```
import pandas as pd
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, confusion matrix,
classification report
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.tree import export text
data = pd.read csv('bank.csv')
data.head()
               job marital education default balance housing loan
   age
contact \
    59
            admin.
                    married
                             secondary
                                             no
                                                    2343
                                                             yes
                                                                   no
unknown
    56
            admin.
                    married
                             secondary
                                             no
                                                      45
                                                              no
                                                                    no
unknown
    41 technician married
                             secondary
                                                    1270
                                             no
                                                             ves
                                                                   no
unknown
    55
                             secondary
                                                    2476
          services married
                                             no
                                                             yes
                                                                   no
unknown
            admin.
    54
                    married
                              tertiary
                                             no
                                                     184
                                                              no
                                                                   no
unknown
   day month
              duration
                        campaign
                                  pdays
                                          previous poutcome deposit
0
     5
         may
                  1042
                               1
                                      - 1
                                                    unknown
                                                                yes
     5
1
                  1467
                               1
                                      - 1
                                                 0
                                                    unknown
         may
                                                                yes
2
     5
                  1389
                                1
                                      - 1
                                                 0
                                                    unknown
         may
                                                                yes
     5
3
         may
                   579
                                1
                                      - 1
                                                 0
                                                    unknown
                                                                yes
4
     5
                                2
                   673
                                      - 1
                                                    unknown
         may
                                                                yes
data.tail()
                    job marital education default balance housing
       age
loan \
        33 blue-collar
11157
                          single
                                     primary
                                                            1
                                                  no
                                                                  yes
no
11158
        39
                                                          733
               services married
                                  secondary
                                                  no
                                                                   no
no
11159
        32
             technician
                          single
                                  secondary
                                                           29
                                                  no
                                                                   no
no
11160
        43
             technician married secondary
                                                  no
                                                                   no
yes
11161
        34
             technician married secondary
                                                  no
                                                                   no
no
        contact day month duration campaign
                                                 pdays previous
poutcome \
```

11157 ce							
unknown	llular	20	apr	257	1	-1	0
11158 u	nknown	16	jun	83	4	-1	0
	llular	19	aug	156	2	-1	0
	llular	8	may	9	2	172	5
failure 11161 ce unknown	llular	9	jul	628	1	-1	0
dep 11157 11158 11159 11160 11161 data.colu	osit no no no no no						
'housing' 'l 'pdays', 'p dty	oan', 'c revious' pe='obje	ontac , 'po	t', 'da	', 'educati y', 'month' , 'deposit'	, 'durat		
data.desc			b a 1		al a	ala	L:
campaign	\	ge		ance	day		
count 11 11162.000		00 1	1162.00	0000 11162	2.000000	11162.00	9000
mean 2.508421	41.2319	48	1528.53	8524 15	.658036	371.99	3818
std	11.9133	69	3225.41	3326 8	120710		
2 722077					3.420740	347.12	8386
2.722077 min	18.0000	00 -	6847.00		.000000	2.00	
	18.0000 32.0000		6847.00 122.00	0000 1			9000
min 1.000000 25% 1.000000 50%		00		0000 1 0000 8	.000000	2.00	9000 9000
min 1.000000 25% 1.000000 50% 2.000000 75%	32.0000	00 00	122.00	0000 1 0000 8 0000 15	.000000	2.00	9000 9000 9000
min 1.000000 25% 1.000000 50% 2.000000	32.0000 39.0000 49.0000 95.0000	00 00 00	122.00 550.00	0000 1 0000 8 0000 15 0000 22	000000 3.000000 5.000000	2.000 138.000 255.000	9000 9000 9000 9000

```
51.330407
                          0.832557
mean
                          2.292007
std
         108.758282
min
          -1.000000
                          0.000000
25%
          -1.000000
                          0.000000
50%
          -1.000000
                          0.000000
75%
          20.750000
                          1.000000
         854.000000
                         58.000000
max
data.isna().sum()
             0
age
              0
job
              0
marital
education
              0
              0
default
balance
              0
              0
housing
              0
loan
              0
contact
              0
day
month
              0
              0
duration
              0
campaign
              0
pdays
              0
previous
              0
poutcome
              0
deposit
dtype: int64
data.info()
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 11162 entries, 0 to 11161
Data columns (total 17 columns):
#
     Column
                 Non-Null Count Dtype
- - -
 0
                 11162 non-null
                                  int64
     age
1
                 11162 non-null
                                  object
     iob
 2
     marital
                 11162 non-null
                                  object
 3
                 11162 non-null
                                  object
     education
 4
                 11162 non-null
     default
                                  object
 5
     balance
                 11162 non-null
                                  int64
 6
     housing
                 11162 non-null
                                  object
 7
                 11162 non-null
                                  object
     loan
 8
     contact
                 11162 non-null
                                  object
 9
     day
                 11162 non-null
                                  int64
 10
     month
                 11162 non-null
                                  object
 11
                 11162 non-null
                                  int64
     duration
 12
                 11162 non-null
                                  int64
     campaign
 13
                 11162 non-null
     pdays
