

telecom churn prediction Part 2 Feature (transformation, Scaling, feature selection,model building)

```
In [1]: #Load necessary Libraries

import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np
```

```
In [2]: df=pd.read_csv('df_part_1_completed.csv')
```

```
In [6]: df.head()
```

```
Out[6]:
```

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	MultipleLines	Inte
0	7590-VHVEG	Female	0	Yes	No	1	No	No phone service	
1	5575-GNVDE	Male	0	No	No	34	Yes	No	
2	3668-QPYBK	Male	0	No	No	2	Yes	No	
3	7795-CFOCW	Male	0	No	No	45	No	No phone service	
4	9237-HQITU	Female	0	No	No	2	Yes	No	

5 rows × 21 columns

Lets not include customerID column in train test split- this is not required for model buidling

Yes, it is generally recommended to perform the train-test split before encoding categorical variables. The train-test split is typically done to separate the dataset into two subsets: one for training the model and the other for evaluating its performance.

```
In [3]: from sklearn.model_selection import train_test_split
```

```
In [4]: X=df.iloc[:,1:-1]
        y=df.iloc[:, -1]
```

```
In [5]: X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.30, random_state=42)
```

```
In [6]: #All shapes Look fine
        X_train.shape,X_test.shape,y_train.shape,y_test.shape
```

```
Out[6]: ((4930, 19), (2113, 19), (4930,), (2113,))
```

Lets also change No Phone service and No Internet service to No (to make things simple)

We can do this because No internet service mean - person is also not taking other service like online backup, device protecton,streaming services

```
In [7]: X_train.replace('No internet service', 'No', inplace=True)
        X_train.replace('No phone service', 'No', inplace=True)
```

```
In [242... X_train.head(5)
```

```
Out[242]:
```

	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	MultipleLines	InternetService
1695	Male	0	Yes	Yes	54	Yes	Yes	D
1095	Male	0	No	No	1	Yes	No	Fiber opt
3889	Male	0	No	No	13	Yes	No	N
3667	Female	1	Yes	Yes	24	Yes	No	Fiber opt
2902	Female	1	No	No	6	Yes	No	Fiber opt

```
In [8]: X_test.replace('No internet service', 'No', inplace=True)
        X_test.replace('No phone service', 'No', inplace=True)
```

```
In [ ]:
```

Feature engg

1. Feature Transformation

```
In [10]: X_train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 4930 entries, 1695 to 860
Data columns (total 19 columns):
#   Column                Non-Null Count  Dtype
---  -
0   gender                 4930 non-null   object
1   SeniorCitizen          4930 non-null   int64
2   Partner                4930 non-null   object
3   Dependents             4930 non-null   object
4   tenure                 4930 non-null   int64
5   PhoneService           4930 non-null   object
6   MultipleLines          4930 non-null   object
7   InternetService        4930 non-null   object
8   OnlineSecurity         4930 non-null   object
9   OnlineBackup           4930 non-null   object
10  DeviceProtection       4930 non-null   object
11  TechSupport            4930 non-null   object
12  StreamingTV            4930 non-null   object
13  StreamingMovies        4930 non-null   object
14  Contract               4930 non-null   object
15  PaperlessBilling       4930 non-null   object
16  PaymentMethod          4930 non-null   object
17  MonthlyCharges         4930 non-null   float64
18  TotalCharges           4930 non-null   float64
dtypes: float64(2), int64(2), object(15)
memory usage: 770.3+ KB
```

* All object column (except contract) can be converted using nominal encoding(one hot encoding using sparse_output =True as our data is value is going to have lot of 0 values after this

* Contract column will be converted using ordinal encoding as it is containing order in the data

* Churn column will be converted using label encoder

* Lets use column transformer to do within a single command

Implementation: One-Hot Encoding is a general concept that can be implemented using different libraries or frameworks. In scikit-learn, the OneHotEncoder class is used to perform One-Hot Encoding. On the other hand, get_dummies() is a specific function provided by the pandas library, which simplifies the process of creating dummy variables.

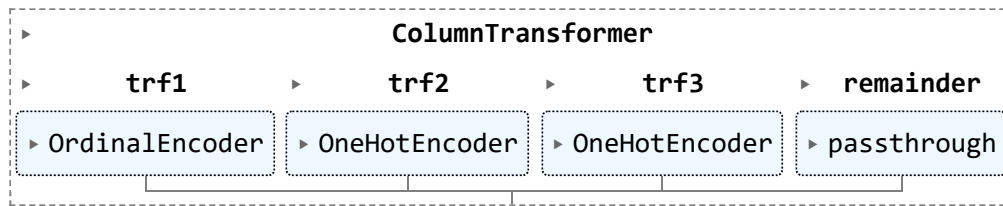
Handling categorical variable

```
In [9]: from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OrdinalEncoder , OneHotEncoder , LabelEncoder
```

```
In [10]: transformer = ColumnTransformer(transformers=[
    ("trf1",OrdinalEncoder(categories=[['Month-to-month', 'One year', 'Two year']]),
    ("trf2",OneHotEncoder(sparse_output=True,drop='first',dtype='int64'),['gender', 'F
    ("trf3",OneHotEncoder(sparse_output=True,drop=None,dtype='int64'),['InternetService
],remainder='passthrough')

transformer
```

Out[10]:



```
In [11]: transformer.fit_transform(X_train)
transformer.fit_transform(X_test)
column_names=transformer.get_feature_names_out()
column_names
```

```
Out[11]: array(['trf1_Contract', 'trf2_gender_Male', 'trf2_Partner_Yes',
        'trf2_Dependents_Yes', 'trf2_PhoneService_Yes',
        'trf2_MultipleLines_Yes', 'trf2_OnlineSecurity_Yes',
        'trf2_OnlineBackup_Yes', 'trf2_DeviceProtection_Yes',
        'trf2_TechSupport_Yes', 'trf2_StreamingTV_Yes',
        'trf2_StreamingMovies_Yes', 'trf2_PaperlessBilling_Yes',
        'trf2_PaymentMethod_Credit card (automatic)',
        'trf2_PaymentMethod_Electronic check',
        'trf2_PaymentMethod_Mailed check', 'trf3_InternetService_DSL',
        'trf3_InternetService_Fiber optic', 'trf3_InternetService_No',
        'remainder_SeniorCitizen', 'remainder_tenure',
        'remainder_MonthlyCharges', 'remainder_TotalCharges'],
        dtype=object)
```

```
In [12]: X_train=pd.DataFrame(transformer.fit_transform(X_train),columns=column_names)
X_train
```

Out[12]:

	trf1_Contract	trf2_gender_Male	trf2_Partner_Yes	trf2_Dependents_Yes	trf2_PhoneService_Yes
0	1.0	1.0	1.0	1.0	1.
1	0.0	1.0	0.0	0.0	1.
2	1.0	1.0	0.0	0.0	1.
3	2.0	0.0	1.0	1.0	1.
4	0.0	0.0	0.0	0.0	1.
...	
4925	0.0	1.0	1.0	0.0	1.
4926	2.0	0.0	1.0	1.0	1.
4927	0.0	1.0	1.0	1.0	1.
4928	0.0	1.0	0.0	0.0	1.
4929	1.0	1.0	0.0	0.0	1.

4930 rows × 23 columns

```
In [13]: X_test=pd.DataFrame(transformer.fit_transform(X_test),columns=column_names)
X_test
```

Out[13]:

	trf1_Contract	trf2_gender_Male	trf2_Partner_Yes	trf2_Dependents_Yes	trf2_PhoneService_Yes
0	0.0	0.0	1.0	0.0	0.0
1	0.0	1.0	0.0	0.0	1.0
2	2.0	0.0	1.0	1.0	1.0
3	0.0	0.0	0.0	0.0	1.0
4	2.0	1.0	0.0	0.0	1.0
...
2108	0.0	0.0	0.0	0.0	1.0
2109	0.0	1.0	0.0	0.0	0.0
2110	2.0	1.0	1.0	1.0	1.0
2111	0.0	1.0	0.0	0.0	1.0
2112	0.0	1.0	1.0	1.0	1.0

2113 rows × 23 columns

2. Feature Construction

```
In [20]: #cross val score prior to feature construction
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import cross_val_score
from sklearn.metrics import accuracy_score
#np.mean(cross_val_score(LogisticRegression(),X_train,y_train,scoring='accuracy',cv=20))
```

a. Grouping existing features(partner and dependents) in dataset and create new feature family type(alone, couple, large family) -Also test whehter it is improving the performance of model)

```
In [15]: X_train_reduced=X_train.copy()
X_test_reduced = X_test.copy()
```

```
In [16]: def myfunc(num):
    if num == 1.0:
        #alone
        return 0.0
    elif num ==2.0:
        # couple
        return 1.0
    else:
```

```
# large family
return 2.0
```

```
In [17]: X_train_reduced.insert(4,'Family_size', X_train_reduced['trf2__Partner_Yes'] + X_train_reduced['trf2__Dependents_Yes'])
X_test_reduced.insert(4,'Family_size', X_test_reduced['trf2__Partner_Yes'] + X_test_reduced['trf2__Dependents_Yes'])

X_train_reduced.insert(5,'Family_Type', X_train_reduced['Family_size'].apply(myfunc))
X_test_reduced.insert(5,'Family_Type', X_test_reduced['Family_size'].apply(myfunc))

X_train_reduced.drop(columns=['trf2__Partner_Yes','trf2__Dependents_Yes','Family_size'])
X_test_reduced.drop(columns=['trf2__Partner_Yes','trf2__Dependents_Yes','Family_size'])
```

```
In [21]: lr = LogisticRegression()
lr_reduced = LogisticRegression()
lr.fit(X_train,y_train)
lr_reduced.fit(X_train_reduced,y_train)

y_pred = lr.predict(X_test)
y_pred_reduced = lr_reduced.predict(X_test_reduced)

print("Actual",accuracy_score(y_test,y_pred))
print("Scaled",accuracy_score(y_test,y_pred_reduced))
```

Actual 0.8088026502602934

Scaled 0.8078561287269286

C:\Users\rupeshv\Anaconda3\envs\rup_venv\lib\site-packages\sklearn\linear_model_logistic.py:458: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:

<https://scikit-learn.org/stable/modules/preprocessing.html>

Please also refer to the documentation for alternative solver options:

https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression

n_iter_i = _check_optimize_result(

Lets not choose for now - above addition of new column family size and drop of depenent and partner column - as accuracy is reducing a little

```
In [22]: #
#Let check performance after adding customer_usage

X_train_reduced=X_train.copy()
X_test_reduced = X_test.copy()
X_train_reduced.insert(20,'customer_services_enrolled', X_train_reduced['trf2__PhoneService'])
X_test_reduced.insert(20,'customer_services_enrolled', X_test_reduced['trf2__PhoneService'])

lr = LogisticRegression()
lr_reduced = LogisticRegression()
lr.fit(X_train,y_train)
lr_reduced.fit(X_train_reduced,y_train)

y_pred = lr.predict(X_test)
y_pred_reduced = lr_reduced.predict(X_test_reduced)

print("Actual",accuracy_score(y_test,y_pred))
print("Scaled",accuracy_score(y_test,y_pred_reduced))
```

Actual 0.8088026502602934
 Scaled 0.8111689540937056

C:\Users\rupeshv\Anaconda3\envs\rup_venv\lib\site-packages\sklearn\linear_model_logistic.py:458: ConvergenceWarning: lbfgs failed to converge (status=1):
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<https://scikit-learn.org/stable/modules/preprocessing.html>
 Please also refer to the documentation for alternative solver options:
https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
 n_iter_i = _check_optimize_result(

Addition of Customer usage - is increasing performacne - this is tested above
 with logistic regression - Lets include in main dataset

b. Create new column customer_usage in dataset

In [263... X_train.head(5)

Out[263]:

	trf1_Contract	trf2_gender_Male	Family_Type	trf2_PhoneService_Yes	trf2_MultipleLines_Yes	trf2
0	1.0	1.0	2.0	1.0	1.0	
1	0.0	1.0	0.0	1.0	0.0	
2	1.0	1.0	0.0	1.0	0.0	
3	2.0	0.0	2.0	1.0	0.0	
4	0.0	0.0	0.0	1.0	0.0	

5 rows × 22 columns

In [277... #X_train.drop(columns=['customer_services_enrolled'], inplace=True)

In [23]: X_train.insert(20, 'customer_services_enrolled', X_train['trf2_PhoneService_Yes'] + X_train['trf2_MultipleLines_Yes'])
 X_test.insert(20, 'customer_services_enrolled', X_test['trf2_PhoneService_Yes'] + X_test['trf2_MultipleLines_Yes'])

In [24]: pd.set_option('display.max_columns', None) # Show all columns
 X_train.head(10)

Out[24]:

	trf1_Contract	trf2_gender_Male	trf2_Partner_Yes	trf2_Dependents_Yes	trf2_PhoneService_Yes	1
0	1.0	1.0	1.0	1.0	1.0	
1	0.0	1.0	0.0	0.0	1.0	
2	1.0	1.0	0.0	0.0	1.0	
3	2.0	0.0	1.0	1.0	1.0	
4	0.0	0.0	0.0	0.0	1.0	
5	0.0	1.0	1.0	0.0	1.0	
6	1.0	0.0	0.0	0.0	1.0	
7	0.0	1.0	0.0	0.0	0.0	
8	2.0	0.0	1.0	1.0	0.0	
9	1.0	1.0	1.0	1.0	1.0	



In []:

b. feature scaling

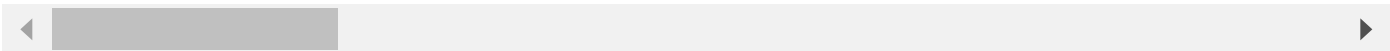
In [194...

X_train

Out[194]:

	trf1_Contract	trf2_gender_Male	trf2_Partner_Yes	trf2_Dependents_Yes	trf2_PhoneService_Yes	1
0	1.0	1.0	1.0	1.0	1.0	1.
1	0.0	1.0	0.0	0.0	1.0	1.
2	1.0	1.0	0.0	0.0	1.0	1.
3	2.0	0.0	1.0	1.0	1.0	1.
4	0.0	0.0	0.0	0.0	1.0	1.
...	
4925	0.0	1.0	1.0	0.0	1.0	1.
4926	2.0	0.0	1.0	1.0	1.0	1.
4927	0.0	1.0	1.0	1.0	1.0	1.
4928	0.0	1.0	0.0	0.0	1.0	1.
4929	1.0	1.0	0.0	0.0	1.0	1.

4930 rows × 29 columns



StandardScaler


```
In [30]: from sklearn.preprocessing import StandardScaler

scaler = StandardScaler()

# fit the scaler to the train set, it will learn the parameters
scaler.fit(X_train)

# transform train and test sets
X_train_scaled = scaler.transform(X_train)
X_test_scaled = scaler.transform(X_test)
X_train_scaled = pd.DataFrame(X_train_scaled, columns=X_train.columns)
X_test_scaled = pd.DataFrame(X_test_scaled, columns=X_test.columns)

lr = LogisticRegression()
lr_scaled = LogisticRegression()

lr.fit(X_train,y_train)
lr_scaled.fit(X_train_scaled,y_train)

y_pred = lr.predict(X_test)
y_pred_scaled = lr_scaled.predict(X_test_scaled)

print("Actual",accuracy_score(y_test,y_pred))
print("Scaled",accuracy_score(y_test,y_pred_scaled))
```

Actual 0.8111689540937056

Scaled 0.812588736393753

C:\Users\rupeshv\Anaconda3\envs\rup_venv\lib\site-packages\sklearn\linear_model_logistic.py:458: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:

<https://scikit-learn.org/stable/modules/preprocessing.html>

Please also refer to the documentation for alternative solver options:

https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression

n_iter_i = _check_optimize_result(

Lets try other scaling tech - Min-Max scaler

```
In [36]: from sklearn.preprocessing import MinMaxScaler

scaler = MinMaxScaler()

# fit the scaler to the train set, it will learn the parameters
scaler.fit(X_train)

# transform train and test sets
X_train_scaled = scaler.transform(X_train)
X_test_scaled = scaler.transform(X_test)
X_train_scaled = pd.DataFrame(X_train_scaled, columns=X_train.columns)
X_test_scaled = pd.DataFrame(X_test_scaled, columns=X_test.columns)

lr = LogisticRegression()
lr_scaled = LogisticRegression()

lr.fit(X_train,y_train)
```

```
lr_scaled.fit(X_train_scaled,y_train)

y_pred = lr.predict(X_test)
y_pred_scaled = lr_scaled.predict(X_test_scaled)

print("Actual",accuracy_score(y_test,y_pred))
print("Scaled",accuracy_score(y_test,y_pred_scaled))
```

Actual 0.8111689540937056

Scaled 0.812588736393753

C:\Users\rupeshv\Anaconda3\envs\rup_venv\lib\site-packages\sklearn\linear_model_logistic.py:458: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:

<https://scikit-learn.org/stable/modules/preprocessing.html>

Please also refer to the documentation for alternative solver options:

https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression

n_iter_i = _check_optimize_result(

Lets try other scaling tech - MaxAbs scaling

In [28]: `from sklearn.preprocessing import MaxAbsScaler`

```
scaler = MaxAbsScaler()

# fit the scaler to the train set, it will learn the parameters
scaler.fit(X_train)

# transform train and test sets
X_train_scaled = scaler.transform(X_train)
X_test_scaled = scaler.transform(X_test)
X_train_scaled = pd.DataFrame(X_train_scaled, columns=X_train.columns)
X_test_scaled = pd.DataFrame(X_test_scaled, columns=X_test.columns)

lr = LogisticRegression()
lr_scaled = LogisticRegression()

lr.fit(X_train,y_train)
lr_scaled.fit(X_train_scaled,y_train)

y_pred = lr.predict(X_test)
y_pred_scaled = lr_scaled.predict(X_test_scaled)

print("Actual",accuracy_score(y_test,y_pred))
print("Scaled",accuracy_score(y_test,y_pred_scaled))
```

Actual 0.8111689540937056

Scaled 0.812588736393753

```
C:\Users\rupeshv\Anaconda3\envs\rup_venv\lib\site-packages\sklearn\linear_model\_logistic.py:458: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.
```

Increase the number of iterations (max_iter) or scale the data as shown in:

<https://scikit-learn.org/stable/modules/preprocessing.html>

Please also refer to the documentation for alternative solver options:

https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression

```
n_iter_i = _check_optimize_result(
```

Lets try other scaling tech - Robust scaling

- The RobustScaler is a preprocessing technique in scikit-learn that is used to scale features using statistics that are robust to outliers. It is particularly useful when the data contains outliers or is not normally distributed.

```
In [34]: from sklearn.preprocessing import RobustScaler

scaler = RobustScaler()

# fit the scaler to the train set, it will learn the parameters
scaler.fit(X_train)

# transform train and test sets
X_train_scaled = scaler.transform(X_train)
X_test_scaled = scaler.transform(X_test)
X_train_scaled = pd.DataFrame(X_train_scaled, columns=X_train.columns)
X_test_scaled = pd.DataFrame(X_test_scaled, columns=X_test.columns)

lr = LogisticRegression()
lr_scaled = LogisticRegression()

lr.fit(X_train,y_train)
lr_scaled.fit(X_train_scaled,y_train)

y_pred = lr.predict(X_test)
y_pred_scaled = lr_scaled.predict(X_test_scaled)

print("Actual",accuracy_score(y_test,y_pred))
print("Scaled",accuracy_score(y_test,y_pred_scaled))
```

Actual 0.8111689540937056

Scaled 0.8140085186938003

```
C:\Users\rupeshv\Anaconda3\envs\rup_venv\lib\site-packages\sklearn\linear_model\_logistic.py:458: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.
```

Increase the number of iterations (max_iter) or scale the data as shown in:

