Лабораторная работа 3

Метрические методы классификации

```
# Подгрузка данных
!wget
https://raw.githubusercontent.com/cnrde/AI_and_ML_3/main/dataset/citru
s.data
```

```
--2024-05-14 17:53:40--
https://raw.githubusercontent.com/cnrde/AI_and_ML_3/main/dataset/citru
s.data
Resolving raw.githubusercontent.com (raw.githubusercontent.com)...
185.199.111.133, 185.199.110.133, 185.199.109.133, ...
Connecting to raw.githubusercontent.com (raw.githubusercontent.com)|
185.199.111.133|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 3353 (3.3K) [text/plain]
Saving to: ‘citrus.data’

 citrus.data           0%[                    ]       0  --.-KB/s
citrus.data         100%[===================>]   3.27K  --.-KB/s    in
0s

2024-05-14 17:53:40 (46.0 MB/s) - ‘citrus.data’ saved [3353/3353]
```

```
import pandas as pd
import numpy as np

data_source = 'citrus.data'
d = pd.read_table(data_source, delimiter=',',
                  header=None,
                  names=['sepal_length','sepal_width',
                         'petal_length','petal_width','answer'])
d.head()
```


```
{"summary":"{\n  \"name\": \"d\",\n  \"rows\": 150,\n  \"fields\": [\n
{\n      \"column\": \"sepal_length\",\n      \"properties\": {\n
\"dtype\": \"number\",\n        \"std\": 1.5198053919927383,\n
\"min\": 2.96,\n        \"max\": 8.79,\n        \"num_unique_values\":
101,\n        \"samples\": [\n          8.53,\n          5.69,\n
7.72\n        ],\n        \"semantic_type\": \"\",\n
\"description\": \"\"\n      }\n    },\n    {\n      \"column\":
\"sepal_width\",\n      \"properties\": {\n        \"dtype\":
\"number\",\n        \"std\": 10,\n        \"min\": 128,\n
```

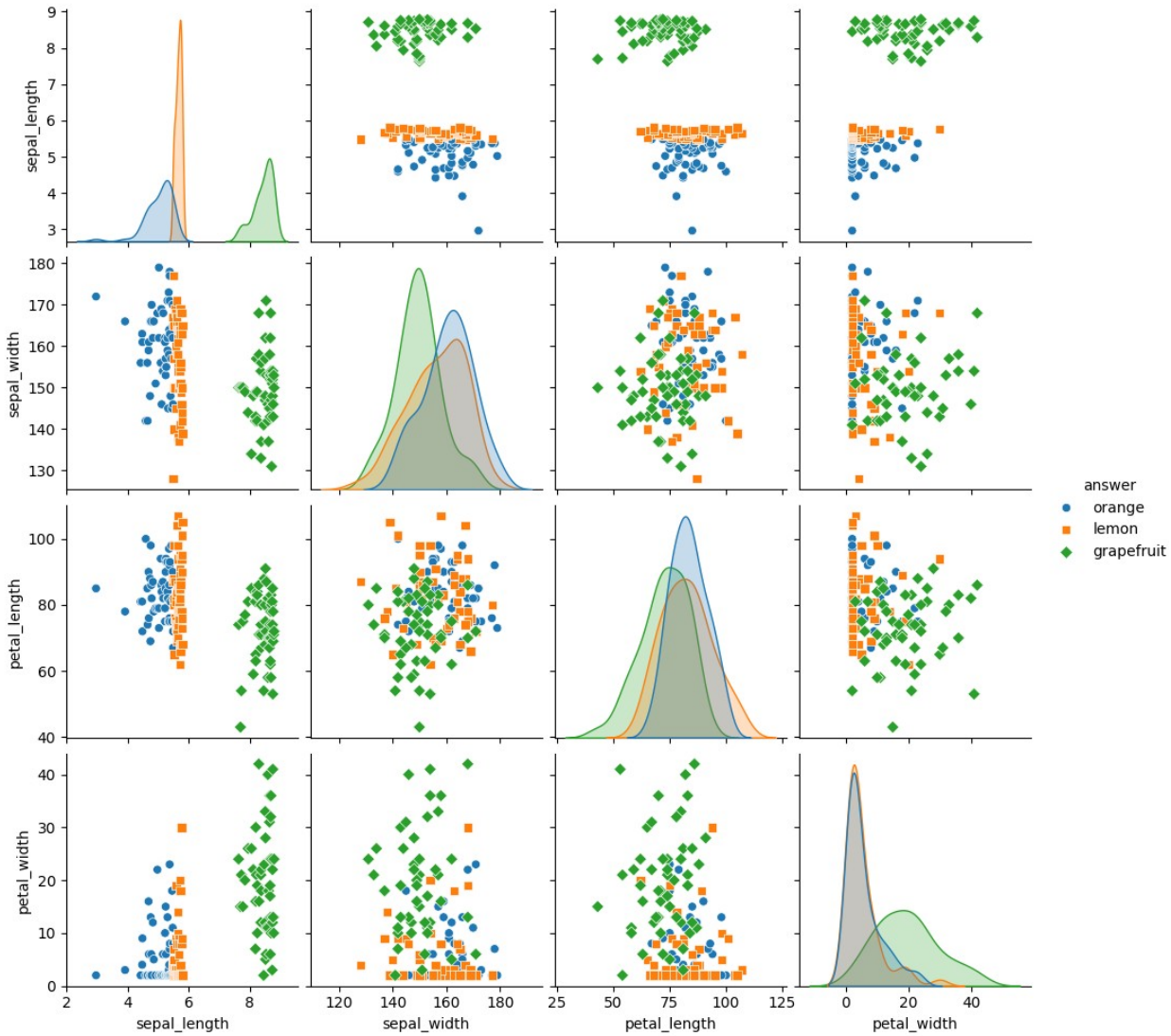
\"max\": 179,\n   \"num_unique_values\": 44,\n