                                  int64
```

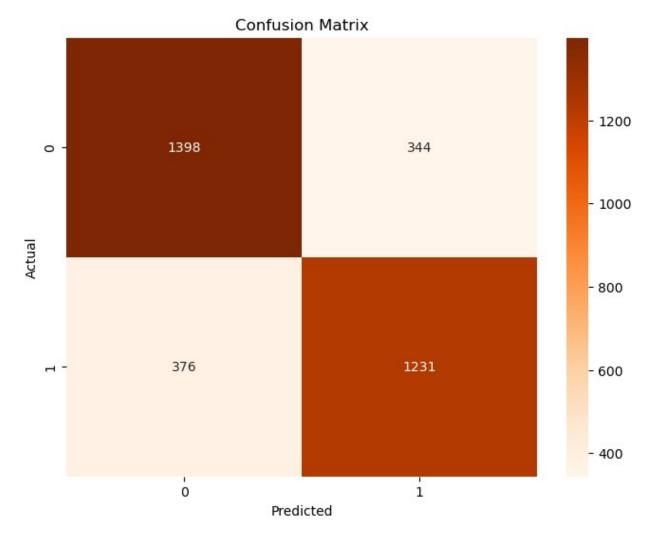
```
14
                 11162 non-null
                                  int64
     previous
15
     poutcome
                 11162 non-null
                                  object
16 deposit
                 11162 non-null
                                  object
dtypes: int64(7), object(10)
memory usage: 1.4+ MB
features = ['age', 'job', 'marital', 'education', 'default',
'balance', 'housing', 'loan', 'contact', 'day', 'month', 'duration', 'campaign', 'pdays', 'previous', 'poutcome']
target = 'deposit'
data = pd.get_dummies(data, columns=['job', 'marital', 'education',
'default', 'housing', 'loan', 'contact', 'month', 'poutcome'],
drop first=True)
X = data.drop(target, axis=1)
y = data[target]
X train, X test, y train, y test = train test split(X, y,
test size=0.3, random state=42)
X train
      age balance day duration campaign pdays previous
job blue-collar \
7968
       57
               950
                       9
                               1272
                                             1
                                                               0
                                                   - 1
False
                                709
1456
                925
                      13
                                             1
                                                   -1
                                                               0
       34
False
361
       41
                 75
                     1
                                479
                                             9
                                                   - 1
                                                               0
True
               4414
                      18
812
       46
                                504
                                             7
                                                   - 1
                                                               0
False
                                               -1
               4465
                                769
1092
       28
                      28
                                             1
False
. . .
5734
       47
                761
                      11
                                 80
                                             2
                                                   - 1
                                                               0
False
5191
       28
                159
                      16
                                449
                                             2
                                                   33
False
5390
       35
               1144
                      20
                                197
                                           13
                                                   - 1
                                                               0
False
       51
                746
                      25
                                372
                                             5
                                                   - 1
                                                               0
860
False
                                                   - 1
7270
                  2
                      23
                                269
                                             1
                                                               0
       30
False
      job entrepreneur job housemaid ... month jul month jun
month mar \
7968
                  False
                                  False
                                                    True
                                                               False
False
1456
                                  False ...
                  False
                                                   False
                                                               False
False
```

361 False		False	False		True	False	
812		False	False		False	False	
False 1092 False		False	False		False	False	
5734 False		False	False		True	False	
5191		False	False		False	False	
False 5390 False		False	False		False	False	
860 False		False	False		False	False	
7270 True		False	False		False	False	
True	month may	month nov mo	nth oct	month ser	poutcome	other \	
7968 1456 361 812 1092	False False False False False	False False False False False False	False False False False False	False False False False False		False False False False False	
	False	False	False	False		False	
5734 5191 5390 860 7270	False False False False	True False False False	False False False False	False False False False) }	False False False False	
	poutcome_s		me_unknow				
7968 1456 361 812 1092		False False False False False	Tru Tru Tru Tru Tru	ie ie ie			
5734 5191 5390 860 7270		False True False False False	Tru Fals Tru Tru Tru	ie e ie			
[7813 X test	rows x 42	columns]					

5527 4541 1964 5007 8928 1052 10702 10466 8809 99	age 65 38 35 47 35 30 44 44 55 35	162 496 822 147 49	44 5 27 16 53 14 29 8 73 12 95 21 12 19	duration 182 1323 456 784 84 641 126 191 58 1205	camp	aign 1 9 1 2 3 1 2 1	pdays -1 -1 300 -1 -1 -1 -1 -1 -1 -1	prev	ious 0 0 1 0 0 0	\	
month_ 5527		\	ollar j False	ob_entrep	reneur False	_		aid lse			
True 4541 False			True		False			lse			
1964 False 5007			True True		False False			lse lse			
False 8928		F	alse		False			lse			
False 											
1052 False 10702			alse alse		False False			lse lse			
False 10466			atse		False			lse			
False 8809 False		i	-alse		False		Fa	lse			
99 False			True		False		Fa	lse			
month_	sep	h_jun \	month_m			month_		onth_			
5527 False 4541		False True	Fal Fal		alse alse		lse ilse		lse lse		
False 1964		False	Fal		Γrue		ilse		lse		
False 5007 False		False	Fal		alse		lse		lse		
8928 False		False	Fal	se -	Γrue	Fa	lse	Fa	lse		

1052	False	False	False	True	False	
False		. 4.55	. 4150			
10702	False	False	False	True	False	
False	_	_		_	_	
10466	False	False	True	False	False	
False	Falso	Ealco	Ealco	Ealco	Folso	
8809 False	False	False	False	False	False	
99	False	False	True	False	False	
False	1 4 1 3 0	racse	1146	. acsc	14150	
5527 4541 1964 5007 8928	poutcome_other False False False False	·	me_success False False False False False	poutcome_un	known True True False True True	
1050						
1052 10702 10466 8809 99	False False False True False		False False False False False		True True True False True	
[3349	rows x 42 colum	ns l				
y_trai		-				
7968 1456 361 812 1092	no yes yes yes yes					
5734 5191 5390 860 7270	no yes no yes no					
	deposit, Length	: 7813, 0	dtype: objec	t		
y_test						
5527	no					
4541	yes					
1964	yes					
5007	yes					
8928	no					

```
1052
         yes
10702
          no
10466
          no
8809
          no
99
         yes
Name: deposit, Length: 3349, dtype: object
clf = DecisionTreeClassifier(random state=42)
clf.fit(X_train, y_train)
DecisionTreeClassifier(random state=42)
y pred = clf.predict(X test)
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)
Accuracy: 0.78501045088086
conf matrix = confusion matrix(y test, y pred)
print("Confusion Matrix:\n", conf matrix)
Confusion Matrix:
 [[1398 344]
 [ 376 1231]]
class_report = classification_report(y_test, y_pred)
print("Classification Report:\n", class report)
Classification Report:
               precision
                            recall f1-score
                                                support
                   0.79
                             0.80
                                        0.80
                                                  1742
          no
                   0.78
                             0.77
                                        0.77
                                                  1607
         yes
                                        0.79
                                                  3349
    accuracy
                   0.78
                             0.78
                                        0.78
                                                  3349
   macro avg
weighted avg
                   0.78
                             0.79
                                        0.78
                                                  3349
confusion = confusion matrix(y_test, y_pred)
plt.figure(figsize=(8, 6))
sns.heatmap(confusion, annot=True, fmt="d", cmap="0ranges")
