Reto Titanic

Team mebers

Nallely Serna	A00833111
Sofía Cantú	A01571120
Ozner Leyva	A01742377
Fernanda Perez	A01742102

Import libraries

```
#!pip install pandas scikit-learn catboost numpy matplotlib seaborn

# Data processing and analysis libraries
import pandas as pd
import numpy as np

# Visualization libraries
import matplotlib.pyplot as plt
import seaborn as sns

# Evaluation metrics
from sklearn.metrics import accuracy_score, roc_auc_score, confusion_matrix, clas

# Machine learning models
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC

# Preprocessing and cross validation
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import GridSearchCV, cross_val_score, cross_val_pred

# CatBoost for boosting models
from catboost import CatBoostClassifier, Pool, cv
```

Exploratory Analysis

```
df = pd.read_csv('train.csv', index_col=0)
```

```
#The first 5 rows of the dataset to understand its structure
df.head()
```

PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fa
1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.25
2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th	female	38.0	1	0	PC 17599	71.28

```
#Stats for numerical variables
df.describe()
```

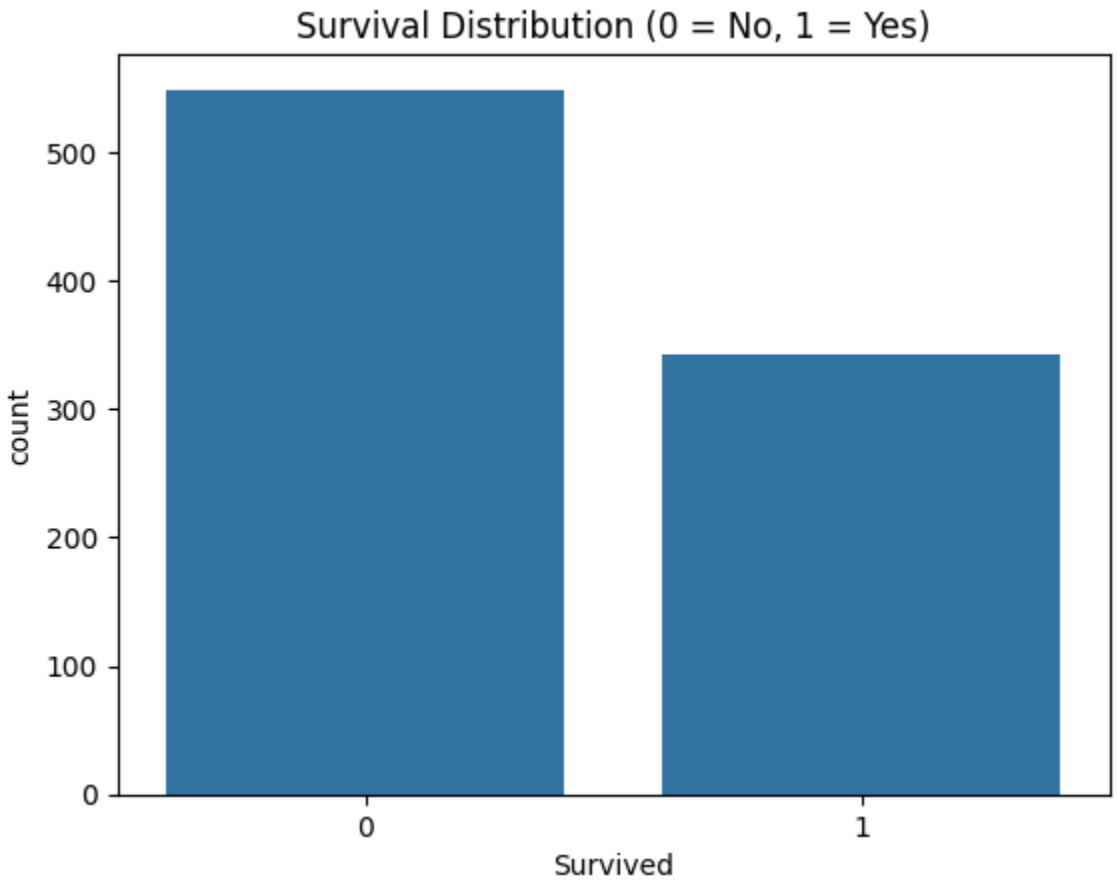
	Survived	Pclass	Age	SibSp	Parch	Fare
count	891.000000	891.000000	714.000000	891.000000	891.000000	891.000000
mean	0.383838	2.308642	29.699118	0.523008	0.381594	32.204208
std	0.486592	0.836071	14.526497	1.102743	0.806057	49.693429
min	0.000000	1.000000	0.420000	0.000000	0.000000	0.000000
25%	0.000000	2.000000	20.125000	0.000000	0.000000	7.910400
50%	0.000000	3.000000	28.000000	0.000000	0.000000	14.454200
75%	1.000000	3.000000	38.000000	1.000000	0.000000	31.000000
max	1.000000	3.000000	80.000000	8.000000	6.000000	512.329200

```
# Percentage of missing values in the columns
missing_values = df.isnull().mean().round(4) * 100
missing_values = missing_values[missing_values > 0]
missing_values
```

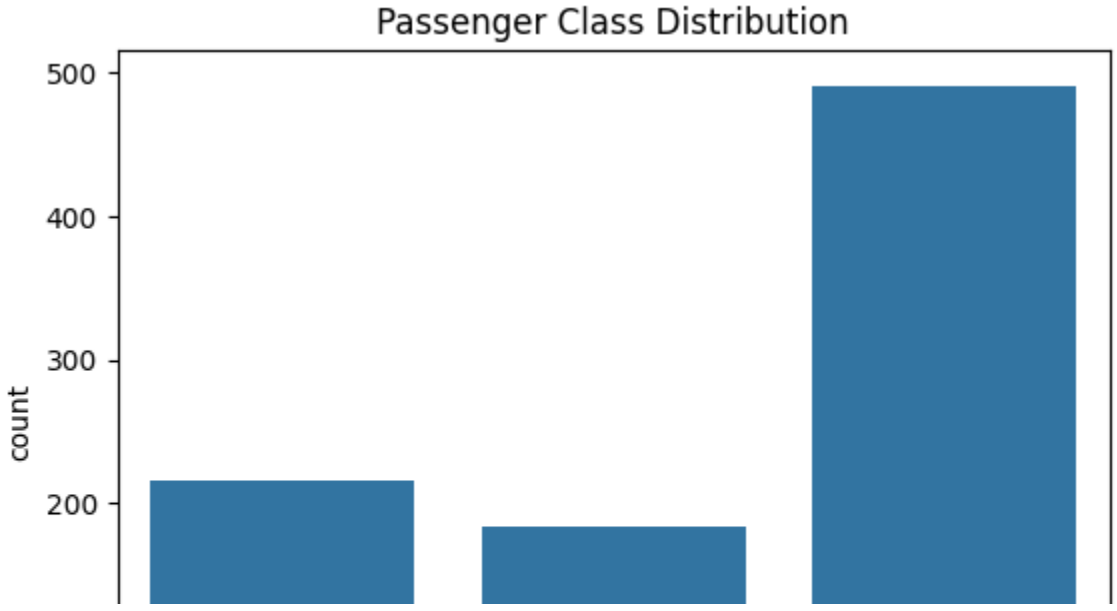
	0
Age	19.87
Cabin	77.10
Embarked	0.22

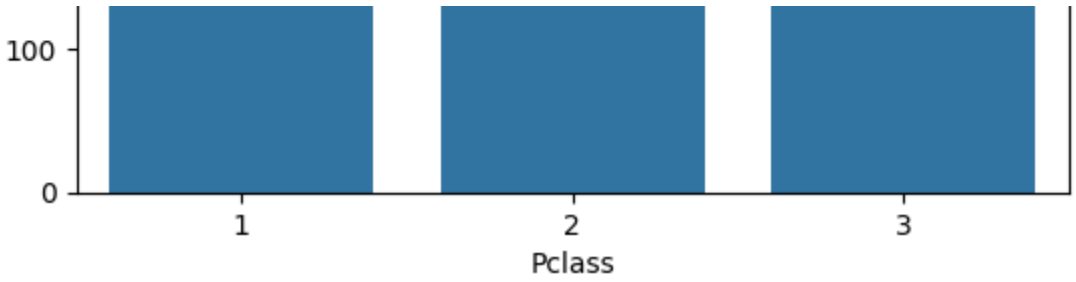
dtype: float64

```
# Distribution of the variable: 'Survived'
sns.countplot(x='Survived', data=df)
plt.title('Survival Distribution (0 = No, 1 = Yes)')
plt.show()
```

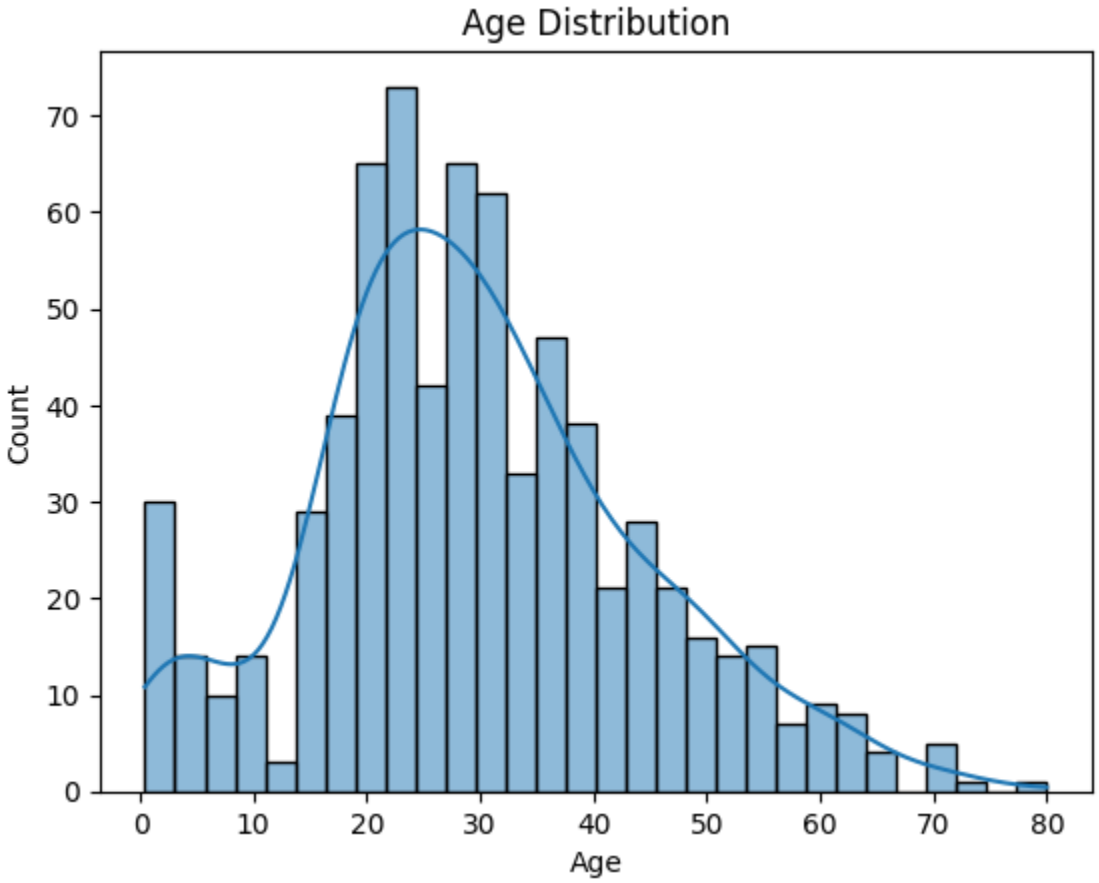



```
# Distribution of varieble: 'Pclass'
sns.countplot(x='Pclass', data=df)
plt.title('Passenger Class Distribution')
plt.show()
```

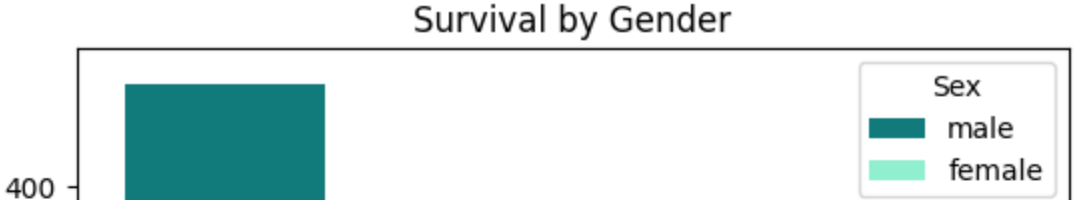


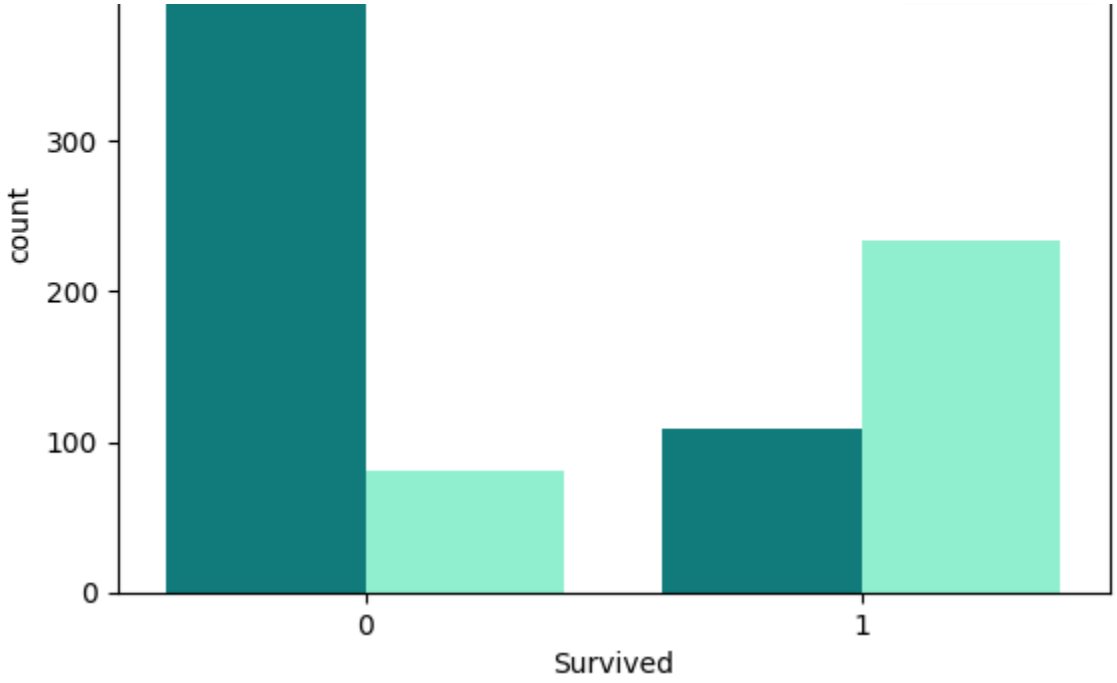



```
# Age distribution
sns.histplot(df['Age'].dropna(), kde=True, bins=30)
plt.title('Age Distribution')
plt.show()
```

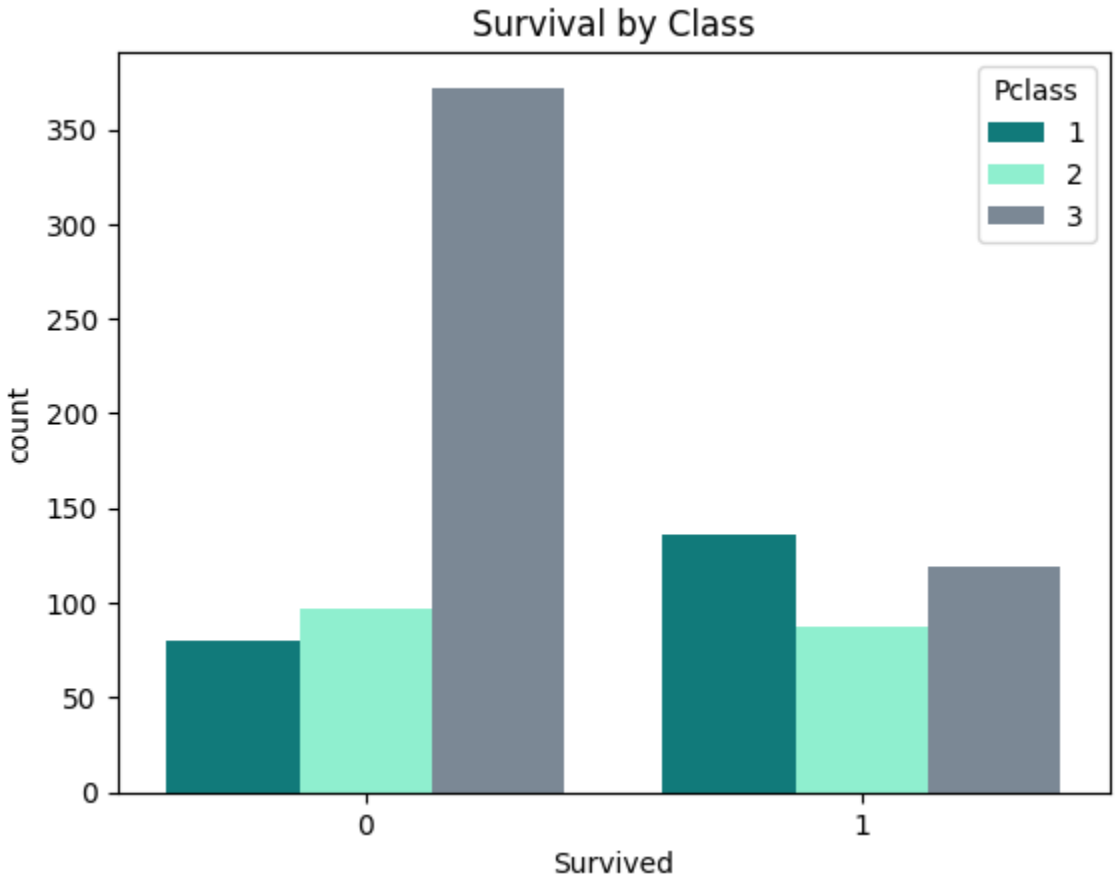



```
# Survival comparison by gender
custom_palette = ['darkcyan', 'aquamarine']
sns.countplot(x='Survived', hue='Sex', data=df, palette=custom_palette)
plt.title('Survival by Gender')
plt.show()
```