<https://scikit-learn.org/stable/modules/preprocessing.html>

Please also refer to the documentation for alternative solver options:

https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression

```
n_iter_i = _check_optimize_result(
```

0.8135352579271179 - Robust scaling and MinMax are giving good result as compared to other scaling techniques - Robust is causing negative values insome column - which is not required here as we will construt new features- so will choose Min-Max [0,1]

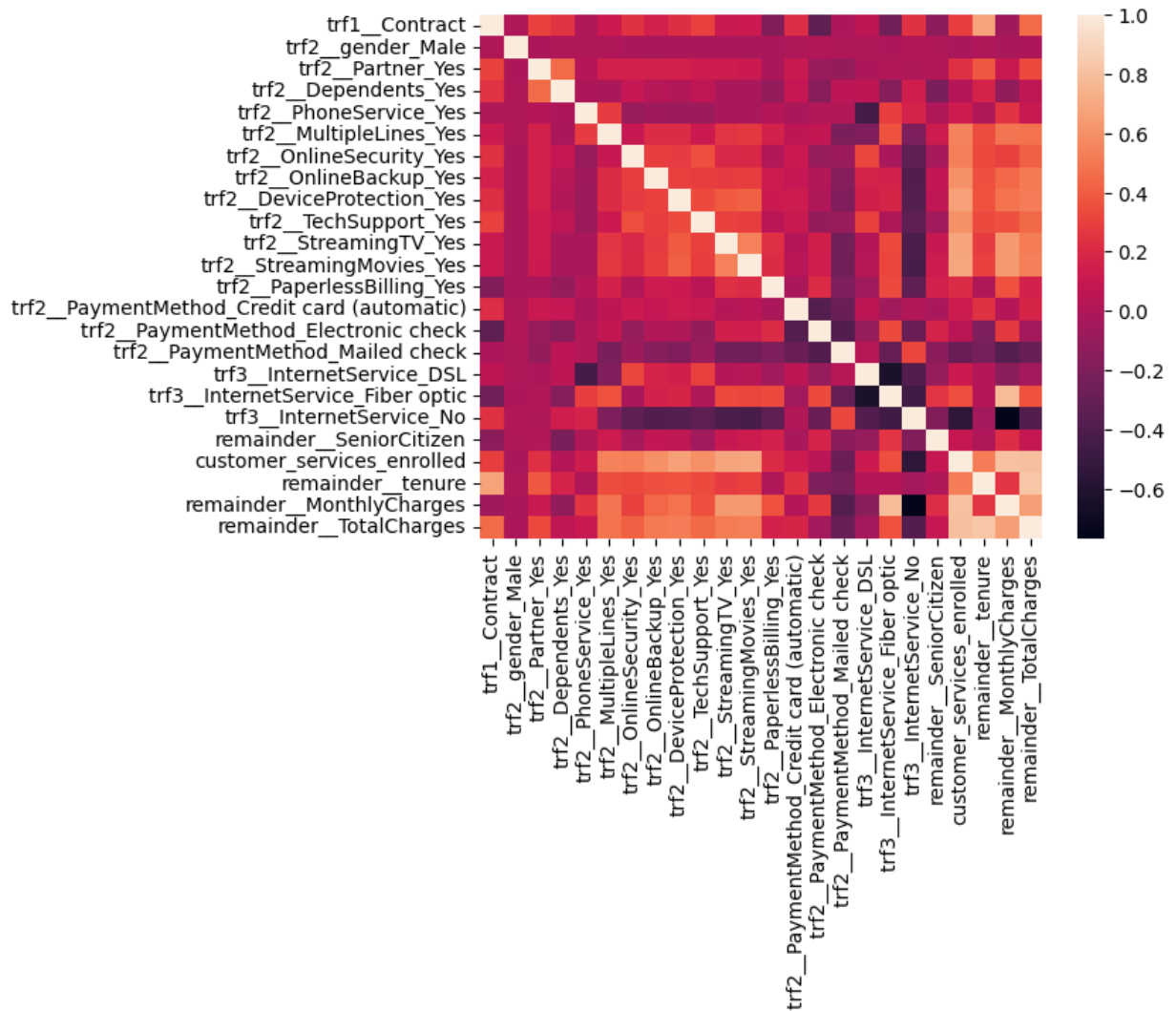
In []:

In [38]: `X_train_scaled.head(10)`

Out[38]:

	trf1_Contract	trf2_gender_Male	trf2_Partner_Yes	trf2_Dependents_Yes	trf2_PhoneService_Yes
0	0.5	1.0	1.0	1.0	1.0
1	0.0	1.0	0.0	0.0	1.0
2	0.5	1.0	0.0	0.0	1.0
3	1.0	0.0	1.0	1.0	1.0
4	0.0	0.0	0.0	0.0	1.0
5	0.0	1.0	1.0	0.0	1.0
6	0.5	0.0	0.0	0.0	1.0
7	0.0	1.0	0.0	0.0	0.0
8	1.0	0.0	1.0	1.0	0.0
9	0.5	1.0	1.0	1.0	1.0

In [40]: `sns.heatmap(X_train_scaled.corr())`Out[40]: `<AxesSubplot: >`



In []:

2. Feature extraction

```
In [52]: #first try with Ensemble methods - Random forest
from sklearn.ensemble import RandomForestClassifier
from sklearn.feature_selection import SelectFromModel
```

```
In [53]: rf=RandomForestClassifier(random_state=42)
```

```
In [54]: rf.fit(X_train_scaled,y_train)
```

```
Out[54]: RandomForestClassifier
RandomForestClassifier(random_state=42)
```

```
In [116... # Print the selected features
selected_features = feature_selector.get_support(indices=True)
for feature_idx in selected_features:
    print("Column",X_train_scaled.columns[feature_idx],"Feature importance value is",
```


Out[129]:

	trf1_Contract	customer_services_enrolled	remainder_tenure	remainder_MonthlyCharges	remainder_churn
0	0.5	0.625	0.750000	0.522671	
1	0.0	0.250	0.013889	0.620827	
2	0.5	0.125	0.180556	0.010463	
3	1.0	0.500	0.333333	0.780269	
4	0.0	0.250	0.083333	0.556552	
...
4925	0.0	0.500	0.013889	0.764823	
4926	1.0	1.000	0.319444	0.725959	
4927	0.0	0.125	0.166667	0.028899	
4928	0.0	0.625	0.166667	0.809168	
4929	0.5	0.125	0.361111	0.015446	

4930 rows × 5 columns



In []:

In []: *#Using decision tree - feature selection*

In [102... `from sklearn.tree import DecisionTreeClassifier`
`dt=DecisionTreeClassifier()`
`dt.fit(X_train_scaled,y_train)`