plt.xlabel('Predicted')
plt.ylabel('Actual')
plt.title('Confusion Matrix')
plt.show()
```



```
tree_structure = export_text(clf, feature_names=list(X.columns))
print("Decision Tree Structure:")
print(tree_structure)
Decision Tree Structure:
|--- duration <= 251.50
    |--- poutcome_success <= 0.50
         |--- duration \leq 123.50
            |--- month_mar <= 0.50
                 |--- month_oct <= 0.50
                    |--- month feb <= 0.50
                         --- job_student <= 0.50
                             |--- day <= 1.50
                                 |--- age <= 36.50
                                    |--- class: no
                                  --- age > 36.50
                                 | |--- class: yes
                                 day > 1.50
                                 |--- duration <= 88.50
```

```
--- month sep \leq 0.50
                                        --- campaign <= 1.50
                                           |--- truncated branch of
depth 9
                                         -- campaign > 1.50
                                           |--- truncated branch of
depth 4
                                       month sep > 0.50
                                        --- campaign <= 2.00
                                           |--- class: no
                                        --- campaign > 2.00
                                          |--- class: yes
                                    duration > 88.50
                                    --- pdays <= 478.00
                                        --- month sep <= 0.50
                                           |--- truncated branch of
depth 14
                                        --- month sep > 0.50
                                           |--- truncated branch of
depth 2
                                   |--- pdays > 478.00
                                      |--- class: yes
                        --- job_student > 0.50
                            --- month may \leq 0.50
                                --- age <= 31.00
                                   |--- month jun \leq 0.50
                                       |--- class: yes
                                    --- month jun > 0.50
                                       |--- day| <= 18.50
                                          |--- class: no
                                        |--- day > 18.50
                               |--- class: no
                            --- month may > 0.50
                               |--- class: no
                        month feb > 0.50
                        --- day <= 10.00
                            --- duration <= 122.50
                                --- age \leq 29.50
                                    --- education_tertiary <= 0.50
                                       |--- class: no
                                    --- education_tertiary > 0.50
                                        |--- balance <= 387.50
                                           |--- class: no
                                        |--- balance > 387.50
                                       | |--- class: yes
                                 -- age > 29.50
                                   |--- balance <= -15.00
```

```
--- balance <= -165.00
                               |--- class: no
                            --- balance > -165.00
                              |--- class: yes
                        --- balance > -15.00
                           |--- class: no
               --- duration > 122.50
                   |--- class: yes
               day > 10.00
                --- balance <= 185.00
                   |--- job_technician <= 0.50
                      |--- class: no
                    --- job_technician > 0.50
                      |--- class: yes
                --- balance > 185.00
                    --- education_unknown <= 0.50
                       |--- age <= 62.00
                           |--- class: yes
                        --- age > 62.00
                           |--- housing yes <= 0.50
                               |--- class: no
                            --- housing yes > 0.50
                               |--- class: yes
                    --- education unknown > 0.50
                       |--- class: no
   --- month_oct > 0.50
       --- age <= 43.00
           --- day <= 26.50
               |--- class: no
           --- day > 26.50
               |--- class: yes
           age > 43.00
           |--- balance <= 196.00
               |--- class: no
           --- balance > 196.00
               |--- job technician <= 0.50
                   |--- marital single <= 0.50
                      |--- class: yes
                   --- marital single > 0.50
                     |--- class: no
               |--- job_technician > 0.50
               | |--- class: no
--- month_mar > 0.50
   --- poutcome other <= 0.50
       |--- age <= 62.00
           --- job_services <= 0.50
               |--- age <= 29.50
                   |--- day| <= 4.00
                    |--- class: no
```

```
|--- day > 4.00
                                   |--- class: yes
                             |--- age > 29.50
                             | |--- class: yes
                         --- job services > 0.50
                             |--- class: no
                        age > 62.00
                         --- age <= 69.00
                            |--- class: no
                         --- age > 69.00
                            |--- class: yes
                 --- poutcome_other > 0.50
                    |--- class: no
             duration > 123.50
             --- contact unknown <= 0.50
                |--- housing yes <= 0.50
                    |--- month aug <= 0.50
                         --- month_jul <= 0.50
                             --- month nov <= 0.50
                                 |--- month jan \leq 0.50
                                     |--- month_feb <= 0.50
                                         --- \overline{month} may \leq 0.50
                                             |--- truncated branch of
depth 20
                                           -- month may > 0.50
                                             |--- truncated branch of
depth 8
                                      --- month feb > 0.50
                                          --- day <= 7.50
                                             |--- truncated branch of
depth 11
                                          --- day > 7.50
                                          |--- truncated branch of
depth 3
                                   -- month jan > 0.50
                                     --- day <= 27.50
                                         |--- class: yes
                                      --- day > 27.50
                                          --- balance <= 1643.50
                                             |--- truncated branch of
depth 5
                                          --- balance > 1643.50
                                           |--- truncated branch of
depth 3
                                 month nov > 0.50
                                 |--- day| <= 16.50
                                     |--- balance <= 154.00
                                         |--- duration <= 217.50
                                             |--- class: no
```

```
--- duration > 217.50
                                          |--- class: yes
                                        balance > 154.00
                                         --- job retired <= 0.50
                                            |--- truncated branch of
depth 3
                                          -- job retired > 0.50
                                            |--- truncated branch of
depth 2
                                 --- day > 16.50
                                    |--- day| <= 23.00
                                        |---| day <= 17.50
                                            |--- truncated branch of
depth 2
                                         --- day > 17.50
                                            |--- class: no
                                     --- day > 23.00
                                        |--- class: yes
