Лабораторная работа №4

Подготовка обучающей и тестовой выборки, кросс- валидация и подбор гиперпараметров на примере метода ближайших соседей.

Цель лабораторной работы: изучение сложных способов подготовки выборки и подбора гиперпараметров на примере метода ближайших соседей.

Задание

1. Выберите набор данных (датасет) для решения задачи классификации или регресии.
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 модель ближайших соседей для произвольно заданного гиперпараметра K. Оцените качество модели с помощью трех подходящих для задачи метрик.
5. Постройте модель и оцените качество модели с использованием кросс-валидации. Проведите эксперименты с тремя различными стратегиями кросс-валидации.
6. Произведите подбор гиперпараметра K с использованием GridSearchCV и кросс-валидации.
7. Повторите пункт 4 для найденного оптимального значения гиперпараметра K. Сравните качество полученной модели с качеством модели, полученной в пункте 4.
8. Постройте кривые обучения и валидации.

Установка окружения

↳ 12 cells hidden

Работа с данными

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import learning_curve, validation_curve
from sklearn.model_selection import KFold, RepeatedKFold, LeaveOneOut, LeavePOu
from sklearn.model_selection import cross_val_score, cross_validate
from sklearn.metrics import roc_curve,confusion_matrix, roc_auc_score, accuracy
plt.style.use('ggplot')
```

```
#Load the dataset
df = pd.read_csv('diabetes.csv')

#Print the first 5 rows of the dataframe.
df.head()
```

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesI
0	6	148	72	35	0	33.6	

```
df.shape
```

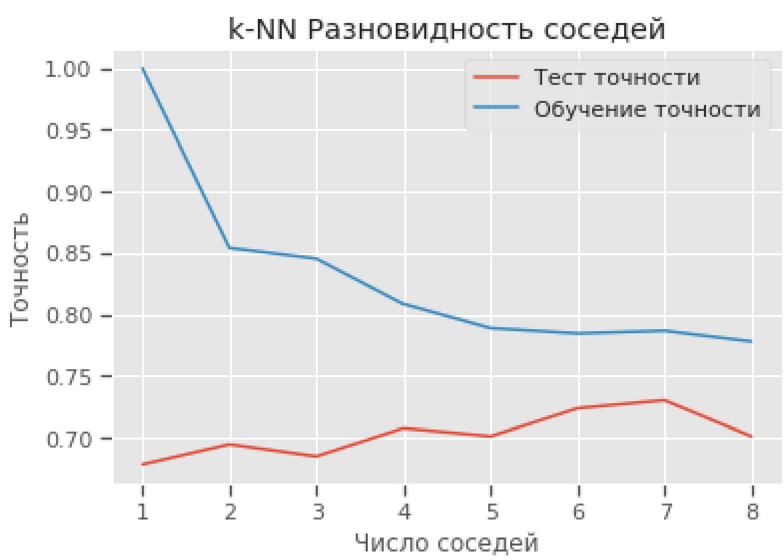
```
(768, 9)
```

```
X = df.drop('Outcome',axis=1).values
y = df['Outcome'].values
```

```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import train_test_split
```

```
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.4,random_state

#Setup arrays to store training and test accuracies
neighbors = np.arange(1,9)
train_accuracy =np.empty(len(neighbors))
test_accuracy = np.empty(len(neighbors))

for i,k in enumerate(neighbors):
    #Setup a knn classifier with k neighbors
    knn = KNeighborsClassifier(n_neighbors=k)

    #Fit the model
    knn.fit(X_train, y_train)

    #Compute accuracy on the training set
    train_accuracy[i] = knn.score(X_train, y_train)

    #Compute accuracy on the test set
    test_accuracy[i] = knn.score(X_test, y_test)
```

```
#Generate plot
plt.title('k-NN Разновидность соседей')
plt.plot(neighbors, test_accuracy, label='Тест точности')
plt.plot(neighbors, train_accuracy, label='Обучение точности')
plt.legend()
plt.xlabel('Число соседей')
plt.ylabel('Точность')
plt.show()
```



```
#Setup a knn classifier with k neighbors
knn = KNeighborsClassifier(n_neighbors=7)
```

```
#Fit the model
knn.fit(X_train,y_train)
```

```
KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='minkowski',
           metric_params=None, n_jobs=None, n_neighbors=7, p=2,
           weights='uniform')
```

```
#Get accuracy. Note: In case of classification algorithms score method represen
knn.score(X_test,y_test)
```

```
0.7305194805194806
```

```
#import classification_report
from sklearn.metrics import classification_report
y_pred = knn.predict(X_test)
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.78      0.82      0.80       201
           1       0.62      0.56      0.59       107

   micro avg       0.73      0.73      0.73       308
   macro avg       0.70      0.69      0.70       308
weighted avg       0.73      0.73      0.73       308
```

Точность

