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Факультет «Информатика и системы управления»

Кафедра ИУ5

Отчёт по
лабораторной работе № 4
«Технологии машинного обучения»

Подготовил:

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Подпись_____

Дата_____

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Цель лабораторной работы: изучение линейных моделей, SVM и деревьев решений.

Задание:

1. Выберите набор данных (датасет) для решения задачи классификации или регрессии.
2. В случае необходимости проведите удаление или заполнение пропусков и кодирование категориальных признаков.
3. С использованием метода train_test_split разделите выборку на обучающую и тестовую.
4. Обучите следующие модели:
    - одну из линейных моделей;
    - SVM;
    - дерево решений.
5. Оцените качество моделей с помощью двух подходящих для задачи метрик. Сравните качество полученных моделей.

Текст программы:

```
import numpy as np
import pandas as pd
from sklearn.datasets import *
from sklearn.model_selection import train_test_split
import seaborn as sns
import matplotlib.pyplot as plt

from operator import itemgetter
import matplotlib.ticker as ticker
import math

from sklearn.metrics import accuracy_score, balanced_accuracy_score
from sklearn.metrics import plot_confusion_matrix
from sklearn.metrics import precision_score, recall_score, f1_score,
classification_report
from sklearn.metrics import confusion_matrix
from sklearn.metrics import mean_absolute_error, mean_squared_error,
mean_squared_log_error, median_absolute_error, r2_score
from sklearn.metrics import roc_curve, roc_auc_score


from sklearn.neighbors import KNeighborsRegressor, KNeighborsClassifier

from sklearn.model_selection import cross_val_score, cross_validate
from sklearn.model_selection import KFold, RepeatedKFold, LeaveOneOut, LeavePOut,
ShuffleSplit, StratifiedKFold



from sklearn.preprocessing import MinMaxScaler, StandardScaler, Normalizer


from sklearn.model_selection import GridSearchCV, RandomizedSearchCV
```

```
from sklearn.model_selection import learning_curve, validation_curve

from sklearn.metrics import confusion_matrix
from sklearn.linear_model import LinearRegression
from sklearn.linear_model import SGDRegressor
from sklearn.linear_model import SGDClassifier
from typing import Dict, Tuple
from scipy import stats
from sklearn.svm import SVC, NuSVC, LinearSVC, OneClassSVM, SVR, NuSVR, LinearSVR
from sklearn.tree import DecisionTreeClassifier, DecisionTreeRegressor,
export_graphviz

%matplotlib inline
sns.set(style="ticks")
```

Выборка датасета и ее разделение на тестовую и обучающую

```
wine = load_wine()

for x in wine:
    print(x)

data
target
frame
target_names
DESCR
feature_names

# Сформируем DataFrame
wine_df = pd.DataFrame(data= np.c_[wine['data']],
                       columns= wine['feature_names'])

wine_df
```

	alcohol	malic_acid	ash	alcalinity_of_ash	magnesium	total_phenols	flavanoids	nonflavanoid_phenols	proanthocyanins	color_tensit
0	14.23	1.71	2.43	15.6	127.0	2.80	3.06	0.28	2.29	5.64
1	13.20	1.78	2.14	11.2	100.0	2.65	2.76	0.26	1.28	4.38
2	13.16	2.36	2.67	18.6	101.0	2.80	3.24	0.30	2.81	5.68
3	14.37	1.95	2.50	16.8	113.0	3.85	3.49	0.24	2.18	7.80
4	13.24	2.59	2.87	21.0	118.0	2.80	2.69	0.39	1.82	4.32
...	...	...	...	...	...	...	...	...	...	...
173	13.71	5.65	2.45	20.5	95.0	1.68	0.61	0.52	1.06	7.70
174	13.40	3.91	2.48	23.0	102.0	1.80	0.75	0.43	1.41	7.30
175	13.27	4.28	2.26	20.0	120.0	1.59	0.69	0.43	1.35	10.20

	alcohol	malic_acid	ash	alcalinity_of_ash	magnesium	total_phenols	flavanoids	nonflavanoid_phenols	proanthocyanins	color_tensit
176	13.17	2.59	2.37	20.0	120.0	1.65	0.68	0.53	1.46	9.30
177	14.13	4.10	2.74	24.5	96.0	2.05	0.76	0.56	1.35	9.20

