Лабораторная работа №3. Сысоев Александр РТ5-61Б

Задание:

> Выберите набор данных (датасет) для решения задачи классификации или регрессии.
> С использованием метода train_test_split разделите выборку на обучающую и тестовую.
> Обучите модель ближайших соседей для произвольно заданного гиперпараметра K. Оцените качество модели с помощью подходящих для задачи метрик.
> Произведите подбор гиперпараметра K с использованием GridSearchCV и/или RandomizedSearchCV и кросс-валидации, оцените качество оптимальной модели. Желательно использование нескольких стратегий кросс-валидации.
> Сравните метрики качества исходной и оптимальной моделей.

Импорт библиотек, чтение датасета и вывод основных параметров

In [1]:
```
import numpy as np
import pandas as pd
import seaborn as sns
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
%matplotlib inline
sns.set(style="ticks")
```

In [2]:
```
data = pd.read_csv('healthcare-dataset-stroke-data.csv', sep=",")
```

In [3]:
```
data.head()
```

Out[3]:

	id	gender	age	hypertension	heart_disease	ever_married	work_type	Residence_type	avg_glucose_level	bmi	smoking_status	stroke
0	9046	Male	67.0	0	1	Yes	Private	Urban	228.69	36.6	formerly smoked	1
1	51676	Female	61.0	0	0	Yes	Self-employed	Rural	202.21	NaN	never smoked	1
2	31112	Male	80.0	0	1	Yes	Private	Rural	105.92	32.5	never smoked	1
3	60182	Female	49.0	0	0	Yes	Private	Urban	171.23	34.4	smokes	1
4	1665	Female	79.0	1	0	Yes	Self-employed	Rural	174.12	24.0	never smoked	1

In [4]:
```
data = data.dropna(subset=['bmi']).reset_index(drop=True)
data = data.drop('id', axis = 1)
```

Кодирование категориальных признаков и масштабирование данных

In [5]:
```
data_temp = pd.get_dummies(data, drop_first = True)
data_temp.head()
```

Out[5]:

	age	hypertension	heart_disease	avg_glucose_level	bmi	stroke	gender_Male	gender_Other	ever_married_Yes	work_type_Never_worked
0	67.0	0	1	228.69	36.6	1	1	0	1	0
1	80.0	0	1	105.92	32.5	1	1	0	1	0
2	49.0	0	0	171.23	34.4	1	0	0	1	0
3	79.0	1	0	174.12	24.0	1	0	0	1	0
4	81.0	0	0	186.21	29.0	1	1	0	1	0

In [6]:
```
from sklearn.preprocessing import MinMaxScaler
```

In [7]:
```
sc1 = MinMaxScaler()
sc1_data = sc1.fit_transform(data_temp[['age', 'avg_glucose_level', 'bmi']])
sc1_data
```

Out[7]:
```
array([[0.81689453, 0.80126489, 0.30126002],
       [0.97558594, 0.23451205, 0.25429553],
```

```
       [0.59716797, 0.53600776, 0.27605956],
       ...,
       [0.42626953, 0.12865848, 0.2325315 ],
       [0.62158203, 0.51320284, 0.17525773],
       [0.53613281, 0.13922999, 0.18213058]])
```

In [8]:
```
for i in range(0, 3):
    if i == 0:
        data_temp['age'] = pd.Series(sc1_data[:, i].tolist())
    elif i == 1:
        data_temp['avg_glucose_level'] = pd.Series(sc1_data[:, i].tolist())
    elif i == 2:
        data_temp['bmi'] = pd.Series(sc1_data[:, i].tolist())
data_temp.head()
```

Out[8]:

	age	hypertension	heart_disease	avg_glucose_level	bmi	stroke	gender_Male	gender_Other	ever_married_Yes	work_type_Never_
0	0.816895	0	1	0.801265	0.301260	1	1	0	1	
1	0.975586	0	1	0.234512	0.254296	1	1	0	1	
2	0.597168	0	0	0.536008	0.276060	1	0	0	1	
3	0.963379	1	0	0.549349	0.156930	1	0	0	1	
4	0.987793	0	0	0.605161	0.214204	1	1	0	1	

Разделение на обучающую и тестовую выборки

In [9]:
```
data_features = data_temp.drop('stroke', axis=1)
data_target = data_temp['stroke']
```

In [10]:
```
features_train, features_test, target_train, target_test = train_test_split(data_features, data_target, random_st
```

In [11]:
```
print(features_train.shape)
print(features_test.shape)
```

```
(3681, 16)
(1228, 16)
```

In [12]:
```
print(target_train.shape)
print(target_test.shape)
```

```
(3681,)
(1228,)
```

Обучение для произвольного K

In [13]:
```
from sklearn.neighbors import KNeighborsClassifier
```

In [14]:
```
KNeighborsClassifierObj = KNeighborsClassifier(n_neighbors=3)
KNeighborsClassifierObj
```

Out[14]:
```
KNeighborsClassifier(n_neighbors=3)
```

In [15]:
```
KNeighborsClassifierObj.fit(features_train, target_train)
predictions_test = KNeighborsClassifierObj.predict(features_test)
```

In [16]:
```
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score, confusion_matrix
```

In [17]:
```
accuracy_score(target_test, predictions_test), precision_score(target_test, predictions_test), recall_score(targe
```

Out[17]:
```
(0.9495114006514658, 0.16666666666666666, 0.017241379310344827, 0.03125)
```