Out[102]: `DecisionTreeClassifier`
`DecisionTreeClassifier()`

In [103... `from sklearn.tree import plot_tree`
`plot_tree(dt)`

```

Out[103]: [Text(0.6280218089432851, 0.9821428571428571, 'x[0] <= 0.25\ngini = 0.387\nsamples =
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= 1213\nvalue = [866, 347]'),
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= [294, 216]'),
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s = 92\nvalue = [56, 36]'),
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Text(0.06037270907130756, 0.48214285714285715, 'x[23] <= 0.006\ngini = 0.43\nsamples = 16\nvalue = [11, 5]'),
Text(0.059140612967811486, 0.44642857142857145, 'x[7] <= 0.5\ngini = 0.337\nsamples = 14\nvalue = [11, 3]'),
Text(0.05667642076081934, 0.4107142857142857, 'x[22] <= 0.255\ngini = 0.165\nsamples = 11\nvalue = [10, 1]'),
Text(0.05544432465732327, 0.375, 'gini = 0.0\nsamples = 7\nvalue = [7, 0]'),
Text(0.05790851686431542, 0.375, 'x[15] <= 0.5\ngini = 0.375\nsamples = 4\nvalue = [3, 1]'),
Text(0.05667642076081934, 0.3392857142857143, 'gini = 0.0\nsamples = 3\nvalue = [3, 0]'),

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Text(0.059140612967811486, 0.3392857142857143, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.061604805174803635, 0.4107142857142857, 'x[23] <= 0.004\ngini = 0.444\nsample
s = 3\nvalue = [1, 2]'),
Text(0.06037270907130756, 0.375, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
Text(0.0628369012782997, 0.375, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.061604805174803635, 0.44642857142857145, 'gini = 0.0\nsamples = 2\nvalue =
[0, 2]'),
Text(0.0628369012782997, 0.48214285714285715, 'gini = 0.0\nsamples = 9\nvalue = [9,
0]'),
Text(0.07207762205452026, 0.5178571428571429, 'x[22] <= 0.252\ngini = 0.497\nsamples
= 26\nvalue = [14, 12]'),
Text(0.07084552595102418, 0.48214285714285715, 'x[22] <= 0.17\ngini = 0.496\nsamples
= 22\nvalue = [10, 12]'),
Text(0.06961342984752811, 0.44642857142857145, 'x[22] <= 0.069\ngini = 0.499\nsample
s = 19\nvalue = [10, 9]'),
Text(0.06653318958878793, 0.4107142857142857, 'x[23] <= 0.003\ngini = 0.444\nsamples
= 6\nvalue = [2, 4]'),
Text(0.06530109348529185, 0.375, 'x[20] <= 0.125\ngini = 0.444\nsamples = 3\nvalue =
[2, 1]'),
Text(0.06406899738179578, 0.3392857142857143, 'x[15] <= 0.5\ngini = 0.5\nsamples = 2
\nvalue = [1, 1]'),
Text(0.0628369012782997, 0.30357142857142855, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.06530109348529185, 0.30357142857142855, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.06653318958878793, 0.3392857142857143, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.067765285692284, 0.375, 'gini = 0.0\nsamples = 3\nvalue = [0, 3]'),
Text(0.07269367010626829, 0.4107142857142857, 'x[1] <= 0.5\ngini = 0.473\nsamples =
13\nvalue = [8, 5]'),
Text(0.07022947789927614, 0.375, 'x[9] <= 0.5\ngini = 0.346\nsamples = 9\nvalue =
[7, 2]'),
Text(0.06899738179578008, 0.3392857142857143, 'gini = 0.0\nsamples = 7\nvalue = [7,
0]'),
Text(0.07146157400277221, 0.3392857142857143, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
Text(0.07515786231326044, 0.375, 'x[22] <= 0.115\ngini = 0.375\nsamples = 4\nvalue =
[1, 3]'),
Text(0.07392576620976436, 0.3392857142857143, 'gini = 0.0\nsamples = 3\nvalue = [0,
3]'),
Text(0.07638995841675651, 0.3392857142857143, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.07207762205452026, 0.44642857142857145, 'gini = 0.0\nsamples = 3\nvalue = [0,
3]'),
Text(0.07330971815801633, 0.48214285714285715, 'gini = 0.0\nsamples = 4\nvalue = [4,
0]'),
Text(0.0897890035422763, 0.5892857142857143, 'x[23] <= 0.005\ngini = 0.495\nsamples
= 107\nvalue = [48, 59]'),
Text(0.0831664869859849, 0.5535714285714286, 'x[23] <= 0.005\ngini = 0.389\nsamples
= 34\nvalue = [9, 25]'),
Text(0.08008624672724472, 0.5178571428571429, 'x[23] <= 0.005\ngini = 0.49\nsamples
= 14\nvalue = [6, 8]'),
Text(0.07762205452025257, 0.48214285714285715, 'x[15] <= 0.5\ngini = 0.245\nsamples
= 7\nvalue = [1, 6]'),
Text(0.07638995841675651, 0.44642857142857145, 'x[12] <= 0.5\ngini = 0.444\nsamples
= 3\nvalue = [1, 2]'),
Text(0.07515786231326044, 0.4107142857142857, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.07762205452025257, 0.4107142857142857, 'gini = 0.0\nsamples = 2\nvalue = [0,

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2]'),
Text(0.07885415062374865, 0.44642857142857145, 'gini = 0.0\nsamples = 4\nvalue = [0,
4]'),
Text(0.08255043893423687, 0.48214285714285715, 'x[13] <= 0.5\ngini = 0.408\nsamples
= 7\nvalue = [5, 2]'),
Text(0.0813183428307408, 0.44642857142857145, 'x[1] <= 0.5\ngini = 0.278\nsamples =
6\nvalue = [5, 1]'),
Text(0.08008624672724472, 0.4107142857142857, 'x[23] <= 0.005\ngini = 0.5\nsamples =
2\nvalue = [1, 1]'),
Text(0.07885415062374865, 0.375, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.0813183428307408, 0.375, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.08255043893423687, 0.4107142857142857, 'gini = 0.0\nsamples = 4\nvalue = [4,
0]'),
Text(0.08378253503773295, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.08624672724472508, 0.5178571428571429, 'x[15] <= 0.5\ngini = 0.255\nsamples =
20\nvalue = [3, 17]'),
Text(0.08501463114122902, 0.48214285714285715, 'gini = 0.0\nsamples = 11\nvalue =
[0, 11]'),
Text(0.08747882334822116, 0.48214285714285715, 'x[22] <= 0.275\ngini = 0.444\nsample
s = 9\nvalue = [3, 6]'),
Text(0.08624672724472508, 0.44642857142857145, 'x[23] <= 0.005\ngini = 0.5\nsamples
= 6\nvalue = [3, 3]'),
Text(0.08501463114122902, 0.4107142857142857, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.08747882334822116, 0.4107142857142857, 'x[12] <= 0.5\ngini = 0.48\nsamples =
5\nvalue = [3, 2]'),
Text(0.08624672724472508, 0.375, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.08871091945171723, 0.375, 'x[23] <= 0.005\ngini = 0.444\nsamples = 3\nvalue =
[1, 2]'),
Text(0.08747882334822116, 0.3392857142857143, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
Text(0.08994301555521331, 0.3392857142857143, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.08871091945171723, 0.44642857142857145, 'gini = 0.0\nsamples = 3\nvalue = [0,
3]'),
Text(0.09641152009856768, 0.5535714285714286, 'x[23] <= 0.006\ngini = 0.498\nsamples
= 73\nvalue = [39, 34]'),
Text(0.09117511165870938, 0.5178571428571429, 'x[3] <= 0.5\ngini = 0.198\nsamples =
9\nvalue = [8, 1]'),
Text(0.08994301555521331, 0.48214285714285715, 'gini = 0.0\nsamples = 7\nvalue = [7,
0]'),
Text(0.09240720776220546, 0.48214285714285715, 'x[15] <= 0.5\ngini = 0.5\nsamples =
2\nvalue = [1, 1]'),
Text(0.09117511165870938, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.09363930386570153, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.101647928538426, 0.5178571428571429, 'x[23] <= 0.006\ngini = 0.5\nsamples = 6
4\nvalue = [31, 33]'),
Text(0.09733559217618974, 0.48214285714285715, 'x[5] <= 0.5\ngini = 0.375\nsamples =
12\nvalue = [3, 9]'),
Text(0.09610349607269367, 0.44642857142857145, 'gini = 0.0\nsamples = 7\nvalue = [0,
7]'),
Text(0.09856768827968582, 0.44642857142857145, 'x[22] <= 0.322\ngini = 0.48\nsamples
= 5\nvalue = [3, 2]'),
Text(0.09733559217618974, 0.4107142857142857, 'x[22] <= 0.319\ngini = 0.5\nsamples =
4\nvalue = [2, 2]'),
Text(0.09610349607269367, 0.375, 'x[14] <= 0.5\ngini = 0.444\nsamples = 3\nvalue =
[2, 1]'),

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Text(0.09487139996919759, 0.3392857142857143, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.09733559217618974, 0.3392857142857143, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.09856768827968582, 0.375, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.09979978438318189, 0.4107142857142857, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.10596026490066225, 0.48214285714285715, 'x[13] <= 0.5\ngini = 0.497\nsamples = 52\nvalue = [28, 24]'),
Text(0.10472816879716618, 0.44642857142857145, 'x[5] <= 0.5\ngini = 0.49\nsamples = 49\nvalue = [28, 21]'),
Text(0.10226397659017403, 0.4107142857142857, 'x[22] <= 0.319\ngini = 0.46\nsamples = 39\nvalue = [25, 14]'),
Text(0.10103188048667797, 0.375, 'x[22] <= 0.311\ngini = 0.492\nsamples = 32\nvalue = [18, 14]'),
Text(0.09979978438318189, 0.3392857142857143, 'x[22] <= 0.261\ngini = 0.471\nsamples = 29\nvalue = [18, 11]'),
Text(0.09856768827968582, 0.30357142857142855, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
Text(0.10103188048667797, 0.30357142857142855, 'x[2] <= 0.5\ngini = 0.444\nsamples = 27\nvalue = [18, 9]'),
Text(0.09979978438318189, 0.26785714285714285, 'x[7] <= 0.5\ngini = 0.483\nsamples = 22\nvalue = [13, 9]'),
Text(0.09856768827968582, 0.23214285714285715, 'x[22] <= 0.263\ngini = 0.499\nsamples = 19\nvalue = [10, 9]'),
Text(0.09733559217618974, 0.19642857142857142, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.09979978438318189, 0.19642857142857142, 'x[12] <= 0.5\ngini = 0.498\nsamples = 17\nvalue = [8, 9]'),
Text(0.09733559217618974, 0.16071428571428573, 'x[23] <= 0.012\ngini = 0.408\nsamples = 7\nvalue = [2, 5]'),
Text(0.09610349607269367, 0.125, 'gini = 0.0\nsamples = 3\nvalue = [0, 3]'),
Text(0.09856768827968582, 0.125, 'x[1] <= 0.5\ngini = 0.5\nsamples = 4\nvalue = [2, 2]'),
Text(0.09733559217618974, 0.08928571428571429, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
Text(0.09979978438318189, 0.08928571428571429, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.10226397659017403, 0.16071428571428573, 'x[23] <= 0.011\ngini = 0.48\nsamples = 10\nvalue = [6, 4]'),
Text(0.10103188048667797, 0.125, 'gini = 0.0\nsamples = 3\nvalue = [3, 0]'),
Text(0.1034960726936701, 0.125, 'x[22] <= 0.273\ngini = 0.49\nsamples = 7\nvalue = [3, 4]'),
Text(0.10226397659017403, 0.08928571428571429, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
Text(0.10472816879716618, 0.08928571428571429, 'x[22] <= 0.276\ngini = 0.48\nsamples = 5\nvalue = [3, 2]'),
Text(0.1034960726936701, 0.05357142857142857, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.10596026490066225, 0.05357142857142857, 'x[23] <= 0.026\ngini = 0.444\nsamples = 3\nvalue = [1, 2]'),
Text(0.10472816879716618, 0.017857142857142856, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
Text(0.10719236100415833, 0.017857142857142856, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.10103188048667797, 0.23214285714285715, 'gini = 0.0\nsamples = 3\nvalue = [3, 0]'),
Text(0.10226397659017403, 0.26785714285714285, 'gini = 0.0\nsamples = 5\nvalue = [5, 0]'),
Text(0.10226397659017403, 0.3392857142857143, 'gini = 0.0\nsamples = 3\nvalue = [0,

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3]'),
  Text(0.1034960726936701, 0.375, 'gini = 0.0\nsamples = 7\nvalue = [7, 0]'),
  Text(0.10719236100415833, 0.4107142857142857, 'x[23] <= 0.012\ngini = 0.42\nsamples = 10\nvalue = [3, 7]'),
  Text(0.10596026490066225, 0.375, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
  Text(0.1084244571076544, 0.375, 'x[23] <= 0.02\ngini = 0.219\nsamples = 8\nvalue = [1, 7]'),
  Text(0.10719236100415833, 0.3392857142857143, 'x[23] <= 0.014\ngini = 0.444\nsamples = 3\nvalue = [1, 2]'),
  Text(0.10596026490066225, 0.30357142857142855, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
  Text(0.1084244571076544, 0.30357142857142855, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.10965655321115048, 0.3392857142857143, 'gini = 0.0\nsamples = 5\nvalue = [0, 5]'),
  Text(0.10719236100415833, 0.44642857142857145, 'gini = 0.0\nsamples = 3\nvalue = [0, 3]'),
  Text(0.11581703372863084, 0.625, 'x[1] <= 0.5\ngini = 0.4\nsamples = 29\nvalue = [2, 1, 8]'),
  Text(0.11212074541814261, 0.5892857142857143, 'x[13] <= 0.5\ngini = 0.219\nsamples = 16\nvalue = [14, 2]'),
  Text(0.11088864931464654, 0.5535714285714286, 'x[23] <= 0.005\ngini = 0.124\nsamples = 15\nvalue = [14, 1]'),
  Text(0.10965655321115048, 0.5178571428571429, 'x[3] <= 0.5\ngini = 0.5\nsamples = 2\nvalue = [1, 1]'),
  Text(0.1084244571076544, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.11088864931464654, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
  Text(0.11212074541814261, 0.5178571428571429, 'gini = 0.0\nsamples = 13\nvalue = [1, 3, 0]'),
  Text(0.11335284152163869, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
  Text(0.11951332203911905, 0.5892857142857143, 'x[23] <= 0.006\ngini = 0.497\nsamples = 13\nvalue = [7, 6]'),
  Text(0.11581703372863084, 0.5535714285714286, 'x[3] <= 0.5\ngini = 0.278\nsamples = 6\nvalue = [5, 1]'),
  Text(0.11458493762513476, 0.5178571428571429, 'gini = 0.0\nsamples = 4\nvalue = [4, 0]'),
  Text(0.11704912983212691, 0.5178571428571429, 'x[2] <= 0.5\ngini = 0.5\nsamples = 2\nvalue = [1, 1]'),
  Text(0.11581703372863084, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
  Text(0.11828122593562297, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.12320961034960727, 0.5535714285714286, 'x[2] <= 0.5\ngini = 0.408\nsamples = 7\nvalue = [2, 5]'),
  Text(0.1219775142461112, 0.5178571428571429, 'x[22] <= 0.358\ngini = 0.278\nsamples = 6\nvalue = [1, 5]'),
  Text(0.12074541814261512, 0.48214285714285715, 'gini = 0.0\nsamples = 5\nvalue = [0, 5]'),
  Text(0.12320961034960727, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.12444170645310335, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.12444170645310335, 0.6607142857142857, 'x[23] <= 0.005\ngini = 0.245\nsamples = 14\nvalue = [2, 12]'),
  Text(0.12320961034960727, 0.625, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.1256738025565994, 0.625, 'x[6] <= 0.5\ngini = 0.142\nsamples = 13\nvalue = [1, 12]'),

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Text(0.12444170645310335, 0.5892857142857143, 'gini = 0.0\nsamples = 10\nvalue = [0,
10]'),
Text(0.1269058986600955, 0.5892857142857143, 'x[23] <= 0.019\ngini = 0.444\nsamples
= 3\nvalue = [1, 2]'),
Text(0.1256738025565994, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.12813799476359156, 0.5535714285714286, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
Text(0.13429847528107192, 0.6964285714285714, 'x[22] <= 0.109\ngini = 0.438\nsamples
= 34\nvalue = [11, 23]'),
Text(0.13306637917757586, 0.6607142857142857, 'gini = 0.0\nsamples = 10\nvalue = [0,
10]'),
Text(0.135530571384568, 0.6607142857142857, 'x[22] <= 0.276\ngini = 0.497\nsamples =
24\nvalue = [11, 13]'),
Text(0.13306637917757586, 0.625, 'x[22] <= 0.268\ngini = 0.48\nsamples = 15\nvalue =
[9, 6]'),
Text(0.13183428307407977, 0.5892857142857143, 'x[22] <= 0.262\ngini = 0.496\nsamples
= 11\nvalue = [5, 6]'),
Text(0.1306021869705837, 0.5535714285714286, 'x[23] <= 0.01\ngini = 0.408\nsamples =
7\nvalue = [5, 2]'),
Text(0.12937009086708764, 0.5178571428571429, 'gini = 0.0\nsamples = 4\nvalue = [4,
0]'),
Text(0.13183428307407977, 0.5178571428571429, 'x[22] <= 0.149\ngini = 0.444\nsamples
= 3\nvalue = [1, 2]'),
Text(0.1306021869705837, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.13306637917757586, 0.48214285714285715, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
Text(0.13306637917757586, 0.5535714285714286, 'gini = 0.0\nsamples = 4\nvalue = [0,
4]'),
Text(0.13429847528107192, 0.5892857142857143, 'gini = 0.0\nsamples = 4\nvalue = [4,
0]'),
Text(0.13799476359156015, 0.625, 'x[15] <= 0.5\ngini = 0.346\nsamples = 9\nvalue =
[2, 7]'),
Text(0.13676266748806407, 0.5892857142857143, 'x[23] <= 0.006\ngini = 0.219\nsamples
= 8\nvalue = [1, 7]'),
Text(0.135530571384568, 0.5535714285714286, 'x[23] <= 0.005\ngini = 0.5\nsamples = 2
\nvalue = [1, 1]'),
Text(0.13429847528107192, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.13676266748806407, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.13799476359156015, 0.5535714285714286, 'gini = 0.0\nsamples = 6\nvalue = [0,
6]'),
Text(0.13922685969505622, 0.5892857142857143, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.12459571846604035, 0.7321428571428571, 'gini = 0.0\nsamples = 6\nvalue = [0,
6]'),
Text(0.14292314800554443, 0.7678571428571429, 'x[13] <= 0.5\ngini = 0.308\nsamples =
21\nvalue = [4, 17]'),
Text(0.14169105190204836, 0.7321428571428571, 'x[3] <= 0.5\ngini = 0.188\nsamples =
19\nvalue = [2, 17]'),
Text(0.14045895579855228, 0.6964285714285714, 'x[22] <= 0.328\ngini = 0.105\nsamples
= 18\nvalue = [1, 17]'),
Text(0.13922685969505622, 0.6607142857142857, 'gini = 0.0\nsamples = 16\nvalue = [0,
16]'),
Text(0.14169105190204836, 0.6607142857142857, 'x[22] <= 0.347\ngini = 0.5\nsamples =
2\nvalue = [1, 1]'),
Text(0.14045895579855228, 0.625, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.14292314800554443, 0.625, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),

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Text(0.14292314800554443, 0.6964285714285714, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.14415524410904051, 0.7321428571428571, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
Text(0.15863237332511937, 0.8035714285714286, 'x[22] <= 0.476\ngini = 0.433\nsamples
= 63\nvalue = [43, 20]'),
Text(0.15216386878176497, 0.7678571428571429, 'x[23] <= 0.019\ngini = 0.389\nsamples
= 53\nvalue = [39, 14]'),
Text(0.14785153241952873, 0.7321428571428571, 'x[21] <= 0.035\ngini = 0.493\nsamples
= 25\nvalue = [14, 11]'),
Text(0.14661943631603266, 0.6964285714285714, 'x[22] <= 0.372\ngini = 0.463\nsamples
= 22\nvalue = [14, 8]'),
Text(0.14538734021253658, 0.6607142857142857, 'gini = 0.0\nsamples = 5\nvalue = [5,
0]'),
Text(0.14785153241952873, 0.6607142857142857, 'x[23] <= 0.007\ngini = 0.498\nsamples
= 17\nvalue = [9, 8]'),
Text(0.14538734021253658, 0.625, 'x[1] <= 0.5\ngini = 0.42\nsamples = 10\nvalue =
[3, 7]'),
Text(0.14415524410904051, 0.5892857142857143, 'gini = 0.0\nsamples = 4\nvalue = [0,
4]'),
Text(0.14661943631603266, 0.5892857142857143, 'x[6] <= 0.5\ngini = 0.5\nsamples = 6
\nvalue = [3, 3]'),
Text(0.14538734021253658, 0.5535714285714286, 'x[3] <= 0.5\ngini = 0.375\nsamples =
4\nvalue = [1, 3]'),
Text(0.14415524410904051, 0.5178571428571429, 'gini = 0.0\nsamples = 3\nvalue = [0,
3]'),
Text(0.14661943631603266, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.14785153241952873, 0.5535714285714286, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
Text(0.15031572462652087, 0.625, 'x[22] <= 0.432\ngini = 0.245\nsamples = 7\nvalue =
[6, 1]'),
Text(0.14908362852302479, 0.5892857142857143, 'gini = 0.0\nsamples = 4\nvalue = [4,
0]'),
Text(0.15154782073001694, 0.5892857142857143, 'x[22] <= 0.44\ngini = 0.444\nsamples
= 3\nvalue = [2, 1]'),
Text(0.15031572462652087, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.15277991683351302, 0.5535714285714286, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
Text(0.14908362852302479, 0.6964285714285714, 'gini = 0.0\nsamples = 3\nvalue = [0,
3]'),
Text(0.15647620514400123, 0.7321428571428571, 'x[2] <= 0.5\ngini = 0.191\nsamples =
28\nvalue = [25, 3]'),
Text(0.15277991683351302, 0.6964285714285714, 'x[7] <= 0.5\ngini = 0.087\nsamples =
22\nvalue = [21, 1]'),
Text(0.15154782073001694, 0.6607142857142857, 'gini = 0.0\nsamples = 17\nvalue = [1
7, 0]'),
Text(0.15401201293700909, 0.6607142857142857, 'x[15] <= 0.5\ngini = 0.32\nsamples =
5\nvalue = [4, 1]'),
Text(0.15277991683351302, 0.625, 'gini = 0.0\nsamples = 3\nvalue = [3, 0]'),
Text(0.15524410904050515, 0.625, 'x[8] <= 0.5\ngini = 0.5\nsamples = 2\nvalue = [1,
1]'),
Text(0.15401201293700909, 0.5892857142857143, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.15647620514400123, 0.5892857142857143, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.16017249345448945, 0.6964285714285714, 'x[5] <= 0.5\ngini = 0.444\nsamples =
6\nvalue = [4, 2]'),
Text(0.15894039735099338, 0.6607142857142857, 'x[21] <= 0.049\ngini = 0.444\nsamples

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= 3\nvalue = [1, 2]'),
Text(0.1577083012474973, 0.625, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.16017249345448945, 0.625, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
Text(0.16140458955798553, 0.6607142857142857, 'gini = 0.0\nsamples = 3\nvalue = [3,
0]'),
Text(0.16510087786847374, 0.7678571428571429, 'x[22] <= 0.517\ngini = 0.48\nsamples
= 10\nvalue = [4, 6]'),
Text(0.16386878176497766, 0.7321428571428571, 'gini = 0.0\nsamples = 4\nvalue = [0,
4]'),
Text(0.1663329739719698, 0.7321428571428571, 'x[21] <= 0.049\ngini = 0.444\nsamples
= 6\nvalue = [4, 2]'),
Text(0.16510087786847374, 0.6964285714285714, 'x[1] <= 0.5\ngini = 0.32\nsamples = 5
\nvalue = [4, 1]'),
Text(0.16386878176497766, 0.6607142857142857, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.1663329739719698, 0.6607142857142857, 'gini = 0.0\nsamples = 4\nvalue = [4,
0]'),
Text(0.1675650700754659, 0.6964285714285714, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.23270974511011858, 0.875, 'x[4] <= 0.5\ngini = 0.303\nsamples = 703\nvalue =
[572, 131]'),
Text(0.19290485907900817, 0.8392857142857143, 'x[23] <= 0.038\ngini = 0.433\nsamples
= 167\nvalue = [114, 53]'),
Text(0.17249345448945017, 0.8035714285714286, 'x[6] <= 0.5\ngini = 0.486\nsamples =
24\nvalue = [10, 14]'),
Text(0.17002926228245804, 0.7678571428571429, 'x[23] <= 0.023\ngini = 0.36\nsamples
= 17\nvalue = [4, 13]'),
Text(0.16879716617896195, 0.7321428571428571, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
Text(0.1712613583859541, 0.7321428571428571, 'x[22] <= 0.242\ngini = 0.231\nsamples
= 15\nvalue = [2, 13]'),
Text(0.17002926228245804, 0.6964285714285714, 'x[22] <= 0.11\ngini = 0.133\nsamples
= 14\nvalue = [1, 13]'),
Text(0.16879716617896195, 0.6607142857142857, 'x[22] <= 0.109\ngini = 0.375\nsamples
= 4\nvalue = [1, 3]'),
Text(0.1675650700754659, 0.625, 'gini = 0.0\nsamples = 3\nvalue = [0, 3]'),
Text(0.17002926228245804, 0.625, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.1712613583859541, 0.6607142857142857, 'gini = 0.0\nsamples = 10\nvalue = [0,
10]'),
Text(0.17249345448945017, 0.6964285714285714, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.17495764669644231, 0.7678571428571429, 'x[12] <= 0.5\ngini = 0.245\nsamples =
7\nvalue = [6, 1]'),
Text(0.17372555059294625, 0.7321428571428571, 'gini = 0.0\nsamples = 6\nvalue = [6,
0]'),
Text(0.1761897427999384, 0.7321428571428571, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.21331626366856615, 0.8035714285714286, 'x[22] <= 0.357\ngini = 0.397\nsamples
= 143\nvalue = [104, 39]'),
Text(0.20362313260434314, 0.7678571428571429, 'x[19] <= 0.5\ngini = 0.359\nsamples =