\"samples\": [\n   139,\n   178,\n   177\n
],\n   \"semantic_type\": \"\",\n   \"description\": \"\"\n
}\n   },\n   {\n   \"column\": \"petal_length\",\n
\"properties\": {\n   \"dtype\": \"number\",\n   \"std\":
11,\n   \"min\": 43,\n   \"max\": 107,\n
\"num_unique_values\": 45,\n   \"samples\": [\n   77,\n
83,\n   104\n   ],\n   \"semantic_type\": \"\",\n
\"description\": \"\"\n   }\n   },\n   {\n   \"column\":
\"petal_width\",\n   \"properties\": {\n   \"dtype\":
\"number\",\n   \"std\": 9,\n   \"min\": 2,\n
\"max\": 42,\n   \"num_unique_values\": 33,\n   \"samples\":
[\n   32,\n   18,\n   28\n   ],\n
\"semantic_type\": \"\",\n   \"description\": \"\"\n   }\
n   },\n   {\n   \"column\": \"answer\",\n   \"properties\":
{\n   \"dtype\": \"category\",\n   \"num_unique_values\":
3,\n   \"samples\": [\n   \"orange\",\n
\"lemon\",\n   \"grapefruit\"\n   ],\n
\"semantic_type\": \"\",\n   \"description\": \"\"\n   }\
n   }\n]\n}","type":"dataframe","variable_name":"d"}

```
d.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 5 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   sepal_length  150 non-null    float64
 1   sepal_width   150 non-null    int64
 2   petal_length  150 non-null    int64
 3   petal_width   150 non-null    int64
 4   answer        150 non-null    object
dtypes: float64(1), int64(3), object(1)
memory usage: 6.0+ KB
```

```
import seaborn as sb
%matplotlib inline
sb.pairplot(d, hue='answer', markers=["o", "s", "D"])
```

```
<seaborn.axisgrid.PairGrid at 0x7f8dd3f99a80>
```

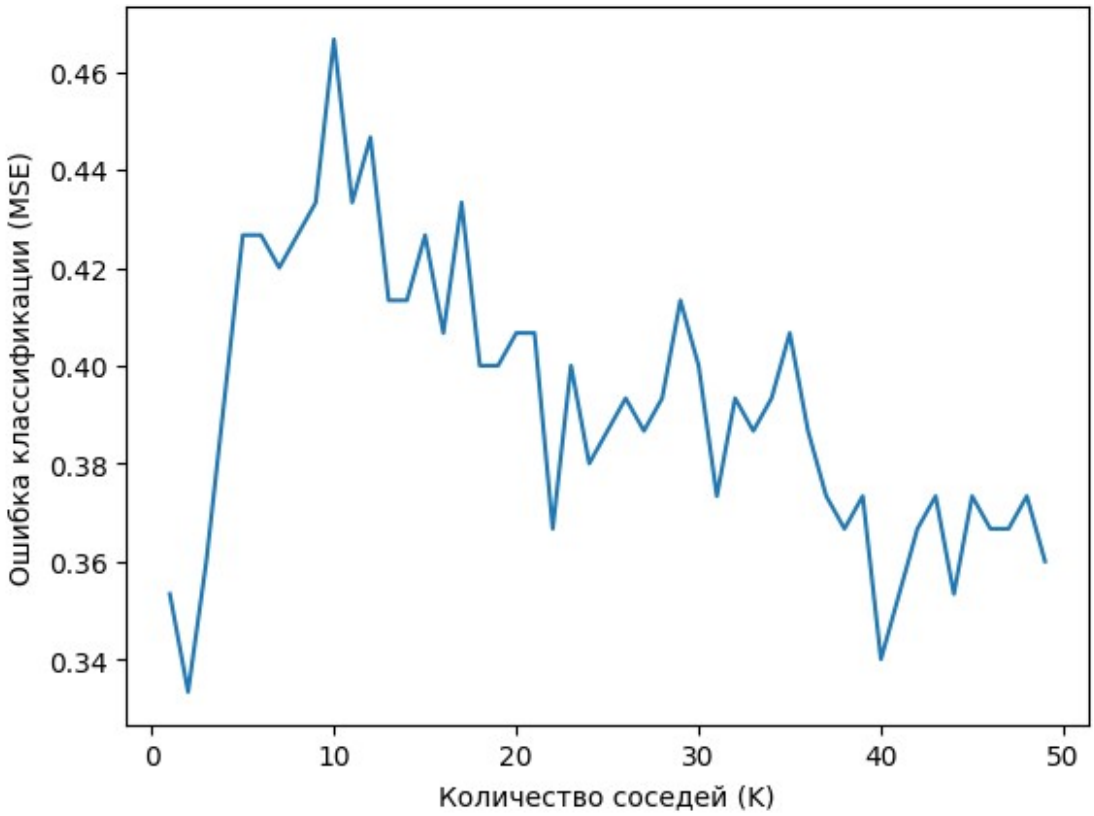



```
from sklearn.neighbors import KNeighborsClassifier

X_train = d[['sepal_length', 'sepal_width', 'petal_length',
'petal_width']]