                         --- month jul > 0.50
                             --- pdays <= 200.00
                                 --- day <= 6.50
                                    |--- balance <= 2.50
                                        |--- class: no
                                     --- balance > 2.50
                                       |--- class: yes
                                 --- day > 6.50
                                    |--- age <= 26.00
                                        |--- job services <= 0.50
                                            |--- class: yes
                                         --- job_services > 0.50
                                           |--- class: no
                                     --- age > 26.00
                                        |--- previous <= 1.50
                                            |--- truncated branch of
depth 9
                                         --- previous > 1.50
                                          |--- truncated branch of
depth 2
                            |--- pdays > 200.00
                               |--- class: yes
                     --- month aug > 0.50
                         --- pdays <= 32.00
                             --- campaign <= 1.50
                                 --- duration <= 183.00
                                    |--- job unemployed <= 0.50
                                        |--- day <= 13.50
                                            |--- class: no
                                         --- day > 13.50
                                            |--- truncated branch of
```

```
depth 2
                                     --- job unemployed > 0.50
                                    | |--- class: yes
                                     duration > 183.00
                                     --- day <= 27.00
                                         --- job_technician <= 0.50
                                            |--- truncated branch of
depth 3
                                         --- job technician > 0.50
                                           |--- class: no
                                     --- day > 27.00
                                        |--- class: no
                                 campaign > 1.50
                                 --- age \leq 26.50
                                    |--- duration <= 164.00
                                        |--- class: no
                                     --- duration > 164.00
                                        |--- class: yes
                                 --- age > 26.50
                                     --- age \leq 62.00
                                         --- job retired <= 0.50
                                            |--- truncated branch of
depth 6
                                          -- job retired > 0.50
                                            |--- truncated branch of
depth 3
                                     --- age > 62.00
                                    | |--- class: yes
                             pdays > 32.00
                             --- job_unemployed <= 0.50
                                --- pdays <= 586.00
                                     --- balance <= 31.00
                                        |--- poutcome other <= 0.50
                                            |--- class: yes
                                         --- poutcome other > 0.50
                                         |--- class: no
                                     --- balance > 31.00
                                        |--- class: yes
                                 --- pdays > 586.00
                                   |--- class: no
                            --- job_unemployed > 0.50
                                |--- class: no
                    housing_yes > 0.50
                     --- month_jun <= 0.50
                        |--- month mar <= 0.50
                            |--- month_oct <= 0.50
                                |---| pdays <= 1.50
                                    |--- age <= 59.50
                                        |--- month sep \leq 0.50
```

```
| | |--- truncated branch of
depth 16
                                        |--- month_sep > 0.50
                                            |--- class: yes
                                     --- age > 59.50
                                        --- job_blue-collar <= 0.50
                                            |--- class: yes
                                         --- job blue-collar > 0.50
                                          |--- class: no
                                    pdays > 1.50
                                     --- pdays <= 97.50
                                        |--- job_management <= 0.50
                                            |--- class: yes
                                         --- job management > 0.50
                                            |--- truncated branch of
depth 3
                                     --- pdays > 97.50
                                        |--- month_aug <= 0.50
                                            |--- truncated branch of
depth 9
                                         --- month aug > 0.50
                                          |--- truncated branch of
depth 2
                                 month oct > 0.50
                                 --- age <= 43.00
                                    |--- campaign <= 3.50
                                        |--- class: yes
                                    |--- campaign > 3.50
                                       |--- class: no
                                 --- age > 43.00
                                    |--- age <= 67.50
                                        |--- class: no
                                    |--- age > 67.50
                                       |--- class: yes
                         --- month mar > 0.50
                             --- poutcome other <= 0.50
                                 --- campaign <= 3.50
                                   |--- class: yes
                                 --- campaign > 3.50
                                    |--- age <= 32.50
                                        |--- class: yes
                                     --- age > 32.50
                                       |--- class: no
                             --- poutcome_other > 0.50
                               |--- class: no
                        month_jun > 0.50
                         --- duration <= 141.00
                            |--- class: no
                         --- duration > 141.00
```

```
--- education tertiary <= 0.50
                                 |--- class: yes
                              --- education_tertiary > 0.50
                                  --- balance <= 706.50
                                    |--- class: yes
                                  --- balance > 706.50
                                     |--- age <= 42.50
                                         |--- class: no
                                      --- age > 42.50
                                        |--- class: yes
              -- contact unknown > 0.50
                     month oct \leq 0.50
                     --- month nov <= 0.50
                         1--- age <= 26.50
                             |--- job_management <= 0.50
                                 \mid ---  housing yes \leq 0.50
                                     |--- balance <= 95.00
                                         |--- class: no
                                     |--- balance > 95.00
                                        |--- class: yes
                                  --- housing yes > 0.50
                                   |--- class: no
                              --- job management > 0.50
                                |--- class: yes
                         --- age > 26.50
                             |--- month jul <= 0.50
                                 |--- day| <= 2.50
                                     |--- duration <= 228.50
                                         |--- class: no
                                      --- duration > 228.50