128\nvalue = [98, 30]'),
Text(0.1922454951486216, 0.7321428571428571, 'x[15] <= 0.5\ngini = 0.315\nsamples =
102\nvalue = [82, 20]'),
Text(0.19101339904512551, 0.6964285714285714, 'x[3] <= 0.5\ngini = 0.348\nsamples =
89\nvalue = [69, 20]'),
Text(0.17749884490990298, 0.6607142857142857, 'x[12] <= 0.5\ngini = 0.387\nsamples =
61\nvalue = [45, 16]'),
Text(0.17249345448945017, 0.625, 'x[21] <= 0.5\ngini = 0.219\nsamples = 16\nvalue =
[14, 2]'),
Text(0.1712613583859541, 0.5892857142857143, 'gini = 0.0\nsamples = 11\nvalue = [11,

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0]'),
Text(0.17372555059294625, 0.5892857142857143, 'x[20] <= 0.188\ngini = 0.48\nsamples
= 5\nvalue = [3, 2]'),
Text(0.17249345448945017, 0.5535714285714286, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
Text(0.17495764669644231, 0.5535714285714286, 'gini = 0.0\nsamples = 3\nvalue = [3,
0]'),
Text(0.18250423533035576, 0.625, 'x[23] <= 0.074\ngini = 0.429\nsamples = 45\nvalue
= [31, 14]'),
Text(0.17865393500693055, 0.5892857142857143, 'x[22] <= 0.127\ngini = 0.469\nsamples
= 8\nvalue = [3, 5]'),
Text(0.17742183890343446, 0.5535714285714286, 'x[21] <= 0.271\ngini = 0.375\nsamples
= 4\nvalue = [3, 1]'),
Text(0.1761897427999384, 0.5178571428571429, 'gini = 0.0\nsamples = 3\nvalue = [3,
0]'),
Text(0.17865393500693055, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.17988603111042661, 0.5535714285714286, 'gini = 0.0\nsamples = 4\nvalue = [0,
4]'),
Text(0.186354535653781, 0.5892857142857143, 'x[23] <= 0.205\ngini = 0.368\nsamples =
37\nvalue = [28, 9]'),
Text(0.18235022331741876, 0.5535714285714286, 'x[23] <= 0.088\ngini = 0.18\nsamples
= 20\nvalue = [18, 2]'),
Text(0.18111812721392268, 0.5178571428571429, 'x[7] <= 0.5\ngini = 0.48\nsamples = 5
\nvalue = [3, 2]'),
Text(0.17988603111042661, 0.48214285714285715, 'x[6] <= 0.5\ngini = 0.444\nsamples =
3\nvalue = [1, 2]'),
Text(0.17865393500693055, 0.44642857142857145, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
Text(0.18111812721392268, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.18235022331741876, 0.48214285714285715, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
Text(0.18358231942091482, 0.5178571428571429, 'gini = 0.0\nsamples = 15\nvalue = [1
5, 0]'),
Text(0.19035884799014324, 0.5535714285714286, 'x[23] <= 0.288\ngini = 0.484\nsamples
= 17\nvalue = [10, 7]'),
Text(0.18727860773140306, 0.5178571428571429, 'x[6] <= 0.5\ngini = 0.48\nsamples = 1
0\nvalue = [4, 6]'),
Text(0.1848144155244109, 0.48214285714285715, 'x[23] <= 0.225\ngini = 0.32\nsamples
= 5\nvalue = [1, 4]'),
Text(0.18358231942091482, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.18604651162790697, 0.44642857142857145, 'gini = 0.0\nsamples = 4\nvalue = [0,
4]'),
Text(0.18974279993839518, 0.48214285714285715, 'x[22] <= 0.267\ngini = 0.48\nsamples
= 5\nvalue = [3, 2]'),
Text(0.18851070383489912, 0.44642857142857145, 'gini = 0.0\nsamples = 3\nvalue = [3,
0]'),
Text(0.19097489604189127, 0.44642857142857145, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
Text(0.19343908824888342, 0.5178571428571429, 'x[23] <= 0.347\ngini = 0.245\nsamples
= 7\nvalue = [6, 1]'),
Text(0.19220699214538733, 0.48214285714285715, 'gini = 0.0\nsamples = 4\nvalue = [4,
0]'),
Text(0.19467118435237948, 0.48214285714285715, 'x[20] <= 0.438\ngini = 0.444\nsample
s = 3\nvalue = [2, 1]'),
Text(0.19343908824888342, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.19590328045587554, 0.44642857142857145, 'gini = 0.0\nsamples = 2\nvalue = [2,

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0]'),
Text(0.20452795318034805, 0.6607142857142857, 'x[21] <= 0.549\ngini = 0.245\nsamples = 28\nvalue = [24, 4]'),
Text(0.203295857076852, 0.625, 'x[21] <= 0.493\ngini = 0.346\nsamples = 18\nvalue = [14, 4]'),
Text(0.20206376097335593, 0.5892857142857143, 'x[9] <= 0.5\ngini = 0.219\nsamples = 16\nvalue = [14, 2]'),
Text(0.19959956876636378, 0.5535714285714286, 'x[2] <= 0.5\ngini = 0.133\nsamples = 14\nvalue = [13, 1]'),
Text(0.1983674726628677, 0.5178571428571429, 'x[23] <= 0.054\ngini = 0.32\nsamples = 5\nvalue = [4, 1]'),
Text(0.19713537655937163, 0.48214285714285715, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.19959956876636378, 0.48214285714285715, 'x[1] <= 0.5\ngini = 0.444\nsamples = 3\nvalue = [2, 1]'),
Text(0.1983674726628677, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.20083166486985984, 0.44642857142857145, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.20083166486985984, 0.5178571428571429, 'gini = 0.0\nsamples = 9\nvalue = [9, 0]'),
Text(0.20452795318034805, 0.5535714285714286, 'x[8] <= 0.5\ngini = 0.5\nsamples = 2\nvalue = [1, 1]'),
Text(0.203295857076852, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.20576004928384414, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.20452795318034805, 0.5892857142857143, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
Text(0.20576004928384414, 0.625, 'gini = 0.0\nsamples = 10\nvalue = [10, 0]'),
Text(0.19347759125211766, 0.6964285714285714, 'gini = 0.0\nsamples = 13\nvalue = [13, 0]'),
Text(0.21500077006006468, 0.7321428571428571, 'x[21] <= 0.438\ngini = 0.473\nsamples = 26\nvalue = [16, 10]'),
Text(0.2119205298013245, 0.6964285714285714, 'x[22] <= 0.179\ngini = 0.498\nsamples = 15\nvalue = [7, 8]'),
Text(0.20945633759433235, 0.6607142857142857, 'x[6] <= 0.5\ngini = 0.278\nsamples = 6\nvalue = [5, 1]'),
Text(0.2082242414908363, 0.625, 'gini = 0.0\nsamples = 5\nvalue = [5, 0]'),
Text(0.21068843369782844, 0.625, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.21438472200831665, 0.6607142857142857, 'x[22] <= 0.237\ngini = 0.346\nsamples = 9\nvalue = [2, 7]'),
Text(0.21315262590482056, 0.625, 'gini = 0.0\nsamples = 6\nvalue = [0, 6]'),
Text(0.2156168181118127, 0.625, 'x[2] <= 0.5\ngini = 0.444\nsamples = 3\nvalue = [2, 1]'),
Text(0.21438472200831665, 0.5892857142857143, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.2168489142153088, 0.5892857142857143, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.21808101031880486, 0.6964285714285714, 'x[21] <= 0.604\ngini = 0.298\nsamples = 11\nvalue = [9, 2]'),
Text(0.2168489142153088, 0.6607142857142857, 'gini = 0.0\nsamples = 5\nvalue = [5, 0]'),
Text(0.21931310642230095, 0.6607142857142857, 'x[21] <= 0.736\ngini = 0.444\nsamples = 6\nvalue = [4, 2]'),
Text(0.21808101031880486, 0.625, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
Text(0.220545202525797, 0.625, 'gini = 0.0\nsamples = 4\nvalue = [4, 0]'),
Text(0.22300939473278916, 0.7678571428571429, 'x[22] <= 0.403\ngini = 0.48\nsamples = 15\nvalue = [6, 9]'),
Text(0.22177729862929307, 0.7321428571428571, 'x[1] <= 0.5\ngini = 0.375\nsamples =

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12\nvalue = [3, 9]'),
  Text(0.220545202525797, 0.6964285714285714, 'gini = 0.0\nsamples = 6\nvalue = [0,
6]'),
  Text(0.22300939473278916, 0.6964285714285714, 'x[22] <= 0.362\ngini = 0.5\nsamples =
6\nvalue = [3, 3]'),
  Text(0.22177729862929307, 0.6607142857142857, 'gini = 0.0\nsamples = 3\nvalue = [0,
3]'),
  Text(0.22424149083628522, 0.6607142857142857, 'gini = 0.0\nsamples = 3\nvalue = [3,
0]'),
  Text(0.22424149083628522, 0.7321428571428571, 'gini = 0.0\nsamples = 3\nvalue = [3,
0]'),
  Text(0.27251463114122904, 0.8392857142857143, 'x[14] <= 0.5\ngini = 0.249\nsamples =
536\nvalue = [458, 78]'),
  Text(0.2470545202525797, 0.8035714285714286, 'x[21] <= 0.243\ngini = 0.209\nsamples
= 396\nvalue = [349, 47]'),
  Text(0.23198059448636993, 0.7678571428571429, 'x[23] <= 0.02\ngini = 0.262\nsamples
= 213\nvalue = [180, 33]'),
  Text(0.22670568304327737, 0.7321428571428571, 'x[2] <= 0.5\ngini = 0.097\nsamples =
39\nvalue = [37, 2]'),
  Text(0.2254735869397813, 0.6964285714285714, 'gini = 0.0\nsamples = 27\nvalue = [27,
0]'),
  Text(0.22793777914677346, 0.6964285714285714, 'x[3] <= 0.5\ngini = 0.278\nsamples =
12\nvalue = [10, 2]'),
  Text(0.22670568304327737, 0.6607142857142857, 'x[1] <= 0.5\ngini = 0.5\nsamples = 4
\nvalue = [2, 2]'),
  Text(0.2254735869397813, 0.625, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
  Text(0.22793777914677346, 0.625, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
  Text(0.22916987525026952, 0.6607142857142857, 'gini = 0.0\nsamples = 8\nvalue = [8,
0]'),
  Text(0.23725550592946248, 0.7321428571428571, 'x[22] <= 0.01\ngini = 0.293\nsamples
= 174\nvalue = [143, 31]'),
  Text(0.23602340982596642, 0.6964285714285714, 'gini = 0.0\nsamples = 3\nvalue = [0,
3]'),
  Text(0.23848760203295857, 0.6964285714285714, 'x[23] <= 0.021\ngini = 0.274\nsamples
= 171\nvalue = [143, 28]'),
  Text(0.23725550592946248, 0.6607142857142857, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
  Text(0.23971969813645463, 0.6607142857142857, 'x[22] <= 0.039\ngini = 0.267\nsamples
= 170\nvalue = [143, 27]'),
  Text(0.23040197135376558, 0.625, 'x[19] <= 0.5\ngini = 0.12\nsamples = 47\nvalue =
[44, 3]'),
  Text(0.22793777914677346, 0.5892857142857143, 'x[23] <= 0.034\ngini = 0.085\nsamples
= 45\nvalue = [43, 2]'),
  Text(0.22670568304327737, 0.5535714285714286, 'gini = 0.0\nsamples = 36\nvalue = [3
6, 0]'),
  Text(0.22916987525026952, 0.5535714285714286, 'x[23] <= 0.034\ngini = 0.346\nsamples
= 9\nvalue = [7, 2]'),
  Text(0.22793777914677346, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
  Text(0.23040197135376558, 0.5178571428571429, 'x[22] <= 0.018\ngini = 0.219\nsamples
= 8\nvalue = [7, 1]'),
  Text(0.22916987525026952, 0.48214285714285715, 'gini = 0.0\nsamples = 5\nvalue = [5,
0]'),
  Text(0.23163406745726167, 0.48214285714285715, 'x[22] <= 0.022\ngini = 0.444\nsample
s = 3\nvalue = [2, 1]'),
  Text(0.23040197135376558, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
  Text(0.23286616356075773, 0.44642857142857145, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
  Text(0.23286616356075773, 0.5892857142857143, 'x[22] <= 0.023\ngini = 0.5\nsamples =

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2\nvalue = [1, 1]'),
  Text(0.23163406745726167, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
  Text(0.23409825966425382, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
  Text(0.24903742491914369, 0.625, 'x[22] <= 0.06\ngini = 0.314\nsamples = 123\nvalue
= [99, 24]'),
  Text(0.24780532881564762, 0.5892857142857143, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
  Text(0.2502695210226398, 0.5892857142857143, 'x[2] <= 0.5\ngini = 0.298\nsamples = 1
21\nvalue = [99, 22]'),
  Text(0.24179886031110426, 0.5535714285714286, 'x[15] <= 0.5\ngini = 0.361\nsamples =
76\nvalue = [58, 18]'),
  Text(0.23779454797474203, 0.5178571428571429, 'x[7] <= 0.5\ngini = 0.438\nsamples =
37\nvalue = [25, 12]'),
  Text(0.23656245187124594, 0.48214285714285715, 'x[3] <= 0.5\ngini = 0.475\nsamples =
31\nvalue = [19, 12]'),
  Text(0.23533035576774988, 0.44642857142857145, 'x[22] <= 0.459\ngini = 0.494\nsample
s = 27\nvalue = [15, 12]'),
  Text(0.23286616356075773, 0.4107142857142857, 'x[22] <= 0.344\ngini = 0.463\nsamples
= 22\nvalue = [14, 8]'),
  Text(0.23163406745726167, 0.375, 'x[22] <= 0.318\ngini = 0.498\nsamples = 15\nvalue
= [7, 8]'),
  Text(0.23040197135376558, 0.3392857142857143, 'x[23] <= 0.06\ngini = 0.497\nsamples
= 13\nvalue = [7, 6]'),
  Text(0.22916987525026952, 0.30357142857142855, 'x[1] <= 0.5\ngini = 0.48\nsamples =
10\nvalue = [4, 6]'),
  Text(0.22793777914677346, 0.26785714285714285, 'gini = 0.0\nsamples = 4\nvalue = [0,
4]'),
  Text(0.23040197135376558, 0.26785714285714285, 'x[23] <= 0.044\ngini = 0.444\nsample
s = 6\nvalue = [4, 2]'),
  Text(0.22916987525026952, 0.23214285714285715, 'gini = 0.0\nsamples = 3\nvalue = [3,
0]'),
  Text(0.23163406745726167, 0.23214285714285715, 'x[22] <= 0.273\ngini = 0.444\nsample
s = 3\nvalue = [1, 2]'),
  Text(0.23040197135376558, 0.19642857142857142, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
  Text(0.23286616356075773, 0.19642857142857142, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
  Text(0.23163406745726167, 0.30357142857142855, 'gini = 0.0\nsamples = 3\nvalue = [3,
0]'),
  Text(0.23286616356075773, 0.3392857142857143, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
  Text(0.23409825966425382, 0.375, 'gini = 0.0\nsamples = 7\nvalue = [7, 0]'),
  Text(0.23779454797474203, 0.4107142857142857, 'x[20] <= 0.562\ngini = 0.32\nsamples
= 5\nvalue = [1, 4]'),
  Text(0.23656245187124594, 0.375, 'gini = 0.0\nsamples = 4\nvalue = [0, 4]'),
  Text(0.2390266440782381, 0.375, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.23779454797474203, 0.44642857142857145, 'gini = 0.0\nsamples = 4\nvalue = [4,
0]'),
  Text(0.2390266440782381, 0.48214285714285715, 'gini = 0.0\nsamples = 6\nvalue = [6,
0]'),
  Text(0.2458031726474665, 0.5178571428571429, 'x[23] <= 0.075\ngini = 0.26\nsamples =
39\nvalue = [33, 6]'),
  Text(0.24272293238872633, 0.48214285714285715, 'x[22] <= 0.268\ngini = 0.074\nsample
s = 26\nvalue = [25, 1]'),
  Text(0.24149083628523024, 0.44642857142857145, 'x[22] <= 0.265\ngini = 0.198\nsample
s = 9\nvalue = [8, 1]'),
  Text(0.24025874018173418, 0.4107142857142857, 'gini = 0.0\nsamples = 8\nvalue = [8,
0]'),

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Text(0.24272293238872633, 0.4107142857142857, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.2439550284922224, 0.44642857142857145, 'gini = 0.0\nsamples = 17\nvalue = [1 7, 0]'),
Text(0.2488834129062067, 0.48214285714285715, 'x[23] <= 0.082\ngini = 0.473\nsamples = 13\nvalue = [8, 5]'),
Text(0.24641922069921454, 0.44642857142857145, 'x[23] <= 0.075\ngini = 0.375\nsamples = 4\nvalue = [1, 3]'),
Text(0.24518712459571845, 0.4107142857142857, 'x[3] <= 0.5\ngini = 0.5\nsamples = 2\nvalue = [1, 1]'),
Text(0.2439550284922224, 0.375, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.24641922069921454, 0.375, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.2476513168027106, 0.4107142857142857, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
Text(0.2513476051131988, 0.44642857142857145, 'x[21] <= 0.215\ngini = 0.346\nsamples = 9\nvalue = [7, 2]'),
Text(0.25011550900970275, 0.4107142857142857, 'gini = 0.0\nsamples = 5\nvalue = [5, 0]'),
Text(0.25257970121669493, 0.4107142857142857, 'x[22] <= 0.321\ngini = 0.5\nsamples = 4\nvalue = [2, 2]'),
Text(0.2513476051131988, 0.375, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.253811797320191, 0.375, 'x[23] <= 0.116\ngini = 0.444\nsamples = 3\nvalue = [1, 2]'),
Text(0.25257970121669493, 0.3392857142857143, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
Text(0.25504389342368705, 0.3392857142857143, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.2587401817341753, 0.5535714285714286, 'x[21] <= 0.09\ngini = 0.162\nsamples = 45\nvalue = [41, 4]'),
Text(0.2562759895271831, 0.5178571428571429, 'x[7] <= 0.5\ngini = 0.5\nsamples = 4\nvalue = [2, 2]'),
Text(0.25504389342368705, 0.48214285714285715, 'x[1] <= 0.5\ngini = 0.444\nsamples = 3\nvalue = [2, 1]'),
Text(0.253811797320191, 0.44642857142857145, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.2562759895271831, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.2575080856306792, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.2612043739411674, 0.5178571428571429, 'x[1] <= 0.5\ngini = 0.093\nsamples = 4\nvalue = [39, 2]'),
Text(0.25997227783767135, 0.48214285714285715, 'x[7] <= 0.5\ngini = 0.188\nsamples = 19\nvalue = [17, 2]'),
Text(0.2587401817341753, 0.44642857142857145, 'x[23] <= 0.097\ngini = 0.32\nsamples = 10\nvalue = [8, 2]'),
Text(0.2575080856306792, 0.4107142857142857, 'x[9] <= 0.5\ngini = 0.198\nsamples = 9\nvalue = [8, 1]'),
Text(0.2562759895271831, 0.375, 'gini = 0.0\nsamples = 7\nvalue = [7, 0]'),
Text(0.2587401817341753, 0.375, 'x[11] <= 0.5\ngini = 0.5\nsamples = 2\nvalue = [1, 1]'),
Text(0.2575080856306792, 0.3392857142857143, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.25997227783767135, 0.3392857142857143, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.25997227783767135, 0.4107142857142857, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.2612043739411674, 0.44642857142857145, 'gini = 0.0\nsamples = 9\nvalue = [9, 0]'),
Text(0.2624364700446635, 0.48214285714285715, 'gini = 0.0\nsamples = 22\nvalue = [2 2, 0]'),

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Text(0.2621284460187895, 0.7678571428571429, 'x[21] <= 0.396\ngini = 0.141\nsamples = 183\nvalue = [169, 14]'),
Text(0.25458185738487604, 0.7321428571428571, 'x[6] <= 0.5\ngini = 0.077\nsamples = 100\nvalue = [96, 4]'),
Text(0.25150161712613583, 0.6964285714285714, 'x[8] <= 0.5\ngini = 0.028\nsamples = 70\nvalue = [69, 1]'),
Text(0.2502695210226398, 0.6607142857142857, 'gini = 0.0\nsamples = 59\nvalue = [59, 0]'),
Text(0.2527337132296319, 0.6607142857142857, 'x[23] <= 0.102\ngini = 0.165\nsamples = 11\nvalue = [10, 1]'),
Text(0.25150161712613583, 0.625, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.25396580933312796, 0.625, 'gini = 0.0\nsamples = 10\nvalue = [10, 0]'),
Text(0.2576620976436162, 0.6964285714285714, 'x[22] <= 0.312\ngini = 0.18\nsamples = 30\nvalue = [27, 3]'),
Text(0.25643000154012013, 0.6607142857142857, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.25889419374711226, 0.6607142857142857, 'x[22] <= 0.376\ngini = 0.128\nsamples = 29\nvalue = [27, 2]'),
Text(0.25643000154012013, 0.625, 'x[22] <= 0.368\ngini = 0.375\nsamples = 4\nvalue = [3, 1]'),
Text(0.2551979054366241, 0.5892857142857143, 'gini = 0.0\nsamples = 3\nvalue = [3, 0]'),
Text(0.2576620976436162, 0.5892857142857143, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.26135838595410443, 0.625, 'x[3] <= 0.5\ngini = 0.077\nsamples = 25\nvalue = [24, 1]'),
Text(0.26012628985060837, 0.5892857142857143, 'gini = 0.0\nsamples = 19\nvalue = [19, 0]'),
Text(0.2625904820576005, 0.5892857142857143, 'x[8] <= 0.5\ngini = 0.278\nsamples = 6\nvalue = [5, 1]'),
Text(0.26135838595410443, 0.5535714285714286, 'gini = 0.0\nsamples = 5\nvalue = [5, 0]'),
Text(0.26382257816109655, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.2696750346527029, 0.7321428571428571, 'x[22] <= 0.014\ngini = 0.212\nsamples = 83\nvalue = [73, 10]'),
Text(0.26628677036808873, 0.6964285714285714, 'x[15] <= 0.5\ngini = 0.5\nsamples = 6\nvalue = [3, 3]'),
Text(0.2650546742645926, 0.6607142857142857, 'x[21] <= 0.431\ngini = 0.375\nsamples = 4\nvalue = [3, 1]'),
Text(0.26382257816109655, 0.625, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.26628677036808873, 0.625, 'gini = 0.0\nsamples = 3\nvalue = [3, 0]'),
Text(0.2675188664715848, 0.6607142857142857, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
Text(0.2730632989373171, 0.6964285714285714, 'x[2] <= 0.5\ngini = 0.165\nsamples = 7\nvalue = [70, 7]'),
Text(0.2699830586785769, 0.6607142857142857, 'x[22] <= 0.364\ngini = 0.284\nsamples = 35\nvalue = [29, 6]'),
Text(0.26875096257508085, 0.625, 'gini = 0.0\nsamples = 16\nvalue = [16, 0]'),
Text(0.271215154782073, 0.625, 'x[22] <= 0.419\ngini = 0.432\nsamples = 19\nvalue = [13, 6]'),
Text(0.26875096257508085, 0.5892857142857143, 'x[8] <= 0.5\ngini = 0.408\nsamples = 7\nvalue = [2, 5]'),
Text(0.2675188664715848, 0.5535714285714286, 'x[21] <= 0.451\ngini = 0.278\nsamples = 6\nvalue = [1, 5]'),
Text(0.26628677036808873, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.26875096257508085, 0.5178571428571429, 'gini = 0.0\nsamples = 5\nvalue = [0, 5]'),
Text(0.2699830586785769, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [1,

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0]'),
Text(0.27367934698906515, 0.5892857142857143, 'x[21] <= 0.41\ngini = 0.153\nsamples
= 12\nvalue = [11, 1]'),
Text(0.2724472508855691, 0.5535714285714286, 'x[11] <= 0.5\ngini = 0.5\nsamples = 2
\nvalue = [1, 1]'),
Text(0.271215154782073, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.27367934698906515, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.2749114430925612, 0.5535714285714286, 'gini = 0.0\nsamples = 10\nvalue = [10,
0]'),
Text(0.2761435391960573, 0.6607142857142857, 'x[20] <= 0.812\ngini = 0.046\nsamples
= 42\nvalue = [41, 1]'),
Text(0.2749114430925612, 0.625, 'gini = 0.0\nsamples = 40\nvalue = [40, 0]'),
Text(0.2773756352995534, 0.625, 'x[22] <= 0.621\ngini = 0.5\nsamples = 2\nvalue =
[1, 1]'),
Text(0.2761435391960573, 0.5892857142857143, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.27860773140304945, 0.5892857142857143, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.29797474202987834, 0.8035714285714286, 'x[21] <= 0.368\ngini = 0.345\nsamples
= 140\nvalue = [109, 31]'),
Text(0.29192977052210073, 0.7678571428571429, 'x[22] <= 0.256\ngini = 0.407\nsamples
= 102\nvalue = [73, 29]'),
Text(0.28353611581703375, 0.7321428571428571, 'x[21] <= 0.111\ngini = 0.236\nsamples
= 22\nvalue = [19, 3]'),
Text(0.28230401971353764, 0.6964285714285714, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.2847682119205298, 0.6964285714285714, 'x[22] <= 0.018\ngini = 0.172\nsamples
= 21\nvalue = [19, 2]'),
Text(0.28353611581703375, 0.6607142857142857, 'x[21] <= 0.271\ngini = 0.375\nsamples
= 8\nvalue = [6, 2]'),
Text(0.28230401971353764, 0.625, 'x[22] <= 0.016\ngini = 0.245\nsamples = 7\nvalue =
[6, 1]'),
Text(0.2810719236100416, 0.5892857142857143, 'gini = 0.0\nsamples = 4\nvalue = [4,
0]'),
Text(0.28353611581703375, 0.5892857142857143, 'x[2] <= 0.5\ngini = 0.444\nsamples =
3\nvalue = [2, 1]'),
Text(0.28230401971353764, 0.5535714285714286, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
Text(0.2847682119205298, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.2847682119205298, 0.625, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.2860003080240259, 0.6607142857142857, 'gini = 0.0\nsamples = 13\nvalue = [13,
0]'),
Text(0.3003234252271677, 0.7321428571428571, 'x[23] <= 0.033\ngini = 0.439\nsamples
= 80\nvalue = [54, 26]'),
Text(0.29909132912367165, 0.6964285714285714, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
Text(0.30155552133066377, 0.6964285714285714, 'x[22] <= 0.263\ngini = 0.426\nsamples
= 78\nvalue = [54, 24]'),
Text(0.3003234252271677, 0.6607142857142857, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
Text(0.3027876174341599, 0.6607142857142857, 'x[21] <= 0.188\ngini = 0.411\nsamples
= 76\nvalue = [54, 22]'),
Text(0.29431695672262437, 0.625, 'x[7] <= 0.5\ngini = 0.325\nsamples = 44\nvalue =