y_train = d['answer']

K = 3

# Создание и настройка классификатора
knn = KNeighborsClassifier(n_neighbors=K)
# построение модели классификатора (процедура обучения)
knn.fit(X_train.values, y_train)

# Использование классификатора
# Объявление признаков объекта
X_test = np.array([[1.2, 1.0, 2.8, 1.2]])
# Получение ответа для нового объекта
```

```
target = knn.predict(X_test)
print(target)
```

```
['grapefruit']
```

```
from sklearn.model_selection import cross_val_score
import matplotlib.pyplot as plt

# Значения параметра K
k_list = list(range(1,50))
# Пустой список для хранения значений точности
cv_scores = []
# В цикле проходим все значения K
for K in k_list:
    knn = KNeighborsClassifier(n_neighbors=K)
    scores = cross_val_score(knn, d.iloc[ : , 0:4 ], d['answer'],
cv=10, scoring='accuracy')
    cv_scores.append(scores.mean())

# Вычисляем ошибку (misclassification error)
MSE = [1-x for x in cv_scores]

# Строим график
plt.plot(k_list, MSE)
plt.xlabel('Количество соседей (K)');
plt.ylabel('Ошибка классификации (MSE)')
plt.show()

# Ищем минимум
k_min = min(MSE)

# Пробуем найти прочие минимумы (если их несколько)
all_k_min = []
for i in range(len(MSE)):
    if MSE[i] <= k_min:
        all_k_min.append(k_list[i])

# печатаем все K, оптимальные для модели
print('Оптимальные значения K: ', all_k_min)
```




```
Оптимальные значения K:  [2]
```

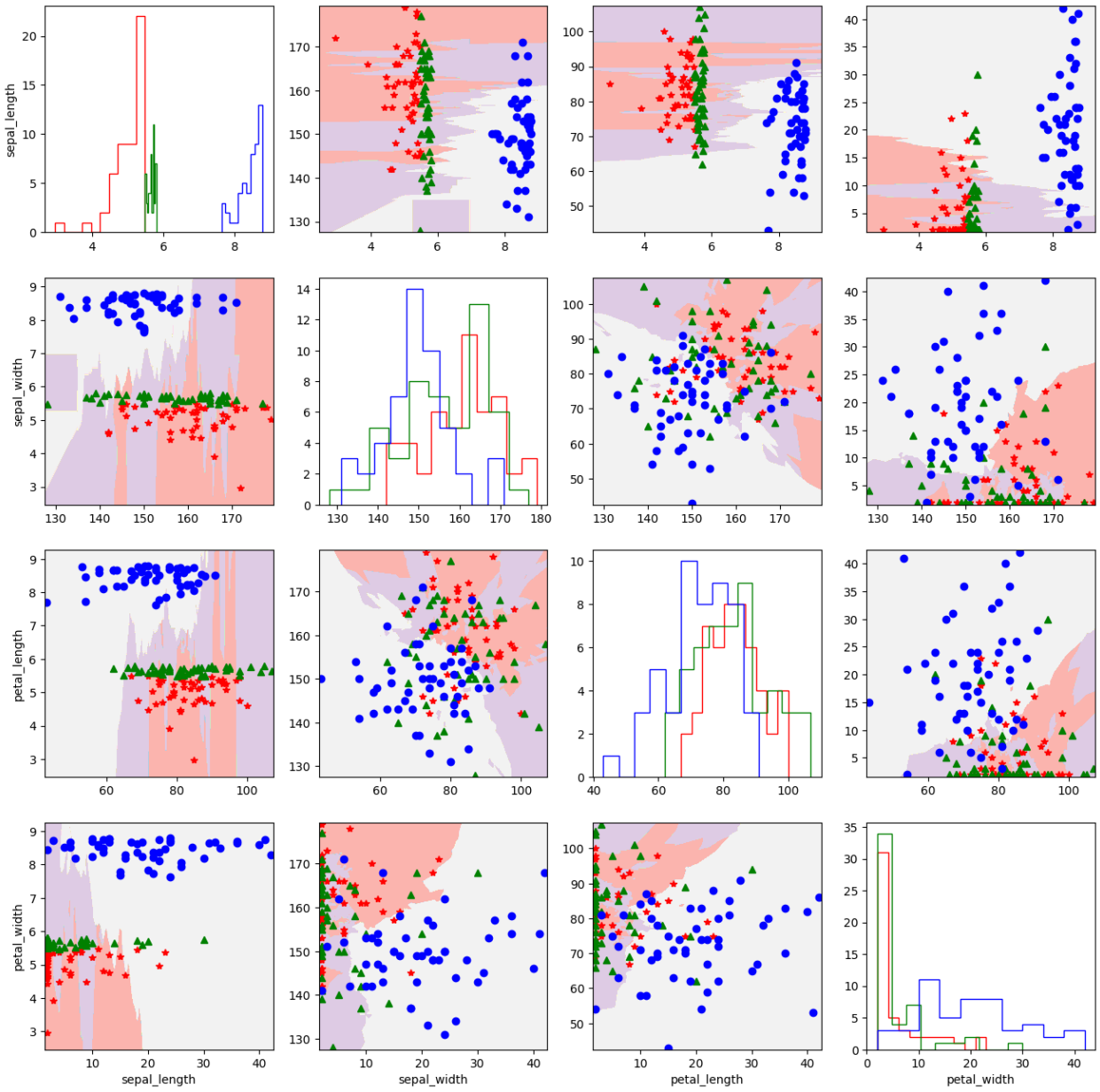
Палитры, которые можно использовать для визуализации

```
print(sorted(list(plt.colormaps)))
```

```
['Accent', 'Accent_r', 'Blues', 'Blues_r', 'BrBG', 'BrBG_r', 'BuGn',
'BuGn_r', 'BuPu', 'BuPu_r', 'CMRmap', 'CMRmap_r', 'Dark2', 'Dark2_r',
'GnBu', 'GnBu_r', 'Greens', 'Greens_r', 'Greys', 'Greys_r', 'OrRd',