                                        |--- class: yes
                                  --- day > 2.50
                                     |--- job blue-collar <= 0.50
                                         |--- class: no
                                      --- job blue-collar > 0.50
                                          --- day <= 5.50
                                             |--- truncated branch of
depth 2
                                          --- day > 5.50
                                           |--- truncated branch of
depth 4
                                 month jul > 0.50
                                  --- education_secondary <= 0.50
                                     |--- class: no
                                  --- education secondary > 0.50
                                     |--- balance <= 862.50
                                         I--- class: no
                                      --- balance > 862.50
                                         |--- class: yes
```

```
--- month nov > 0.50
                       |--- class: yes
                |--- month oct > 0.50
                    |--- class: yes
        poutcome success > 0.50
         --- duration <= 79.50
            --- balance <= 1742.00
                |--- class: no
             --- balance > 1742.00
                |--- duration <= 68.00
                    |--- class: no
                |--- duration > 68.00
                   |--- class: yes
         --- duration > 79.50
             --- duration <= 147.00
                |--- duration <= 145.50
                    |--- contact telephone <= 0.50
                         --- pdays <= 82.50
                             |--- balance <= 98.00
                                |--- class: yes
                             --- balance > 98.00
                                 --- month jun <= 0.50
                                    |--- class: no
                                 --- month jun > 0.50
                                    |--- age <= 43.00
                                        |--- class: yes
                                     --- age > 43.00
                                    | |--- class: no
                         --- pdays > 82.50
                             --- pdays <= 99.50
                                 |--- duration <= 86.50
                                     |---| pdays <= 93.50
                                       |--- class: no
                                    |--- pdays > 93.50
                                       |--- class: yes
                                 --- duration > 86.50
                                    |--- class: yes
                              -- pdays > 99.50
                                 --- housing yes <= 0.50
                                     |---| day <= 13.50
                                         --- pdays <= 182.50
                                            |--- class: no
                                         --- pdays > 182.50
                                            |--- truncated branch of
depth 2
                                    |--- day > 13.50
                                        |--- previous <= 6.00
                                         | |--- truncated branch of
depth 5
```

```
--- previous > 6.00
                                          |--- class: no
                                |--- housing_yes > 0.50
                                   |--- class: yes
                     --- contact telephone > 0.50
                       |--- class: no
                 --- duration > 145.50
                    |--- class: no
                duration > 147.00
                 --- previous <= 21.00
                    |---| pdays <= 508.00
                        |--- campaign \leq 3.50
                            --- age <= 47.50
                                |--- pdays <= 82.50
                                    |--- pdays <= 81.00
                                        |--- month may <= 0.50
                                            |--- class: yes
                                        --- month_may > 0.50
                                            |--- truncated branch of
depth 2
                                     --- pdays > 81.00
                                     |--- class: no
                                     pdays > 82.50
                                     --- age <= 39.50
                                        |--- month aug <= 0.50
                                            |--- class: yes
                                         --- month aug > 0.50
                                            |--- truncated branch of
depth 3
                                     --- age > 39.50
                                         --- balance <= 803.00
                                            |--- truncated branch of
depth 2
                                         --- balance > 803.00
                                        | |--- class: yes
                                age > 47.50
                                 --- month_jun <= 0.50
                                     --- marital single <= 0.50
                                        --- job unknown <= 0.50
                                            |--- truncated branch of
depth 4
                                         --- job unknown > 0.50
                                          |--- class: no
                                     --- marital single > 0.50
                                       I--- class: no
                                    month_jun > 0.50
                                    |--- pdays <= 81.50
                                        |--- class: yes
                                     --- pdays > 81.50
```

```
|  |  |--- class: no
                          --- campaign > 3.50
                             |--- duration <= 160.00
                                 |--- class: no
                              --- duration > 160.00
                                 |--- day <= 6.00
                                    |--- class: no
                                  --- day > 6.00
                                  |--- class: yes
                     --- pdays > 508.00
                        |--- class: no
                 --- previous > 21.00
                    |--- class: no
 --- duration > 251.50
    |--- duration <= 474.50
        --- contact unknown <= 0.50
            |--- poutcome success <= 0.50
                 |--- housing_yes <= 0.50
                     --- loan yes \leq 0.50
                          --- \overline{\text{month}} aug <= 0.50
                             |--- month jul <= 0.50
                                 |--- month jan <= 0.50
                                     |--- month nov \leq 0.50
                                         |--- day <= 14.50
                                             |--- truncated branch of
depth 12
                                           -- day > 14.50
                                             |--- truncated branch of
depth 12
                                       -- month nov > 0.50
                                          --- day <= 16.50
                                             |--- truncated branch of
depth 4
                                          --- day > 16.50
                                            |--- truncated branch of
depth 9
                                     month jan > 0.50
                                      --- day <= 27.50
                                         |--- class: yes
                                      --- day > 27.50
                                          --- balance <= -248.50
                                             |--- class: yes
                                          --- balance > -248.50
                                           |--- truncated branch of
depth 5
                                 month_jul > 0.50
                                  --- duration <= 308.50
                                     |--- age <= 60.50
                                          --- education unknown <= 0.50
                                             |--- truncated branch of
```

```
depth 6
                                        |--- education unknown > 0.50
                                            |--- truncated branch of
depth 2