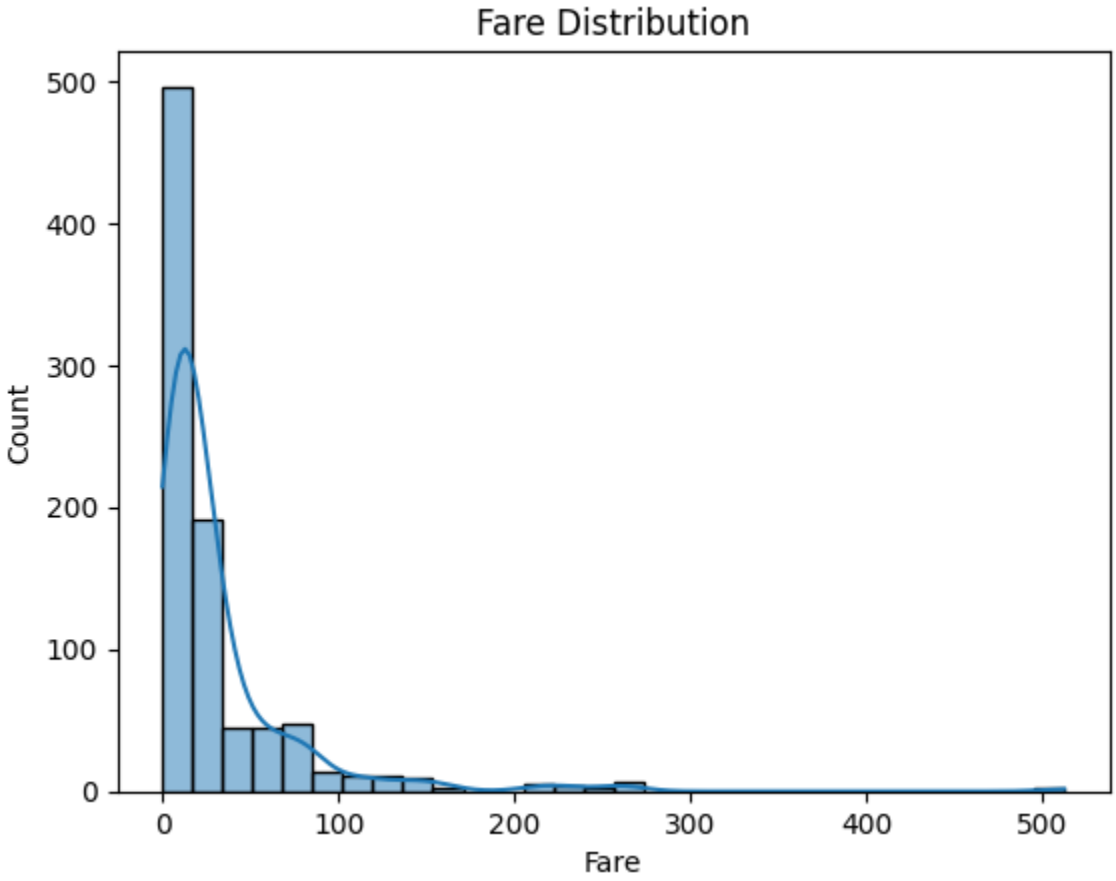




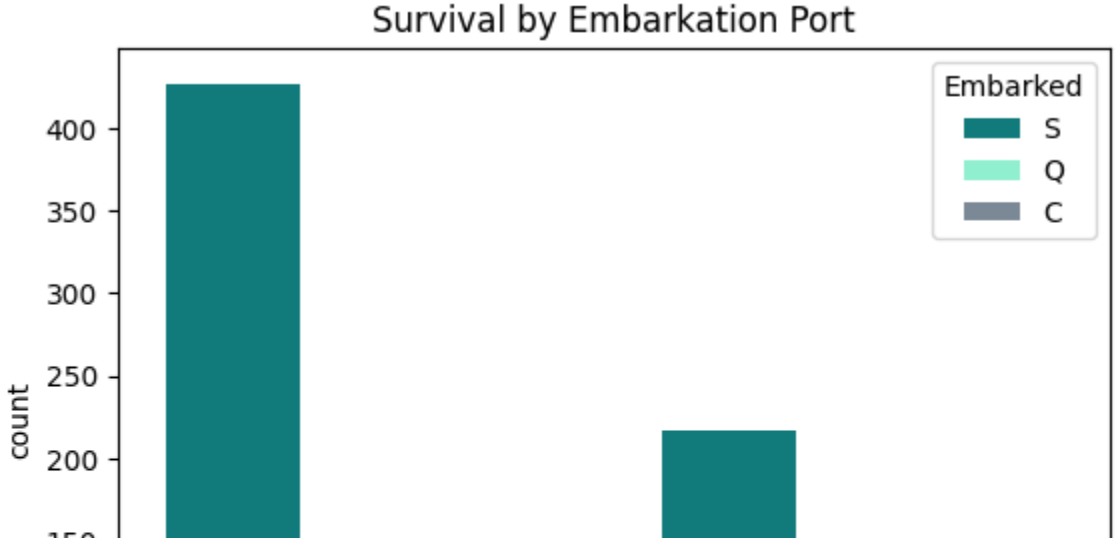

```
# Survival comparison by class
custom_palette = ['darkcyan', 'aquamarine', 'lightslategrey']
sns.countplot(x='Survived', hue='Pclass', data=df, palette=custom_palette)
plt.title('Survival by Class')
plt.show()
```

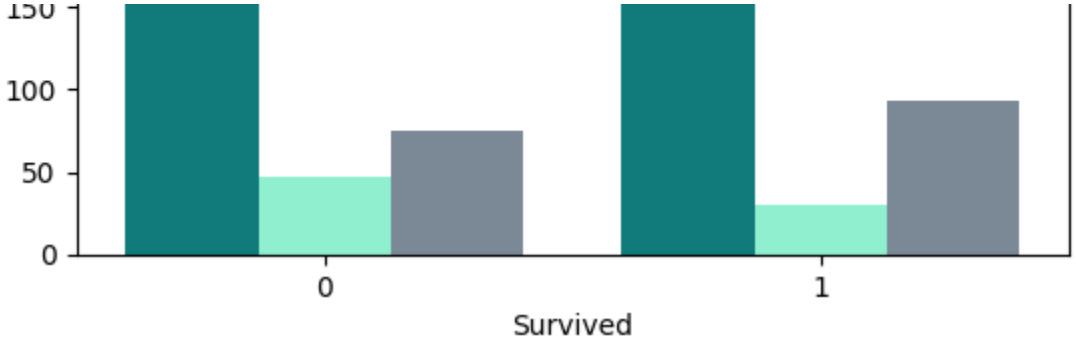


```
# Analysis of the fare paid
sns.histplot(df['Fare'], kde=True, bins=30)
plt.title('Fare Distribution')
plt.show()
```

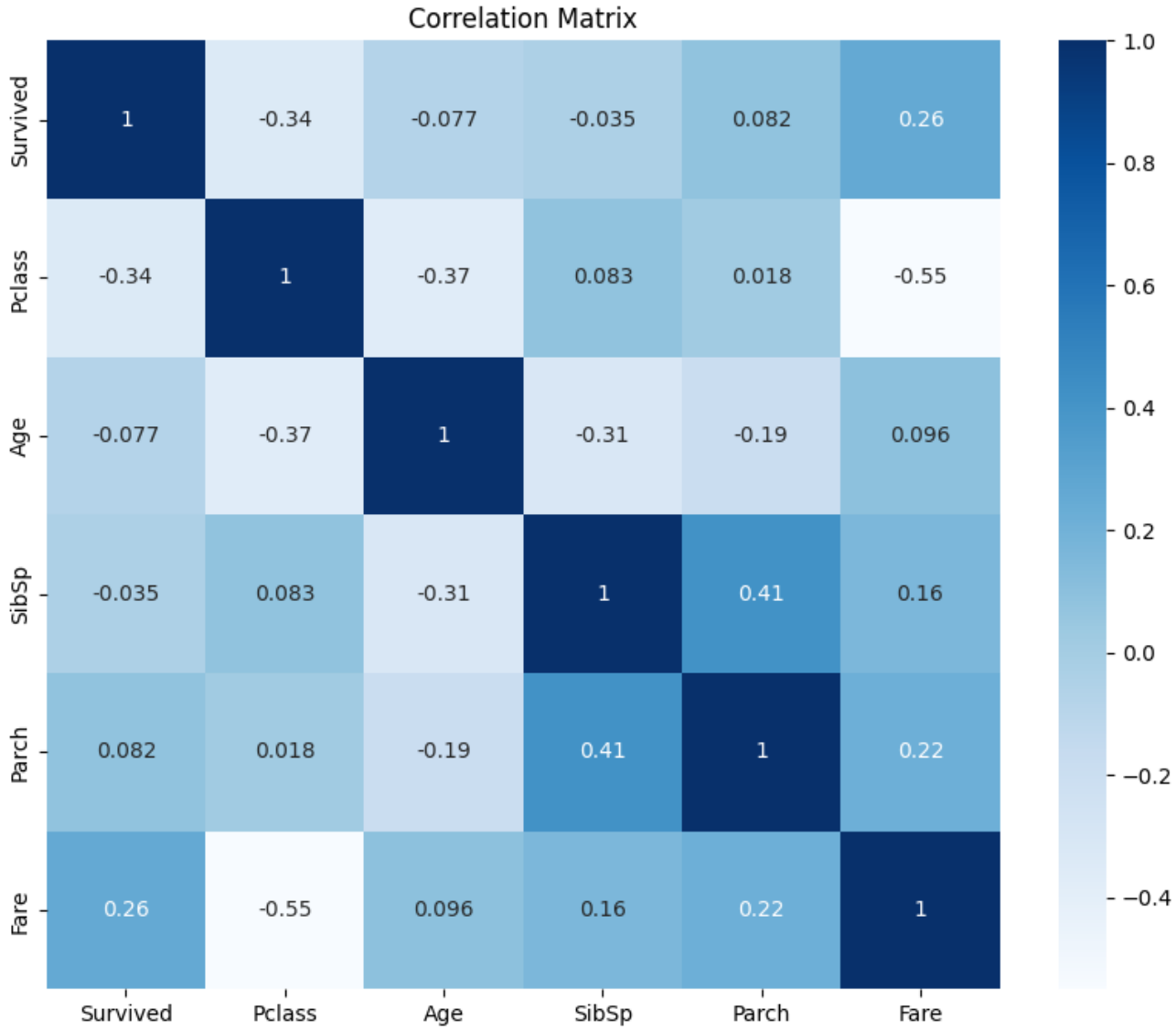



```
# Survival comparison by embarkation port
custom_palette = ['darkcyan', 'aquamarine', 'lightslategrey']
sns.countplot(x='Survived', hue='Embarked', data=df, palette=custom_palette)
plt.title('Survival by Embarkation Port')
plt.show()
```






```
# Correlation matrix between numerical variables
plt.figure(figsize=(10, 8))
numeric_cols = df.select_dtypes(include=['float64', 'int64']).columns
sns.heatmap(df[numeric_cols].corr(), annot=True, cmap='Blues')
plt.title('Correlation Matrix')
plt.show()
```



Cleaning the data

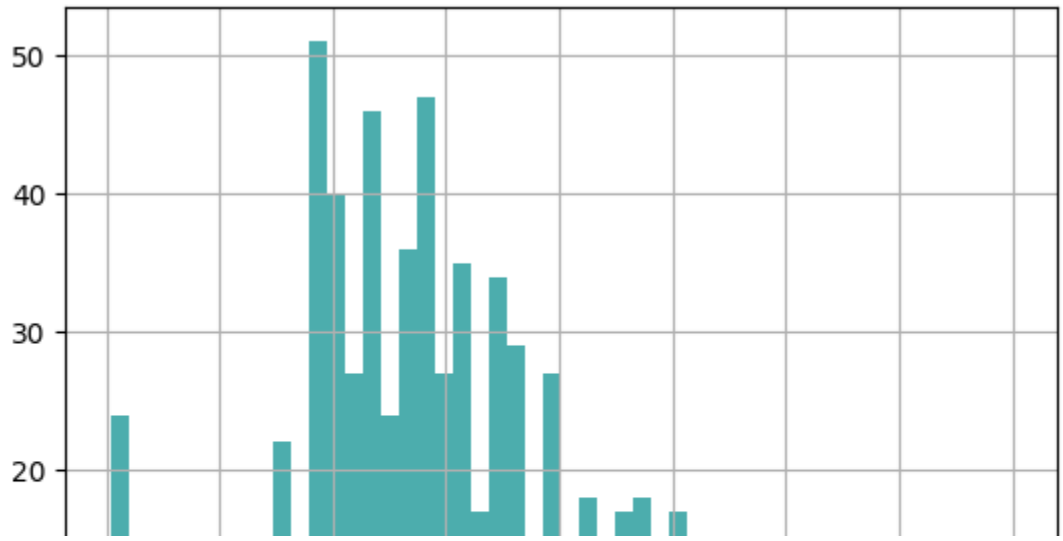
First of all, the data must be observed. Looking at the dataset information, we can see which are the types of values we are going to work with and which of the data we are interested in will require an imputation method to be applied to them.