```
# 7 ближайших соседа
cl1_1 = KNeighborsClassifier(n_neighbors=7)
cl1_1.fit(X_train, y_train)
target1_1 = cl1_1.predict(X_test)
accuracy_score(y_test, target1_1)
```

```
0.7305194805194806
```

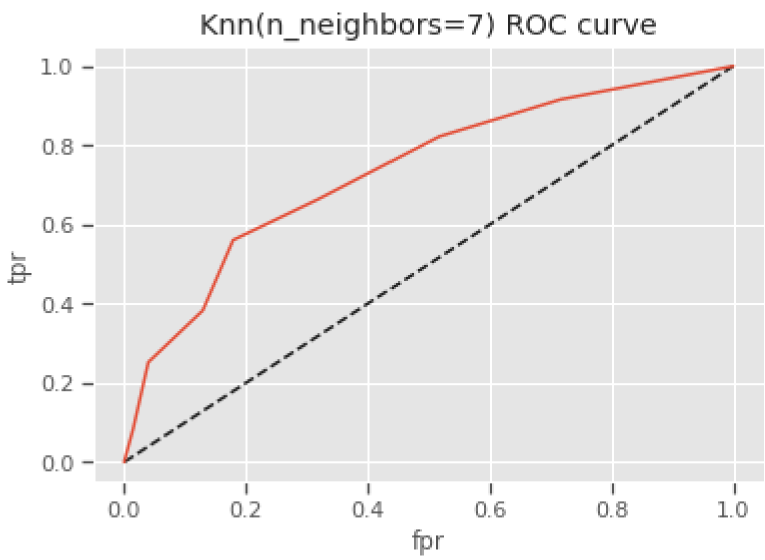
Конфигурационная матрица

```
y_pred = knn.predict(X_test)
confusion_matrix(y_test,y_pred)
pd.crosstab(y_test, y_pred, rownames=['True'], colnames=['Predicted'], margins=
```

Predicted	0	1	All
True			
0	165	36	201
1	47	60	107
All	212	96	308

ROC (рабочая характеристика приемника) кривая

```
y_pred_proba = knn.predict_proba(X_test)[:,1]
fpr, tpr, thresholds = roc_curve(y_test, y_pred_proba)
plt.plot([0,1],[0,1],'k--')
plt.plot(fpr,tpr, label='Knn')
plt.xlabel('fpr')
plt.ylabel('tpr')
plt.title('Knn(n_neighbors=7) ROC curve')
plt.show()
```




```
roc_auc_score(y_test,y_pred_proba)
```

```
0.7345050448691124
```

Перекрестная Проверка

```
param_grid = {'n_neighbors':np.arange(1,50)}
knn = KNeighborsClassifier()
knn_cv= GridSearchCV(knn,param_grid,cv=5)
knn_cv.fit(X,y)
```

```
GridSearchCV(cv=5, error_score='raise-deprecating',
       estimator=KNeighborsClassifier(algorithm='auto', leaf_size=30, metric=
           metric_params=None, n_jobs=None, n_neighbors=5, p=2,
           weights='uniform'),
       fit_params=None, iid='warn', n_jobs=None,
       param_grid={'n_neighbors': array([ 1,  2,  3,  4,  5,  6,  7,  8,  9,
       18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34,
       35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49])},
       pre_dispatch='2*n_jobs', refit=True, return_train_score='warn',
       scoring=None, verbose=0)
```

```
knn_cv.best_score_
```

```
0.7578125
```

```
knn_cv.best_params_
```

```
{'n_neighbors': 14}
```

K-раз

```
scores = cross_val_score(KNeighborsClassifier(n_neighbors=2),
                         X, y,
                         cv=KFold(n_splits=3))
scores
```

```
array([0.671875  , 0.72265625, 0.73046875])
```

Оставить один (LOO)

```
# Эквивалент KFold(n_splits=n)
loo = LeaveOneOut()
loo.get_n_splits(X)

for train_index, test_index in loo.split(X):
   print("TRAIN:", train_index, "TEST:", test_index)
   X_train, X_test = X[train_index], X[test_index]
   y_train, y_test = y[train_index], y[test_index]
   print(X_train, X_test, y_train, y_test)
```

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[[  6.    148.     72.    ...  33.6     0.627  50.   ]
 [  1.     85.     66.    ...  26.6     0.351  31.   ]
 [  1.     89.     66.    ...  28.1     0.167  21.   ]
 ...
 [  5.    121.     72.    ...  26.2     0.245  30.   ]
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 0 0 1 0 0 1 0 1 1 1 0 0 1 1 1 0 1 0 1 0 1 0 0 0 0 1 0] [1]
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  37  38  39  40  41  42  43  44  45  46  47  48  49  50  51  52  53  54
  55  56  57  58  59  60  61  62  63  64  65  66  67  68  69  70  71  72
  73  74  75  76  77  78  79  80  81  82  83  84  85  86  87  88  89  90
  91  92  93  94  95  96  97  98  99 100 101 102 103 104 105 106 107 108
 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126
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