In [18]:
```
confusion_matrix(target_test, predictions_test)
```

Out[18]:
```
array([[1165,    5],
       [  57,    1]], dtype=int64)
```

Подбор K с использованием GridSearchCV и кросс-валидации

In [19]:
```
from sklearn.model_selection import cross_val_score, GridSearchCV
```

In [20]:
```
n_range = np.array(range(5, 55, 5))
tuned_parameters = [{'n_neighbors': n_range}]
tuned_parameters
```

Out[20]:
```
[{'n_neighbors': array([ 5, 10, 15, 20, 25, 30, 35, 40, 45, 50])}]
```

In [21]:
```
clf_gs = GridSearchCV(KNeighborsClassifier(), tuned_parameters, cv = 3, scoring = 'accuracy')
clf_gs.fit(data_features, data_target)
```

Out[21]:
```
GridSearchCV(cv=3, estimator=KNeighborsClassifier(),
             param_grid=[{'n_neighbors': array([ 5, 10, 15, 20, 25, 30, 35, 40, 45, 50])}],
             scoring='accuracy')
```

In [22]:
```
clf_gs.cv_results_
```

Out[22]:
```
{'mean_fit_time': array([0.00300511, 0.00531999, 0.00399033, 0.00299231, 0.0026594 ,
        0.00299199, 0.0036575 , 0.00232673, 0.00432134, 0.00299231]),
 'std_fit_time': array([8.30399517e-04, 9.40830554e-04, 8.15561630e-04, 5.94720425e-07,
        4.70415035e-04, 8.77806426e-07, 9.40268113e-04, 4.69516145e-04,
        9.40043491e-04, 4.49566384e-07]),
 'mean_score_time': array([0.16388098, 0.20212523, 0.18650063, 0.16056999, 0.18284416,
        0.17852203, 0.17486644, 0.19081489, 0.17553043, 0.1781985 ]),
 'std_score_time': array([0.00478471, 0.01175301, 0.00508501, 0.00325796, 0.00329001,
        0.01310384, 0.00690862, 0.01005791, 0.01525607, 0.00448548]),
 'param_n_neighbors': masked_array(data=[5, 10, 15, 20, 25, 30, 35, 40, 45, 50],
              mask=[False, False, False, False, False, False, False, False,
                    False, False],
        fill_value='?',
             dtype=object),
 'params': [{'n_neighbors': 5},
  {'n_neighbors': 10},
  {'n_neighbors': 15},
  {'n_neighbors': 20},
  {'n_neighbors': 25},
  {'n_neighbors': 30},
  {'n_neighbors': 35},
  {'n_neighbors': 40},
  {'n_neighbors': 45},
  {'n_neighbors': 50}],
 'split0_test_score': array([0.95540623, 0.95723885, 0.95723885, 0.95723885, 0.95723885,
        0.95723885, 0.95723885, 0.95723885, 0.95723885, 0.95723885]),
 'split1_test_score': array([0.95476773, 0.95721271, 0.95721271, 0.95721271, 0.95721271,
        0.95721271, 0.95721271, 0.95721271, 0.95721271, 0.95721271]),
 'split2_test_score': array([0.95843521, 0.95782396, 0.95782396, 0.95782396, 0.95782396,
        0.95782396, 0.95782396, 0.95782396, 0.95782396, 0.95782396]),
 'mean_test_score': array([0.95620305, 0.95742518, 0.95742518, 0.95742518, 0.95742518,
        0.95742518, 0.95742518, 0.95742518, 0.95742518, 0.95742518]),
 'std_test_score': array([0.00159975, 0.00028219, 0.00028219, 0.00028219, 0.00028219,
        0.00028219, 0.00028219, 0.00028219, 0.00028219, 0.00028219]),
 'rank_test_score': array([10,  1,  1,  1,  1,  1,  1,  1,  1,  1])}
```

In [23]:
```
clf_gs.best_estimator_
```

Out[23]:
```
KNeighborsClassifier(n_neighbors=10)
```

In [24]:
```
clf_gs.best_score
```

```
clf_gs.best_score_
```

Out[24]:
```
0.9574251754581179
```

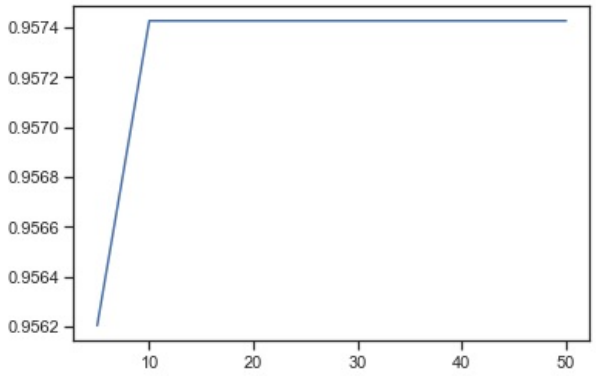
In [25]:
```
clf_gs.best_params_
```

Out[25]:
```
{'n_neighbors': 10}
```

In [26]:
```
import matplotlib.pyplot as plt
```

In [27]:
```
plt.plot(n_range, clf_gs.cv_results_['mean_test_score'])
```

Out[27]:
```
[<matplotlib.lines.Line2D at 0x1b2ecd98c10>]
```



In [28]:
```
scores = cross_val_score(KNeighborsClassifier(n_neighbors=3), data_features, data_target, scoring = 'f1_weighted'
scores
```

Out[28]:
```
array([0.93525181, 0.93208705, 0.93746124])
```

In [29]:
```
predictions_tuned_test = clf_gs.best_estimator_.predict(features_test)
```

In [30]:
```
accuracy_score(target_test, predictions_tuned_test)
```

Out[30]:
```
0.9527687296416938
```