                                     --- age > 60.50
                                        |--- class: yes
                                     duration > 308.50
                                     --- day <= 8.50
                                         --- campaign <= 6.00
                                            |--- truncated branch of
depth 2
                                         --- campaign > 6.00
                                         |--- class: no
                                        day > 8.50
                                         --- duration <= 422.00
                                            |--- truncated branch of
depth 6
                                         |--- duration > 422.00
                                        | |--- class: yes
                             month_aug > 0.50
                             --- campaign <= 1.50
                                 --- day \leq 21.50
                                    |--- duration <= 341.00
                                         --- duration <= 310.00
                                            |--- truncated branch of
depth 5
                                          -- duration > 310.00
                                            |--- truncated branch of
depth 3
                                     --- duration > 341.00
                                    | |--- class: yes
                                 --- day > 21.50
                                     --- balance <= 1036.50
                                        |--- class: no
                                     --- balance > 1036.50
                                        |--- class: yes
                                 campaign > 1.50
                                 --- age \leq 59.50
                                    |--- duration <= 361.50
                                        |---| pdays <= 152.00
                                            |--- truncated branch of
depth 10
                                         --- pdays > 152.00
                                            |--- class: yes
                                     --- duration > 361.50
                                         --- balance <= 2.50
                                            |--- class: no
                                         --- balance > 2.50
                                            |--- truncated branch of
```

```
depth 7
                                |--- age > 59.50
                                | |--- class: yes
                         loan yes > 0.50
                         --- duration <= 414.00
                             --- balance <= 116.00
                                |--- day <= 1.50
                                    |--- class: yes
                                 --- day > 1.50
                                   |--- class: no
                              -- balance > 116.00
                                 --- month sep <= 0.50
                                    |--- duration \leq 370.50
                                         --- age <= 61.50
                                            |--- truncated branch of
depth 5
                                         --- age > 61.50
                                         | |--- class: yes
                                     --- duration > 370.50
                                        |--- class: yes
                                 --- month sep > 0.50
                                    |--- class: yes
                         --- duration > 414.00
                            |--- campaign <= 3.50
                                |--- class: yes
                            --- campaign > 3.50
                              |--- class: no
                     housing_yes > 0.50
                         pdays <= 374.50
                         --- month_jun <= 0.50
                            |--- duration <= 392.50
                                |--- month mar <= 0.50
                                    |--- month sep \leq 0.50
                                         --- day <= 29.50
                                            |--- truncated branch of
depth 19
                                         --- day > 29.50
                                            |--- truncated branch of
depth 4
                                     --- month sep > 0.50
                                    | |--- class: yes
                                 --- month mar > 0.50
                                   |--- class: yes
                                duration > 392.50
                                 --- duration <= 460.00
                                    |--- job_blue-collar <= 0.50</pre>
                                         |--- duration <= 453.50
                                            |--- truncated branch of
depth 14
```

```
--- duration > 453.50
                                           |--- class: yes
                                        job blue-collar > 0.50
                                         --- balance <= 622.00
                                            I--- truncated branch of
depth 3
                                          -- balance > 622.00
                                            |--- truncated branch of
depth 4
                                  -- duration > 460.00
                                     --- balance <= 1227.00
                                        |--- job management <= 0.50
                                            |--- class: no
                                         --- job management > 0.50
                                            |--- truncated branch of
depth 2
                                        balance > 1227.00
                                        |--- previous <= 6.00
                                            |--- truncated branch of
depth 2
                                        |--- previous > 6.00
                                          |--- class: no
                         --- month_jun > 0.50
                             --- job services <= 0.50
                                |--- class: yes
                             --- job services > 0.50
                                |--- age <= 40.50
                                   |--- class: no
                                 --- age > 40.50
                                  |--- class: yes
                     --- pdays > 374.50
                        |--- class: yes
                poutcome_success > 0.50
                 --- previous <= 10.50
                     --- campaign <= 4.50
                         --- month jun <= 0.50
                             --- pdays <= 186.50
                                |--- month nov \leq 0.50
                                    |--- class: yes
                                 --- month_nov > 0.50
                                    |--- job_technician <= 0.50
                                        |--- class: yes
                                     --- job_technician > 0.50
                                        |--- pdays <= 92.50
                                           |--- class: yes
                                        --- pdays > 92.50
                                        | |--- class: no
                                pdays > 186.50
                                |--- age <= 74.50
```

```
--- month jan <= 0.50
                                         |--- day| <= 2.50
                                             |--- truncated branch of
depth 2
                                         |--- day > 2.50
                                             |--- class: yes
                                      --- month jan > 0.50
                                         --- job_retired <= 0.50
                                             |--- class: no
                                         |--- job_retired > 0.50
                                           |--- class: yes
                                 --- age > 74.50
                                     |--- previous <= 5.00
                                         |--- class: no
                                     --- previous > 5.00
                                         |--- class: yes
                         --- month_jun > 0.50
                             --- previous <= 6.50
                                 --- balance <= 4454.00
                                     --- balance <= 219.50
                                         |--- job blue-collar <= 0.50</pre>
                                             |--- class: yes
                                          --- job blue-collar > 0.50
                                           |--- class: no
                                      --- balance > 219.50
                                       |--- class: yes
                                  --- balance > 4454.00
                                    |--- class: no
                             --- previous > 6.50
                                |--- class: no
                     --- campaign > 4.50
                         --- balance <= 3110.50
                            |--- class: yes
                         --- balance > 3110.50
                            |--- class: no
                     previous > 10.50
                     --- marital married <= 0.50
                        |--- class: yes
                     --- marital married > 0.50
                       |--- class: no
             contact unknown > 0.50
             --- poutcome unknown <= 0.50
                |--- class: yes
             --- poutcome unknown > 0.50
                |--- month oct <= 0.50
                    |--- duration <= 380.50
                        |--- month nov \leq 0.50
                            |---| age <= 50.50
                                |--- class: no
```

```
-- age > 50.50
                                 --- job services <= 0.50
                                    |--- age <= 51.50
                                        |--- month may <= 0.50
                                           |--- class: yes
                                         --- month_may > 0.50
                                         |--- class: no
                                     --- age > 51.50
                                        |--- class: no
                                 --- job services > 0.50
                                    |--- class: yes
                         --- month_nov > 0.50
                            --- job_retired <= 0.50
                                |--- class: yes
                             --- job_retired > 0.50
                               |--- class: no
                     --- duration > 380.50
                         --- default yes <= 0.50
                             --- job entrepreneur <= 0.50
                                 --- duration <= 472.50
                                     --- day <= 2.50
                                        |--- class: yes
                                     --- day > 2.50
                                         --- campaign <= 1.50
                                          |--- truncated branch of
depth 5
                                         --- campaign > 1.50
                                          |--- truncated branch of
depth 6
                                 --- duration > 472.50
                                | |--- class: yes
                             --- job_entrepreneur > 0.50
                                |--- class: yes
                         --- default yes > 0.50
                            |--- class: yes
                --- month_oct > 0.50
                   |--- class: yes
        duration > 474.50
         --- duration <= 648.50
             --- contact unknown <= 0.50
                --- poutcome success <= 0.50
                    |--- month nov <= 0.50
                        |--- month_jul <= 0.50
                            |--- month_jun <= 0.50
                                |--- duration <= 609.50
                                    \mid ---  housing yes \leq 0.50
                                        |--- duration <= 604.50
                                          |--- truncated branch of
depth 12
```

duration > 604.50		
depth 10		age <= 35.50
depth 10	depth 8	
	depth 10	
		age <= 62.00
	depth 5	
depth 5		pdays <= 185.50 class: no pdays > 185.50 class: yes nth_jun > 0.50 - class: yes jul > 0.50 - blue-collar <= 0.50 - balance <= 1933.00 age <= 32.50 class: no
		truncated branch of
	depth 5	1 22 50
		job_management <= 0.50
<pre>depth 3 </pre>	depth 9	
	depth 3	The change of the control of
		duration <= 502.00

```
--- campaign > 6.50
                                         --- duration <= 585.00
                                             |--- class: no
                                         --- duration > 585.00
                                            |--- class: yes
                                 --- education_tertiary > 0.50
                                   |--- class: no
                        month nov > 0.50
                         --- duration <= 629.00
                             |---| day <= 19.50
                                 |--- contact telephone <= 0.50
                                     |--- balance <= 55.00
                                         |--- class: no
                                     --- balance > 55.00
                                         |--- previous <= 1.50
                                             |--- truncated branch of
depth 6
                                         --- previous > 1.50
                                           |--- truncated branch of
depth 2
                                 --- contact telephone > 0.50
                             | |--- class: yes
--- day > 19.50
                                 --- balance <= 12433.50
                                     --- balance <= 734.50
                                         |--- balance <= 174.00
                                            |--- class: yes
                                         --- balance > 174.00
                                            I--- truncated branch of
depth 2
                                     |--- balance > 734.50
                                    | |--- class: yes
                                 --- balance > 12433.50
                                    |--- job_management <= 0.50
                                         |--- class: no
                                     |--- job management > 0.50
                                       |--- class: yes
                         --- duration > 629.00
                             --- duration <= 642.50
                                |--- class: no
                             --- duration > 642.50
                                |--- age <= 32.50
                                   |--- class: no
                                 --- age > 32.50
                                | |--- class: yes
                     poutcome_success > 0.50
                     --- job_student <= 0.50
                        |--- balance <= 13362.50
                            |---| day <= 3.50
```

```
--- month jul <= 0.50
                    |--- class: no
                 --- month_jul > 0.50
                   |--- class: yes
             --- day > 3.50
                 --- pdays <= 67.50
                    |---| pdays <= 57.00
                        |--- class: yes
                     --- pdays > 57.00
                       |--- class: no
                 --- pdays > 67.50
                  |--- class: yes
         --- balance > 13362.50
            |--- class: no
        job_student > 0.50
         --- duration <= 526.50
            |--- class: no
         --- duration > 526.50
           |--- class: yes
contact unknown > 0.50
--- month may <= 0.50
    --- balance <= 2910.50
         --- balance <= 273.50
            |--- job entrepreneur <= 0.50
                 --- day \leq 3.50
                    |--- campaign <= 2.50
                        --- balance <= 136.00
                           |--- class: no
                        |--- balance > 136.00
                           |--- class: yes
                     --- campaign > 2.50
                        |--- class: yes
                 --- day > 3.50
                     --- age <= 50.50
                        |--- class: yes
                     --- age > 50.50
                        |--- duration <= 540.00
                           |--- class: yes
                        --- duration > 540.00
                           |--- class: no
            |--- job_entrepreneur > 0.50
               |--- class: no
         --- balance > 273.50