'OrRd_r', 'Oranges', 'Oranges_r', 'PRGn', 'PRGn_r', 'Paired',
'Paired_r', 'Pastel1', 'Pastel1_r', 'Pastel2', 'Pastel2_r', 'PiYG',
'PiYG_r', 'PuBu', 'PuBuGn', 'PuBuGn_r', 'PuBu_r', 'PuOr', 'PuOr_r',
'PuRd', 'PuRd_r', 'Purples', 'Purples_r', 'RdBu', 'RdBu_r', 'RdGy',
'RdGy_r', 'RdPu', 'RdPu_r', 'RdYlBu', 'RdYlBu_r', 'RdYlGn',
'RdYlGn_r', 'Reds', 'Reds_r', 'Set1', 'Set1_r', 'Set2', 'Set2_r',
'Set3', 'Set3_r', 'Spectral', 'Spectral_r', 'Wistia', 'Wistia_r',
'YlGn', 'YlGnBu', 'YlGnBu_r', 'YlGn_r', 'YlOrBr', 'YlOrBr_r',
'YlOrRd', 'YlOrRd_r', 'afmhot', 'afmhot_r', 'autumn', 'autumn_r',
'binary', 'binary_r', 'bone', 'bone_r', 'brg', 'brg_r', 'bwr',
'bwr_r', 'cividis', 'cividis_r', 'cool', 'cool_r', 'coolwarm',
'coolwarm_r', 'copper', 'copper_r', 'crest', 'crest_r', 'cubehelix',
'cubehelix_r', 'flag', 'flag_r', 'flare', 'flare_r', 'gist_earth',
'gist_earth_r', 'gist_gray', 'gist_gray_r', 'gist_heat',
'gist_heat_r', 'gist_ncar', 'gist_ncar_r', 'gist_rainbow',
```

```
'gist_rainbow_r', 'gist_stern', 'gist_stern_r', 'gist_yarg',
'gist_yarg_r', 'gnuplot', 'gnuplot2', 'gnuplot2_r', 'gnuplot_r',
'gray', 'gray_r', 'hot', 'hot_r', 'hsv', 'hsv_r', 'icefire',
'icefire_r', 'inferno', 'inferno_r', 'jet', 'jet_r', 'magma',
'magma_r', 'mako', 'mako_r', 'nipy_spectral', 'nipy_spectral_r',
'ocean', 'ocean_r', 'pink', 'pink_r', 'plasma', 'plasma_r', 'prism',
'prism_r', 'rainbow', 'rainbow_r', 'rocket', 'rocket_r', 'seismic',
'seismic_r', 'spring', 'spring_r', 'summer', 'summer_r', 'tab10',
'tab10_r', 'tab20', 'tab20_r', 'tab20b', 'tab20b_r', 'tab20c',
'tab20c_r', 'terrain', 'terrain_r', 'turbo', 'turbo_r', 'twilight',
'twilight_r', 'twilight_shifted', 'twilight_shifted_r', 'viridis',
'viridis_r', 'vlag', 'vlag_r', 'winter', 'winter_r']