[35, 9]'),
Text(0.29031264438626214, 0.5892857142857143, 'x[12] <= 0.5\ngini = 0.417\nsamples =
27\nvalue = [19, 8]'),
Text(0.28723240412752193, 0.5535714285714286, 'x[23] <= 0.049\ngini = 0.48\nsamples

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= 5\nvalue = [2, 3]'),
  Text(0.2860003080240259, 0.5178571428571429, 'x[8] <= 0.5\ngini = 0.444\nsamples = 3\nvalue = [2, 1]'),
  Text(0.2847682119205298, 0.48214285714285715, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
  Text(0.28723240412752193, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
  Text(0.288464500231018, 0.5178571428571429, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
  Text(0.2933928846450023, 0.5535714285714286, 'x[9] <= 0.5\ngini = 0.351\nsamples = 2\nvalue = [17, 5]'),
  Text(0.2909286924380102, 0.5178571428571429, 'x[22] <= 0.34\ngini = 0.266\nsamples = 19\nvalue = [16, 3]'),
  Text(0.2896965963345141, 0.48214285714285715, 'x[21] <= 0.104\ngini = 0.49\nsamples = 7\nvalue = [4, 3]'),
  Text(0.288464500231018, 0.44642857142857145, 'gini = 0.0\nsamples = 3\nvalue = [3, 0]'),
  Text(0.2909286924380102, 0.44642857142857145, 'x[21] <= 0.153\ngini = 0.375\nsamples = 4\nvalue = [1, 3]'),
  Text(0.2896965963345141, 0.4107142857142857, 'gini = 0.0\nsamples = 3\nvalue = [0, 3]'),
  Text(0.29216078854150623, 0.4107142857142857, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.29216078854150623, 0.48214285714285715, 'gini = 0.0\nsamples = 12\nvalue = [1 2, 0]'),
  Text(0.29585707685199447, 0.5178571428571429, 'x[5] <= 0.5\ngini = 0.444\nsamples = 3\nvalue = [1, 2]'),
  Text(0.29462498074849836, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.29708917295549053, 0.48214285714285715, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
  Text(0.2983212690589866, 0.5892857142857143, 'x[22] <= 0.553\ngini = 0.111\nsamples = 17\nvalue = [16, 1]'),
  Text(0.29708917295549053, 0.5535714285714286, 'gini = 0.0\nsamples = 14\nvalue = [1 4, 0]'),
  Text(0.29955336516248265, 0.5535714285714286, 'x[23] <= 0.073\ngini = 0.444\nsamples = 3\nvalue = [2, 1]'),
  Text(0.2983212690589866, 0.5178571428571429, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
  Text(0.30078546126597877, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
  Text(0.31125827814569534, 0.625, 'x[23] <= 0.146\ngini = 0.482\nsamples = 32\nvalue = [19, 13]'),
  Text(0.30694594178345913, 0.5892857142857143, 'x[22] <= 0.307\ngini = 0.5\nsamples = 22\nvalue = [11, 11]'),
  Text(0.30448174957646695, 0.5535714285714286, 'x[19] <= 0.5\ngini = 0.32\nsamples = 5\nvalue = [4, 1]'),
  Text(0.3032496534729709, 0.5178571428571429, 'gini = 0.0\nsamples = 4\nvalue = [4, 0]'),
  Text(0.305713845679963, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
  Text(0.30941013399045125, 0.5535714285714286, 'x[21] <= 0.285\ngini = 0.484\nsamples = 17\nvalue = [7, 10]'),
  Text(0.3081780378869552, 0.5178571428571429, 'x[23] <= 0.101\ngini = 0.5\nsamples = 14\nvalue = [7, 7]'),
  Text(0.30694594178345913, 0.48214285714285715, 'gini = 0.0\nsamples = 3\nvalue = [0, 3]'),
  Text(0.30941013399045125, 0.48214285714285715, 'x[2] <= 0.5\ngini = 0.463\nsamples = 11\nvalue = [7, 4]'),
  Text(0.3081780378869552, 0.44642857142857145, 'x[22] <= 0.408\ngini = 0.346\nsamples

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= 9\nvalue = [7, 2]'),
Text(0.30694594178345913, 0.4107142857142857, 'gini = 0.0\nsamples = 5\nvalue = [5,
0]'),
Text(0.30941013399045125, 0.4107142857142857, 'x[22] <= 0.411\ngini = 0.5\nsamples =
4\nvalue = [2, 2]'),
Text(0.3081780378869552, 0.375, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
Text(0.3106422300939473, 0.375, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.3106422300939473, 0.44642857142857145, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
Text(0.3106422300939473, 0.5178571428571429, 'gini = 0.0\nsamples = 3\nvalue = [0,
3]'),
Text(0.3155706145079316, 0.5892857142857143, 'x[23] <= 0.174\ngini = 0.32\nsamples =
10\nvalue = [8, 2]'),
Text(0.31433851840443555, 0.5535714285714286, 'x[5] <= 0.5\ngini = 0.198\nsamples =
9\nvalue = [8, 1]'),
Text(0.3131064223009395, 0.5178571428571429, 'gini = 0.0\nsamples = 6\nvalue = [6,
0]'),
Text(0.3155706145079316, 0.5178571428571429, 'x[23] <= 0.156\ngini = 0.444\nsamples
= 3\nvalue = [2, 1]'),
Text(0.31433851840443555, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.3168027106114277, 0.48214285714285715, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
Text(0.3168027106114277, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.30401971353765594, 0.7678571428571429, 'x[22] <= 0.427\ngini = 0.1\nsamples =
38\nvalue = [36, 2]'),
Text(0.3027876174341599, 0.7321428571428571, 'gini = 0.0\nsamples = 22\nvalue = [22,
0]'),
Text(0.305251809641152, 0.7321428571428571, 'x[20] <= 0.438\ngini = 0.219\nsamples =
16\nvalue = [14, 2]'),
Text(0.30401971353765594, 0.6964285714285714, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.30648390574464807, 0.6964285714285714, 'x[22] <= 0.449\ngini = 0.124\nsamples
= 15\nvalue = [14, 1]'),
Text(0.305251809641152, 0.6607142857142857, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.3077160018481442, 0.6607142857142857, 'gini = 0.0\nsamples = 14\nvalue = [14,
0]'),
Text(0.53264663628138, 0.9107142857142857, 'x[21] <= 0.188\ngini = 0.498\nsamples =
1477\nvalue = [687, 790]'),
Text(0.39575793161866624, 0.875, 'x[23] <= 0.014\ngini = 0.42\nsamples = 666\nvalue
= [200, 466]'),
Text(0.3455259510241799, 0.8392857142857143, 'x[22] <= 0.514\ngini = 0.242\nsamples
= 163\nvalue = [23, 140]'),
Text(0.3442938549206838, 0.8035714285714286, 'gini = 0.0\nsamples = 27\nvalue = [0,
27]'),
Text(0.34675804712767594, 0.8035714285714286, 'x[23] <= 0.009\ngini = 0.281\nsamples
= 136\nvalue = [23, 113]'),
Text(0.3362082242414908, 0.7678571428571429, 'x[13] <= 0.5\ngini = 0.394\nsamples =
63\nvalue = [17, 46]'),
Text(0.33497612813799477, 0.7321428571428571, 'x[22] <= 0.57\ngini = 0.371\nsamples
= 61\nvalue = [15, 46]'),
Text(0.3337440320344987, 0.6964285714285714, 'x[23] <= 0.009\ngini = 0.358\nsamples
= 60\nvalue = [14, 46]'),
Text(0.3297397196981365, 0.6607142857142857, 'x[3] <= 0.5\ngini = 0.405\nsamples = 4
6\nvalue = [13, 33]'),
Text(0.32850762359464036, 0.625, 'x[23] <= 0.008\ngini = 0.433\nsamples = 41\nvalue
= [13, 28]'),
Text(0.32419528723240415, 0.5892857142857143, 'x[23] <= 0.008\ngini = 0.375\nsamples

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= 32\nvalue = [8, 24]'),
  Text(0.32296319112890803, 0.5535714285714286, 'x[22] <= 0.521\ngini = 0.417\nsamples = 27\nvalue = [8, 19]'),
  Text(0.3204989989219159, 0.5178571428571429, 'x[2] <= 0.5\ngini = 0.351\nsamples = 2\nvalue = [5, 17]'),
  Text(0.31926690281841985, 0.48214285714285715, 'x[19] <= 0.5\ngini = 0.388\nsamples = 19\nvalue = [5, 14]'),
  Text(0.3168027106114277, 0.44642857142857145, 'x[14] <= 0.5\ngini = 0.32\nsamples = 15\nvalue = [3, 12]'),
  Text(0.3155706145079316, 0.4107142857142857, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
  Text(0.3180348067149238, 0.4107142857142857, 'x[23] <= 0.008\ngini = 0.355\nsamples = 13\nvalue = [3, 10]'),
  Text(0.3168027106114277, 0.375, 'x[22] <= 0.519\ngini = 0.397\nsamples = 11\nvalue = [3, 8]'),
  Text(0.3155706145079316, 0.3392857142857143, 'x[12] <= 0.5\ngini = 0.32\nsamples = 1\nvalue = [2, 8]'),
  Text(0.3131064223009395, 0.30357142857142855, 'x[22] <= 0.516\ngini = 0.5\nsamples = 2\nvalue = [1, 1]'),
  Text(0.3118743261974434, 0.26785714285714285, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
  Text(0.31433851840443555, 0.26785714285714285, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.3180348067149238, 0.30357142857142855, 'x[22] <= 0.515\ngini = 0.219\nsamples = 8\nvalue = [1, 7]'),
  Text(0.3168027106114277, 0.26785714285714285, 'gini = 0.444\nsamples = 3\nvalue = [1, 2]'),
  Text(0.31926690281841985, 0.26785714285714285, 'gini = 0.0\nsamples = 5\nvalue = [0, 5]'),
  Text(0.3180348067149238, 0.3392857142857143, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.31926690281841985, 0.375, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
  Text(0.321731095025412, 0.44642857142857145, 'x[22] <= 0.516\ngini = 0.5\nsamples = 4\nvalue = [2, 2]'),
  Text(0.3204989989219159, 0.4107142857142857, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
  Text(0.32296319112890803, 0.4107142857142857, 'x[1] <= 0.5\ngini = 0.444\nsamples = 3\nvalue = [2, 1]'),
  Text(0.321731095025412, 0.375, 'x[23] <= 0.008\ngini = 0.5\nsamples = 2\nvalue = [1, 1]'),
  Text(0.3204989989219159, 0.3392857142857143, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
  Text(0.32296319112890803, 0.3392857142857143, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.32419528723240415, 0.375, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.321731095025412, 0.48214285714285715, 'gini = 0.0\nsamples = 3\nvalue = [0, 3]'),
  Text(0.3254273833359002, 0.5178571428571429, 'x[15] <= 0.5\ngini = 0.48\nsamples = 5\nvalue = [3, 2]'),
  Text(0.32419528723240415, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
  Text(0.32665947943939627, 0.48214285714285715, 'x[12] <= 0.5\ngini = 0.375\nsamples = 4\nvalue = [3, 1]'),
  Text(0.3254273833359002, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
  Text(0.32789157554289233, 0.44642857142857145, 'gini = 0.0\nsamples = 3\nvalue = [3, 0]'),
  Text(0.3254273833359002, 0.5535714285714286, 'gini = 0.0\nsamples = 5\nvalue = [0, 5]'),
  Text(0.33281995995687663, 0.5892857142857143, 'x[8] <= 0.5\ngini = 0.494\nsamples =

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9\nvalue = [5, 4]'),
  Text(0.33158786385338057, 0.5535714285714286, 'x[12] <= 0.5\ngini = 0.469\nsamples =
8\nvalue = [5, 3]'),
  Text(0.3303557677498845, 0.5178571428571429, 'gini = 0.0\nsamples = 3\nvalue = [3,
0]'),
  Text(0.33281995995687663, 0.5178571428571429, 'x[23] <= 0.008\ngini = 0.48\nsamples
= 5\nvalue = [2, 3]'),
  Text(0.33158786385338057, 0.48214285714285715, 'x[22] <= 0.528\ngini = 0.444\nsample
s = 3\nvalue = [2, 1]'),
  Text(0.3303557677498845, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
  Text(0.33281995995687663, 0.44642857142857145, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
  Text(0.3340520560603727, 0.48214285714285715, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
  Text(0.3340520560603727, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
  Text(0.33097181580163254, 0.625, 'gini = 0.0\nsamples = 5\nvalue = [0, 5]'),
  Text(0.33774834437086093, 0.6607142857142857, 'x[22] <= 0.566\ngini = 0.133\nsamples
= 14\nvalue = [1, 13]'),
  Text(0.33651624826736487, 0.625, 'gini = 0.0\nsamples = 7\nvalue = [0, 7]'),
  Text(0.338980440474357, 0.625, 'x[22] <= 0.568\ngini = 0.245\nsamples = 7\nvalue =
[1, 6]'),
  Text(0.33774834437086093, 0.5892857142857143, 'x[1] <= 0.5\ngini = 0.5\nsamples = 2
\nvalue = [1, 1]'),
  Text(0.33651624826736487, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
  Text(0.338980440474357, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
  Text(0.34021253657785305, 0.5892857142857143, 'gini = 0.0\nsamples = 5\nvalue = [0,
5]'),
  Text(0.3362082242414908, 0.6964285714285714, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
  Text(0.3374403203449869, 0.7321428571428571, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
  Text(0.3573078700138611, 0.7678571428571429, 'x[3] <= 0.5\ngini = 0.151\nsamples = 7
3\nvalue = [6, 67]'),
  Text(0.3522254735869398, 0.7321428571428571, 'x[22] <= 0.771\ngini = 0.117\nsamples
= 64\nvalue = [4, 60]'),
  Text(0.34822116125057756, 0.6964285714285714, 'x[15] <= 0.5\ngini = 0.094\nsamples =
61\nvalue = [3, 58]'),
  Text(0.3439088248883413, 0.6607142857142857, 'x[22] <= 0.621\ngini = 0.071\nsamples
= 54\nvalue = [2, 52]'),
  Text(0.34267672878484523, 0.625, 'gini = 0.0\nsamples = 23\nvalue = [0, 23]'),
  Text(0.34514092099183735, 0.625, 'x[23] <= 0.009\ngini = 0.121\nsamples = 31\nvalue
= [2, 29]'),
  Text(0.34267672878484523, 0.5892857142857143, 'x[2] <= 0.5\ngini = 0.5\nsamples = 2
\nvalue = [1, 1]'),
  Text(0.34144463268134917, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
  Text(0.3439088248883413, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
  Text(0.34760511319882953, 0.5892857142857143, 'x[22] <= 0.707\ngini = 0.067\nsamples
= 29\nvalue = [1, 28]'),
  Text(0.3463730170953334, 0.5535714285714286, 'gini = 0.0\nsamples = 16\nvalue = [0,
16]'),
  Text(0.3488372093023256, 0.5535714285714286, 'x[22] <= 0.708\ngini = 0.142\nsamples
= 13\nvalue = [1, 12]'),
  Text(0.34760511319882953, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),

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Text(0.35006930540582165, 0.5178571428571429, 'gini = 0.0\nsamples = 12\nvalue = [0,
12]'),
Text(0.3525334976128138, 0.6607142857142857, 'x[23] <= 0.009\ngini = 0.245\nsamples
= 7\nvalue = [1, 6]'),
Text(0.3513014015093177, 0.625, 'x[23] <= 0.009\ngini = 0.5\nsamples = 2\nvalue =
[1, 1]'),
Text(0.35006930540582165, 0.5892857142857143, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.3525334976128138, 0.5892857142857143, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.3537655937163099, 0.625, 'gini = 0.0\nsamples = 5\nvalue = [0, 5]'),
Text(0.356229785923302, 0.6964285714285714, 'x[5] <= 0.5\ngini = 0.444\nsamples = 3
\nvalue = [1, 2]'),
Text(0.35499768981980595, 0.6607142857142857, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.3574618820267981, 0.6607142857142857, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
Text(0.36239026644078237, 0.7321428571428571, 'x[23] <= 0.01\ngini = 0.346\nsamples
= 9\nvalue = [2, 7]'),
Text(0.3611581703372863, 0.6964285714285714, 'x[23] <= 0.009\ngini = 0.48\nsamples =
5\nvalue = [2, 3]'),
Text(0.35992607423379025, 0.6607142857142857, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
Text(0.36239026644078237, 0.6607142857142857, 'x[12] <= 0.5\ngini = 0.444\nsamples =
3\nvalue = [2, 1]'),
Text(0.3611581703372863, 0.625, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.36362236254427843, 0.625, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.36362236254427843, 0.6964285714285714, 'gini = 0.0\nsamples = 4\nvalue = [0,
4]'),
Text(0.44598991221315265, 0.8392857142857143, 'x[5] <= 0.5\ngini = 0.456\nsamples =
503\nvalue = [177, 326]'),
Text(0.40587940859387034, 0.8035714285714286, 'x[22] <= 0.572\ngini = 0.494\nsamples
= 270\nvalue = [120, 150]'),
Text(0.3861851224395503, 0.7678571428571429, 'x[15] <= 0.5\ngini = 0.495\nsamples =
98\nvalue = [54, 44]'),
Text(0.37363314338518405, 0.7321428571428571, 'x[22] <= 0.51\ngini = 0.5\nsamples =
82\nvalue = [42, 40]'),
Text(0.3660865547512706, 0.6964285714285714, 'x[22] <= 0.506\ngini = 0.346\nsamples
= 9\nvalue = [7, 2]'),
Text(0.36485445864777455, 0.6607142857142857, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.36731865085476667, 0.6607142857142857, 'x[22] <= 0.509\ngini = 0.219\nsamples
= 8\nvalue = [7, 1]'),
Text(0.3660865547512706, 0.625, 'gini = 0.0\nsamples = 5\nvalue = [5, 0]'),
Text(0.36855074695826273, 0.625, 'x[19] <= 0.5\ngini = 0.444\nsamples = 3\nvalue =
[2, 1]'),
Text(0.36731865085476667, 0.5892857142857143, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.3697828430617588, 0.5892857142857143, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
Text(0.3811797320190975, 0.6964285714285714, 'x[22] <= 0.512\ngini = 0.499\nsamples
= 73\nvalue = [35, 38]'),
Text(0.37994763591560143, 0.6607142857142857, 'gini = 0.0\nsamples = 4\nvalue = [0,
4]'),
Text(0.38241182812259356, 0.6607142857142857, 'x[23] <= 0.015\ngini = 0.5\nsamples =
69\nvalue = [35, 34]'),
Text(0.3811797320190975, 0.625, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.3836439242260896, 0.625, 'x[12] <= 0.5\ngini = 0.5\nsamples = 67\nvalue = [3
3, 34]'),
Text(0.37224703526875097, 0.5892857142857143, 'x[23] <= 0.02\ngini = 0.457\nsamples

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= 17\nvalue = [11, 6]'),
  Text(0.3697828430617588, 0.5535714285714286, 'x[20] <= 0.188\ngini = 0.375\nsamples = 4\nvalue = [1, 3]'),
  Text(0.36855074695826273, 0.5178571428571429, 'gini = 0.0\nsamples = 3\nvalue = [0, 3]'),
  Text(0.3710149391652549, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.3747112274757431, 0.5535714285714286, 'x[14] <= 0.5\ngini = 0.355\nsamples = 13\nvalue = [10, 3]'),
  Text(0.37347913137224703, 0.5178571428571429, 'gini = 0.0\nsamples = 5\nvalue = [5, 0]'),
  Text(0.3759433235792392, 0.5178571428571429, 'x[21] <= 0.118\ngini = 0.469\nsamples = 8\nvalue = [5, 3]'),
  Text(0.3747112274757431, 0.48214285714285715, 'x[6] <= 0.5\ngini = 0.5\nsamples = 6\nvalue = [3, 3]'),
  Text(0.37347913137224703, 0.44642857142857145, 'x[22] <= 0.518\ngini = 0.48\nsamples = 5\nvalue = [3, 2]'),
  Text(0.37224703526875097, 0.4107142857142857, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.3747112274757431, 0.4107142857142857, 'x[22] <= 0.537\ngini = 0.5\nsamples = 4\nvalue = [2, 2]'),
  Text(0.37347913137224703, 0.375, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
  Text(0.3759433235792392, 0.375, 'x[22] <= 0.557\ngini = 0.444\nsamples = 3\nvalue = [2, 1]'),
  Text(0.3747112274757431, 0.3392857142857143, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.37717541968273527, 0.3392857142857143, 'x[8] <= 0.5\ngini = 0.5\nsamples = 2\nvalue = [1, 1]'),
  Text(0.3759433235792392, 0.30357142857142855, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.37840751578623133, 0.30357142857142855, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
  Text(0.3759433235792392, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
  Text(0.37717541968273527, 0.48214285714285715, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
  Text(0.3950408131834283, 0.5892857142857143, 'x[23] <= 0.069\ngini = 0.493\nsamples = 50\nvalue = [22, 28]'),
  Text(0.3919605729246881, 0.5535714285714286, 'x[22] <= 0.563\ngini = 0.5\nsamples = 36\nvalue = [18, 18]'),
  Text(0.39072847682119205, 0.5178571428571429, 'x[22] <= 0.56\ngini = 0.496\nsamples = 33\nvalue = [18, 15]'),
  Text(0.389496380717696, 0.48214285714285715, 'x[21] <= 0.076\ngini = 0.499\nsamples = 29\nvalue = [14, 15]'),
  Text(0.38580009240720775, 0.44642857142857145, 'x[1] <= 0.5\ngini = 0.476\nsamples = 23\nvalue = [9, 14]'),
  Text(0.38210380409671957, 0.4107142857142857, 'x[23] <= 0.016\ngini = 0.355\nsamples = 13\nvalue = [3, 10]'),
  Text(0.38087170799322345, 0.375, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
  Text(0.38333590020021563, 0.375, 'x[22] <= 0.518\ngini = 0.165\nsamples = 11\nvalue = [1, 10]'),
  Text(0.38210380409671957, 0.3392857142857143, 'x[21] <= 0.049\ngini = 0.444\nsamples = 3\nvalue = [1, 2]'),
  Text(0.38087170799322345, 0.30357142857142855, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.38333590020021563, 0.30357142857142855, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
  Text(0.3845679963037117, 0.3392857142857143, 'gini = 0.0\nsamples = 8\nvalue = [0, 8]'),
  Text(0.389496380717696, 0.4107142857142857, 'x[19] <= 0.5\ngini = 0.48\nsamples = 10

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\value = [6, 4]'),
  Text(0.38826428461419993, 0.375, 'x[21] <= 0.049\ngini = 0.5\nsamples = 8\nvalue =
[4, 4]'),
  Text(0.3870321885107038, 0.3392857142857143, 'x[2] <= 0.5\ngini = 0.444\nsamples = 6
\nvalue = [4, 2]'),
  Text(0.38580009240720775, 0.30357142857142855, 'x[23] <= 0.016\ngini = 0.32\nsamples
= 5\nvalue = [4, 1]'),
  Text(0.3845679963037117, 0.26785714285714285, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
  Text(0.3870321885107038, 0.26785714285714285, 'gini = 0.0\nsamples = 4\nvalue = [4,
0]'),
  Text(0.38826428461419993, 0.30357142857142855, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
  Text(0.389496380717696, 0.3392857142857143, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
  Text(0.39072847682119205, 0.375, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
  Text(0.39319266902818417, 0.44642857142857145, 'x[2] <= 0.5\ngini = 0.278\nsamples =
6\nvalue = [5, 1]'),
  Text(0.3919605729246881, 0.4107142857142857, 'gini = 0.0\nsamples = 4\nvalue = [4,
0]'),
  Text(0.3944247651316803, 0.4107142857142857, 'x[14] <= 0.5\ngini = 0.5\nsamples = 2
\nvalue = [1, 1]'),
  Text(0.39319266902818417, 0.375, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
  Text(0.39565686123517635, 0.375, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.3919605729246881, 0.48214285714285715, 'gini = 0.0\nsamples = 4\nvalue = [4,
0]'),
  Text(0.39319266902818417, 0.5178571428571429, 'gini = 0.0\nsamples = 3\nvalue = [0,
3]'),
  Text(0.39812105344216847, 0.5535714285714286, 'x[23] <= 0.096\ngini = 0.408\nsamples
= 14\nvalue = [4, 10]'),
  Text(0.39565686123517635, 0.5178571428571429, 'x[1] <= 0.5\ngini = 0.198\nsamples =
9\nvalue = [1, 8]'),
  Text(0.3944247651316803, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
  Text(0.3968889573386724, 0.48214285714285715, 'gini = 0.0\nsamples = 8\nvalue = [0,
8]'),
  Text(0.40058524564916065, 0.5178571428571429, 'x[1] <= 0.5\ngini = 0.48\nsamples = 5
\nvalue = [3, 2]'),
  Text(0.3993531495456646, 0.48214285714285715, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
  Text(0.4018173417526567, 0.48214285714285715, 'gini = 0.0\nsamples = 3\nvalue = [3,
0]'),
  Text(0.3987371014939165, 0.7321428571428571, 'x[19] <= 0.5\ngini = 0.375\nsamples =
16\nvalue = [12, 4]'),
  Text(0.3962729092869244, 0.6964285714285714, 'x[22] <= 0.51\ngini = 0.26\nsamples =
13\nvalue = [11, 2]'),
  Text(0.3950408131834283, 0.6607142857142857, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
  Text(0.39750500539042044, 0.6607142857142857, 'x[8] <= 0.5\ngini = 0.153\nsamples =
12\nvalue = [11, 1]'),
  Text(0.3962729092869244, 0.625, 'gini = 0.0\nsamples = 10\nvalue = [10, 0]'),
  Text(0.3987371014939165, 0.625, 'x[21] <= 0.069\ngini = 0.5\nsamples = 2\nvalue =
[1, 1]'),
  Text(0.39750500539042044, 0.5892857142857143, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
  Text(0.3999691975974126, 0.5892857142857143, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
  Text(0.4012012937009087, 0.6964285714285714, 'x[22] <= 0.524\ngini = 0.444\nsamples
= 3\nvalue = [1, 2]'),
  Text(0.3999691975974126, 0.6607142857142857, 'gini = 0.0\nsamples = 2\nvalue = [0,

