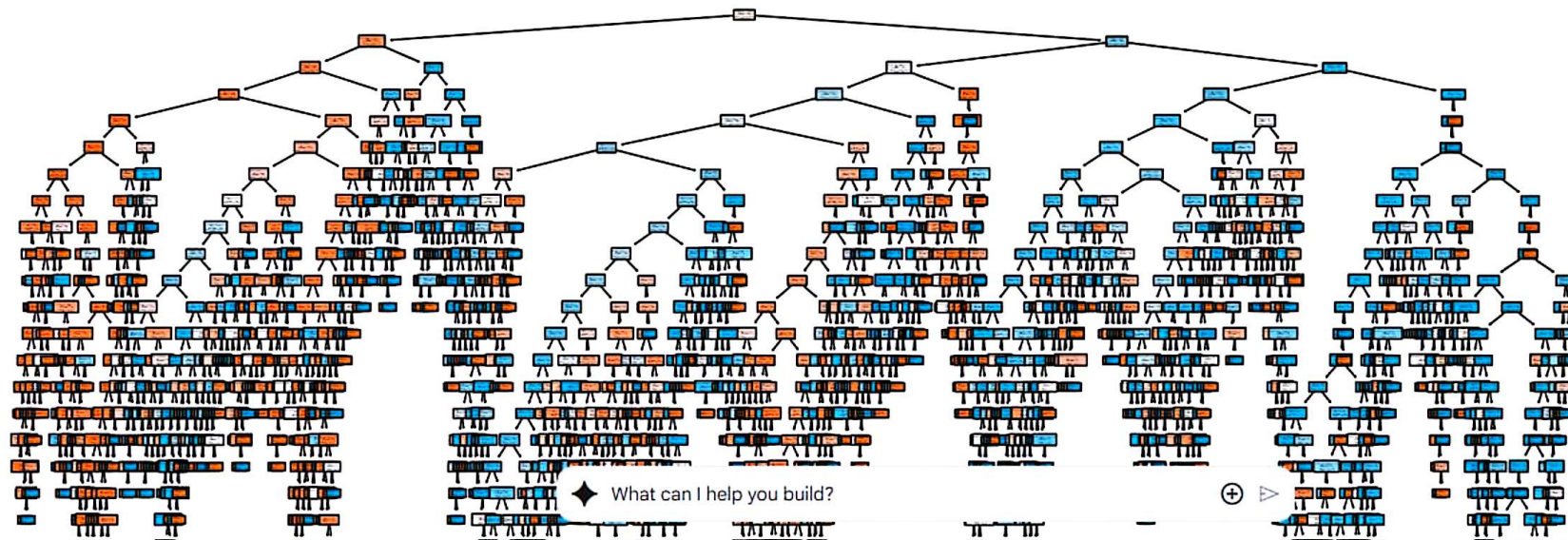
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Predicted

```
[45] from sklearn.tree import plot_tree
import matplotlib.pyplot as plt

plt.figure(figsize=(15,8))
plot_tree(clf,
          filled=True,
          feature_names=X.columns,
          class_names=['No', 'Yes'],
          rounded=True)
plt.show()
```

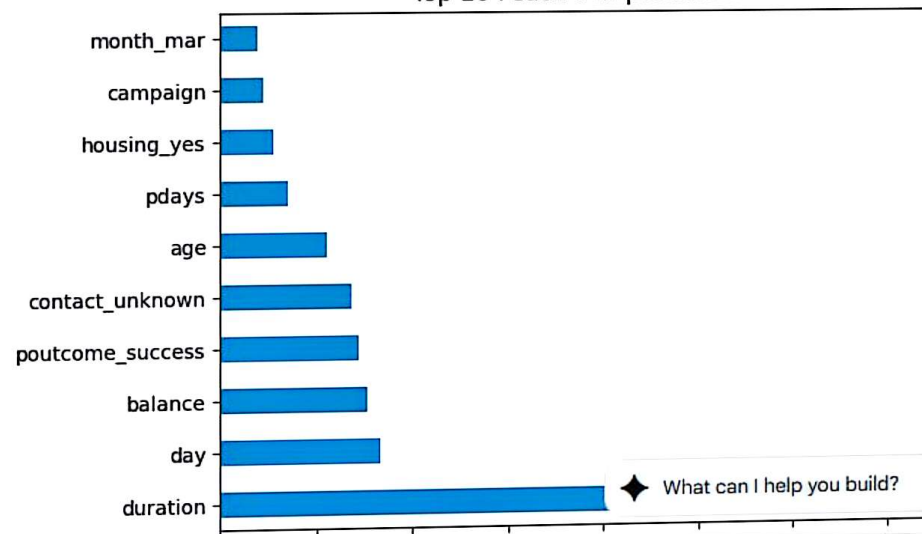


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```
import pandas as pd
```

```
feature_importances = pd.Series(clf.feature_importances_, index=X.columns)  
feature_importances.nlargest(10).plot(kind='barh')  
plt.title('Top 10 Feature Importances')  
plt.show()
```

Top 10 Feature Importances



What can I help you build?

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```
feature_importances = pd.Series(clf.feature_importances_, index=X.columns)
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