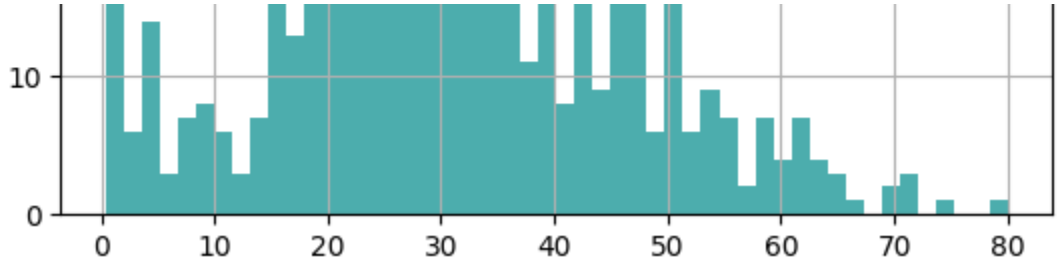
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 891 entries, 1 to 891
Data columns (total 11 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   Survived  891 non-null    int64
 1   Pclass    891 non-null    int64
 2   Name      891 non-null    object
 3   Sex       891 non-null    object
 4   Age       714 non-null    float64
 5   SibSp     891 non-null    int64
 6   Parch     891 non-null    int64
 7   Ticket    891 non-null    object
 8   Fare      891 non-null    float64
 9   Cabin     204 non-null    object
 10  Embarked  889 non-null    object
dtypes: float64(2), int64(4), object(5)
memory usage: 83.5+ KB
```

```
df["Age"].hist(bins=50, color='darkcyan', alpha=0.7)
```

```
<Axes: >
```

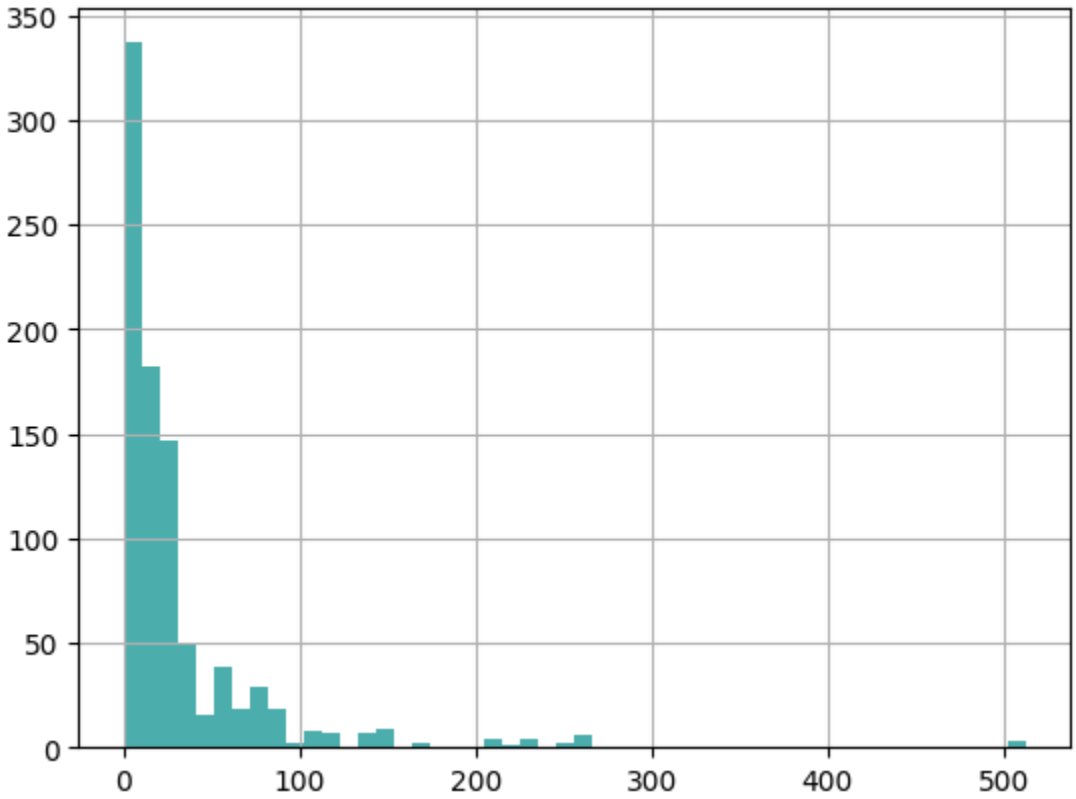




We will use the median to fill the null values in Age

```
df["Fare"].hist(bins=50, color='darkcyan', alpha=0.7)
```

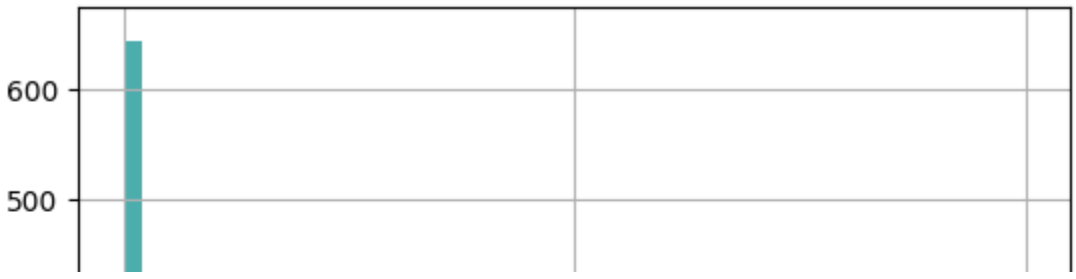
```
<Axes: >
```

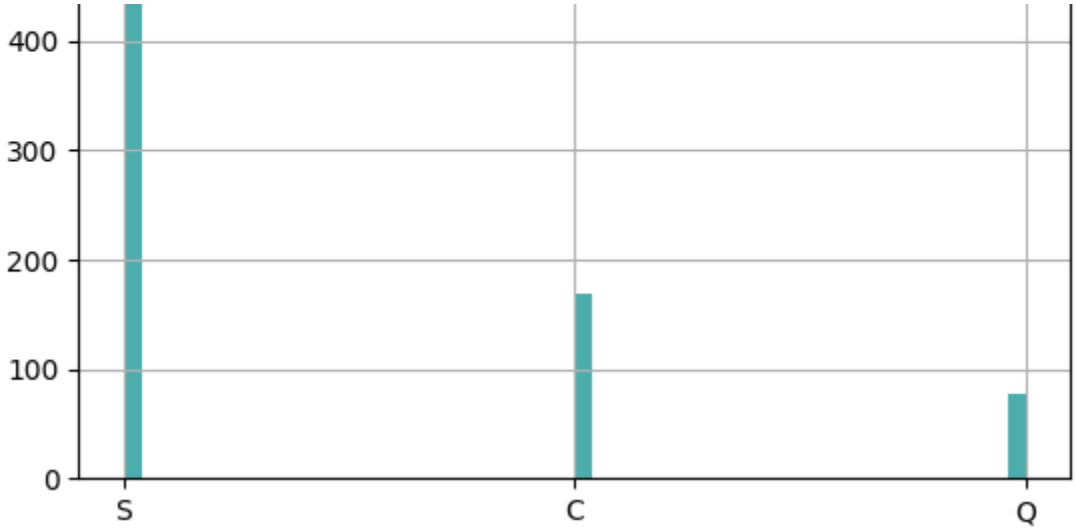


We will use the median to fill the null values in Fare

```
df["Embarked"].hist(bins=50, color='darkcyan', alpha=0.7)
```

```
<Axes: >
```





We will use mode to fill the null values in Embarked

We know that there is 77.1% of missing data in the 'cabin' column, we tried to fill it using a knn model but we did not have a good accuracy, then we decided to try with random forest, and after several more attempts we decided to eliminate the 'cabin' column as we did not get the expected results to fill this column and it did not add something good to our results so it is better not to use the column.

Model Selection

Due the nature of the problem (lots of categorical variables) we will include CatBoost into the comparison of models.

```
def basic_preprocess_data(data):
    data.drop(['Name', 'Ticket', 'Cabin'], axis=1, inplace=True)
    data['Age'].fillna(data['Age'].median(), inplace=True)
    data['Embarked'].fillna(data['Embarked'].mode()[0], inplace=True)
    data['Fare'].fillna(data['Fare'].median(), inplace=True)
    data['Sex'] = data['Sex'].map({'female': 1, 'male': 0})
    data = pd.get_dummies(data, columns=['Embarked'])
    return data

def compare_models(train, test, X_train, y_train, X_test, y_test):

    train.columns = train.columns.str.lower()
    test.columns = test.columns.str.lower()

    features = X_train
```

```
target = y_train

train_for_cat = train.copy()
test_for_cat = test.copy()
train_features_for_cat = train_for_cat.drop('survived', axis=1)
train_target_for_cat = train_for_cat['survived']
test_features_for_cat = test_for_cat.drop('survived', axis=1)
test_target_for_cat = test_for_cat['survived']

features_index = np.where(train_features_for_cat.dtypes != float)[0]

cat = CatBoostClassifier(loss_function='Logloss',
                     eval_metric='Accuracy',
                     random_seed=42,
                     verbose=False)

cat.fit(train_features_for_cat, train_target_for_cat, cat_features=features_i

x_train_for_cat = train_features_for_cat
x_test_for_cat = test_features_for_cat
y_train_for_cat = train_target_for_cat
y_test_for_cat = test_target_for_cat

cat_features_index = np.where(train_features_for_cat.dtypes != float)[0]

dct_with_models = {}

for label_model, model in {'RF': [RandomForestClassifier(random_state=42), 'n
                       'DT': [DecisionTreeClassifier(random_state=42), 'no_s
                       'LR': [LogisticRegression(random_state=42), 'need_sca
                       'KNB': [KNeighborsClassifier(), 'need_scaler'],
                       'SVC': [SVC(random_state=42, probability=True), 'need
                       'CAT': [CatBoostClassifier(loss_function='Logloss', e


    if model[1] == 'need_scaler':
        scaled_features = StandardScaler().fit_transform(features)
        scores = cross_val_score(model[0], scaled_features, target, cv=9, sco
        scaler = StandardScaler()
        scaled_train = scaler.fit_transform(X_train)
        scaled_test = scaler.transform(X_test)
        model[0].fit(scaled_train, y_train)
        dct_with_models[f'{label_model}_overall_accuracy_for_model_for_datase
        dct_with_models[f'{label_model}_accuracy_for_x_test_with_default_para
        dct_with_models[f'{label_model}_roc_auc_for_x_test_with_default_param

    elif model[1] == 'no_scaler':
        scores = cross_val_score(model[0], features, target, cv=9, scoring='a
        model[0].fit(X_train, y_train)
        dct_with_models[f'{label_model}_overall_accuracy_for_model_for_datase
        dct_with_models[f'{label_model}_accuracy_for_x_test_with_default_para
```

```
            dct_with_models[f'{label_model}_roc_auc_for_x_test_with_default_param

        elif model[1] == 'cat':
            scores = cv(Pool(train_features_for_cat, train_target_for_cat, cat_fe
                        {"loss_function": "Logloss",
                        "eval_metric": "Accuracy",
                        "verbose": False,
                        "random_seed": 42},
                        fold_count=5)
            model[0].fit(x_train_for_cat, y_train_for_cat,
                        cat_features=cat_features_index,
                        eval_set=(x_test_for_cat, y_test_for_cat),
                        verbose=True,
                        plot=False)
            dct_with_models[f'{label_model}_overall_accuracy_for_model_for_datase
            dct_with_models[f'{label_model}_accuracy_for_x_test_with_default_para
            dct_with_models[f'{label_model}_roc_auc_for_x_test_with_default_param
    model = []
    overall_accuracy_for_dataset = []
    accuracy_for_x_test_with_default_params = []
    roc_auc_for_x_test_with_default_params = []

    for name_model in ['DT', 'RF', 'LR', 'KNB', 'SVC', 'CAT']:
        model.append(name_model)
        overall_accuracy_for_dataset.append(dct_with_models[f'{name_model}_overal
        accuracy_for_x_test_with_default_params.append(dct_with_models[f'{name_mo
        roc_auc_for_x_test_with_default_params.append(dct_with_models[f'{name_mod

    results = {
    'Model' : model,
    'OVERALL ACCURACY FOR TRAIN DATASET' : pd.Series(overall_accuracy_for_dataset
    'ROC_AUC FOR X_TEST WITH DEFAULT PARAMS' : pd.Series(roc_auc_for_x_test_with_
    'ACCURACY FOR X_TEST WITH DEFAULT PARAMS' : pd.Series(accuracy_for_x_test_wit

    display(pd.DataFrame(results).style.highlight_max(color='green'))

train = pd.read_csv("train.csv", index_col=0)
train = basic_preprocess_data(train)

y_train = train['Survived']
X_train = train.drop('Survived', axis=1)

len(X_train), len(y_train)
```

```
(891, 891)
```

```
test = pd.read_csv('test_with_survived.csv', index_col=0)
test = basic_preprocess_data(test)

y_test = test['Survived']
```

```
X_test = test.drop(["Survived"], axis=1)

compare_models(train, test, X_train, y_train, X_test, y_test)
```

```
    Training on fold [0/5]

    bestTest = 0.8100558659
    bestIteration = 13

    Training on fold [1/5]

    bestTest = 0.8882681564
    bestIteration = 60

    Training on fold [2/5]

    bestTest = 0.8595505618
    bestIteration = 1

    Training on fold [3/5]

    bestTest = 0.7865168539
    bestIteration = 130

    Training on fold [4/5]

    bestTest = 0.8192090395
    bestIteration = 188

    Learning rate set to 0.030798
    0:  learn: 0.8226712  test: 0.7775120   best: 0.7775120 (0)   total: 3.36ms
    1:  learn: 0.8193042  test: 0.7751196   best: 0.7775120 (0)   total: 9.02ms
    2:  learn: 0.8204265  test: 0.7727273   best: 0.7775120 (0)   total: 12.2ms
    3:  learn: 0.8193042  test: 0.7751196   best: 0.7775120 (0)   total: 15.7ms
    4:  learn: 0.8170595  test: 0.7751196   best: 0.7775120 (0)   total: 18.4ms
    5:  learn: 0.8260382  test: 0.7751196   best: 0.7775120 (0)   total: 21.9ms
    6:  learn: 0.8226712  test: 0.7727273   best: 0.7775120 (0)   total: 25.4ms
    7:  learn: 0.8249158  test: 0.7751196   best: 0.7775120 (0)   total: 29ms
    8:  learn: 0.8249158  test: 0.7751196   best: 0.7775120 (0)   total: 37.5ms
    9:  learn: 0.8237935  test: 0.7751196   best: 0.7775120 (0)   total: 42.4ms
    10: learn: 0.8237935  test: 0.7799043   best: 0.7799043 (10)  total: 46ms
    11: learn: 0.8271605  test: 0.7846890   best: 0.7846890 (11)  total: 49.4ms
    12: learn: 0.8260382  test: 0.7846890   best: 0.7846890 (11)  total: 53.6ms
    13: learn: 0.8260382  test: 0.7846890   best: 0.7846890 (11)  total: 57.1ms
    14: learn: 0.8260382  test: 0.7846890   best: 0.7846890 (11)  total: 61.8ms
    15: learn: 0.8260382  test: 0.7846890   best: 0.7846890 (11)  total: 66ms
    16: learn: 0.8282828  test: 0.7846890   best: 0.7846890 (11)  total: 69.8ms
    17: learn: 0.8282828  test: 0.7846890   best: 0.7846890 (11)  total: 73.5ms
    18: learn: 0.8260382  test: 0.7870813   best: 0.7870813 (18)  total: 77.3ms
    19: learn: 0.8260382  test: 0.7846890   best: 0.7870813 (18)  total: 80.7ms
    20: learn: 0.8282828  test: 0.7846890   best: 0.7870813 (18)  total: 84.4ms
    21: learn: 0.8282828  test: 0.7870813   best: 0.7870813 (18)  total: 87.9ms
    22: learn: 0.8282828  test: 0.7870813   best: 0.7870813 (18)  total: 91.2ms
```