```

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2]'),
  Text(0.40243338980440474, 0.6607142857142857, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
  Text(0.42557369474819035, 0.7678571428571429, 'x[23] <= 0.022\ngini = 0.473\nsamples
= 172\nvalue = [66, 106]'),
  Text(0.4085938703218851, 0.7321428571428571, 'x[6] <= 0.5\ngini = 0.269\nsamples = 2
5\nvalue = [4, 21]'),
  Text(0.406129678114893, 0.6964285714285714, 'x[22] <= 0.616\ngini = 0.095\nsamples =
20\nvalue = [1, 19]'),
  Text(0.40489758201139686, 0.6607142857142857, 'x[23] <= 0.02\ngini = 0.278\nsamples
= 6\nvalue = [1, 5]'),
  Text(0.4036654859079008, 0.625, 'gini = 0.0\nsamples = 5\nvalue = [0, 5]'),
  Text(0.406129678114893, 0.625, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.40736177421838904, 0.6607142857142857, 'gini = 0.0\nsamples = 14\nvalue = [0,
14]'),
  Text(0.4110580625288773, 0.6964285714285714, 'x[23] <= 0.02\ngini = 0.48\nsamples =
5\nvalue = [3, 2]'),
  Text(0.40982596642538116, 0.6607142857142857, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
  Text(0.41229015863237334, 0.6607142857142857, 'x[3] <= 0.5\ngini = 0.444\nsamples =
3\nvalue = [1, 2]'),
  Text(0.4110580625288773, 0.625, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
  Text(0.4135222547358694, 0.625, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.4425535191744956, 0.7321428571428571, 'x[21] <= 0.146\ngini = 0.488\nsamples
= 147\nvalue = [62, 85]'),
  Text(0.4272293238872632, 0.6964285714285714, 'x[22] <= 0.667\ngini = 0.474\nsamples
= 119\nvalue = [46, 73]'),
  Text(0.4184506391498537, 0.6607142857142857, 'x[23] <= 0.075\ngini = 0.401\nsamples
= 54\nvalue = [15, 39]'),
  Text(0.4159864469428615, 0.625, 'x[23] <= 0.069\ngini = 0.455\nsamples = 40\nvalue =
[14, 26]'),
  Text(0.41475435083936546, 0.5892857142857143, 'x[23] <= 0.058\ngini = 0.401\nsamples
= 36\nvalue = [10, 26]'),
  Text(0.4135222547358694, 0.5535714285714286, 'x[6] <= 0.5\ngini = 0.452\nsamples = 2
9\nvalue = [10, 19]'),
  Text(0.41229015863237334, 0.5178571428571429, 'x[22] <= 0.656\ngini = 0.417\nsamples
= 27\nvalue = [8, 19]'),
  Text(0.4110580625288773, 0.48214285714285715, 'x[23] <= 0.057\ngini = 0.393\nsamples
= 26\nvalue = [7, 19]'),
  Text(0.40982596642538116, 0.44642857142857145, 'x[15] <= 0.5\ngini = 0.365\nsamples
= 25\nvalue = [6, 19]'),
  Text(0.40736177421838904, 0.4107142857142857, 'x[22] <= 0.617\ngini = 0.298\nsamples
= 22\nvalue = [4, 18]'),
  Text(0.406129678114893, 0.375, 'gini = 0.0\nsamples = 9\nvalue = [0, 9]'),
  Text(0.4085938703218851, 0.375, 'x[23] <= 0.045\ngini = 0.426\nsamples = 13\nvalue =
[4, 9]'),
  Text(0.40736177421838904, 0.3392857142857143, 'x[21] <= 0.063\ngini = 0.5\nsamples =
8\nvalue = [4, 4]'),
  Text(0.406129678114893, 0.30357142857142855, 'x[23] <= 0.032\ngini = 0.444\nsamples
= 6\nvalue = [2, 4]'),
  Text(0.40489758201139686, 0.26785714285714285, 'x[23] <= 0.026\ngini = 0.444\nsample
s = 3\nvalue = [2, 1]'),
  Text(0.4036654859079008, 0.23214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
  Text(0.406129678114893, 0.23214285714285715, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
  Text(0.40736177421838904, 0.26785714285714285, 'gini = 0.0\nsamples = 3\nvalue = [0,
3]'),
  Text(0.4085938703218851, 0.30357142857142855, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),

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Text(0.40982596642538116, 0.3392857142857143, 'gini = 0.0\nsamples = 5\nvalue = [0, 5]'),
Text(0.41229015863237334, 0.4107142857142857, 'x[21] <= 0.049\ngini = 0.444\nsamples = 3\nvalue = [2, 1]'),
Text(0.4110580625288773, 0.375, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.4135222547358694, 0.375, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.41229015863237334, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.4135222547358694, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.41475435083936546, 0.5178571428571429, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.4159864469428615, 0.5535714285714286, 'gini = 0.0\nsamples = 7\nvalue = [0, 7]'),
Text(0.41721854304635764, 0.5892857142857143, 'gini = 0.0\nsamples = 4\nvalue = [4, 0]'),
Text(0.4209148313568458, 0.625, 'x[22] <= 0.614\ngini = 0.133\nsamples = 14\nvalue = [1, 13]'),
Text(0.41968273525334976, 0.5892857142857143, 'x[22] <= 0.612\ngini = 0.32\nsamples = 5\nvalue = [1, 4]'),
Text(0.4184506391498537, 0.5535714285714286, 'gini = 0.0\nsamples = 4\nvalue = [0, 4]'),
Text(0.4209148313568458, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.4221469274603419, 0.5892857142857143, 'gini = 0.0\nsamples = 9\nvalue = [0, 9]'),
Text(0.4360080086246727, 0.6607142857142857, 'x[22] <= 0.757\ngini = 0.499\nsamples = 65\nvalue = [31, 34]'),
Text(0.4276913599260742, 0.625, 'x[23] <= 0.031\ngini = 0.478\nsamples = 38\nvalue = [23, 15]'),
Text(0.42461111966733406, 0.5892857142857143, 'x[19] <= 0.5\ngini = 0.219\nsamples = 8\nvalue = [7, 1]'),
Text(0.423379023563838, 0.5535714285714286, 'gini = 0.0\nsamples = 7\nvalue = [7, 0]'),
Text(0.4258432157708301, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.4307716001848144, 0.5892857142857143, 'x[2] <= 0.5\ngini = 0.498\nsamples = 3\nvalue = [16, 14]'),
Text(0.4283074079778223, 0.5535714285714286, 'x[8] <= 0.5\ngini = 0.455\nsamples = 2\nvalue = [13, 7]'),
Text(0.4270753118743262, 0.5178571428571429, 'x[22] <= 0.707\ngini = 0.5\nsamples = 14\nvalue = [7, 7]'),
Text(0.4258432157708301, 0.48214285714285715, 'x[21] <= 0.056\ngini = 0.346\nsamples = 9\nvalue = [7, 2]'),
Text(0.42461111966733406, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.4270753118743262, 0.44642857142857145, 'x[22] <= 0.67\ngini = 0.219\nsamples = 8\nvalue = [7, 1]'),
Text(0.4258432157708301, 0.4107142857142857, 'x[1] <= 0.5\ngini = 0.5\nsamples = 2\nvalue = [1, 1]'),
Text(0.42461111966733406, 0.375, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.4270753118743262, 0.375, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.4283074079778223, 0.4107142857142857, 'gini = 0.0\nsamples = 6\nvalue = [6, 0]'),
Text(0.4283074079778223, 0.48214285714285715, 'gini = 0.0\nsamples = 5\nvalue = [0, 5]'),
Text(0.42953950408131836, 0.5178571428571429, 'gini = 0.0\nsamples = 6\nvalue = [6, 0]'),
Text(0.43323579239180654, 0.5535714285714286, 'x[11] <= 0.5\ngini = 0.42\nsamples = 10\nvalue = [3, 7]'),

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Text(0.4320036962883105, 0.5178571428571429, 'gini = 0.0\nsamples = 4\nvalue = [0,
4]'),
Text(0.43446788849530266, 0.5178571428571429, 'x[22] <= 0.707\ngini = 0.5\nsamples =
6\nvalue = [3, 3]'),
Text(0.43323579239180654, 0.48214285714285715, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
Text(0.4356999845987987, 0.48214285714285715, 'x[23] <= 0.056\ngini = 0.375\nsamples =
4\nvalue = [1, 3]'),
Text(0.43446788849530266, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.4369320807022948, 0.44642857142857145, 'gini = 0.0\nsamples = 3\nvalue = [0,
3]'),
Text(0.4443246573232712, 0.625, 'x[8] <= 0.5\ngini = 0.417\nsamples = 27\nvalue =
[8, 19]'),
Text(0.4418604651162791, 0.5892857142857143, 'x[22] <= 0.815\ngini = 0.49\nsamples =
7\nvalue = [4, 3]'),
Text(0.440628369012783, 0.5535714285714286, 'x[2] <= 0.5\ngini = 0.48\nsamples = 5\n
value = [2, 3]'),
Text(0.4393962729092869, 0.5178571428571429, 'x[22] <= 0.767\ngini = 0.444\nsamples =
3\nvalue = [2, 1]'),
Text(0.43816417680579084, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.440628369012783, 0.48214285714285715, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
Text(0.4418604651162791, 0.5178571428571429, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
Text(0.44309256121977514, 0.5535714285714286, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
Text(0.4467888495302634, 0.5892857142857143, 'x[14] <= 0.5\ngini = 0.32\nsamples = 2
0\nvalue = [4, 16]'),
Text(0.44555675342676726, 0.5535714285714286, 'gini = 0.0\nsamples = 7\nvalue = [0,
7]'),
Text(0.44802094563375944, 0.5535714285714286, 'x[23] <= 0.092\ngini = 0.426\nsamples =
13\nvalue = [4, 9]'),
Text(0.4467888495302634, 0.5178571428571429, 'x[22] <= 0.81\ngini = 0.494\nsamples =
9\nvalue = [4, 5]'),
Text(0.44555675342676726, 0.48214285714285715, 'x[19] <= 0.5\ngini = 0.408\nsamples =
7\nvalue = [2, 5]'),
Text(0.4443246573232712, 0.44642857142857145, 'x[3] <= 0.5\ngini = 0.278\nsamples =
6\nvalue = [1, 5]'),
Text(0.44309256121977514, 0.4107142857142857, 'gini = 0.0\nsamples = 5\nvalue = [0,
5]'),
Text(0.44555675342676726, 0.4107142857142857, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.4467888495302634, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.44802094563375944, 0.48214285714285715, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
Text(0.4492530417372555, 0.5178571428571429, 'gini = 0.0\nsamples = 4\nvalue = [0,
4]'),
Text(0.45787771446172804, 0.6964285714285714, 'x[23] <= 0.123\ngini = 0.49\nsamples =
28\nvalue = [16, 12]'),
Text(0.45541352225473586, 0.6607142857142857, 'x[22] <= 0.657\ngini = 0.42\nsamples =
20\nvalue = [14, 6]'),
Text(0.4541814261512398, 0.625, 'x[12] <= 0.5\ngini = 0.48\nsamples = 15\nvalue =
[9, 6]'),
Text(0.45294933004774374, 0.5892857142857143, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
Text(0.45541352225473586, 0.5892857142857143, 'x[20] <= 0.438\ngini = 0.426\nsamples =
13\nvalue = [9, 4]'),