             --- campaign \leq 2.50
                |--- class: yes
             --- campaign > 2.50
                |--- balance <= 2076.50
                   |--- duration <= 597.00
                        |--- class: yes
```

```
--- duration > 597.00
                                        --- age <= 38.00
                                            |--- class: no
                                         --- age > 38.00
                                           |--- class: yes
                                 --- balance > 2076.50
                                   |--- class: no
                        balance > 2910.50
                        |--- marital married <= 0.50
                            |--- class: yes
                         --- marital married > 0.50
                            |--- class: no
                    month_may > 0.50
                        balance <= 1488.50
                         --- age <= 57.50
                            |--- duration <= 519.00
                                |--- education unknown <= 0.50
                                    |--- balance <= 791.50
                                         --- duration <= 485.50
                                            |--- truncated branch of
depth 2
                                           - duration > 485.50
                                            |--- truncated branch of
depth 3
                                     --- balance > 791.50
                                    | |--- class: yes
                                 --- education unknown > 0.50
                                  |--- class: yes
                               - duration > 519.00
                                 --- balance <= -439.50
                                    |--- class: no
                                 --- balance > -439.50
                                    |--- balance <= 57.00
                                        |--- age <= 42.50
                                           |--- class: yes
                                         --- age > 42.50
                                            |--- truncated branch of
depth 2
                                      -- balance > 57.00
                                        --- age <= 51.50
                                            |--- truncated branch of
depth 5
                                        |--- age > 51.50
                                         |--- class: no
                         --- age > 57.50
                            |--- class: no
                        balance > 1488.50
                         --- balance <= 4907.50
                            |--- class: no
```

```
|---| balance > 4907.50
                        | |--- class: yes
         --- duration > 648.50
             --- balance <= 19640.00
                |--- day| <= 3.50
                    |--- pdays <= 201.50
                         --- job self-employed <= 0.50
                             --- job_management <= 0.50
                                |--- month oct <= 0.50
                                    |---| age <= 42.50
                                         |--- job housemaid <= 0.50
                                            |--- truncated branch of
depth 5
                                         --- job_housemaid > 0.50
                                           |--- class: no
                                     --- age > 42.50
                                       |--- class: yes
                                 --- month_oct > 0.50
                                    |--- class: no
                                job management > 0.50
                                 --- education tertiary <= 0.50
                                    |--- class: no
                                 --- education tertiary > 0.50
                                    |--- campaign <= 4.00
                                        |--- class: yes
                                    |--- campaign > 4.00
                                        |--- class: no
                         --- job self-employed > 0.50
                            |--- class: no
                         pdays > 201.50
                         --- pdays <= 266.50
                            |--- class: no
                         --- pdays > 266.50
                            |--- day| <= 2.50
                               |--- class: yes
                             --- day > 2.50
                               |--- class: no
                 --- day > 3.50
                     --- duration <= 922.50
                         --- balance <= 1911.00
                             --- balance <= 1841.50
                                |--- marital married <= 0.50
                                    |--- poutcome other <= 0.50
                                         --- duration <= 915.50
                                             |--- truncated branch of
depth 13
                                         --- duration > 915.50
                                           |--- class: no
                                        poutcome_other > 0.50
```

			duration <= 817.50 truncated branch of
depth 2			
depth 13			month_feb > 0.50
 depth 4			truncated branch of
			<pre> pdays > 4.00 job_self-employed <= 0.50 truncated branch of</pre>
depth 4		 	l l ich solf omployed > 0 E0
			job_self-employed > 0.50 class: no ance > 1841.50 month_aug <= 0.50 class: no month_aug > 0.50 class: yes > 1911.00 <= 14.50 age <= 69.50 class: yes age > 69.50 age <= 70.50 class: no class: yes > 14.50 day <= 17.50 campaign <= 2.50 class: no duration > 709.00
			truncated branch of
depth 3			2.50
			campaign > 2.50
l I I	1 1		duration > 920.50
			duration > 920.50 truncated branch of

```
depth 2
                                     --- job self-employed > 0.50
                                         --- day <= 27.50
                                            |--- class: no
                                         --- day > 27.50
                                           |--- class: yes
                        duration > 922.50
                         --- duration <= 1081.50
                             --- previous <= 7.50
                                |--- month oct \leq 0.50
                                     --- balance <= -685.50
                                         --- age <= 35.00
                                            |--- class: no
                                         --- age > 35.00
                                           |--- class: yes
                                        balance > -685.50
                                         --- contact unknown <= 0.50
                                            |--- truncated branch of
depth 5
                                           - contact unknown > 0.50
                                            |--- truncated branch of
depth 6
                                     month oct > 0.50
                                     --- job retired <= 0.50
                                        |--- class: no
                                    |---| job retired > 0.50
                                    | |--- class: yes
                                 previous > 7.50
                                 --- marital single <= 0.50
                                    |--- class: no
                                 --- marital single > 0.50
                                | |--- class: yes
                             duration > 1081.50
                             --- age <= 64.50
                                |--- duration <= 1083.50
                                    |--- balance <= 155.00
                                        |--- class: yes
                                     --- balance > 155.00
                                        |--- class: no
                                     duration > 1083.50
                                    |--- pdays <= 315.00
                                         --- age <= 30.50
                                            |--- truncated branch of
depth 3
                                         --- age > 30.50
                                            |--- truncated branch of
depth 19
                                      -- pdays > 315.00
                                        |--- age <= 30.00
```

·
balance > 19640.00
class: no