```
22: learn: 0.8282828  test: 0.7870813  best: 0.7870813 (18)  total: 91.2ms
23: learn: 0.8271605  test: 0.7870813  best: 0.7870813 (18)  total: 94.9ms
24: learn: 0.8271605  test: 0.7870813  best: 0.7870813 (18)  total: 96.8ms
25: learn: 0.8282828  test: 0.7870813  best: 0.7870813 (18)  total: 100ms
26: learn: 0.8305275  test: 0.7822967  best: 0.7870813 (18)  total: 104ms
27: learn: 0.8327722  test: 0.7799043  best: 0.7870813 (18)  total: 107ms
28: learn: 0.8316498  test: 0.7822967  best: 0.7870813 (18)  total: 111ms
29: learn: 0.8316498  test: 0.7846890  best: 0.7870813 (18)  total: 115ms
30: learn: 0.8316498  test: 0.7799043  best: 0.7870813 (18)  total: 118ms
31: learn: 0.8327722  test: 0.7799043  best: 0.7870813 (18)  total: 121ms
32: learn: 0.8338945  test: 0.7822967  best: 0.7870813 (18)  total: 125ms
33: learn: 0.8327722  test: 0.7870813  best: 0.7870813 (18)  total: 128ms
34: learn: 0.8327722  test: 0.7870813  best: 0.7870813 (18)  total: 130ms
35: learn: 0.8338945  test: 0.7870813  best: 0.7870813 (18)  total: 135ms
36: learn: 0.8338945  test: 0.7870813  best: 0.7870813 (18)  total: 139ms
37: learn: 0.8327722  test: 0.7870813  best: 0.7870813 (18)  total: 142ms
38: learn: 0.8338945  test: 0.7870813  best: 0.7870813 (18)  total: 145ms
39: learn: 0.8338945  test: 0.7870813  best: 0.7870813 (18)  total: 148ms
40: learn: 0.8338945  test: 0.7870813  best: 0.7870813 (18)  total: 157ms
41: learn: 0.8338945  test: 0.7870813  best: 0.7870813 (18)  total: 160ms
42: learn: 0.8361392  test: 0.7870813  best: 0.7870813 (18)  total: 164ms
43: learn: 0.8372615  test: 0.7870813  best: 0.7870813 (18)  total: 167ms
44: learn: 0.8383838  test: 0.7870813  best: 0.7870813 (18)  total: 171ms
45: learn: 0.8383838  test: 0.7870813  best: 0.7870813 (18)  total: 174ms
46: learn: 0.8383838  test: 0.7870813  best: 0.7870813 (18)  total: 178ms
47: learn: 0.8383838  test: 0.7870813  best: 0.7870813 (18)  total: 181ms
48: learn: 0.8383838  test: 0.7870813  best: 0.7870813 (18)  total: 184ms
49: learn: 0.8383838  test: 0.7870813  best: 0.7870813 (18)  total: 188ms
50: learn: 0.8395062  test: 0.7870813  best: 0.7870813 (18)  total: 192ms
51: learn: 0.8428732  test: 0.7894737  best: 0.7894737 (51)  total: 195ms
52: learn: 0.8417508  test: 0.7870813  best: 0.7894737 (51)  total: 198ms
53: learn: 0.8417508  test: 0.7870813  best: 0.7894737 (51)  total: 202ms
54: learn: 0.8439955  test: 0.7894737  best: 0.7894737 (51)  total: 204ms
55: learn: 0.8439955  test: 0.7894737  best: 0.7894737 (51)  total: 207ms
56: learn: 0.8439955  test: 0.7894737  best: 0.7894737 (51)  total: 211ms
57: learn: 0.8451178  test: 0.7894737  best: 0.7894737 (51)  total: 214ms
58: learn: 0.8451178  test: 0.7894737  best: 0.7894737 (51)  total: 218ms
59: learn: 0.8451178  test: 0.7894737  best: 0.7894737 (51)  total: 221ms
60: learn: 0.8451178  test: 0.7894737  best: 0.7894737 (51)  total: 224ms
61: learn: 0.8451178  test: 0.7894737  best: 0.7894737 (51)  total: 227ms
62: learn: 0.8451178  test: 0.7894737  best: 0.7894737 (51)  total: 231ms
63: learn: 0.8417508  test: 0.7870813  best: 0.7894737 (51)  total: 234ms
64: learn: 0.8451178  test: 0.7894737  best: 0.7894737 (51)  total: 238ms
65: learn: 0.8451178  test: 0.7894737  best: 0.7894737 (51)  total: 241ms
66: learn: 0.8451178  test: 0.7894737  best: 0.7894737 (51)  total: 245ms
67: learn: 0.8462402  test: 0.7894737  best: 0.7894737 (51)  total: 248ms
68: learn: 0.8484848  test: 0.7894737  best: 0.7894737 (51)  total: 252ms
69: learn: 0.8484848  test: 0.7894737  best: 0.7894737 (51)  total: 255ms
70: learn: 0.8518519  test: 0.7846890  best: 0.7894737 (51)  total: 259ms
71: learn: 0.8507295  test: 0.7846890  best: 0.7894737 (51)  total: 260ms
72: learn: 0.8518519  test: 0.7846890  best: 0.7894737 (51)  total: 264ms
73: learn: 0.8496072  test: 0.7846890  best: 0.7894737 (51)  total: 267ms
74: learn: 0.8518519  test: 0.7846890  best: 0.7894737 (51)  total: 271ms
```

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75: learn: 0.8518519  test: 0.7846890   best: 0.7894737 (51)  total: 273ms
76: learn: 0.8518519  test: 0.7846890   best: 0.7894737 (51)  total: 277ms
77: learn: 0.8540965  test: 0.7846890   best: 0.7894737 (51)  total: 280ms
78: learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 282ms
79: learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 285ms
80: learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 289ms
81: learn: 0.8540965  test: 0.7846890   best: 0.7894737 (51)  total: 292ms
82: learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 296ms
83: learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 300ms
84: learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 303ms
85: learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 307ms
86: learn: 0.8540965  test: 0.7846890   best: 0.7894737 (51)  total: 310ms
87: learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 313ms
88: learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 317ms
89: learn: 0.8540965  test: 0.7846890   best: 0.7894737 (51)  total: 320ms
90: learn: 0.8540965  test: 0.7846890   best: 0.7894737 (51)  total: 324ms
91: learn: 0.8540965  test: 0.7846890   best: 0.7894737 (51)  total: 327ms
92: learn: 0.8529742  test: 0.7822967   best: 0.7894737 (51)  total: 332ms
93: learn: 0.8529742  test: 0.7822967   best: 0.7894737 (51)  total: 335ms
94: learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 338ms
95: learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 342ms
96: learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 345ms
97: learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 351ms
98: learn: 0.8529742  test: 0.7822967   best: 0.7894737 (51)  total: 356ms
99: learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 360ms
100:    learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 363m
101:    learn: 0.8529742  test: 0.7822967   best: 0.7894737 (51)  total: 366m
102:    learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 372m
103:    learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 374m
104:    learn: 0.8529742  test: 0.7822967   best: 0.7894737 (51)  total: 378m
105:    learn: 0.8529742  test: 0.7822967   best: 0.7894737 (51)  total: 381m
106:    learn: 0.8529742  test: 0.7822967   best: 0.7894737 (51)  total: 384m
107:    learn: 0.8529742  test: 0.7822967   best: 0.7894737 (51)  total: 386m
108:    learn: 0.8529742  test: 0.7822967   best: 0.7894737 (51)  total: 390m
109:    learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 394m
110:    learn: 0.8529742  test: 0.7822967   best: 0.7894737 (51)  total: 399m
111:    learn: 0.8529742  test: 0.7822967   best: 0.7894737 (51)  total: 402m
112:    learn: 0.8529742  test: 0.7822967   best: 0.7894737 (51)  total: 406m
113:    learn: 0.8529742  test: 0.7822967   best: 0.7894737 (51)  total: 409m
114:    learn: 0.8529742  test: 0.7846890   best: 0.7894737 (51)  total: 412m
115:    learn: 0.8529742  test: 0.7870813   best: 0.7894737 (51)  total: 419m
116:    learn: 0.8529742  test: 0.7870813   best: 0.7894737 (51)  total: 424m
117:    learn: 0.8529742  test: 0.7870813   best: 0.7894737 (51)  total: 428m
118:    learn: 0.8529742  test: 0.7870813   best: 0.7894737 (51)  total: 431m
119:    learn: 0.8529742  test: 0.7870813   best: 0.7894737 (51)  total: 435m
120:    learn: 0.8529742  test: 0.7870813   best: 0.7894737 (51)  total: 438m
121:    learn: 0.8540965  test: 0.7894737   best: 0.7894737 (51)  total: 442m
122:    learn: 0.8529742  test: 0.7870813   best: 0.7894737 (51)  total: 446m
123:    learn: 0.8529742  test: 0.7894737   best: 0.7894737 (51)  total: 450m
124:    learn: 0.8529742  test: 0.7894737   best: 0.7894737 (51)  total: 452m
125:    learn: 0.8540965  test: 0.7894737   best: 0.7894737 (51)  total: 456m
126:    learn: 0.8540965  test: 0.7870813   best: 0.7894737 (51)  total: 459m
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127:   learn: 0.8540965  test: 0.7894737   best: 0.7894737 (51)  total: 463m
128:   learn: 0.8563412  test: 0.7870813   best: 0.7894737 (51)  total: 466m
129:   learn: 0.8563412  test: 0.7918660   best: 0.7918660 (129) total: 469m
130:   learn: 0.8552189  test: 0.7918660   best: 0.7918660 (129) total: 472m
131:   learn: 0.8563412  test: 0.7966507   best: 0.7966507 (131) total: 475m
132:   learn: 0.8563412  test: 0.7966507   best: 0.7966507 (131) total: 477m
133:   learn: 0.8563412  test: 0.7942584   best: 0.7966507 (131) total: 480m
134:   learn: 0.8552189  test: 0.7942584   best: 0.7966507 (131) total: 483m
135:   learn: 0.8552189  test: 0.7942584   best: 0.7966507 (131) total: 486m
136:   learn: 0.8540965  test: 0.7942584   best: 0.7966507 (131) total: 488m
137:   learn: 0.8540965  test: 0.7942584   best: 0.7966507 (131) total: 491m
138:   learn: 0.8552189  test: 0.7966507   best: 0.7966507 (131) total: 494m
139:   learn: 0.8540965  test: 0.7918660   best: 0.7966507 (131) total: 498m
140:   learn: 0.8540965  test: 0.7942584   best: 0.7966507 (131) total: 501m
141:   learn: 0.8540965  test: 0.7942584   best: 0.7966507 (131) total: 503m
142:   learn: 0.8540965  test: 0.7942584   best: 0.7966507 (131) total: 506m
143:   learn: 0.8540965  test: 0.7942584   best: 0.7966507 (131) total: 510m
144:   learn: 0.8540965  test: 0.7918660   best: 0.7966507 (131) total: 513m
145:   learn: 0.8540965  test: 0.7918660   best: 0.7966507 (131) total: 516m
146:   learn: 0.8540965  test: 0.7942584   best: 0.7966507 (131) total: 520m
147:   learn: 0.8540965  test: 0.7942584   best: 0.7966507 (131) total: 523m
148:   learn: 0.8540965  test: 0.7942584   best: 0.7966507 (131) total: 527m
149:   learn: 0.8540965  test: 0.7942584   best: 0.7966507 (131) total: 530m
150:   learn: 0.8540965  test: 0.7942584   best: 0.7966507 (131) total: 533m
151:   learn: 0.8540965  test: 0.7942584   best: 0.7966507 (131) total: 535m
152:   learn: 0.8540965  test: 0.7942584   best: 0.7966507 (131) total: 538m
153:   learn: 0.8563412  test: 0.7942584   best: 0.7966507 (131) total: 543m
154:   learn: 0.8585859  test: 0.7942584   best: 0.7966507 (131) total: 549m
155:   learn: 0.8574635  test: 0.7966507   best: 0.7966507 (131) total: 553m
156:   learn: 0.8597082  test: 0.7918660   best: 0.7966507 (131) total: 556m
157:   learn: 0.8597082  test: 0.7918660   best: 0.7966507 (131) total: 562m
158:   learn: 0.8585859  test: 0.7918660   best: 0.7966507 (131) total: 566m
159:   learn: 0.8597082  test: 0.7918660   best: 0.7966507 (131) total: 569m
160:   learn: 0.8608305  test: 0.7918660   best: 0.7966507 (131) total: 572m
161:   learn: 0.8597082  test: 0.7918660   best: 0.7966507 (131) total: 576m
162:   learn: 0.8597082  test: 0.7918660   best: 0.7966507 (131) total: 578m
163:   learn: 0.8608305  test: 0.7918660   best: 0.7966507 (131) total: 582m
164:   learn: 0.8608305  test: 0.7918660   best: 0.7966507 (131) total: 586m
165:   learn: 0.8608305  test: 0.7918660   best: 0.7966507 (131) total: 589m
166:   learn: 0.8608305  test: 0.7918660   best: 0.7966507 (131) total: 592m
167:   learn: 0.8619529  test: 0.7918660   best: 0.7966507 (131) total: 596m
168:   learn: 0.8619529  test: 0.7918660   best: 0.7966507 (131) total: 599m
169:   learn: 0.8608305  test: 0.7918660   best: 0.7966507 (131) total: 604m
170:   learn: 0.8619529  test: 0.7918660   best: 0.7966507 (131) total: 610m
171:   learn: 0.8619529  test: 0.7918660   best: 0.7966507 (131) total: 614m
172:   learn: 0.8619529  test: 0.7918660   best: 0.7966507 (131) total: 617m
173:   learn: 0.8619529  test: 0.7918660   best: 0.7966507 (131) total: 619m
174:   learn: 0.8619529  test: 0.7894737   best: 0.7966507 (131) total: 622m
175:   learn: 0.8619529  test: 0.7918660   best: 0.7966507 (131) total: 625m
176:   learn: 0.8619529  test: 0.7918660   best: 0.7966507 (131) total: 628m
177:   learn: 0.8619529  test: 0.7918660   best: 0.7966507 (131) total: 631m
178:   learn: 0.8608305  test: 0.7918660   best: 0.7966507 (131) total: 635m
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179:    learn: 0.8619529  test: 0.7918660   best: 0.7966507 (131) total: 638m
180:    learn: 0.8641975  test: 0.7894737   best: 0.7966507 (131) total: 644m
181:    learn: 0.8641975  test: 0.7894737   best: 0.7966507 (131) total: 646m
182:    learn: 0.8653199  test: 0.7894737   best: 0.7966507 (131) total: 650m
183:    learn: 0.8653199  test: 0.7894737   best: 0.7966507 (131) total: 652m
184:    learn: 0.8653199  test: 0.7894737   best: 0.7966507 (131) total: 656m
185:    learn: 0.8664422  test: 0.7894737   best: 0.7966507 (131) total: 660m
186:    learn: 0.8664422  test: 0.7870813   best: 0.7966507 (131) total: 663m
187:    learn: 0.8664422  test: 0.7870813   best: 0.7966507 (131) total: 667m
188:    learn: 0.8664422  test: 0.7894737   best: 0.7966507 (131) total: 670m
189:    learn: 0.8664422  test: 0.7894737   best: 0.7966507 (131) total: 672m
190:    learn: 0.8653199  test: 0.7870813   best: 0.7966507 (131) total: 675m
191:    learn: 0.8664422  test: 0.7918660   best: 0.7966507 (131) total: 679m
192:    learn: 0.8653199  test: 0.7918660   best: 0.7966507 (131) total: 684m
193:    learn: 0.8664422  test: 0.7918660   best: 0.7966507 (131) total: 688m
194:    learn: 0.8675645  test: 0.7918660   best: 0.7966507 (131) total: 691m
195:    learn: 0.8675645  test: 0.7918660   best: 0.7966507 (131) total: 695m
196:    learn: 0.8686869  test: 0.7942584   best: 0.7966507 (131) total: 699m
197:    learn: 0.8686869  test: 0.7942584   best: 0.7966507 (131) total: 702m
198:    learn: 0.8686869  test: 0.7942584   best: 0.7966507 (131) total: 705m
199:    learn: 0.8686869  test: 0.7966507   best: 0.7966507 (131) total: 709m
200:    learn: 0.8698092  test: 0.7966507   best: 0.7966507 (131) total: 713m
201:    learn: 0.8698092  test: 0.7966507   best: 0.7966507 (131) total: 715m
202:    learn: 0.8698092  test: 0.7942584   best: 0.7966507 (131) total: 718m
203:    learn: 0.8709315  test: 0.7942584   best: 0.7966507 (131) total: 722m
204:    learn: 0.8709315  test: 0.7942584   best: 0.7966507 (131) total: 725m
205:    learn: 0.8698092  test: 0.7990431   best: 0.7990431 (205) total: 728m
206:    learn: 0.8709315  test: 0.7966507   best: 0.7990431 (205) total: 731m
207:    learn: 0.8731762  test: 0.7966507   best: 0.7990431 (205) total: 736m
208:    learn: 0.8731762  test: 0.7966507   best: 0.7990431 (205) total: 742m
209:    learn: 0.8742985  test: 0.7966507   best: 0.7990431 (205) total: 746m
210:    learn: 0.8731762  test: 0.7966507   best: 0.7990431 (205) total: 750m
211:    learn: 0.8731762  test: 0.7966507   best: 0.7990431 (205) total: 753m
212:    learn: 0.8742985  test: 0.7966507   best: 0.7990431 (205) total: 757m
213:    learn: 0.8742985  test: 0.7966507   best: 0.7990431 (205) total: 761m
214:    learn: 0.8742985  test: 0.7966507   best: 0.7990431 (205) total: 765m
215:    learn: 0.8742985  test: 0.7966507   best: 0.7990431 (205) total: 768m
216:    learn: 0.8742985  test: 0.7966507   best: 0.7990431 (205) total: 771m
217:    learn: 0.8754209  test: 0.7966507   best: 0.7990431 (205) total: 774m
218:    learn: 0.8754209  test: 0.7966507   best: 0.7990431 (205) total: 778m
219:    learn: 0.8754209  test: 0.7966507   best: 0.7990431 (205) total: 780m
220:    learn: 0.8754209  test: 0.7966507   best: 0.7990431 (205) total: 784m
221:    learn: 0.8754209  test: 0.7966507   best: 0.7990431 (205) total: 787m
222:    learn: 0.8754209  test: 0.7966507   best: 0.7990431 (205) total: 792m
223:    learn: 0.8754209  test: 0.7942584   best: 0.7990431 (205) total: 803m
224:    learn: 0.8754209  test: 0.7966507   best: 0.7990431 (205) total: 806m
225:    learn: 0.8754209  test: 0.7966507   best: 0.7990431 (205) total: 809m
226:    learn: 0.8754209  test: 0.7942584   best: 0.7990431 (205) total: 815m
227:    learn: 0.8754209  test: 0.7942584   best: 0.7990431 (205) total: 820m
228:    learn: 0.8754209  test: 0.7942584   best: 0.7990431 (205) total: 822m
229:    learn: 0.8754209  test: 0.7942584   best: 0.7990431 (205) total: 825m
230:    learn: 0.8765432  test: 0.7942584   best: 0.7990431 (205) total: 829m
231:    learn: 0.8765432  test: 0.7966507   best: 0.7990431 (205) total: 832m
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232:   learn: 0.8765432  test: 0.7990431   best: 0.7990431 (205) total: 836m
233:   learn: 0.8765432  test: 0.7990431   best: 0.7990431 (205) total: 838m
234:   learn: 0.8765432  test: 0.7990431   best: 0.7990431 (205) total: 842m
235:   learn: 0.8765432  test: 0.7990431   best: 0.7990431 (205) total: 845m
236:   learn: 0.8765432  test: 0.7942584   best: 0.7990431 (205) total: 849m
237:   learn: 0.8765432  test: 0.7942584   best: 0.7990431 (205) total: 851m
238:   learn: 0.8776655  test: 0.7942584   best: 0.7990431 (205) total: 854m
239:   learn: 0.8776655  test: 0.7942584   best: 0.7990431 (205) total: 857m
240:   learn: 0.8776655  test: 0.7894737   best: 0.7990431 (205) total: 861m
241:   learn: 0.8776655  test: 0.7894737   best: 0.7990431 (205) total: 865m
242:   learn: 0.8776655  test: 0.7870813   best: 0.7990431 (205) total: 868m
243:   learn: 0.8776655  test: 0.7870813   best: 0.7990431 (205) total: 872m
244:   learn: 0.8776655  test: 0.7870813   best: 0.7990431 (205) total: 875m
245:   learn: 0.8776655  test: 0.7870813   best: 0.7990431 (205) total: 879m
246:   learn: 0.8776655  test: 0.7894737   best: 0.7990431 (205) total: 883m
247:   learn: 0.8765432  test: 0.7894737   best: 0.7990431 (205) total: 887m
248:   learn: 0.8776655  test: 0.7894737   best: 0.7990431 (205) total: 889m
249:   learn: 0.8776655  test: 0.7894737   best: 0.7990431 (205) total: 893m
250:   learn: 0.8776655  test: 0.7846890   best: 0.7990431 (205) total: 897m
251:   learn: 0.8765432  test: 0.7846890   best: 0.7990431 (205) total: 901m
252:   learn: 0.8765432  test: 0.7846890   best: 0.7990431 (205) total: 904m
253:   learn: 0.8765432  test: 0.7846890   best: 0.7990431 (205) total: 906m
254:   learn: 0.8754209  test: 0.7846890   best: 0.7990431 (205) total: 911m
255:   learn: 0.8765432  test: 0.7846890   best: 0.7990431 (205) total: 914m
256:   learn: 0.8765432  test: 0.7846890   best: 0.7990431 (205) total: 917m
257:   learn: 0.8765432  test: 0.7846890   best: 0.7990431 (205) total: 920m
258:   learn: 0.8765432  test: 0.7846890   best: 0.7990431 (205) total: 923m
259:   learn: 0.8765432  test: 0.7846890   best: 0.7990431 (205) total: 927m
260:   learn: 0.8765432  test: 0.7846890   best: 0.7990431 (205) total: 930m
261:   learn: 0.8754209  test: 0.7846890   best: 0.7990431 (205) total: 934m
262:   learn: 0.8776655  test: 0.7870813   best: 0.7990431 (205) total: 941m
263:   learn: 0.8776655  test: 0.7870813   best: 0.7990431 (205) total: 945m
264:   learn: 0.8776655  test: 0.7870813   best: 0.7990431 (205) total: 948m
265:   learn: 0.8776655  test: 0.7870813   best: 0.7990431 (205) total: 952m
266:   learn: 0.8776655  test: 0.7870813   best: 0.7990431 (205) total: 959m
267:   learn: 0.8787879  test: 0.7870813   best: 0.7990431 (205) total: 965m
268:   learn: 0.8787879  test: 0.7870813   best: 0.7990431 (205) total: 972m
269:   learn: 0.8787879  test: 0.7870813   best: 0.7990431 (205) total: 975m
270:   learn: 0.8787879  test: 0.7894737   best: 0.7990431 (205) total: 979m
271:   learn: 0.8787879  test: 0.7894737   best: 0.7990431 (205) total: 981m
272:   learn: 0.8787879  test: 0.7894737   best: 0.7990431 (205) total: 984m
273:   learn: 0.8787879  test: 0.7870813   best: 0.7990431 (205) total: 988m
274:   learn: 0.8787879  test: 0.7870813   best: 0.7990431 (205) total: 992m
275:   learn: 0.8799102  test: 0.7894737   best: 0.7990431 (205) total: 995m
276:   learn: 0.8810325  test: 0.7870813   best: 0.7990431 (205) total: 999m
277:   learn: 0.8810325  test: 0.7870813   best: 0.7990431 (205) total: 1s
278:   learn: 0.8810325  test: 0.7870813   best: 0.7990431 (205) total: 1.01
279:   learn: 0.8821549  test: 0.7894737   best: 0.7990431 (205) total: 1.01
280:   learn: 0.8810325  test: 0.7894737   best: 0.7990431 (205) total: 1.02
281:   learn: 0.8832772  test: 0.7870813   best: 0.7990431 (205) total: 1.02
282:   learn: 0.8832772  test: 0.7870813   best: 0.7990431 (205) total: 1.03
283:   learn: 0.8832772  test: 0.7870813   best: 0.7990431 (205) total: 1.04
```