dX = d.iloc[:,0:4]
dy = d['answer']

plot_markers = ['r*', 'g^', 'bo']
answers = dy.unique()

# Создаем подграфики для каждой пары признаков
f, places = plt.subplots(4, 4, figsize=(16,16))

fmin = dX.min()-0.5
fmax = dX.max()+0.5
plot_step = 0.05

# Обходим все subplot
for i in range(0,4):
    for j in range(0,4):

        # Строим решающие границы
        if(i != j):
            xx, yy = np.meshgrid(np.arange(fmin[i], fmax[i],
plot_step),
                                 np.arange(fmin[j], fmax[j], plot_step))
            model = KNeighborsClassifier(n_neighbors=13)
            model.fit(dX.iloc[:, [i,j]].values, dy)
            p = model.predict(np.c_[xx.ravel(), yy.ravel()])
            p = p.reshape(xx.shape)
            p[p==answers[0]] = 0
            p[p==answers[1]] = 1
            p[p==answers[2]] = 2
            p=p.astype('int32')
            places[i,j].contourf(xx, yy, p, cmap='Pastel1')

        # Обход всех классов
        for id_answer in range(len(answers)):
            idx = np.where(dy == answers[id_answer])
            if i==j:
                places[i, j].hist(dX.iloc[idx].iloc[:,i],
```

```
                                    color=plot_markers[id_answer][0],
                                   histtype = 'step')
            else:
                places[i, j].plot(dX.iloc[idx].iloc[:,i],
dX.iloc[idx].iloc[:,j],
                                    plot_markers[id_answer],
                                    label=answers[id_answer],
markersize=6)

        if j==0:
            places[i, j].set_ylabel(dX.columns[i])

        if i==3:
            places[i, j].set_xlabel(dX.columns[j])
```


sepal_length
sepal_width
petal_length
petal_width
sepal_length
sepal_width
petal_length
petal_width