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Text(0.4541814261512398, 0.5535714285714286, 'x[2] <= 0.5\ngini = 0.375\nsamples = 12\nvalue = [9, 3]'),
Text(0.4517172339442477, 0.5178571428571429, 'x[22] <= 0.622\ngini = 0.198\nsamples = 9\nvalue = [8, 1]'),
Text(0.45048513784075156, 0.48214285714285715, 'gini = 0.0\nsamples = 6\nvalue = [6, 0]'),
Text(0.45294933004774374, 0.48214285714285715, 'x[10] <= 0.5\ngini = 0.444\nsamples = 3\nvalue = [2, 1]'),
Text(0.4517172339442477, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.4541814261512398, 0.44642857142857145, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.4566456183582319, 0.5178571428571429, 'x[20] <= 0.312\ngini = 0.444\nsamples = 3\nvalue = [1, 2]'),
Text(0.45541352225473586, 0.48214285714285715, 'gini = 0.0\nsamples = 2\nvalue = [0, 2]'),
Text(0.45787771446172804, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.4566456183582319, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.4566456183582319, 0.625, 'gini = 0.0\nsamples = 5\nvalue = [5, 0]'),
Text(0.46034190666872016, 0.6607142857142857, 'x[23] <= 0.14\ngini = 0.375\nsamples = 8\nvalue = [2, 6]'),
Text(0.4591098105652241, 0.625, 'gini = 0.0\nsamples = 6\nvalue = [0, 6]'),
Text(0.4615740027722162, 0.625, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.4861004158324349, 0.8035714285714286, 'x[23] <= 0.018\ngini = 0.37\nsamples = 233\nvalue = [57, 176]'),
Text(0.4763591560141691, 0.7678571428571429, 'x[13] <= 0.5\ngini = 0.278\nsamples = 6\nvalue = [5, 1]'),
Text(0.47512705991067306, 0.7321428571428571, 'gini = 0.0\nsamples = 5\nvalue = [5, 0]'),
Text(0.4775912521176652, 0.7321428571428571, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.49584167565070075, 0.7678571428571429, 'x[22] <= 0.619\ngini = 0.353\nsamples = 227\nvalue = [52, 175]'),
Text(0.4800554443246573, 0.7321428571428571, 'x[22] <= 0.61\ngini = 0.458\nsamples = 62\nvalue = [22, 40]'),
Text(0.4714307716001848, 0.6964285714285714, 'x[21] <= 0.076\ngini = 0.406\nsamples = 53\nvalue = [15, 38]'),
Text(0.46527029108270446, 0.6607142857142857, 'x[14] <= 0.5\ngini = 0.191\nsamples = 28\nvalue = [3, 25]'),
Text(0.4640381949792084, 0.625, 'gini = 0.0\nsamples = 11\nvalue = [0, 11]'),
Text(0.4665023871862005, 0.625, 'x[23] <= 0.036\ngini = 0.291\nsamples = 17\nvalue = [3, 14]'),
Text(0.46527029108270446, 0.5892857142857143, 'x[23] <= 0.03\ngini = 0.397\nsamples = 11\nvalue = [3, 8]'),
Text(0.4628060988757123, 0.5535714285714286, 'x[22] <= 0.564\ngini = 0.219\nsamples = 8\nvalue = [1, 7]'),
Text(0.4615740027722162, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
Text(0.4640381949792084, 0.5178571428571429, 'gini = 0.0\nsamples = 7\nvalue = [0, 7]'),
Text(0.4677344832896966, 0.5535714285714286, 'x[2] <= 0.5\ngini = 0.444\nsamples = 3\nvalue = [2, 1]'),
Text(0.4665023871862005, 0.5178571428571429, 'gini = 0.0\nsamples = 2\nvalue = [2, 0]'),
Text(0.4689665793931927, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [0, 1]'),
Text(0.4677344832896966, 0.5892857142857143, 'gini = 0.0\nsamples = 6\nvalue = [0, 6]'),

```

```

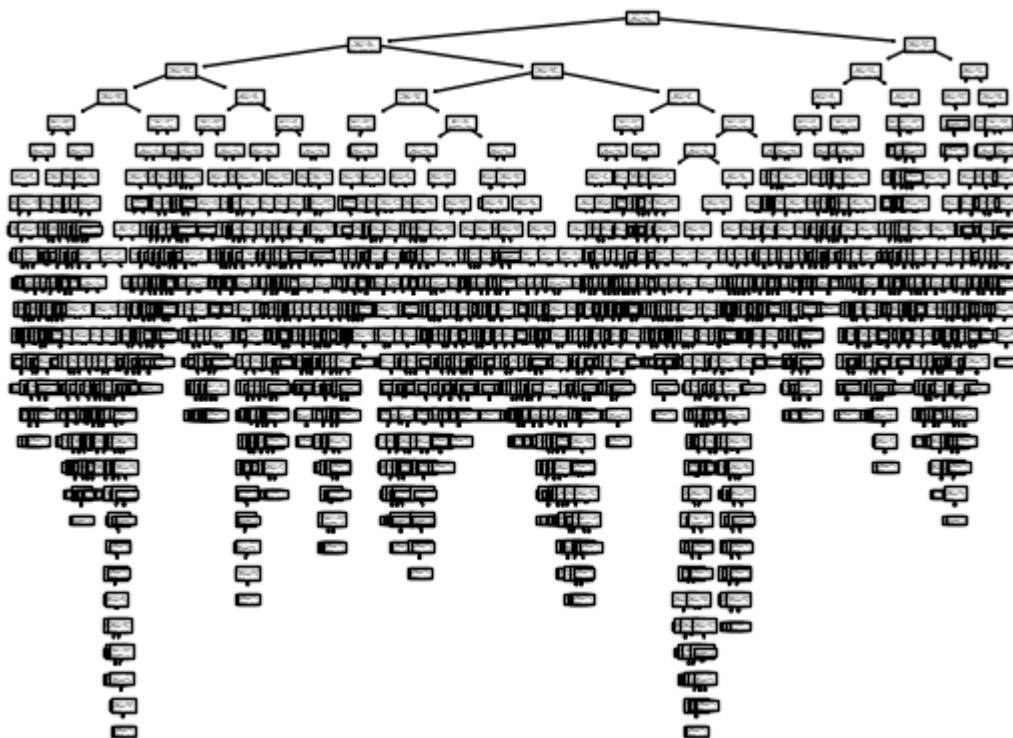
Text(0.4775912521176652, 0.6607142857142857, 'x[23] <= 0.091\ngini = 0.499\nsamples
= 25\nvalue = [12, 13]'),
Text(0.47389496380717694, 0.625, 'x[22] <= 0.554\ngini = 0.444\nsamples = 15\nvalue
= [10, 5]'),
Text(0.4726628677036809, 0.5892857142857143, 'gini = 0.0\nsamples = 2\nvalue = [0,
2]'),
Text(0.47512705991067306, 0.5892857142857143, 'x[22] <= 0.605\ngini = 0.355\nsamples
= 13\nvalue = [10, 3]'),
Text(0.47389496380717694, 0.5535714285714286, 'x[21] <= 0.09\ngini = 0.278\nsamples
= 12\nvalue = [10, 2]'),
Text(0.4714307716001848, 0.5178571428571429, 'x[15] <= 0.5\ngini = 0.5\nsamples = 2
\nvalue = [1, 1]'),
Text(0.47019867549668876, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.4726628677036809, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.4763591560141691, 0.5178571428571429, 'x[22] <= 0.564\ngini = 0.18\nsamples =
10\nvalue = [9, 1]'),
Text(0.47512705991067306, 0.48214285714285715, 'x[22] <= 0.56\ngini = 0.5\nsamples =
2\nvalue = [1, 1]'),
Text(0.47389496380717694, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.4763591560141691, 0.44642857142857145, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.4775912521176652, 0.48214285714285715, 'gini = 0.0\nsamples = 8\nvalue = [8,
0]'),
Text(0.4763591560141691, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.4812875404281534, 0.625, 'x[19] <= 0.5\ngini = 0.32\nsamples = 10\nvalue =
[2, 8]'),
Text(0.4800554443246573, 0.5892857142857143, 'x[22] <= 0.581\ngini = 0.198\nsamples
= 9\nvalue = [1, 8]'),
Text(0.47882334822116124, 0.5535714285714286, 'gini = 0.0\nsamples = 7\nvalue = [0,
7]'),
Text(0.4812875404281534, 0.5535714285714286, 'x[22] <= 0.59\ngini = 0.5\nsamples = 2
\nvalue = [1, 1]'),
Text(0.4800554443246573, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.4825196365316495, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.4825196365316495, 0.5892857142857143, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.48868011704912984, 0.6964285714285714, 'x[2] <= 0.5\ngini = 0.346\nsamples =
9\nvalue = [7, 2]'),
Text(0.4874480209456338, 0.6607142857142857, 'x[14] <= 0.5\ngini = 0.219\nsamples =
8\nvalue = [7, 1]'),
Text(0.4862159248421377, 0.625, 'x[22] <= 0.613\ngini = 0.444\nsamples = 3\nvalue =
[2, 1]'),
Text(0.4849838287386416, 0.5892857142857143, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.4874480209456338, 0.5892857142857143, 'x[22] <= 0.617\ngini = 0.5\nsamples =
2\nvalue = [1, 1]'),
Text(0.4862159248421377, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.48868011704912984, 0.5535714285714286, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
Text(0.48868011704912984, 0.625, 'gini = 0.0\nsamples = 5\nvalue = [5, 0]'),
Text(0.4899122131526259, 0.6607142857142857, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
Text(0.5116279069767442, 0.7321428571428571, 'x[12] <= 0.5\ngini = 0.298\nsamples =

```

```

165\nvalue = [30, 135]'),
  Text(0.49607269367010626, 0.6964285714285714, 'x[23] <= 0.143\ngini = 0.444\nsamples
= 27\nvalue = [9, 18]'),
  Text(0.4948405975666102, 0.6607142857142857, 'x[22] <= 0.861\ngini = 0.403\nsamples
= 25\nvalue = [7, 18]'),
  Text(0.49360850146311414, 0.625, 'x[14] <= 0.5\ngini = 0.375\nsamples = 24\nvalue =
[6, 18]'),
  Text(0.4923764053596181, 0.5892857142857143, 'gini = 0.0\nsamples = 8\nvalue = [0,
8]'),
  Text(0.4948405975666102, 0.5892857142857143, 'x[22] <= 0.678\ngini = 0.469\nsamples
= 16\nvalue = [6, 10]'),
  Text(0.49114430925612196, 0.5535714285714286, 'x[19] <= 0.5\ngini = 0.375\nsamples =
4\nvalue = [3, 1]'),
  Text(0.4899122131526259, 0.5178571428571429, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
  Text(0.4923764053596181, 0.5178571428571429, 'x[23] <= 0.089\ngini = 0.5\nsamples =
2\nvalue = [1, 1]'),
  Text(0.49114430925612196, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
  Text(0.49360850146311414, 0.48214285714285715, 'gini = 0.0\nsamples = 1\nvalue = [0,
1]'),
  Text(0.49853688587709843, 0.5535714285714286, 'x[6] <= 0.5\ngini = 0.375\nsamples =
12\nvalue = [3, 9]'),
  Text(0.4973047897736023, 0.5178571428571429, 'x[22] <= 0.76\ngini = 0.298\nsamples =
11\nvalue = [2, 9]'),
  Text(0.49607269367010626, 0.48214285714285715, 'gini = 0.0\nsamples = 6\nvalue = [0,
6]'),
  Text(0.49853688587709843, 0.48214285714285715, 'x[22] <= 0.765\ngini = 0.48\nsamples
= 5\nvalue = [2, 3]'),
  Text(0.4973047897736023, 0.44642857142857145, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
  Text(0.4997689819805945, 0.44642857142857145, 'gini = 0.0\nsamples = 3\nvalue = [0,
3]'),
  Text(0.4997689819805945, 0.5178571428571429, 'gini = 0.0\nsamples = 1\nvalue = [1,
0]'),
  Text(0.49607269367010626, 0.625, 'gini = 0.0\nsamples = 1\nvalue = [1, 0]'),
  Text(0.4973047897736023, 0.6607142857142857, 'gini = 0.0\nsamples = 2\nvalue = [2,
0]'),
  Text(0.5271831202833821, 0.6964285714285714, 'x[22] <= 0.726\ngini = 0.258\nsamples
= 138\nvalue = [21, 117]'),
  Text(0.5182504235330356, 0.6607142857142857, 'x[22] <= 0.69\ngini = 0.338\nsamples =
65\nvalue = [14, 51]'),
  Text(0.5133220391190513, 0.625, 'x[23] <= 0.135\ngini = 0.237\nsamples = 51\nvalue =
[7, 44]'),
  Text(0.5120899430155552, 0.5892857142857143, 'x[6] <= 0.5\ngini = 0.211\nsamples = 5
0\nvalue = [6, 44]'),
  Text(0.5108578469120592, 0.5535714285714286, 'x[10] <= 0.5\ngini = 0.183\nsamples =
49\nvalue = [5, 44]'),
  Text(0.5059294624980748, 0.5178571428571429, 'x[9] <= 0.5\ngini = 0.105\nsamples = 3
6\nvalue = [2, 34]'),
  Text(0.5034652702910827, 0.48214285714285715, 'x[22] <= 0.67\ngini = 0.061\nsamples
= 32\nvalue = [1, 31]'),
  Text(0.5022331741875866, 0.44642857142857145, 'gini = 0.0\nsamples = 26\nvalue = [0,
26]'),
  ...]

```



```
In [117... # Get the feature importances
importance = dt.feature_importances_

# Create a dictionary of feature importance values
feature_importances = dict(zip(X_train_scaled.columns, importance))

# Sort the features by importance in descending order
sorted_features = sorted(feature_importances.items(), key=lambda x: x[1], reverse=True)

# Print the important features
for feature, importance in sorted_features:
    print(f"{feature}: {importance}")
```



```
remainder__MonthlyCharges: 0.20677203713795786
remainder__TotalCharges: 0.19113261299368783
trf1__Contract: 0.16540078357547214
remainder__tenure: 0.13975753642108474
trf3__InternetService_Fiber optic: 0.043374977632616926
trf2__gender_Male: 0.030555705116431714
trf2__Partner_Yes: 0.023419948110488358
trf2__Dependents_Yes: 0.019030067350557085
customer_services_enrolled: 0.018997903543823105
trf2__OnlineSecurity_Yes: 0.018589335512474395
trf2__PaperlessBilling_Yes: 0.018026251023975676
trf2__PaymentMethod_Electronic check: 0.01579095831885737
trf2__MultipleLines_Yes: 0.014764672970168332
trf2__DeviceProtection_Yes: 0.01468215806741994
trf2__PaymentMethod_Mailed check: 0.014679914387158955
remainder__SeniorCitizen: 0.013785856679696003
trf2__PaymentMethod_Credit card (automatic): 0.011814159703443685
trf2__OnlineBackup_Yes: 0.01085276093377559
trf2__TechSupport_Yes: 0.010374642282002055
trf2__StreamingMovies_Yes: 0.008938520524203923
trf2__StreamingTV_Yes: 0.004792387520345167
trf2__PhoneService_Yes: 0.004350355797663051
trf3__InternetService_DSL: 0.00011645439669612883
trf3__InternetService_No: 0.0
```

In []:

Random forests tend to provide more robust feature selection compared to individual decision trees. They can mitigate the issue of overfitting by reducing the impact of noise and capturing the generalizable patterns in the data.

so used random forest for feature selection

In [130...]

In []:

In [175...]

X_train_final

Out[175]:

	trf1_Contract	customer_services_enrolled	remainder_tenure	remainder_MonthlyCharges	remainder_churn
0	0.5	0.625	0.750000	0.522671	
1	0.0	0.250	0.013889	0.620827	
2	0.5	0.125	0.180556	0.010463	
3	1.0	0.500	0.333333	0.780269	
4	0.0	0.250	0.083333	0.556552	
...
4925	0.0	0.500	0.013889	0.764823	
4926	1.0	1.000	0.319444	0.725959	
4927	0.0	0.125	0.166667	0.028899	
4928	0.0	0.625	0.166667	0.809168	
4929	0.5	0.125	0.361111	0.015446	

4930 rows × 5 columns

In [176...]

```

# Python Project Template
# 1. Prepare Problem
# a) Load Libraries
# b) Load dataset
# 2. Summarize Data
# a) Descriptive statistics
# b) Data visualizations
# 3. Prepare Data
# a) Data Cleaning
# b) Feature Selection
# c) Data Transforms

#all step are completed

```

4. Evaluate Algorithms.

In [205...]

```

# Load Libraries
import numpy
from matplotlib import pyplot
from pandas import read_csv
from pandas import set_option
#from pandas.tools.plotting import scatter_matrix
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import GridSearchCV
from sklearn.metrics import classification_report
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score
from sklearn.pipeline import Pipeline

```

```

from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.discriminant_analysis import LinearDiscriminantAnalysis
from sklearn.naive_bayes import GaussianNB
from sklearn.svm import SVC
from sklearn.ensemble import AdaBoostClassifier
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.ensemble import ExtraTreesClassifier

```

In []:

In [187...

```

# Spot-Check Algorithms
seed = 7
models = []
models.append(('LR', LogisticRegression()))
models.append(('LDA', LinearDiscriminantAnalysis()))
models.append(('KNN', KNeighborsClassifier()))
models.append(('CART', DecisionTreeClassifier()))
models.append(('NB', GaussianNB()))
models.append(('SVM', SVC()))
models.append(('RANDOM_FOREST', RandomForestClassifier()))
# evaluate each model in turn
results = []
names = []
for name, model in models:
    kfold = KFold(n_splits=10, random_state=seed, shuffle=True)
    cv_results = cross_val_score(model, X_train_final, y_train, cv=kfold, scoring='acc')
    results.append(cv_results)
    names.append(name)
    msg = "%s: %f (%f)" % (name, cv_results.mean(), cv_results.std())
    print(msg)

```

```

LR: 0.785193 (0.014183)
LDA: 0.784787 (0.013919)
KNN: 0.769777 (0.017360)
CART: 0.728398 (0.014212)
NB: 0.700406 (0.023093)
SVM: 0.791075 (0.018188)
RANDOM_FOREST: 0.768357 (0.020622)

```

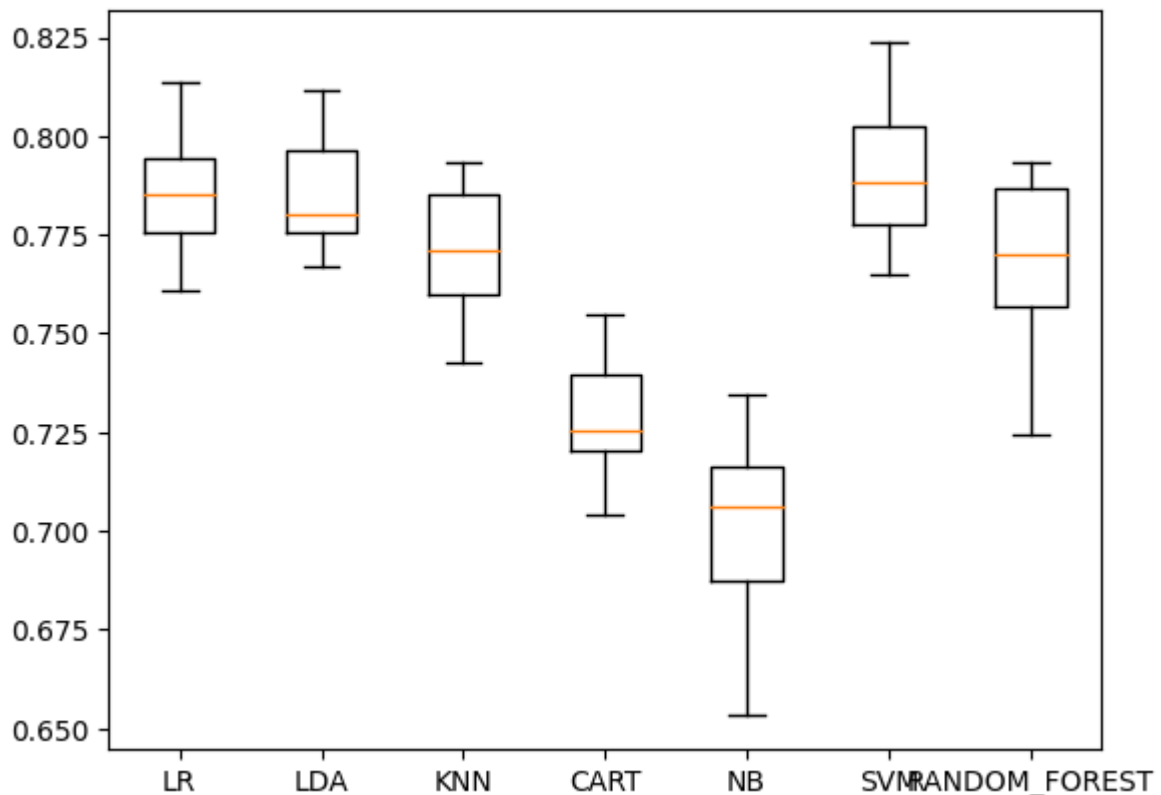
In [188...