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284:   learn: 0.8832772  test: 0.7870813   best: 0.7990431 (205) total: 1.04
285:   learn: 0.8832772  test: 0.7870813   best: 0.7990431 (205) total: 1.04
286:   learn: 0.8832772  test: 0.7846890   best: 0.7990431 (205) total: 1.05
287:   learn: 0.8832772  test: 0.7846890   best: 0.7990431 (205) total: 1.05
288:   learn: 0.8832772  test: 0.7846890   best: 0.7990431 (205) total: 1.05
289:   learn: 0.8832772  test: 0.7822967   best: 0.7990431 (205) total: 1.06
290:   learn: 0.8832772  test: 0.7822967   best: 0.7990431 (205) total: 1.06
291:   learn: 0.8832772  test: 0.7822967   best: 0.7990431 (205) total: 1.07
292:   learn: 0.8832772  test: 0.7822967   best: 0.7990431 (205) total: 1.07
293:   learn: 0.8832772  test: 0.7822967   best: 0.7990431 (205) total: 1.07
294:   learn: 0.8843996  test: 0.7822967   best: 0.7990431 (205) total: 1.08
295:   learn: 0.8843996  test: 0.7822967   best: 0.7990431 (205) total: 1.08
296:   learn: 0.8843996  test: 0.7822967   best: 0.7990431 (205) total: 1.08
297:   learn: 0.8843996  test: 0.7822967   best: 0.7990431 (205) total: 1.09
298:   learn: 0.8843996  test: 0.7822967   best: 0.7990431 (205) total: 1.09
299:   learn: 0.8843996  test: 0.7822967   best: 0.7990431 (205) total: 1.1s
300:   learn: 0.8843996  test: 0.7822967   best: 0.7990431 (205) total: 1.1s
301:   learn: 0.8855219  test: 0.7822967   best: 0.7990431 (205) total: 1.1s
302:   learn: 0.8843996  test: 0.7822967   best: 0.7990431 (205) total: 1.11
303:   learn: 0.8843996  test: 0.7822967   best: 0.7990431 (205) total: 1.11
304:   learn: 0.8843996  test: 0.7822967   best: 0.7990431 (205) total: 1.11
305:   learn: 0.8843996  test: 0.7822967   best: 0.7990431 (205) total: 1.12
306:   learn: 0.8843996  test: 0.7822967   best: 0.7990431 (205) total: 1.12
307:   learn: 0.8843996  test: 0.7822967   best: 0.7990431 (205) total: 1.13
308:   learn: 0.8843996  test: 0.7846890   best: 0.7990431 (205) total: 1.13
309:   learn: 0.8843996  test: 0.7846890   best: 0.7990431 (205) total: 1.14
310:   learn: 0.8855219  test: 0.7846890   best: 0.7990431 (205) total: 1.14
311:   learn: 0.8855219  test: 0.7846890   best: 0.7990431 (205) total: 1.14
312:   learn: 0.8855219  test: 0.7846890   best: 0.7990431 (205) total: 1.15
313:   learn: 0.8855219  test: 0.7846890   best: 0.7990431 (205) total: 1.15
314:   learn: 0.8855219  test: 0.7822967   best: 0.7990431 (205) total: 1.16
315:   learn: 0.8866442  test: 0.7822967   best: 0.7990431 (205) total: 1.16
316:   learn: 0.8877666  test: 0.7822967   best: 0.7990431 (205) total: 1.17
317:   learn: 0.8877666  test: 0.7822967   best: 0.7990431 (205) total: 1.17
318:   learn: 0.8877666  test: 0.7822967   best: 0.7990431 (205) total: 1.17
319:   learn: 0.8877666  test: 0.7822967   best: 0.7990431 (205) total: 1.18
320:   learn: 0.8877666  test: 0.7822967   best: 0.7990431 (205) total: 1.18
321:   learn: 0.8877666  test: 0.7822967   best: 0.7990431 (205) total: 1.19
322:   learn: 0.8877666  test: 0.7822967   best: 0.7990431 (205) total: 1.19
323:   learn: 0.8877666  test: 0.7822967   best: 0.7990431 (205) total: 1.19
324:   learn: 0.8877666  test: 0.7822967   best: 0.7990431 (205) total: 1.2s
325:   learn: 0.8877666  test: 0.7822967   best: 0.7990431 (205) total: 1.2s
326:   learn: 0.8877666  test: 0.7822967   best: 0.7990431 (205) total: 1.21
327:   learn: 0.8877666  test: 0.7822967   best: 0.7990431 (205) total: 1.22
328:   learn: 0.8877666  test: 0.7822967   best: 0.7990431 (205) total: 1.23
329:   learn: 0.8877666  test: 0.7822967   best: 0.7990431 (205) total: 1.23
330:   learn: 0.8888889  test: 0.7822967   best: 0.7990431 (205) total: 1.23
331:   learn: 0.8888889  test: 0.7822967   best: 0.7990431 (205) total: 1.24
332:   learn: 0.8888889  test: 0.7822967   best: 0.7990431 (205) total: 1.25
333:   learn: 0.8900112  test: 0.7822967   best: 0.7990431 (205) total: 1.26
334:   learn: 0.8900112  test: 0.7822967   best: 0.7990431 (205) total: 1.26
335:   learn: 0.8888889  test: 0.7822967   best: 0.7990431 (205) total: 1.27
```

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336:   learn: 0.8900112  test: 0.7822967   best: 0.7990431 (205) total: 1.27
337:   learn: 0.8911336  test: 0.7822967   best: 0.7990431 (205) total: 1.28
338:   learn: 0.8911336  test: 0.7822967   best: 0.7990431 (205) total: 1.29
339:   learn: 0.8911336  test: 0.7822967   best: 0.7990431 (205) total: 1.3s
340:   learn: 0.8922559  test: 0.7846890   best: 0.7990431 (205) total: 1.3s
341:   learn: 0.8922559  test: 0.7846890   best: 0.7990431 (205) total: 1.31
342:   learn: 0.8911336  test: 0.7822967   best: 0.7990431 (205) total: 1.31
343:   learn: 0.8922559  test: 0.7822967   best: 0.7990431 (205) total: 1.33
344:   learn: 0.8922559  test: 0.7822967   best: 0.7990431 (205) total: 1.34
345:   learn: 0.8900112  test: 0.7822967   best: 0.7990431 (205) total: 1.35
346:   learn: 0.8900112  test: 0.7846890   best: 0.7990431 (205) total: 1.36
347:   learn: 0.8933782  test: 0.7846890   best: 0.7990431 (205) total: 1.36
348:   learn: 0.8945006  test: 0.7846890   best: 0.7990431 (205) total: 1.37
349:   learn: 0.8945006  test: 0.7846890   best: 0.7990431 (205) total: 1.38
350:   learn: 0.8945006  test: 0.7846890   best: 0.7990431 (205) total: 1.39
351:   learn: 0.8945006  test: 0.7846890   best: 0.7990431 (205) total: 1.4s
352:   learn: 0.8945006  test: 0.7846890   best: 0.7990431 (205) total: 1.4s
353:   learn: 0.8945006  test: 0.7846890   best: 0.7990431 (205) total: 1.41
354:   learn: 0.8945006  test: 0.7846890   best: 0.7990431 (205) total: 1.41
355:   learn: 0.8945006  test: 0.7846890   best: 0.7990431 (205) total: 1.42
356:   learn: 0.8945006  test: 0.7870813   best: 0.7990431 (205) total: 1.42
357:   learn: 0.8945006  test: 0.7870813   best: 0.7990431 (205) total: 1.43
358:   learn: 0.8945006  test: 0.7870813   best: 0.7990431 (205) total: 1.44
359:   learn: 0.8945006  test: 0.7870813   best: 0.7990431 (205) total: 1.45
360:   learn: 0.8945006  test: 0.7870813   best: 0.7990431 (205) total: 1.45
361:   learn: 0.8933782  test: 0.7870813   best: 0.7990431 (205) total: 1.46
362:   learn: 0.8945006  test: 0.7870813   best: 0.7990431 (205) total: 1.47
363:   learn: 0.8945006  test: 0.7870813   best: 0.7990431 (205) total: 1.48
364:   learn: 0.8945006  test: 0.7870813   best: 0.7990431 (205) total: 1.49
365:   learn: 0.8945006  test: 0.7870813   best: 0.7990431 (205) total: 1.49
366:   learn: 0.8978676  test: 0.7870813   best: 0.7990431 (205) total: 1.51
367:   learn: 0.8989899  test: 0.7846890   best: 0.7990431 (205) total: 1.51
368:   learn: 0.8989899  test: 0.7846890   best: 0.7990431 (205) total: 1.52
369:   learn: 0.8978676  test: 0.7846890   best: 0.7990431 (205) total: 1.53
370:   learn: 0.8978676  test: 0.7846890   best: 0.7990431 (205) total: 1.54
371:   learn: 0.8989899  test: 0.7846890   best: 0.7990431 (205) total: 1.55
372:   learn: 0.8989899  test: 0.7846890   best: 0.7990431 (205) total: 1.56
373:   learn: 0.9001122  test: 0.7846890   best: 0.7990431 (205) total: 1.57
374:   learn: 0.8989899  test: 0.7846890   best: 0.7990431 (205) total: 1.57
375:   learn: 0.8978676  test: 0.7846890   best: 0.7990431 (205) total: 1.58
376:   learn: 0.8978676  test: 0.7846890   best: 0.7990431 (205) total: 1.58
377:   learn: 0.9001122  test: 0.7846890   best: 0.7990431 (205) total: 1.59
378:   learn: 0.9001122  test: 0.7846890   best: 0.7990431 (205) total: 1.6s
379:   learn: 0.9001122  test: 0.7846890   best: 0.7990431 (205) total: 1.61
380:   learn: 0.9001122  test: 0.7846890   best: 0.7990431 (205) total: 1.62
381:   learn: 0.9001122  test: 0.7846890   best: 0.7990431 (205) total: 1.62
382:   learn: 0.9001122  test: 0.7846890   best: 0.7990431 (205) total: 1.63
383:   learn: 0.9001122  test: 0.7846890   best: 0.7990431 (205) total: 1.64
384:   learn: 0.9012346  test: 0.7846890   best: 0.7990431 (205) total: 1.68
385:   learn: 0.9012346  test: 0.7846890   best: 0.7990431 (205) total: 1.71
386:   learn: 0.9012346  test: 0.7846890   best: 0.7990431 (205) total: 1.76
387:   learn: 0.9001122  test: 0.7846890   best: 0.7990431 (205) total: 1.8s
388:   learn: 0.9012346  test: 0.7870813   best: 0.7990431 (205) total: 1.84
```

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388:    learn: 0.9012346  test: 0.7870813   best: 0.7990431 (205) total: 1.84
389:    learn: 0.9023569  test: 0.7846890   best: 0.7990431 (205) total: 1.87
390:    learn: 0.9012346  test: 0.7846890   best: 0.7990431 (205) total: 1.89
391:    learn: 0.9023569  test: 0.7846890   best: 0.7990431 (205) total: 1.92
392:    learn: 0.9023569  test: 0.7846890   best: 0.7990431 (205) total: 1.96
393:    learn: 0.9012346  test: 0.7870813   best: 0.7990431 (205) total: 1.98
394:    learn: 0.9012346  test: 0.7894737   best: 0.7990431 (205) total: 2.02
395:    learn: 0.9023569  test: 0.7870813   best: 0.7990431 (205) total: 2.06
396:    learn: 0.9023569  test: 0.7894737   best: 0.7990431 (205) total: 2.08
397:    learn: 0.9034792  test: 0.7846890   best: 0.7990431 (205) total: 2.12
398:    learn: 0.9023569  test: 0.7846890   best: 0.7990431 (205) total: 2.16
399:    learn: 0.9012346  test: 0.7846890   best: 0.7990431 (205) total: 2.19
400:    learn: 0.9012346  test: 0.7846890   best: 0.7990431 (205) total: 2.21
401:    learn: 0.9012346  test: 0.7846890   best: 0.7990431 (205) total: 2.25
402:    learn: 0.9012346  test: 0.7846890   best: 0.7990431 (205) total: 2.29
403:    learn: 0.9023569  test: 0.7822967   best: 0.7990431 (205) total: 2.31
404:    learn: 0.9023569  test: 0.7822967   best: 0.7990431 (205) total: 2.37
405:    learn: 0.9034792  test: 0.7822967   best: 0.7990431 (205) total: 2.39
406:    learn: 0.9034792  test: 0.7822967   best: 0.7990431 (205) total: 2.43
407:    learn: 0.9068462  test: 0.7822967   best: 0.7990431 (205) total: 2.46
408:    learn: 0.9068462  test: 0.7822967   best: 0.7990431 (205) total: 2.48
409:    learn: 0.9068462  test: 0.7822967   best: 0.7990431 (205) total: 2.49
410:    learn: 0.9068462  test: 0.7846890   best: 0.7990431 (205) total: 2.54
411:    learn: 0.9068462  test: 0.7846890   best: 0.7990431 (205) total: 2.58
412:    learn: 0.9068462  test: 0.7846890   best: 0.7990431 (205) total: 2.6s
413:    learn: 0.9068462  test: 0.7846890   best: 0.7990431 (205) total: 2.62
414:    learn: 0.9090909  test: 0.7799043   best: 0.7990431 (205) total: 2.65
415:    learn: 0.9090909  test: 0.7799043   best: 0.7990431 (205) total: 2.67
416:    learn: 0.9102132  test: 0.7799043   best: 0.7990431 (205) total: 2.69
417:    learn: 0.9090909  test: 0.7799043   best: 0.7990431 (205) total: 2.7s
418:    learn: 0.9090909  test: 0.7799043   best: 0.7990431 (205) total: 2.71
419:    learn: 0.9090909  test: 0.7799043   best: 0.7990431 (205) total: 2.72
420:    learn: 0.9090909  test: 0.7799043   best: 0.7990431 (205) total: 2.73
421:    learn: 0.9102132  test: 0.7799043   best: 0.7990431 (205) total: 2.74
422:    learn: 0.9124579  test: 0.7799043   best: 0.7990431 (205) total: 2.75
423:    learn: 0.9124579  test: 0.7799043   best: 0.7990431 (205) total: 2.75
424:    learn: 0.9124579  test: 0.7799043   best: 0.7990431 (205) total: 2.76
425:    learn: 0.9135802  test: 0.7799043   best: 0.7990431 (205) total: 2.77
426:    learn: 0.9135802  test: 0.7822967   best: 0.7990431 (205) total: 2.79
427:    learn: 0.9135802  test: 0.7822967   best: 0.7990431 (205) total: 2.8s
428:    learn: 0.9135802  test: 0.7799043   best: 0.7990431 (205) total: 2.81
429:    learn: 0.9135802  test: 0.7799043   best: 0.7990431 (205) total: 2.81
430:    learn: 0.9135802  test: 0.7799043   best: 0.7990431 (205) total: 2.82
431:    learn: 0.9135802  test: 0.7799043   best: 0.7990431 (205) total: 2.83
432:    learn: 0.9135802  test: 0.7822967   best: 0.7990431 (205) total: 2.83
433:    learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.84
434:    learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.85
435:    learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.85
436:    learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.86
437:    learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.87
438:    learn: 0.9147026  test: 0.7846890   best: 0.7990431 (205) total: 2.87
439:    learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.88
440:    learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.88
```

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441:   learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.88
442:   learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.89
443:   learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.9s
444:   learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.91
445:   learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.92
446:   learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.92
447:   learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.93
448:   learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.94
449:   learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.94
450:   learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.95
451:   learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.96
452:   learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.97
453:   learn: 0.9147026  test: 0.7822967   best: 0.7990431 (205) total: 2.98
454:   learn: 0.9158249  test: 0.7822967   best: 0.7990431 (205) total: 3s
455:   learn: 0.9158249  test: 0.7799043   best: 0.7990431 (205) total: 3s
456:   learn: 0.9158249  test: 0.7799043   best: 0.7990431 (205) total: 3.01
457:   learn: 0.9158249  test: 0.7799043   best: 0.7990431 (205) total: 3.02
458:   learn: 0.9158249  test: 0.7799043   best: 0.7990431 (205) total: 3.03
459:   learn: 0.9158249  test: 0.7799043   best: 0.7990431 (205) total: 3.04
460:   learn: 0.9158249  test: 0.7799043   best: 0.7990431 (205) total: 3.04
461:   learn: 0.9158249  test: 0.7822967   best: 0.7990431 (205) total: 3.05
462:   learn: 0.9158249  test: 0.7822967   best: 0.7990431 (205) total: 3.06
463:   learn: 0.9158249  test: 0.7822967   best: 0.7990431 (205) total: 3.07
464:   learn: 0.9158249  test: 0.7822967   best: 0.7990431 (205) total: 3.08
465:   learn: 0.9158249  test: 0.7822967   best: 0.7990431 (205) total: 3.08
466:   learn: 0.9169473  test: 0.7846890   best: 0.7990431 (205) total: 3.09
467:   learn: 0.9169473  test: 0.7846890   best: 0.7990431 (205) total: 3.12
468:   learn: 0.9169473  test: 0.7846890   best: 0.7990431 (205) total: 3.15
469:   learn: 0.9169473  test: 0.7846890   best: 0.7990431 (205) total: 3.17
470:   learn: 0.9169473  test: 0.7846890   best: 0.7990431 (205) total: 3.21
471:   learn: 0.9180696  test: 0.7846890   best: 0.7990431 (205) total: 3.24
472:   learn: 0.9169473  test: 0.7822967   best: 0.7990431 (205) total: 3.26
473:   learn: 0.9169473  test: 0.7822967   best: 0.7990431 (205) total: 3.29
474:   learn: 0.9180696  test: 0.7822967   best: 0.7990431 (205) total: 3.32
475:   learn: 0.9169473  test: 0.7822967   best: 0.7990431 (205) total: 3.35
476:   learn: 0.9169473  test: 0.7822967   best: 0.7990431 (205) total: 3.38
477:   learn: 0.9169473  test: 0.7822967   best: 0.7990431 (205) total: 3.41
478:   learn: 0.9180696  test: 0.7822967   best: 0.7990431 (205) total: 3.43
479:   learn: 0.9169473  test: 0.7822967   best: 0.7990431 (205) total: 3.46
480:   learn: 0.9180696  test: 0.7822967   best: 0.7990431 (205) total: 3.49
481:   learn: 0.9191919  test: 0.7846890   best: 0.7990431 (205) total: 3.51
482:   learn: 0.9203143  test: 0.7822967   best: 0.7990431 (205) total: 3.54
483:   learn: 0.9191919  test: 0.7846890   best: 0.7990431 (205) total: 3.57
484:   learn: 0.9191919  test: 0.7846890   best: 0.7990431 (205) total: 3.59
485:   learn: 0.9191919  test: 0.7846890   best: 0.7990431 (205) total: 3.63
486:   learn: 0.9191919  test: 0.7846890   best: 0.7990431 (205) total: 3.65
487:   learn: 0.9191919  test: 0.7846890   best: 0.7990431 (205) total: 3.68
488:   learn: 0.9191919  test: 0.7846890   best: 0.7990431 (205) total: 3.69
489:   learn: 0.9191919  test: 0.7846890   best: 0.7990431 (205) total: 3.71
490:   learn: 0.9191919  test: 0.7846890   best: 0.7990431 (205) total: 3.74
491:   learn: 0.9191919  test: 0.7846890   best: 0.7990431 (205) total: 3.75
492:   learn: 0.9191919  test: 0.7822967   best: 0.7990431 (205) total: 3.77
```

```
493:   learn: 0.9191919  test: 0.7822967   best: 0.7990431 (205) total: 3.79
494:   learn: 0.9191919  test: 0.7822967   best: 0.7990431 (205) total: 3.8s
495:   learn: 0.9191919  test: 0.7822967   best: 0.7990431 (205) total: 3.81
496:   learn: 0.9191919  test: 0.7822967   best: 0.7990431 (205) total: 3.82
497:   learn: 0.9191919  test: 0.7822967   best: 0.7990431 (205) total: 3.84
498:   learn: 0.9191919  test: 0.7822967   best: 0.7990431 (205) total: 3.87
499:   learn: 0.9203143  test: 0.7822967   best: 0.7990431 (205) total: 3.9s
500:   learn: 0.9203143  test: 0.7822967   best: 0.7990431 (205) total: 3.92
501:   learn: 0.9214366  test: 0.7822967   best: 0.7990431 (205) total: 3.94
502:   learn: 0.9214366  test: 0.7822967   best: 0.7990431 (205) total: 3.96
503:   learn: 0.9214366  test: 0.7822967   best: 0.7990431 (205) total: 3.98
504:   learn: 0.9214366  test: 0.7822967   best: 0.7990431 (205) total: 4s
505:   learn: 0.9214366  test: 0.7822967   best: 0.7990431 (205) total: 4.01
506:   learn: 0.9214366  test: 0.7822967   best: 0.7990431 (205) total: 4.02
507:   learn: 0.9214366  test: 0.7822967   best: 0.7990431 (205) total: 4.04
508:   learn: 0.9214366  test: 0.7822967   best: 0.7990431 (205) total: 4.06
509:   learn: 0.9214366  test: 0.7822967   best: 0.7990431 (205) total: 4.08
510:   learn: 0.9214366  test: 0.7822967   best: 0.7990431 (205) total: 4.09
511:   learn: 0.9214366  test: 0.7822967   best: 0.7990431 (205) total: 4.1s
512:   learn: 0.9214366  test: 0.7822967   best: 0.7990431 (205) total: 4.1s
513:   learn: 0.9214366  test: 0.7846890   best: 0.7990431 (205) total: 4.11
514:   learn: 0.9214366  test: 0.7799043   best: 0.7990431 (205) total: 4.12
515:   learn: 0.9214366  test: 0.7822967   best: 0.7990431 (205) total: 4.13
516:   learn: 0.9214366  test: 0.7822967   best: 0.7990431 (205) total: 4.14
517:   learn: 0.9214366  test: 0.7822967   best: 0.7990431 (205) total: 4.15
518:   learn: 0.9214366  test: 0.7799043   best: 0.7990431 (205) total: 4.15
519:   learn: 0.9214366  test: 0.7799043   best: 0.7990431 (205) total: 4.16
520:   learn: 0.9214366  test: 0.7799043   best: 0.7990431 (205) total: 4.17
521:   learn: 0.9214366  test: 0.7799043   best: 0.7990431 (205) total: 4.18
522:   learn: 0.9214366  test: 0.7799043   best: 0.7990431 (205) total: 4.19
523:   learn: 0.9214366  test: 0.7799043   best: 0.7990431 (205) total: 4.2s
524:   learn: 0.9214366  test: 0.7799043   best: 0.7990431 (205) total: 4.2s
525:   learn: 0.9214366  test: 0.7799043   best: 0.7990431 (205) total: 4.21
526:   learn: 0.9203143  test: 0.7799043   best: 0.7990431 (205) total: 4.22
527:   learn: 0.9203143  test: 0.7799043   best: 0.7990431 (205) total: 4.23
528:   learn: 0.9203143  test: 0.7799043   best: 0.7990431 (205) total: 4.24
529:   learn: 0.9203143  test: 0.7751196   best: 0.7990431 (205) total: 4.25
530:   learn: 0.9203143  test: 0.7822967   best: 0.7990431 (205) total: 4.26
531:   learn: 0.9203143  test: 0.7822967   best: 0.7990431 (205) total: 4.27
532:   learn: 0.9203143  test: 0.7822967   best: 0.7990431 (205) total: 4.28
533:   learn: 0.9203143  test: 0.7822967   best: 0.7990431 (205) total: 4.29
534:   learn: 0.9203143  test: 0.7822967   best: 0.7990431 (205) total: 4.29
535:   learn: 0.9203143  test: 0.7822967   best: 0.7990431 (205) total: 4.3s
536:   learn: 0.9203143  test: 0.7822967   best: 0.7990431 (205) total: 4.31
537:   learn: 0.9203143  test: 0.7822967   best: 0.7990431 (205) total: 4.32
538:   learn: 0.9203143  test: 0.7822967   best: 0.7990431 (205) total: 4.33
539:   learn: 0.9203143  test: 0.7822967   best: 0.7990431 (205) total: 4.33
540:   learn: 0.9203143  test: 0.7822967   best: 0.7990431 (205) total: 4.34
541:   learn: 0.9203143  test: 0.7775120   best: 0.7990431 (205) total: 4.35
542:   learn: 0.9203143  test: 0.7775120   best: 0.7990431 (205) total: 4.36
543:   learn: 0.9203143  test: 0.7775120   best: 0.7990431 (205) total: 4.37
544:   learn: 0.9203143  test: 0.7775120   best: 0.7990431 (205) total: 4.38
```

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545:   learn: 0.9203143  test: 0.7775120   best: 0.7990431 (205) total: 4.38
546:   learn: 0.9203143  test: 0.7775120   best: 0.7990431 (205) total: 4.39
547:   learn: 0.9203143  test: 0.7775120   best: 0.7990431 (205) total: 4.4s
548:   learn: 0.9214366  test: 0.7775120   best: 0.7990431 (205) total: 4.41
549:   learn: 0.9214366  test: 0.7775120   best: 0.7990431 (205) total: 4.42
550:   learn: 0.9214366  test: 0.7775120   best: 0.7990431 (205) total: 4.43
551:   learn: 0.9214366  test: 0.7775120   best: 0.7990431 (205) total: 4.44
552:   learn: 0.9236813  test: 0.7775120   best: 0.7990431 (205) total: 4.45
553:   learn: 0.9236813  test: 0.7775120   best: 0.7990431 (205) total: 4.49
554:   learn: 0.9236813  test: 0.7775120   best: 0.7990431 (205) total: 4.5s
555:   learn: 0.9225589  test: 0.7775120   best: 0.7990431 (205) total: 4.51
556:   learn: 0.9236813  test: 0.7775120   best: 0.7990431 (205) total: 4.54
557:   learn: 0.9236813  test: 0.7775120   best: 0.7990431 (205) total: 4.56
558:   learn: 0.9236813  test: 0.7775120   best: 0.7990431 (205) total: 4.57
559:   learn: 0.9236813  test: 0.7775120   best: 0.7990431 (205) total: 4.59
560:   learn: 0.9236813  test: 0.7775120   best: 0.7990431 (205) total: 4.61
561:   learn: 0.9236813  test: 0.7775120   best: 0.7990431 (205) total: 4.63
562:   learn: 0.9236813  test: 0.7775120   best: 0.7990431 (205) total: 4.67
563:   learn: 0.9248036  test: 0.7775120   best: 0.7990431 (205) total: 4.7s
564:   learn: 0.9248036  test: 0.7775120   best: 0.7990431 (205) total: 4.72
565:   learn: 0.9248036  test: 0.7775120   best: 0.7990431 (205) total: 4.75
566:   learn: 0.9248036  test: 0.7775120   best: 0.7990431 (205) total: 4.76
567:   learn: 0.9248036  test: 0.7775120   best: 0.7990431 (205) total: 4.8s
568:   learn: 0.9248036  test: 0.7775120   best: 0.7990431 (205) total: 4.83
569:   learn: 0.9248036  test: 0.7775120   best: 0.7990431 (205) total: 4.85
570:   learn: 0.9248036  test: 0.7775120   best: 0.7990431 (205) total: 4.89
571:   learn: 0.9248036  test: 0.7775120   best: 0.7990431 (205) total: 4.91
572:   learn: 0.9248036  test: 0.7775120   best: 0.7990431 (205) total: 4.93
573:   learn: 0.9248036  test: 0.7775120   best: 0.7990431 (205) total: 4.94
574:   learn: 0.9236813  test: 0.7775120   best: 0.7990431 (205) total: 4.96
575:   learn: 0.9236813  test: 0.7775120   best: 0.7990431 (205) total: 4.98
576:   learn: 0.9236813  test: 0.7775120   best: 0.7990431 (205) total: 5s
577:   learn: 0.9236813  test: 0.7775120   best: 0.7990431 (205) total: 5.01
578:   learn: 0.9259259  test: 0.7775120   best: 0.7990431 (205) total: 5.03
579:   learn: 0.9259259  test: 0.7775120   best: 0.7990431 (205) total: 5.04
580:   learn: 0.9259259  test: 0.7775120   best: 0.7990431 (205) total: 5.06
581:   learn: 0.9259259  test: 0.7775120   best: 0.7990431 (205) total: 5.08
582:   learn: 0.9259259  test: 0.7775120   best: 0.7990431 (205) total: 5.09
583:   learn: 0.9259259  test: 0.7775120   best: 0.7990431 (205) total: 5.1s
584:   learn: 0.9259259  test: 0.7775120   best: 0.7990431 (205) total: 5.12
585:   learn: 0.9270483  test: 0.7775120   best: 0.7990431 (205) total: 5.13
586:   learn: 0.9270483  test: 0.7775120   best: 0.7990431 (205) total: 5.14
587:   learn: 0.9259259  test: 0.7775120   best: 0.7990431 (205) total: 5.15
588:   learn: 0.9270483  test: 0.7775120   best: 0.7990431 (205) total: 5.16
589:   learn: 0.9270483  test: 0.7775120   best: 0.7990431 (205) total: 5.16
590:   learn: 0.9270483  test: 0.7775120   best: 0.7990431 (205) total: 5.17
591:   learn: 0.9270483  test: 0.7799043   best: 0.7990431 (205) total: 5.17
592:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.17
593:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.18
594:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.18
595:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.18
596:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.19
597:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.2s
```

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597:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.2s
598:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.2s
599:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.2s
600:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.21
601:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.21
602:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.21
603:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.22
604:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.22
605:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.23
606:   learn: 0.9259259  test: 0.7775120   best: 0.7990431 (205) total: 5.23
607:   learn: 0.9259259  test: 0.7775120   best: 0.7990431 (205) total: 5.24
608:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.25
609:   learn: 0.9259259  test: 0.7775120   best: 0.7990431 (205) total: 5.25
610:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.25
611:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.26
612:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.26
613:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.27
614:   learn: 0.9259259  test: 0.7799043   best: 0.7990431 (205) total: 5.27
615:   learn: 0.9270483  test: 0.7799043   best: 0.7990431 (205) total: 5.27
616:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.28
617:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.28
618:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.29
619:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.29
620:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.29
621:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.3s
622:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.3s
623:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.3s
624:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.31
625:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.31
626:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.31
627:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.32
628:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.32
629:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.33
630:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.33
631:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.34
632:   learn: 0.9281706  test: 0.7799043   best: 0.7990431 (205) total: 5.34
633:   learn: 0.9292929  test: 0.7799043   best: 0.7990431 (205) total: 5.35
634:   learn: 0.9292929  test: 0.7799043   best: 0.7990431 (205) total: 5.35
635:   learn: 0.9292929  test: 0.7799043   best: 0.7990431 (205) total: 5.35
636:   learn: 0.9292929  test: 0.7799043   best: 0.7990431 (205) total: 5.36
637:   learn: 0.9292929  test: 0.7799043   best: 0.7990431 (205) total: 5.36
638:   learn: 0.9315376  test: 0.7799043   best: 0.7990431 (205) total: 5.37
639:   learn: 0.9315376  test: 0.7799043   best: 0.7990431 (205) total: 5.37
640:   learn: 0.9315376  test: 0.7799043   best: 0.7990431 (205) total: 5.37
641:   learn: 0.9315376  test: 0.7799043   best: 0.7990431 (205) total: 5.38
642:   learn: 0.9315376  test: 0.7799043   best: 0.7990431 (205) total: 5.38
643:   learn: 0.9326599  test: 0.7799043   best: 0.7990431 (205) total: 5.39
644:   learn: 0.9326599  test: 0.7799043   best: 0.7990431 (205) total: 5.39
645:   learn: 0.9326599  test: 0.7799043   best: 0.7990431 (205) total: 5.4s
646:   learn: 0.9326599  test: 0.7799043   best: 0.7990431 (205) total: 5.4s
647:   learn: 0.9326599  test: 0.7799043   best: 0.7990431 (205) total: 5.4s
648:   learn: 0.9326599  test: 0.7799043   best: 0.7990431 (205) total: 5.41
649:   learn: 0.9337823  test: 0.7799043   best: 0.7990431 (205) total: 5.41
```

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650:   learn: 0.9337823  test: 0.7799043   best: 0.7990431 (205) total: 5.42
651:   learn: 0.9337823  test: 0.7799043   best: 0.7990431 (205) total: 5.42
652:   learn: 0.9337823  test: 0.7799043   best: 0.7990431 (205) total: 5.42
653:   learn: 0.9349046  test: 0.7799043   best: 0.7990431 (205) total: 5.43
654:   learn: 0.9349046  test: 0.7799043   best: 0.7990431 (205) total: 5.43
655:   learn: 0.9349046  test: 0.7799043   best: 0.7990431 (205) total: 5.44
656:   learn: 0.9360269  test: 0.7799043   best: 0.7990431 (205) total: 5.44
657:   learn: 0.9360269  test: 0.7799043   best: 0.7990431 (205) total: 5.45
658:   learn: 0.9360269  test: 0.7799043   best: 0.7990431 (205) total: 5.45
659:   learn: 0.9360269  test: 0.7799043   best: 0.7990431 (205) total: 5.46
660:   learn: 0.9360269  test: 0.7799043   best: 0.7990431 (205) total: 5.46
661:   learn: 0.9337823  test: 0.7799043   best: 0.7990431 (205) total: 5.46
662:   learn: 0.9349046  test: 0.7799043   best: 0.7990431 (205) total: 5.47
663:   learn: 0.9349046  test: 0.7799043   best: 0.7990431 (205) total: 5.47
664:   learn: 0.9349046  test: 0.7799043   best: 0.7990431 (205) total: 5.47
665:   learn: 0.9349046  test: 0.7799043   best: 0.7990431 (205) total: 5.48
666:   learn: 0.9337823  test: 0.7799043   best: 0.7990431 (205) total: 5.48
667:   learn: 0.9337823  test: 0.7799043   best: 0.7990431 (205) total: 5.49
668:   learn: 0.9326599  test: 0.7799043   best: 0.7990431 (205) total: 5.49
669:   learn: 0.9337823  test: 0.7799043   best: 0.7990431 (205) total: 5.49
670:   learn: 0.9349046  test: 0.7799043   best: 0.7990431 (205) total: 5.5s
671:   learn: 0.9349046  test: 0.7799043   best: 0.7990431 (205) total: 5.5s
672:   learn: 0.9349046  test: 0.7799043   best: 0.7990431 (205) total: 5.51
673:   learn: 0.9360269  test: 0.7799043   best: 0.7990431 (205) total: 5.51
674:   learn: 0.9360269  test: 0.7799043   best: 0.7990431 (205) total: 5.51
675:   learn: 0.9360269  test: 0.7799043   best: 0.7990431 (205) total: 5.52
676:   learn: 0.9360269  test: 0.7799043   best: 0.7990431 (205) total: 5.52
677:   learn: 0.9360269  test: 0.7799043   best: 0.7990431 (205) total: 5.53
678:   learn: 0.9371493  test: 0.7799043   best: 0.7990431 (205) total: 5.53
679:   learn: 0.9371493  test: 0.7799043   best: 0.7990431 (205) total: 5.53
680:   learn: 0.9371493  test: 0.7799043   best: 0.7990431 (205) total: 5.54
681:   learn: 0.9371493  test: 0.7799043   best: 0.7990431 (205) total: 5.54
682:   learn: 0.9360269  test: 0.7799043   best: 0.7990431 (205) total: 5.54
683:   learn: 0.9360269  test: 0.7799043   best: 0.7990431 (205) total: 5.55
684:   learn: 0.9360269  test: 0.7799043   best: 0.7990431 (205) total: 5.55
685:   learn: 0.9360269  test: 0.7799043   best: 0.7990431 (205) total: 5.55
686:   learn: 0.9371493  test: 0.7799043   best: 0.7990431 (205) total: 5.56
687:   learn: 0.9371493  test: 0.7799043   best: 0.7990431 (205) total: 5.56
688:   learn: 0.9371493  test: 0.7799043   best: 0.7990431 (205) total: 5.57
689:   learn: 0.9371493  test: 0.7799043   best: 0.7990431 (205) total: 5.57
690:   learn: 0.9371493  test: 0.7799043   best: 0.7990431 (205) total: 5.57
691:   learn: 0.9371493  test: 0.7799043   best: 0.7990431 (205) total: 5.58
692:   learn: 0.9371493  test: 0.7799043   best: 0.7990431 (205) total: 5.59
693:   learn: 0.9360269  test: 0.7775120   best: 0.7990431 (205) total: 5.59
694:   learn: 0.9360269  test: 0.7775120   best: 0.7990431 (205) total: 5.59
695:   learn: 0.9371493  test: 0.7775120   best: 0.7990431 (205) total: 5.6s
696:   learn: 0.9371493  test: 0.7775120   best: 0.7990431 (205) total: 5.6s
697:   learn: 0.9371493  test: 0.7775120   best: 0.7990431 (205) total: 5.61
698:   learn: 0.9371493  test: 0.7775120   best: 0.7990431 (205) total: 5.61
699:   learn: 0.9371493  test: 0.7775120   best: 0.7990431 (205) total: 5.62
700:   learn: 0.9360269  test: 0.7775120   best: 0.7990431 (205) total: 5.62
701:   learn: 0.9360269  test: 0.7775120   best: 0.7990431 (205) total: 5.63
```

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702:   learn: 0.9360269  test: 0.7775120   best: 0.7990431 (205) total: 5.63
703:   learn: 0.9360269  test: 0.7775120   best: 0.7990431 (205) total: 5.63
704:   learn: 0.9360269  test: 0.7775120   best: 0.7990431 (205) total: 5.64
705:   learn: 0.9360269  test: 0.7775120   best: 0.7990431 (205) total: 5.65
706:   learn: 0.9360269  test: 0.7775120   best: 0.7990431 (205) total: 5.65
707:   learn: 0.9360269  test: 0.7775120   best: 0.7990431 (205) total: 5.65
708:   learn: 0.9360269  test: 0.7775120   best: 0.7990431 (205) total: 5.66
709:   learn: 0.9360269  test: 0.7775120   best: 0.7990431 (205) total: 5.66
710:   learn: 0.9360269  test: 0.7775120   best: 0.7990431 (205) total: 5.66
711:   learn: 0.9360269  test: 0.7775120   best: 0.7990431 (205) total: 5.67
712:   learn: 0.9371493  test: 0.7775120   best: 0.7990431 (205) total: 5.67
713:   learn: 0.9371493  test: 0.7775120   best: 0.7990431 (205) total: 5.68
714:   learn: 0.9371493  test: 0.7775120   best: 0.7990431 (205) total: 5.68
715:   learn: 0.9371493  test: 0.7775120   best: 0.7990431 (205) total: 5.68
716:   learn: 0.9371493  test: 0.7775120   best: 0.7990431 (205) total: 5.69
717:   learn: 0.9371493  test: 0.7775120   best: 0.7990431 (205) total: 5.69
718:   learn: 0.9382716  test: 0.7751196   best: 0.7990431 (205) total: 5.7s
719:   learn: 0.9382716  test: 0.7751196   best: 0.7990431 (205) total: 5.7s
720:   learn: 0.9382716  test: 0.7751196   best: 0.7990431 (205) total: 5.7s
721:   learn: 0.9382716  test: 0.7775120   best: 0.7990431 (205) total: 5.71
722:   learn: 0.9382716  test: 0.7775120   best: 0.7990431 (205) total: 5.71
723:   learn: 0.9382716  test: 0.7775120   best: 0.7990431 (205) total: 5.71
724:   learn: 0.9382716  test: 0.7751196   best: 0.7990431 (205) total: 5.72
725:   learn: 0.9393939  test: 0.7751196   best: 0.7990431 (205) total: 5.72
726:   learn: 0.9393939  test: 0.7775120   best: 0.7990431 (205) total: 5.72
727:   learn: 0.9393939  test: 0.7775120   best: 0.7990431 (205) total: 5.73
728:   learn: 0.9393939  test: 0.7751196   best: 0.7990431 (205) total: 5.73
729:   learn: 0.9393939  test: 0.7751196   best: 0.7990431 (205) total: 5.74
730:   learn: 0.9393939  test: 0.7751196   best: 0.7990431 (205) total: 5.74
731:   learn: 0.9393939  test: 0.7751196   best: 0.7990431 (205) total: 5.74
732:   learn: 0.9393939  test: 0.7751196   best: 0.7990431 (205) total: 5.75
733:   learn: 0.9393939  test: 0.7751196   best: 0.7990431 (205) total: 5.75
734:   learn: 0.9393939  test: 0.7751196   best: 0.7990431 (205) total: 5.75
735:   learn: 0.9393939  test: 0.7775120   best: 0.7990431 (205) total: 5.76
736:   learn: 0.9393939  test: 0.7775120   best: 0.7990431 (205) total: 5.76
737:   learn: 0.9393939  test: 0.7775120   best: 0.7990431 (205) total: 5.76
738:   learn: 0.9393939  test: 0.7775120   best: 0.7990431 (205) total: 5.77
739:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.77
740:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.78
741:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.78
742:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.79
743:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.8s
744:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.81
745:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.82
746:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.82
747:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.82
748:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.83
749:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.83
750:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.84
751:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.84
752:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.85
753:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.85
```

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754:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.86
755:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.86
756:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.86
757:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.87
758:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.87
759:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.88
760:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.88
761:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.88
762:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.89
763:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.89
764:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.89
765:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.9s
766:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.9s
767:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.9s
768:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.91
769:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.91
770:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.92
771:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.92
772:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.92
773:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.93
774:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.93
775:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.93
776:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.94
777:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.94
778:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.95
779:   learn: 0.9393939  test: 0.7799043   best: 0.7990431 (205) total: 5.95
780:   learn: 0.9393939  test: 0.7822967   best: 0.7990431 (205) total: 5.95
781:   learn: 0.9393939  test: 0.7775120   best: 0.7990431 (205) total: 5.96
782:   learn: 0.9393939  test: 0.7775120   best: 0.7990431 (205) total: 5.96
783:   learn: 0.9393939  test: 0.7775120   best: 0.7990431 (205) total: 5.96
784:   learn: 0.9393939  test: 0.7775120   best: 0.7990431 (205) total: 5.97
785:   learn: 0.9393939  test: 0.7775120   best: 0.7990431 (205) total: 5.98
786:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 5.98
787:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 5.99
788:   learn: 0.9393939  test: 0.7775120   best: 0.7990431 (205) total: 5.99
789:   learn: 0.9393939  test: 0.7775120   best: 0.7990431 (205) total: 5.99
790:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6s
791:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6s
792:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6s
793:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.01
794:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.01
795:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.02
796:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.02
797:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.03
798:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.03
799:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.04
800:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.04
801:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.04
802:   learn: 0.9393939  test: 0.7775120   best: 0.7990431 (205) total: 6.05
803:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.05
804:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.05
805:   learn: 0.9405163  test: 0.7799043   best: 0.7990431 (205) total: 6.06
806:   learn: 0.9405163  test: 0.7799043   best: 0.7990431 (205) total: 6.06
```

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807:   learn: 0.9405163  test: 0.7799043   best: 0.7990431 (205) total: 6.07
808:   learn: 0.9405163  test: 0.7799043   best: 0.7990431 (205) total: 6.07
809:   learn: 0.9405163  test: 0.7799043   best: 0.7990431 (205) total: 6.07
810:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.08
811:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.08
812:   learn: 0.9405163  test: 0.7799043   best: 0.7990431 (205) total: 6.08
813:   learn: 0.9405163  test: 0.7799043   best: 0.7990431 (205) total: 6.09
814:   learn: 0.9405163  test: 0.7799043   best: 0.7990431 (205) total: 6.09
815:   learn: 0.9405163  test: 0.7799043   best: 0.7990431 (205) total: 6.09
816:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.1s
817:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.1s
818:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.11
819:   learn: 0.9405163  test: 0.7775120   best: 0.7990431 (205) total: 6.11
820:   learn: 0.9416386  test: 0.7775120   best: 0.7990431 (205) total: 6.11
821:   learn: 0.9416386  test: 0.7775120   best: 0.7990431 (205) total: 6.12
822:   learn: 0.9416386  test: 0.7775120   best: 0.7990431 (205) total: 6.12
823:   learn: 0.9416386  test: 0.7775120   best: 0.7990431 (205) total: 6.13
824:   learn: 0.9416386  test: 0.7775120   best: 0.7990431 (205) total: 6.13
825:   learn: 0.9416386  test: 0.7799043   best: 0.7990431 (205) total: 6.13
826:   learn: 0.9405163  test: 0.7799043   best: 0.7990431 (205) total: 6.14
827:   learn: 0.9405163  test: 0.7799043   best: 0.7990431 (205) total: 6.14
828:   learn: 0.9405163  test: 0.7799043   best: 0.7990431 (205) total: 6.14
829:   learn: 0.9416386  test: 0.7775120   best: 0.7990431 (205) total: 6.15
830:   learn: 0.9416386  test: 0.7775120   best: 0.7990431 (205) total: 6.15
831:   learn: 0.9427609  test: 0.7751196   best: 0.7990431 (205) total: 6.16
832:   learn: 0.9427609  test: 0.7751196   best: 0.7990431 (205) total: 6.16
833:   learn: 0.9416386  test: 0.7751196   best: 0.7990431 (205) total: 6.16
834:   learn: 0.9416386  test: 0.7775120   best: 0.7990431 (205) total: 6.17
835:   learn: 0.9416386  test: 0.7775120   best: 0.7990431 (205) total: 6.18
836:   learn: 0.9416386  test: 0.7775120   best: 0.7990431 (205) total: 6.18
837:   learn: 0.9416386  test: 0.7775120   best: 0.7990431 (205) total: 6.18
838:   learn: 0.9416386  test: 0.7775120   best: 0.7990431 (205) total: 6.19
839:   learn: 0.9416386  test: 0.7775120   best: 0.7990431 (205) total: 6.19
840:   learn: 0.9416386  test: 0.7775120   best: 0.7990431 (205) total: 6.2s
841:   learn: 0.9427609  test: 0.7775120   best: 0.7990431 (205) total: 6.2s
842:   learn: 0.9427609  test: 0.7775120   best: 0.7990431 (205) total: 6.2s
843:   learn: 0.9427609  test: 0.7775120   best: 0.7990431 (205) total: 6.21
844:   learn: 0.9427609  test: 0.7775120   best: 0.7990431 (205) total: 6.21
845:   learn: 0.9427609  test: 0.7775120   best: 0.7990431 (205) total: 6.22
846:   learn: 0.9416386  test: 0.7775120   best: 0.7990431 (205) total: 6.22
847:   learn: 0.9427609  test: 0.7775120   best: 0.7990431 (205) total: 6.23
848:   learn: 0.9427609  test: 0.7775120   best: 0.7990431 (205) total: 6.23
849:   learn: 0.9427609  test: 0.7775120   best: 0.7990431 (205) total: 6.23
850:   learn: 0.9427609  test: 0.7775120   best: 0.7990431 (205) total: 6.24
851:   learn: 0.9427609  test: 0.7775120   best: 0.7990431 (205) total: 6.24
852:   learn: 0.9438833  test: 0.7775120   best: 0.7990431 (205) total: 6.25
853:   learn: 0.9438833  test: 0.7775120   best: 0.7990431 (205) total: 6.25
854:   learn: 0.9438833  test: 0.7775120   best: 0.7990431 (205) total: 6.25
855:   learn: 0.9438833  test: 0.7775120   best: 0.7990431 (205) total: 6.26
856:   learn: 0.9438833  test: 0.7775120   best: 0.7990431 (205) total: 6.26
857:   learn: 0.9438833  test: 0.7775120   best: 0.7990431 (205) total: 6.27
858:   learn: 0.9438833  test: 0.7775120   best: 0.7990431 (205) total: 6.27
```

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859:   learn: 0.9438833  test: 0.7775120   best: 0.7990431 (205) total: 6.28
860:   learn: 0.9438833  test: 0.7775120   best: 0.7990431 (205) total: 6.28
861:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.29
862:   learn: 0.9450056  test: 0.7751196   best: 0.7990431 (205) total: 6.29
863:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.29
864:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.3s
865:   learn: 0.9450056  test: 0.7751196   best: 0.7990431 (205) total: 6.3s
866:   learn: 0.9450056  test: 0.7751196   best: 0.7990431 (205) total: 6.31
867:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.31
868:   learn: 0.9450056  test: 0.7751196   best: 0.7990431 (205) total: 6.32
869:   learn: 0.9450056  test: 0.7751196   best: 0.7990431 (205) total: 6.32
870:   learn: 0.9450056  test: 0.7751196   best: 0.7990431 (205) total: 6.32
871:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.33
872:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.33
873:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.33
874:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.34
875:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.34
876:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.34
877:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.35
878:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.35
879:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.36
880:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.36
881:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.37
882:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.37
883:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.38
884:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.38
885:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.38
886:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.39
887:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.39
888:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.39
889:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.4s
890:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.4s
891:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.41
892:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.42
893:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.42
894:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.42
895:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.43
896:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.43
897:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.43
898:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.44
899:   learn: 0.9461279  test: 0.7775120   best: 0.7990431 (205) total: 6.44
900:   learn: 0.9461279  test: 0.7775120   best: 0.7990431 (205) total: 6.45
901:   learn: 0.9461279  test: 0.7775120   best: 0.7990431 (205) total: 6.45
902:   learn: 0.9461279  test: 0.7775120   best: 0.7990431 (205) total: 6.45
903:   learn: 0.9461279  test: 0.7775120   best: 0.7990431 (205) total: 6.46
904:   learn: 0.9461279  test: 0.7775120   best: 0.7990431 (205) total: 6.46
905:   learn: 0.9461279  test: 0.7775120   best: 0.7990431 (205) total: 6.47
906:   learn: 0.9461279  test: 0.7775120   best: 0.7990431 (205) total: 6.47
907:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.47
908:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.48
909:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.48
910:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.49
```

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911:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.49
912:   learn: 0.9461279  test: 0.7775120   best: 0.7990431 (205) total: 6.49
913:   learn: 0.9461279  test: 0.7775120   best: 0.7990431 (205) total: 6.5s
914:   learn: 0.9461279  test: 0.7775120   best: 0.7990431 (205) total: 6.5s
915:   learn: 0.9461279  test: 0.7775120   best: 0.7990431 (205) total: 6.5s
916:   learn: 0.9461279  test: 0.7775120   best: 0.7990431 (205) total: 6.51
917:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.51
918:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.52
919:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.52
920:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.52
921:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.53
922:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.53
923:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.53
924:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.54
925:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.54
926:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.54
927:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.55
928:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.55
929:   learn: 0.9461279  test: 0.7751196   best: 0.7990431 (205) total: 6.56
930:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.56
931:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.57
932:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.59
933:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.6s
934:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.6s
935:   learn: 0.9450056  test: 0.7775120   best: 0.7990431 (205) total: 6.61
936:   learn: 0.9461279  test: 0.7775120   best: 0.7990431 (205) total: 6.61
937:   learn: 0.9461279  test: 0.7775120   best: 0.7990431 (205) total: 6.61
938:   learn: 0.9472503  test: 0.7727273   best: 0.7990431 (205) total: 6.62
939:   learn: 0.9472503  test: 0.7727273   best: 0.7990431 (205) total: 6.62
940:   learn: 0.9472503  test: 0.7727273   best: 0.7990431 (205) total: 6.62
941:   learn: 0.9472503  test: 0.7727273   best: 0.7990431 (205) total: 6.63
942:   learn: 0.9472503  test: 0.7727273   best: 0.7990431 (205) total: 6.63
943:   learn: 0.9472503  test: 0.7727273   best: 0.7990431 (205) total: 6.63
944:   learn: 0.9461279  test: 0.7727273   best: 0.7990431 (205) total: 6.64
945:   learn: 0.9461279  test: 0.7727273   best: 0.7990431 (205) total: 6.64
946:   learn: 0.9461279  test: 0.7727273   best: 0.7990431 (205) total: 6.64
947:   learn: 0.9461279  test: 0.7727273   best: 0.7990431 (205) total: 6.65
948:   learn: 0.9461279  test: 0.7727273   best: 0.7990431 (205) total: 6.65
949:   learn: 0.9461279  test: 0.7727273   best: 0.7990431 (205) total: 6.66
950:   learn: 0.9461279  test: 0.7727273   best: 0.7990431 (205) total: 6.66
951:   learn: 0.9461279  test: 0.7727273   best: 0.7990431 (205) total: 6.66
952:   learn: 0.9472503  test: 0.7727273   best: 0.7990431 (205) total: 6.67
953:   learn: 0.9472503  test: 0.7727273   best: 0.7990431 (205) total: 6.67
954:   learn: 0.9461279  test: 0.7727273   best: 0.7990431 (205) total: 6.67
955:   learn: 0.9461279  test: 0.7727273   best: 0.7990431 (205) total: 6.68
956:   learn: 0.9461279  test: 0.7727273   best: 0.7990431 (205) total: 6.68
957:   learn: 0.9461279  test: 0.7727273   best: 0.7990431 (205) total: 6.69
958:   learn: 0.9483726  test: 0.7727273   best: 0.7990431 (205) total: 6.69
959:   learn: 0.9483726  test: 0.7727273   best: 0.7990431 (205) total: 6.69
960:   learn: 0.9494949  test: 0.7727273   best: 0.7990431 (205) total: 6.7s
961:   learn: 0.9483726  test: 0.7727273   best: 0.7990431 (205) total: 6.7s
962:   learn: 0.9483726  test: 0.7727273   best: 0.7990431 (205) total: 6.71
```

```
963:   learn: 0.9483726  test: 0.7727273   best: 0.7990431 (205) total: 6.71
964:   learn: 0.9494949  test: 0.7727273   best: 0.7990431 (205) total: 6.71
965:   learn: 0.9494949  test: 0.7727273   best: 0.7990431 (205) total: 6.72
966:   learn: 0.9494949  test: 0.7727273   best: 0.7990431 (205) total: 6.72
967:   learn: 0.9494949  test: 0.7727273   best: 0.7990431 (205) total: 6.72
968:   learn: 0.9483726  test: 0.7727273   best: 0.7990431 (205) total: 6.73
969:   learn: 0.9483726  test: 0.7727273   best: 0.7990431 (205) total: 6.73
970:   learn: 0.9483726  test: 0.7727273   best: 0.7990431 (205) total: 6.73
971:   learn: 0.9483726  test: 0.7727273   best: 0.7990431 (205) total: 6.74
972:   learn: 0.9483726  test: 0.7727273   best: 0.7990431 (205) total: 6.74
973:   learn: 0.9483726  test: 0.7727273   best: 0.7990431 (205) total: 6.75
974:   learn: 0.9494949  test: 0.7727273   best: 0.7990431 (205) total: 6.75
975:   learn: 0.9494949  test: 0.7703349   best: 0.7990431 (205) total: 6.76
976:   learn: 0.9494949  test: 0.7703349   best: 0.7990431 (205) total: 6.76
977:   learn: 0.9494949  test: 0.7703349   best: 0.7990431 (205) total: 6.77
978:   learn: 0.9494949  test: 0.7703349   best: 0.7990431 (205) total: 6.78
979:   learn: 0.9494949  test: 0.7703349   best: 0.7990431 (205) total: 6.79
980:   learn: 0.9494949  test: 0.7703349   best: 0.7990431 (205) total: 6.8s
981:   learn: 0.9494949  test: 0.7703349   best: 0.7990431 (205) total: 6.8s
982:   learn: 0.9506173  test: 0.7703349   best: 0.7990431 (205) total: 6.8s
983:   learn: 0.9506173  test: 0.7703349   best: 0.7990431 (205) total: 6.81
984:   learn: 0.9506173  test: 0.7703349   best: 0.7990431 (205) total: 6.81
985:   learn: 0.9506173  test: 0.7703349   best: 0.7990431 (205) total: 6.82
986:   learn: 0.9506173  test: 0.7703349   best: 0.7990431 (205) total: 6.82
987:   learn: 0.9506173  test: 0.7703349   best: 0.7990431 (205) total: 6.82
988:   learn: 0.9506173  test: 0.7703349   best: 0.7990431 (205) total: 6.83
989:   learn: 0.9517396  test: 0.7703349   best: 0.7990431 (205) total: 6.83
990:   learn: 0.9517396  test: 0.7703349   best: 0.7990431 (205) total: 6.83
991:   learn: 0.9517396  test: 0.7703349   best: 0.7990431 (205) total: 6.84
992:   learn: 0.9517396  test: 0.7703349   best: 0.7990431 (205) total: 6.84
993:   learn: 0.9517396  test: 0.7703349   best: 0.7990431 (205) total: 6.85
994:   learn: 0.9517396  test: 0.7703349   best: 0.7990431 (205) total: 6.85
995:   learn: 0.9539843  test: 0.7703349   best: 0.7990431 (205) total: 6.85
996:   learn: 0.9539843  test: 0.7703349   best: 0.7990431 (205) total: 6.86
997:   learn: 0.9539843  test: 0.7679426   best: 0.7990431 (205) total: 6.86
998:   learn: 0.9539843  test: 0.7679426   best: 0.7990431 (205) total: 6.87
999:   learn: 0.9539843  test: 0.7679426   best: 0.7990431 (205) total: 6.87

bestTest = 0.7990430622
bestIteration = 205

Shrink model to first 206 iterations.
```

	Model	OVERALL ACCURACY FOR TRAIN DATASET	ROC_AUC FOR X_TEST WITH DEFAULT PARAMS	ACCURACY FOR X_TEST WITH DEFAULT PARAMS
0	DT	0.790123	0.710723	0.712919
1	RF	0.808081	0.799769	0.758373
2	LR	0.791246	0.811916	0.765550
3	KNB	0.800224	0.794292	0.717703
4	SVC	0.823793	0.810236	0.779904

5	CAT	0.814097	0.828201	0.799043

As we can see, CatBoost and SVM are the best models for this problem. We will use CatBoost as our base model for the moment.

Feature engineering

...

Data Preprocessing Function

```
def preprocess_data(data):

    data.drop(['Name', 'Ticket', 'Cabin'], axis=1, inplace=True)

    data['Age'].fillna(data['Age'].median(), inplace=True)
    data['Embarked'].fillna(data['Embarked'].mode()[0], inplace=True)
    data['Fare'].fillna(data['Fare'].median(), inplace=True)
    data['Sex'] = data['Sex'].map({'female': 1, 'male': 0})
    data = pd.get_dummies(data, columns=['Embarked'])

    return data
```

Prepare the Data

```
train = pd.read_csv("train.csv", index_col=0)
train = preprocess_data(train)

y_train = train['Survived']
X_train = train.drop('Survived', axis=1)

len(X_train), len(y_train)
```

```
(891, 891)
```

```
test = pd.read_csv('test_with_survived.csv', index_col=0)
test = preprocess_data(test)

y_test = test['Survived']
X_test = test.drop(["Survived"], axis=1)

len(X_test), len(y_test)
```

```
(418, 418)
```

Model

We will use catboost, therefore we need to indicate the categorical features.

```
cat_features = np.where(X_train.dtypes != float)[0]
cat_features
```

```
array([0, 1, 3, 4, 6, 7, 8])
```

Create the Model

```
# fit the model
model = CatBoostClassifier(loss_function='Logloss', eval_metric='Accuracy', verbo
model.fit(X_train, y_train, eval_set=(X_test, y_test))

# make predictions
y_pred = model.predict(X_test)

# evaluate predictions
accuracy = accuracy_score(y_test, y_pred)
accuracy # 0.7990430622009569
```

```
0.7990430622009569
```

```
print(classification_report(y_test, y_pred))
```

```
                  precision    recall  f1-score   support

               0       0.81      0.88      0.85       260
               1       0.77      0.66      0.71       158

        accuracy                           0.80       418
       macro avg       0.79      0.77      0.78       418
    weighted avg       0.80      0.80      0.80       418
```

```
plt.figure(figsize = (4,4))
cm = sns.heatmap(confusion_matrix(y_test, y_pred), fmt='g', annot=True)
cm.set(title='Confusion Matrix')
cm.set(xlabel='Predicted', ylabel='Actual')
plt.show()
```


```
# get the feature importance
feature_importance = model.get_feature_importance(prettified=True)
feature_importance
```

	Feature Id	Importances
0	Sex	42.971406
1	Pclass	18.585748
2	Age	11.570046
3	Fare	9.734781
4	SibSp	7.140632
5	Parch	6.359841
6	Embarked_S	1.829718
7	Embarked_C	1.089721
8	Embarked_Q	0.718109

Hyperparameter Tuning

We are going to find the best parameters for the model using GridSearchCV. Also, we are going to use Cross Validation to avoid overfitting.

```
'''
cat_for_search = CatBoostClassifier(loss_function='Logloss',
                                    eval_metric='Accuracy',
                                    verbose=False,
                                    random_state=42)

params = {
    'depth': [4, 6, 8, 10],
    'learning_rate': [0.01, 0.05, 0.1, 0.2],
    'iterations': [100, 200, 300, 500],
    'l2_leaf_reg': [1, 3, 5, 7],
}
```

```
grid = cat_for_search.grid_search(params, Pool(X_train, y_train, cat_features=cat

best_model = CatBoostClassifier(depth=grid['params']['depth'],
                                loss_function='Logloss',
                                eval_metric='Accuracy',
                                use_best_model=True,
                                random_seed=42,
                                verbose=False)

best_model.fit(X_train, y_train, cat_features=cat_features, eval_set = (X_test, y

accuracy_score(y_test, best_model.predict(X_test))
'''
```

```
'\ncat_for_search = CatBoostClassifier(loss_function='Logloss',\n
eval_metric='Accuracy',\n                                    verbose=False,\n
random_state=42)\n\nparams = {\n    'depth': [4, 6, 8, 10],\n    'learning_ra
te': [0.01, 0.05, 0.1, 0.2],\n    'iterations': [100, 200, 300, 500],\n    'l
2_leaf_reg': [1, 3, 5, 7],\n}\n\ngrid = cat_for_search.grid_search(params, Po
ol(X_train, y_train, cat_features=cat_features), shuffle=True, cv=5, verbose=
```