178 rows × 13 columns

```
sc = MinMaxScaler()
wine_sc = sc.fit_transform(wine_df)

X_train, X_test, Y_train, Y_test = train_test_split(
wine_sc, wine.target, test_size=0.33, random_state=1)

X_train = X_train.to_numpy()

X_test = X_test.to_numpy()
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
<ipython-input-15-fd9283572801> in <module>
----> 1 X_train = X_train.to_numpy()
      2
      3 X_test = X_test.to_numpy()

AttributeError: 'numpy.ndarray' object has no attribute 'to_numpy'
```

Обучение моделей

Обучение линейной модели

```
# Обучим линейную регрессию и сравним коэффициенты с рассчитанными ранее
reg1 = LinearRegression().fit(X_train, Y_train.reshape(-1, 1))
reg1.coef_, reg1.intercept_
```

```
(array([[-0.3976376 ,  0.06900004, -0.09455592,  0.67398288, -0.28642767,
          0.52588975, -1.74765428, -0.17922208,  0.03652941,  0.96993586,
         -0.36623749, -0.65402594, -1.20252002]]),
 array([1.9579414]))
```

```
target1 = reg1.predict(X_test)

mean_squared_error(Y_test, target1), mean_absolute_error(Y_test, target1)
```

```
(0.07434617175982262, 0.21742003782587782)
```

Обучение SVM

```
svr = SVR()
svr.fit(X_train, Y_train)
```

```
SVR()
```

```
target2 = svr.predict(X_test)
```

```
mean_squared_error(Y_test, target2), mean_absolute_error(Y_test, target2)
```

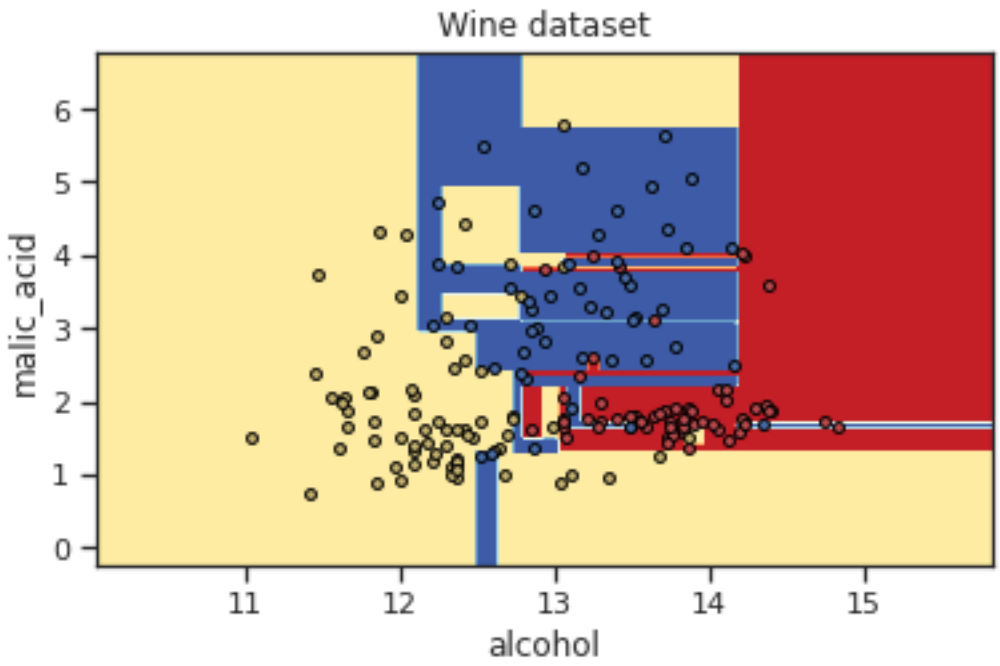
```
(0.02266297424014328, 0.1065218053756329)
```

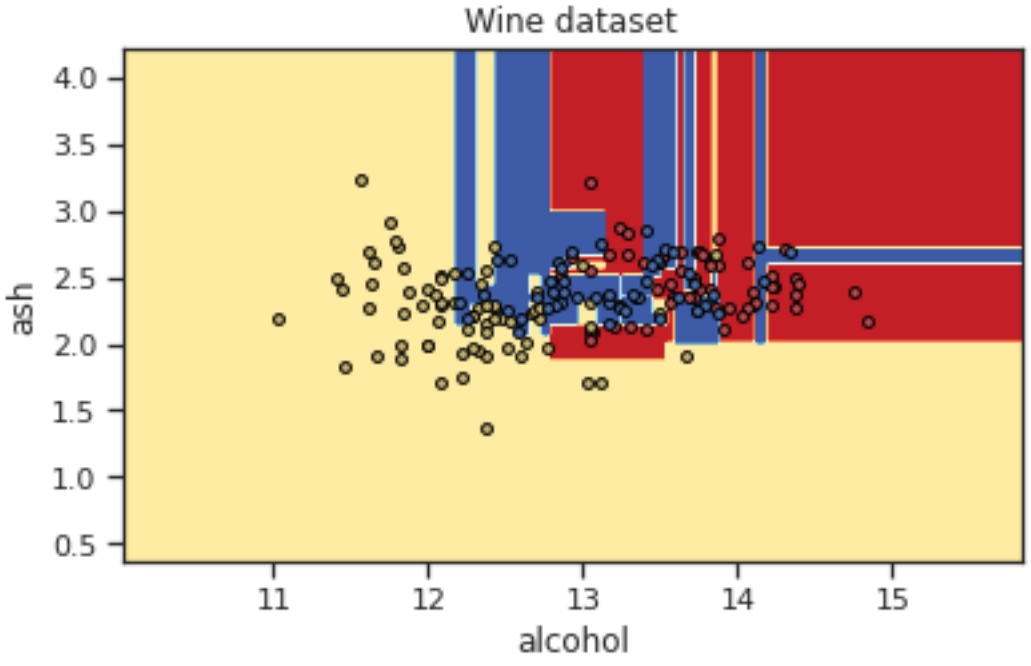
Обучение деревья решений

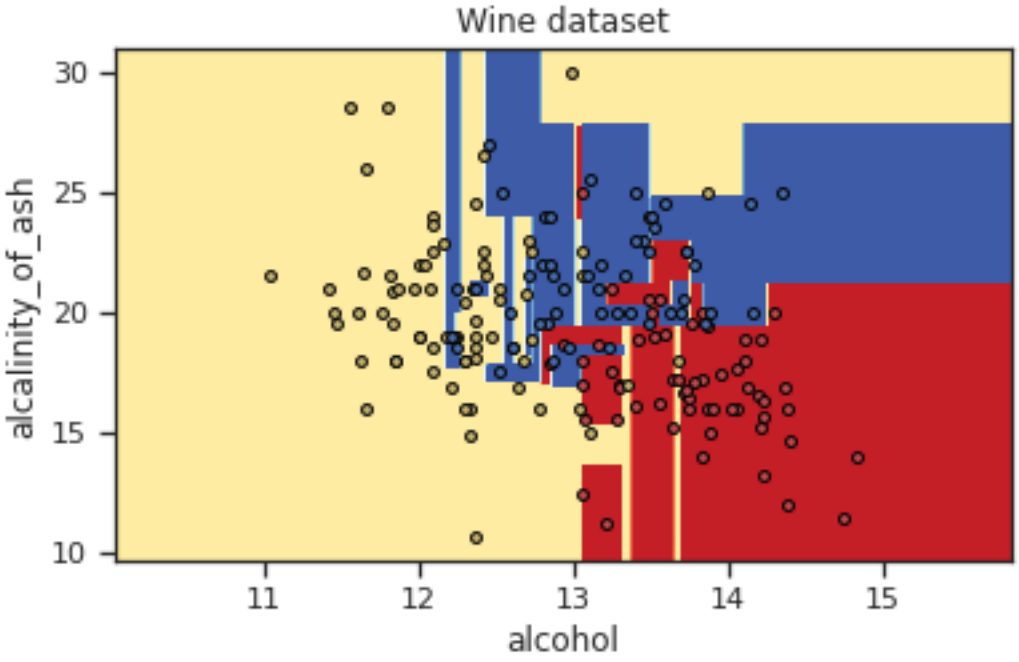
Классификация

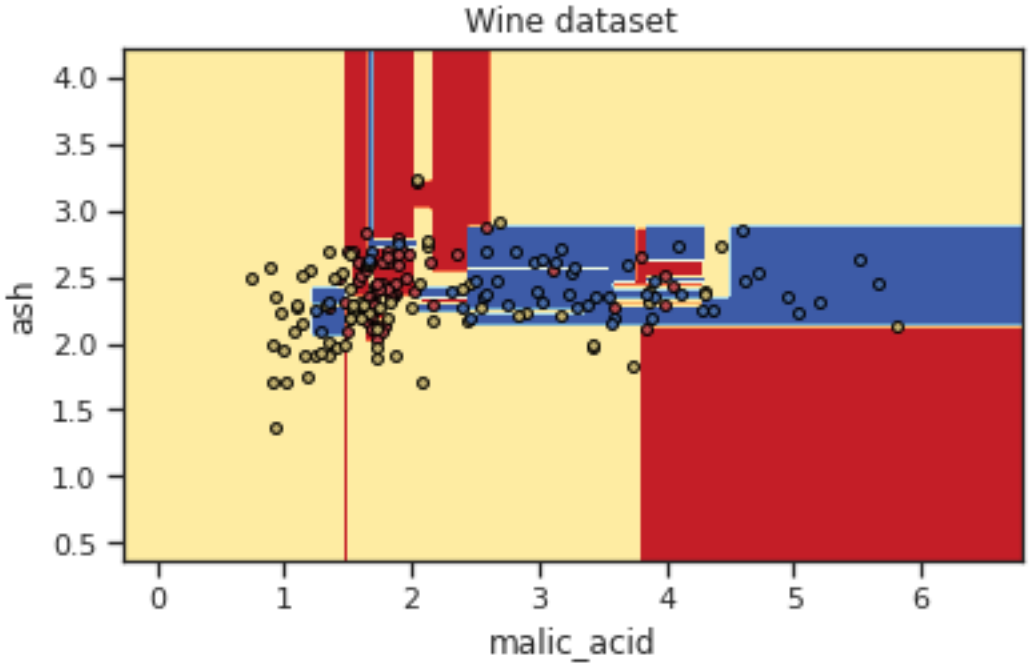
```
def plot_tree_classification(title_param, ds):
    """
    Построение деревьев и вывод графиков для заданного датасета
    """

    n_classes = len(np.unique(ds.target))
    plot_colors = "ryb"
    plot_step = 0.02

    for pairidx, pair in enumerate([[0, 1], [0, 2], [0, 3],
                                    [1, 2], [1, 3], [2, 3]]):
        # We only take the two corresponding features
        X = ds.data[:, pair]
        y = ds.target

        # Train
        clf = DecisionTreeClassifier(random_state=1).fit(X, y)

        plt.title(title_param)

        x_min, x_max = X[:, 0].min() - 1, X[:, 0].max() + 1
        y_min, y_max = X[:, 1].min() - 1, X[:, 1].max() + 1
        xx, yy = np.meshgrid(np.arange(x_min, x_max, plot_step),
                             np.arange(y_min, y_max, plot_step))
        plt.tight_layout(h_pad=0.5, w_pad=0.5, pad=2.5)

        Z = clf.predict(np.c_[xx.ravel(), yy.ravel()])

        Z = Z.reshape(xx.shape)
        cs = plt.contourf(xx, yy, Z, cmap=plt.cm.RdYlBu)

        plt.xlabel(ds.feature_names[pair[0]])
        plt.ylabel(ds.feature_names[pair[1]])

        # Plot the training points
        for i, color in zip(range(n_classes), plot_colors):
            idx = np.where(y == i)
            plt.scatter(X[idx, 0], X[idx, 1], c=color, label=ds.target_names[i],
                        cmap=plt.cm.RdYlBu, edgecolor='black', s=15)

        plt.show()
```

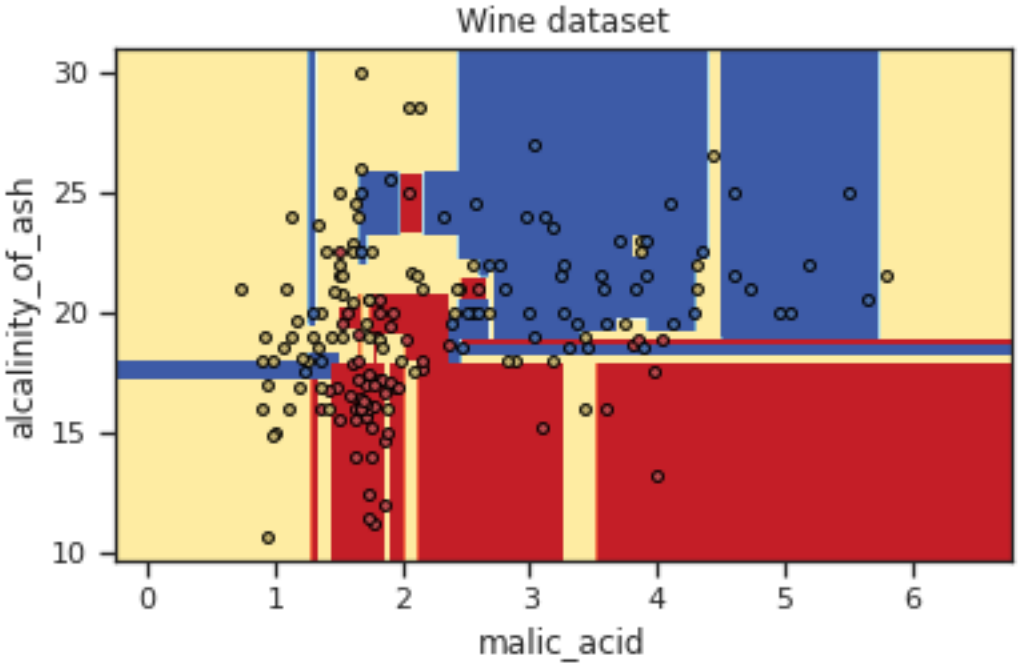
```
plot_tree_classification('Wine dataset', wine)
```

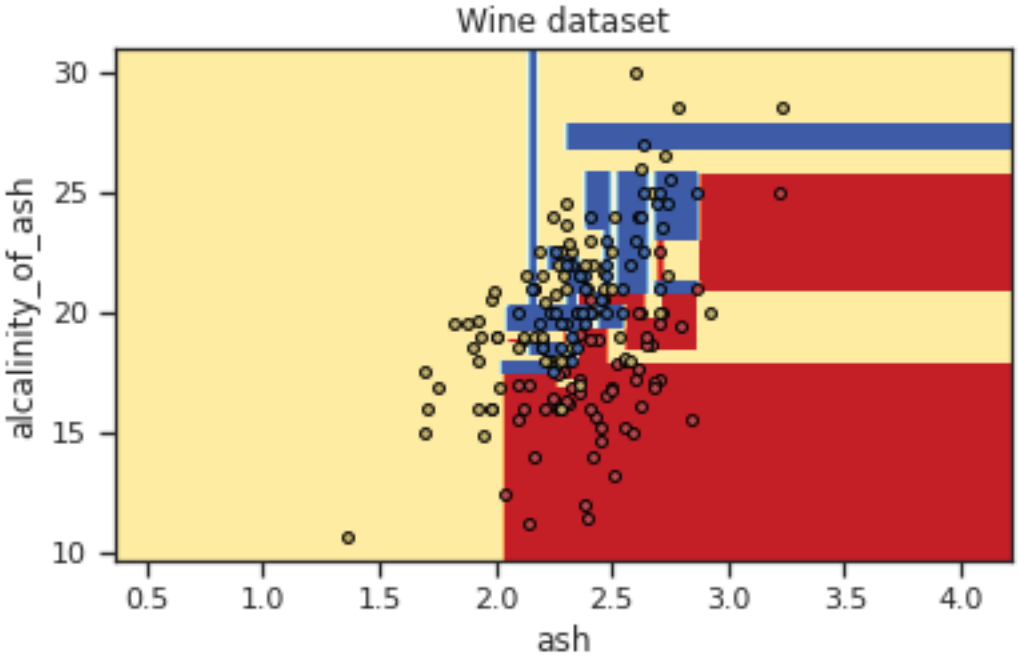





Wine dataset
alcalinity_of_ash
alcohol
30
25
20
15
10
11
12
13
14
15


Wine dataset
ash
malic_acid
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
1
2
3
4
5
6





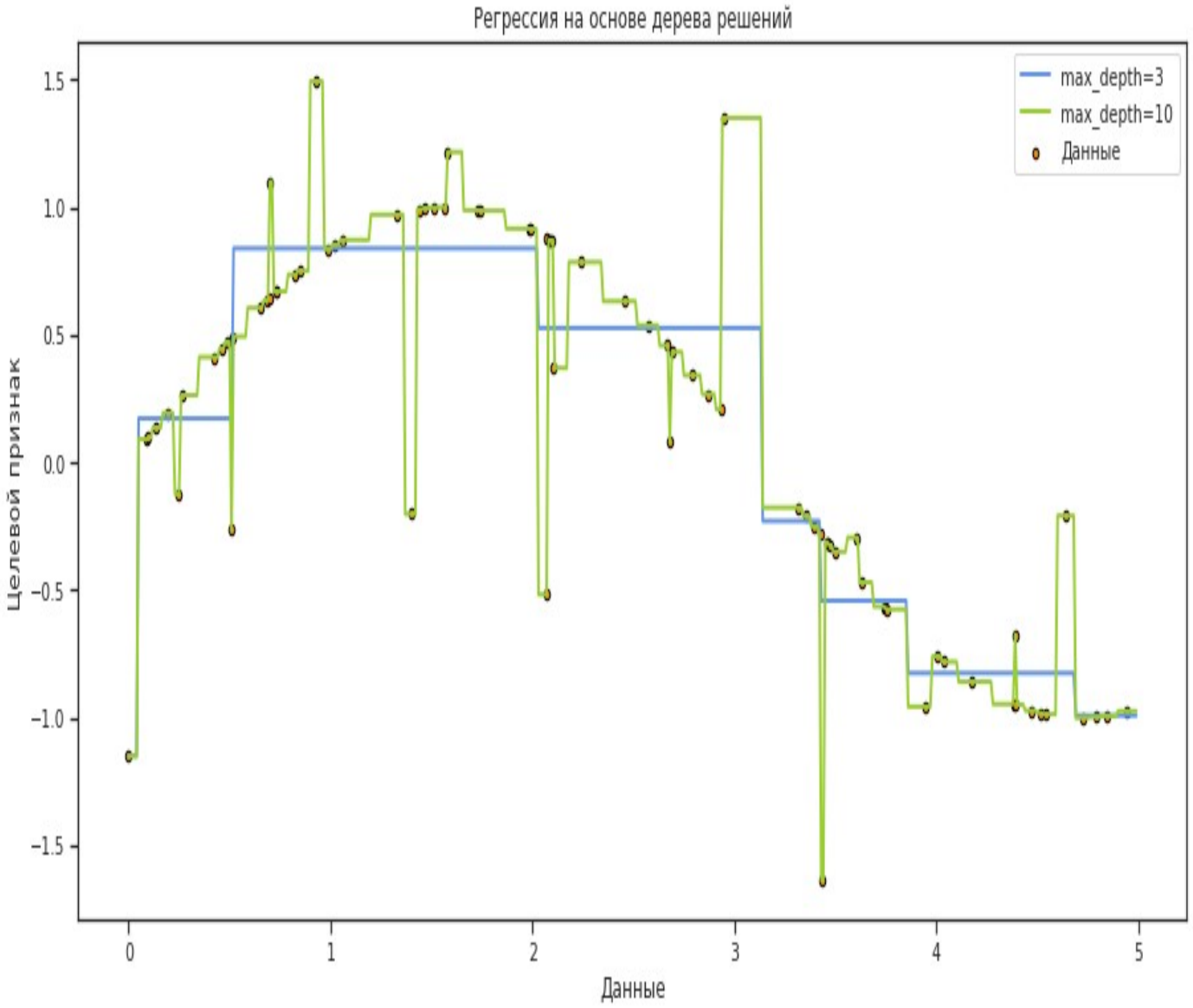

```
clf = DecisionTreeClassifier(random_state=1).fit(X_train, Y_train)
target3 = clf.predict(X_test)
accuracy_score(Y_test, target3), precision_score(Y_test, target3, average='macro')
```

```
(0.9491525423728814, 0.9464285714285715)
```

Регрессия

```
def random_dataset_for_regression():
    """
```

```
    Создание случайного набора данных для регрессии
    """
    rng = np.random.RandomState(1)
    X_train = np.sort(5 * rng.rand(80, 1), axis=0)
    y_train = np.sin(X_train).ravel()
    y_train[::5] += 3 * (0.5 - rng.rand(16))
    X_test = np.arange(0.0, 5.0, 0.01)[:, np.newaxis]
    return X_train, y_train, X_test

def plot_tree_regression(X_train, y_train, X_test):
    """
    Построение деревьев и вывод графиков для заданного датасета
    """

    # Обучение регрессионной модели
    regr_1 = DecisionTreeRegressor(max_depth=3)
    regr_2 = DecisionTreeRegressor(max_depth=10)
    regr_1.fit(X_train, y_train)
    regr_2.fit(X_train, y_train)

    # Предсказание
    y_1 = regr_1.predict(X_test)
    y_2 = regr_2.predict(X_test)

    # Вывод графика
    fig, ax = plt.subplots(figsize=(15,7))
    plt.scatter(X_train, y_train, s=20, edgecolor="black", c="darkorange",
label="Данные")
    plt.plot(X_test, y_1, color="cornflowerblue", label="max_depth=3", linewidth=2)
    plt.plot(X_test, y_2, color="yellowgreen", label="max_depth=10", linewidth=2)
    plt.xlabel("Данные")
    plt.ylabel("Целевой признак")
    plt.title("Регрессия на основе дерева решений")
    plt.legend()
    plt.show()

X_train, Y_train, X_test = random_dataset_for_regression()
plot_tree_regression(X_train, Y_train, X_test)
```




```
clf = DecisionTreeRegressor(random_state=1).fit(X_train, Y_train)
target4 = clf.predict(X_test)
mean_squared_error(Y_test, target4), mean_absolute_error(Y_test, target4)
```

```
(0.0847457627118644, 0.0847457627118644)
```