```

# Compare Algorithms
fig = pyplot.figure()
fig.suptitle('Algorithm Comparison')
ax = fig.add_subplot(111)
pyplot.boxplot(results)
ax.set_xticklabels(names)
pyplot.show()

```

Algorithm Comparison



For now Make Predictions on test dataset with top 3 models:
SVM,LR,LDA

```
In [191... # Make predictions on validation dataset
svm = SVC()
svm.fit(X_train_final, y_train)
predictions = svm.predict(X_test_final)
print(accuracy_score(y_test, predictions))
print(confusion_matrix(y_test, predictions))
print(classification_report(y_test, predictions))
```

0.7893989588263133

```
[[1434 105]
 [ 340 234]]
```

	precision	recall	f1-score	support
No	0.81	0.93	0.87	1539
Yes	0.69	0.41	0.51	574
accuracy			0.79	2113
macro avg	0.75	0.67	0.69	2113
weighted avg	0.78	0.79	0.77	2113

```
In [192... # Make predictions on validation dataset
lr = LogisticRegression()
lr.fit(X_train_final, y_train)
predictions = lr.predict(X_test_final)
print(accuracy_score(y_test, predictions))
```

```
print(confusion_matrix(y_test, predictions))
print(classification_report(y_test, predictions))
```

```
0.7974443918599148
```

```
[[1392  147]
 [ 281  293]]
```

	precision	recall	f1-score	support
No	0.83	0.90	0.87	1539
Yes	0.67	0.51	0.58	574
accuracy			0.80	2113
macro avg	0.75	0.71	0.72	2113
weighted avg	0.79	0.80	0.79	2113

In [193...

```
# Make predictions on validation dataset
lda = LinearDiscriminantAnalysis()
lda.fit(X_train_final, y_train)
predictions = lda.predict(X_test_final)
print(accuracy_score(y_test, predictions))
print(confusion_matrix(y_test, predictions))
print(classification_report(y_test, predictions))
```

```
0.7950780880265026
```

```
[[1377  162]
 [ 271  303]]
```

	precision	recall	f1-score	support
No	0.84	0.89	0.86	1539
Yes	0.65	0.53	0.58	574
accuracy			0.80	2113
macro avg	0.74	0.71	0.72	2113
weighted avg	0.79	0.80	0.79	2113

In []:

Algo Tunning

In [207...

```
#Lets do tuning - start with SVM

# Tune scaled SVM
# scaler = StandardScaler().fit(X_train) -#my data is already scaled - so no need to
# rescaledX = scaler.transform(X_train)
c_values = [0.1, 0.3, 0.5, 0.7, 0.9, 1.0, 1.3, 1.5, 1.7, 2.0]
kernel_values = ['linear', 'poly', 'rbf', 'sigmoid']
param_grid = dict(C=c_values, kernel=kernel_values)
model = SVC()
num_folds=10
scoring = 'accuracy'
kfold = KFold(n_splits=num_folds, random_state=seed, shuffle=True)
grid = GridSearchCV(estimator=model, param_grid=param_grid, scoring=scoring, cv=kfold)
grid_result = grid.fit(X_train_final, y_train)
print("Best: %f using %s" % (grid_result.best_score_, grid_result.best_params_))
means = grid_result.cv_results_['mean_test_score']
stds = grid_result.cv_results_['std_test_score']
```

```

params = grid_result.cv_results_['params']
for mean, stdev, param in zip(means, stds, params):
    print("%f (%f) with: %r" % (mean, stdev, param))

```

```

Best: 0.793306 using {'C': 0.5, 'kernel': 'poly'}
0.786815 (0.022704) with: {'C': 0.1, 'kernel': 'linear'}
0.780933 (0.020405) with: {'C': 0.1, 'kernel': 'poly'}
0.791481 (0.020014) with: {'C': 0.1, 'kernel': 'rbf'}
0.724341 (0.015001) with: {'C': 0.1, 'kernel': 'sigmoid'}
0.783773 (0.013307) with: {'C': 0.3, 'kernel': 'linear'}
0.793103 (0.019243) with: {'C': 0.3, 'kernel': 'poly'}
0.791886 (0.019396) with: {'C': 0.3, 'kernel': 'rbf'}
0.721907 (0.020048) with: {'C': 0.3, 'kernel': 'sigmoid'}
0.784787 (0.012747) with: {'C': 0.5, 'kernel': 'linear'}
0.793306 (0.018820) with: {'C': 0.5, 'kernel': 'poly'}
0.791886 (0.020002) with: {'C': 0.5, 'kernel': 'rbf'}
0.719067 (0.020106) with: {'C': 0.5, 'kernel': 'sigmoid'}
0.784787 (0.012152) with: {'C': 0.7, 'kernel': 'linear'}
0.792089 (0.018216) with: {'C': 0.7, 'kernel': 'poly'}
0.791684 (0.018986) with: {'C': 0.7, 'kernel': 'rbf'}
0.717850 (0.019550) with: {'C': 0.7, 'kernel': 'sigmoid'}
0.784381 (0.012172) with: {'C': 0.9, 'kernel': 'linear'}
0.791886 (0.018749) with: {'C': 0.9, 'kernel': 'poly'}
0.791075 (0.018457) with: {'C': 0.9, 'kernel': 'rbf'}
0.717647 (0.019662) with: {'C': 0.9, 'kernel': 'sigmoid'}
0.784381 (0.012538) with: {'C': 1.0, 'kernel': 'linear'}
0.791886 (0.019544) with: {'C': 1.0, 'kernel': 'poly'}
0.791075 (0.018188) with: {'C': 1.0, 'kernel': 'rbf'}
0.716836 (0.019076) with: {'C': 1.0, 'kernel': 'sigmoid'}
0.784990 (0.012034) with: {'C': 1.3, 'kernel': 'linear'}
0.791886 (0.019649) with: {'C': 1.3, 'kernel': 'poly'}
0.791684 (0.017938) with: {'C': 1.3, 'kernel': 'rbf'}
0.716227 (0.018534) with: {'C': 1.3, 'kernel': 'sigmoid'}
0.784990 (0.012238) with: {'C': 1.5, 'kernel': 'linear'}
0.792292 (0.019502) with: {'C': 1.5, 'kernel': 'poly'}
0.791684 (0.017938) with: {'C': 1.5, 'kernel': 'rbf'}
0.715619 (0.018047) with: {'C': 1.5, 'kernel': 'sigmoid'}
0.784990 (0.012238) with: {'C': 1.7, 'kernel': 'linear'}
0.792698 (0.019766) with: {'C': 1.7, 'kernel': 'poly'}
0.791278 (0.018198) with: {'C': 1.7, 'kernel': 'rbf'}
0.715619 (0.018093) with: {'C': 1.7, 'kernel': 'sigmoid'}
0.784787 (0.012050) with: {'C': 2.0, 'kernel': 'linear'}
0.793103 (0.019456) with: {'C': 2.0, 'kernel': 'poly'}
0.791684 (0.018166) with: {'C': 2.0, 'kernel': 'rbf'}
0.715619 (0.018652) with: {'C': 2.0, 'kernel': 'sigmoid'}

```

In [218...

```
#Lets do tuning - Logistic regression
```

```
# Define the parameter grid for grid search
```

```

param_grid = {'penalty': ['l1', 'l2', 'elasticnet'],
              'C': [0.1, 1, 10],
              'fit_intercept': [True, False],
              'solver': ['newton-cg', 'lbfgs', 'liblinear', 'sag', 'saga'],
              'max_iter': [100, 200, 500]}

```

```
# Create a Logistic regression model
```

```
model = LogisticRegression()
```

```
scoring = 'accuracy'
```

```
kfold = KFold(n_splits=num_folds, random_state=seed,shuffle=True)
grid = GridSearchCV(estimator=model, param_grid=param_grid, scoring=scoring, cv=kfold)
grid_result = grid.fit(X_train_final, y_train)
print("Best: %f using %s" % (grid_result.best_score_, grid_result.best_params_))
means = grid_result.cv_results_['mean_test_score']
stds = grid_result.cv_results_['std_test_score']
params = grid_result.cv_results_['params']
for mean, stdev, param in zip(means, stds, params):
    print("%f (%f) with: %r" % (mean, stdev, param))
```

```

Best: 0.792089 using {'C': 0.1, 'fit_intercept': True, 'max_iter': 100, 'penalty': 'l2'}
nan (nan) with: {'C': 0.1, 'fit_intercept': True, 'max_iter': 100, 'penalty': 'l1'}
0.792089 (0.018126) with: {'C': 0.1, 'fit_intercept': True, 'max_iter': 100, 'penalty': 'l2'}
nan (nan) with: {'C': 0.1, 'fit_intercept': True, 'max_iter': 100, 'penalty': 'elasticnet'}
nan (nan) with: {'C': 0.1, 'fit_intercept': True, 'max_iter': 200, 'penalty': 'l1'}
0.792089 (0.018126) with: {'C': 0.1, 'fit_intercept': True, 'max_iter': 200, 'penalty': 'l2'}
nan (nan) with: {'C': 0.1, 'fit_intercept': True, 'max_iter': 200, 'penalty': 'elasticnet'}
nan (nan) with: {'C': 0.1, 'fit_intercept': True, 'max_iter': 500, 'penalty': 'l1'}
0.792089 (0.018126) with: {'C': 0.1, 'fit_intercept': True, 'max_iter': 500, 'penalty': 'l2'}
nan (nan) with: {'C': 0.1, 'fit_intercept': True, 'max_iter': 500, 'penalty': 'elasticnet'}
nan (nan) with: {'C': 0.1, 'fit_intercept': False, 'max_iter': 100, 'penalty': 'l1'}
0.788032 (0.011375) with: {'C': 0.1, 'fit_intercept': False, 'max_iter': 100, 'penalty': 'l2'}
nan (nan) with: {'C': 0.1, 'fit_intercept': False, 'max_iter': 100, 'penalty': 'elasticnet'}
nan (nan) with: {'C': 0.1, 'fit_intercept': False, 'max_iter': 200, 'penalty': 'l1'}
0.788032 (0.011375) with: {'C': 0.1, 'fit_intercept': False, 'max_iter': 200, 'penalty': 'l2'}
nan (nan) with: {'C': 0.1, 'fit_intercept': False, 'max_iter': 200, 'penalty': 'elasticnet'}
nan (nan) with: {'C': 0.1, 'fit_intercept': False, 'max_iter': 500, 'penalty': 'l1'}
0.788032 (0.011375) with: {'C': 0.1, 'fit_intercept': False, 'max_iter': 500, 'penalty': 'l2'}
nan (nan) with: {'C': 0.1, 'fit_intercept': False, 'max_iter': 500, 'penalty': 'elasticnet'}
nan (nan) with: {'C': 1, 'fit_intercept': True, 'max_iter': 100, 'penalty': 'l1'}
0.785193 (0.014183) with: {'C': 1, 'fit_intercept': True, 'max_iter': 100, 'penalty': 'l2'}
nan (nan) with: {'C': 1, 'fit_intercept': True, 'max_iter': 100, 'penalty': 'elasticnet'}
nan (nan) with: {'C': 1, 'fit_intercept': True, 'max_iter': 200, 'penalty': 'l1'}
0.785193 (0.014183) with: {'C': 1, 'fit_intercept': True, 'max_iter': 200, 'penalty': 'l2'}
nan (nan) with: {'C': 1, 'fit_intercept': True, 'max_iter': 200, 'penalty': 'elasticnet'}
nan (nan) with: {'C': 1, 'fit_intercept': True, 'max_iter': 500, 'penalty': 'l1'}
0.785193 (0.014183) with: {'C': 1, 'fit_intercept': True, 'max_iter': 500, 'penalty': 'l2'}
nan (nan) with: {'C': 1, 'fit_intercept': True, 'max_iter': 500, 'penalty': 'elasticnet'}
nan (nan) with: {'C': 1, 'fit_intercept': False, 'max_iter': 100, 'penalty': 'l1'}
0.786410 (0.009980) with: {'C': 1, 'fit_intercept': False, 'max_iter': 100, 'penalty': 'l2'}
nan (nan) with: {'C': 1, 'fit_intercept': False, 'max_iter': 100, 'penalty': 'elasticnet'}
nan (nan) with: {'C': 1, 'fit_intercept': False, 'max_iter': 200, 'penalty': 'l1'}
0.786410 (0.009980) with: {'C': 1, 'fit_intercept': False, 'max_iter': 200, 'penalty': 'l2'}
nan (nan) with: {'C': 1, 'fit_intercept': False, 'max_iter': 200, 'penalty': 'elasticnet'}
nan (nan) with: {'C': 1, 'fit_intercept': False, 'max_iter': 500, 'penalty': 'l1'}
0.786410 (0.009980) with: {'C': 1, 'fit_intercept': False, 'max_iter': 500, 'penalty': 'l2'}

```



```
nan (nan) with: {'C': 1, 'fit_intercept': False, 'max_iter': 500, 'penalty': 'elastic
net'}
nan (nan) with: {'C': 10, 'fit_intercept': True, 'max_iter': 100, 'penalty': 'l1'}
0.786004 (0.014913) with: {'C': 10, 'fit_intercept': True, 'max_iter': 100, 'penalt
y': 'l2'}
nan (nan) with: {'C': 10, 'fit_intercept': True, 'max_iter': 100, 'penalty': 'elastic
net'}
nan (nan) with: {'C': 10, 'fit_intercept': True, 'max_iter': 200, 'penalty': 'l1'}
0.786004 (0.014913) with: {'C': 10, 'fit_intercept': True, 'max_iter': 200, 'penalt
y': 'l2'}
nan (nan) with: {'C': 10, 'fit_intercept': True, 'max_iter': 200, 'penalty': 'elastic
net'}
nan (nan) with: {'C': 10, 'fit_intercept': True, 'max_iter': 500, 'penalty': 'l1'}
0.786004 (0.014913) with: {'C': 10, 'fit_intercept': True, 'max_iter': 500, 'penalt
y': 'l2'}
nan (nan) with: {'C': 10, 'fit_intercept': True, 'max_iter': 500, 'penalty': 'elastic
net'}
nan (nan) with: {'C': 10, 'fit_intercept': False, 'max_iter': 100, 'penalty': 'l1'}
0.787627 (0.009429) with: {'C': 10, 'fit_intercept': False, 'max_iter': 100, 'penalt
y': 'l2'}
nan (nan) with: {'C': 10, 'fit_intercept': False, 'max_iter': 100, 'penalty': 'elasti
cnet'}
nan (nan) with: {'C': 10, 'fit_intercept': False, 'max_iter': 200, 'penalty': 'l1'}
0.787627 (0.009429) with: {'C': 10, 'fit_intercept': False, 'max_iter': 200, 'penalt
y': 'l2'}
nan (nan) with: {'C': 10, 'fit_intercept': False, 'max_iter': 200, 'penalty': 'elasti
cnet'}
nan (nan) with: {'C': 10, 'fit_intercept': False, 'max_iter': 500, 'penalty': 'l1'}
0.787627 (0.009429) with: {'C': 10, 'fit_intercept': False, 'max_iter': 500, 'penalt
y': 'l2'}
nan (nan) with: {'C': 10, 'fit_intercept': False, 'max_iter': 500, 'penalty': 'elasti
cnet'}
```

```
C:\Users\rupeshv\Anaconda3\envs\rup_venv\lib\site-packages\sklearn\model_selection\_validation.py:378: FitFailedWarning:
360 fits failed out of a total of 540.
The score on these train-test partitions for these parameters will be set to nan.
If these failures are not expected, you can try to debug them by setting error_score
='raise'.
```

Below are more details about the failures:

180 fits failed with the following error:

Traceback (most recent call last):

```
File "C:\Users\rupeshv\Anaconda3\envs\rup_venv\lib\site-packages\sklearn\model_selection\_validation.py", line 686, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
```

```
File "C:\Users\rupeshv\Anaconda3\envs\rup_venv\lib\site-packages\sklearn\linear_model\_logistic.py", line 1162, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
```

```
File "C:\Users\rupeshv\Anaconda3\envs\rup_venv\lib\site-packages\sklearn\linear_model\_logistic.py", line 54, in _check_solver
    raise ValueError(
```

```
ValueError: Solver lbfgs supports only 'l2' or 'none' penalties, got l1 penalty.
```

180 fits failed with the following error:

Traceback (most recent call last):

```
File "C:\Users\rupeshv\Anaconda3\envs\rup_venv\lib\site-packages\sklearn\model_selection\_validation.py", line 686, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
```

```
File "C:\Users\rupeshv\Anaconda3\envs\rup_venv\lib\site-packages\sklearn\linear_model\_logistic.py", line 1162, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
```

```
File "C:\Users\rupeshv\Anaconda3\envs\rup_venv\lib\site-packages\sklearn\linear_model\_logistic.py", line 54, in _check_solver
    raise ValueError(
```

```
ValueError: Solver lbfgs supports only 'l2' or 'none' penalties, got elasticnet penalty.
```

```
warnings.warn(some_fits_failed_message, FitFailedWarning)
```

```
C:\Users\rupeshv\Anaconda3\envs\rup_venv\lib\site-packages\sklearn\model_selection\_search.py:952: UserWarning: One or more of the test scores are non-finite: [      nan
0.79208925      nan      nan 0.79208925      nan
```

```
      nan 0.79208925      nan      nan 0.78803245      nan
      nan 0.78803245      nan      nan 0.78803245      nan
```

```
      nan 0.7851927      nan      nan 0.7851927      nan
      nan 0.7851927      nan      nan 0.78640974      nan
```

```
      nan 0.78640974      nan      nan 0.78640974      nan
      nan 0.78600406      nan      nan 0.78600406      nan
```

```
      nan 0.78600406      nan      nan 0.78762677      nan
      nan 0.78762677      nan      nan 0.78762677      nan]
```

```
warnings.warn(
```

In [210...

```
# ensembles
ensembles = []
ensembles.append(('AB', AdaBoostClassifier()))
ensembles.append(('GBM', GradientBoostingClassifier()))
ensembles.append(('RF', RandomForestClassifier()))
ensembles.append(('ET', ExtraTreesClassifier()))
results = []
names = []
for name, model in ensembles:
```

```

kfold = KFold(n_splits=num_folds, random_state=seed,shuffle=True)
cv_results = cross_val_score(model, X_train_final, y_train, cv=kfold, scoring=score)
results.append(cv_results)
names.append(name)
msg = "%s: %f (%f)" % (name, cv_results.mean(), cv_results.std())
print(msg)

```

AB: 0.784584 (0.014983)
 GBM: 0.789858 (0.017827)
 RF: 0.763489 (0.020927)
 ET: 0.751927 (0.022588)

In [211...

```

# Make predictions on validation dataset
AB = AdaBoostClassifier()
AB.fit(X_train_final, y_train)
predictions = AB.predict(X_test_final)
print(accuracy_score(y_test, predictions))
print(confusion_matrix(y_test, predictions))
print(classification_report(y_test, predictions))

```

0.7950780880265026

```
[[1395  144]
 [ 289  285]]
```

	precision	recall	f1-score	support
No	0.83	0.91	0.87	1539
Yes	0.66	0.50	0.57	574
accuracy			0.80	2113
macro avg	0.75	0.70	0.72	2113
weighted avg	0.78	0.80	0.78	2113

Final Result

0.7974443918599148 - Logistic regression is giving high prediction even with default parameters

In []:

In []:

In []:

In []:

In []: