Московский государственный технический университет им. Н.Э. Баумана
Кафедра «Системы обработки информации и управления»

Лабораторная работа №6
по дисциплине
«Методы машинного обучения»
на тему
«Ансамбли моделей машинного обучения»

Выполнил:
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0.1. 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 две ансамблевые модели. Оцените качество моделей с помощью одной из подходящих для задачи метрик. Сравните качество полученных моделей.
5. Произведите для каждой модели подбор значений одного гиперпараметра. В зависимости от используемой библиотеки можно применять функцию GridSearchCV, использовать перебор параметров в цикле, или использовать другие методы.
6. Повторите пункт 4 для найденных оптимальных значений гиперпараметров. Сравните качество полученных моделей с качеством моделей, полученных в пункте 4.

0.1.1. Загрузка данных

```
In [8]: import numpy as np
        import pandas as pd
        import seaborn as sns
        from sklearn.model_selection import GridSearchCV
        from sklearn.model_selection import learning_curve, validation_curve
        from sklearn.model_selection import KFold, RepeatedKFold, LeaveOneOut,
        from sklearn.model_selection import cross_val_score, cross_validate
        from sklearn.metrics import roc_curve,confusion_matrix, roc_auc_score,

        from sklearn.neighbors import KNeighborsClassifier
        from sklearn.model_selection import train_test_split
        from sklearn.metrics import classification_report
        from sklearn.svm import SVC
        from sklearn.model_selection import cross_val_score
        from sklearn.tree import DecisionTreeClassifier
        from sklearn.linear_model import LinearRegression
        import matplotlib.pyplot as plt
        %matplotlib inline
```

```
In [3]: data = pd.read_csv('diabetes.csv')
        data.head()
```

```
Out[3]:    Pregnancies  Glucose  BloodPressure  SkinThickness  Insulin   BMI
        0            6      148             72             35        0  33.6
        1            1       85             66             29        0  26.6
        2            8      183             64              0        0  23.3
        3            1       89             66             23       94  28.1
        4            0      137             40             35      168  43.1

           DiabetesPedigreeFunction  Age  Outcome
        0                     0.627   50        1
        1                     0.351   31        0
        2                     0.672   32        1
        3                     0.167   21        0
        4                     2.288   33        1
```

```
In [4]: data.dtypes

Out[4]: Pregnancies                   int64
        Glucose                       int64
        BloodPressure                 int64
        SkinThickness                 int64
        Insulin                       int64
        BMI                         float64
        DiabetesPedigreeFunction    float64
        Age                           int64
        Outcome                       int64
        dtype: object

In [5]: for col in data.columns:
            print('{} - {}'.format(col, data[data[col].isnull()].shape[0]))

Pregnancies - 0
Glucose - 0
BloodPressure - 0
SkinThickness - 0
Insulin - 0
BMI - 0
DiabetesPedigreeFunction - 0
Age - 0
Outcome - 0


In [6]: data.shape

Out[6]: (768, 9)
```

0.1.2. Разделение на обучающую и тестовую выборки

```
In [9]: CLASS = 'Outcome'
        RANDOM_STATE = 17
        TEST_SIZE = 0.3

        X = data.drop(CLASS, axis=1).values
        Y = data[CLASS].values

        X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=TE
        print('X_train: {}'.format(X_train.shape))
        print('X_test: {}'.format(X_test.shape))

X_train: (537, 8)
X_test: (231, 8)
```

0.1.3. Обучение

```
In [10]: from sklearn.ensemble import RandomForestClassifier, GradientBoosting

         from sklearn.metrics import mean_squared_error
```

```
In [11]: template = "Отклонение на тренируемой выборке: {:.3f} \
         отклонение на тестовой выборке: {:.3f}"
```

```
In [12]: class Classifier():
           def __init__(self, method, x_train, y_train, x_test, y_test):
             self._method = method
             self.x_train = x_train
             self.y_train = y_train
             self.x_test = x_test
             self.y_test = y_test
             self.target_1 = []
             self.target_2 = []

           def training(self):
             self._method.fit(self.x_train, self.y_train)
             self.target_1 = self._method.predict(self.x_train)
             self.target_2 = self._method.predict(self.x_test)

           def result(self, metric):
             print(template.format(metric(self.y_train, self.target_1),
                                   metric(self.y_test, self.target_2)))
```

0.1.4. RandomForestClassifier

```
In [15]: rfr = Classifier(RandomForestClassifier(max_features=1), X_train, Y_t
         rfr.training()
         rfr.result(mean_squared_error)
```

```
Отклонение на тренируемой выборке: 0.017 отклонение на тестовой выборке: 0.294


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  "10 in version 0.20 to 100 in 0.22.", FutureWarning)
```

0.1.5. GradientBoostingClassifier

```
In [16]: gbc = Classifier(GradientBoostingClassifier(max_features=1), X_train,
         gbc.training()
         gbc.result(mean_squared_error)
```

```
Отклонение на тренируемой выборке: 0.106 отклонение на тестовой выборке: 0.212
```

0.1.6. Подбор гиперпараметра K

0.1.7. RandomForestClassifier

```
In [47]: from sklearn.model_selection import GridSearchCV
```

```
In [56]: n_range = np.array(range(1,9))
         param_grid = {'max_features':n_range}
```

```
cl_rfc_gs = GridSearchCV(RandomForestClassifier(), param_grid, cv=5,
# cl_rfc_gs.fit(X, y)
# cl_rfc_gs = RandomForestClassifier(n_estimators=200)
cl_rfc_gs.fit(X_train, Y_train)
```

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  "10 in version 0.20 to 100 in 0.22.", FutureWarning)
```

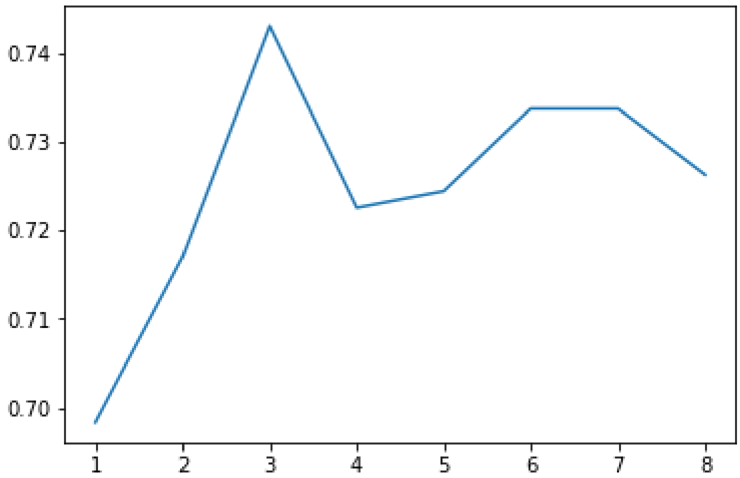
```
Out[56]: GridSearchCV(cv=5, error_score='raise-deprecating',
                estimator=RandomForestClassifier(bootstrap=True, class_weight=
                     max_depth=None, max_features='auto', max_leaf_nodes=None,
                     min_impurity_decrease=0.0, min_impurity_split=None,
                     min_samples_leaf=1, min_samples_split=2,
                     min_weight_fraction_leaf=0.0, n_estimators='warn', n_jobs
                     oob_score=False, random_state=None, verbose=0,
                     warm_start=False),
                fit_params=None, iid='warn', n_jobs=None,
                param_grid={'max_features': array([1, 2, 3, 4, 5, 6, 7, 8])},
                pre_dispatch='2*n_jobs', refit=True, return_train_score='warn'
                scoring='accuracy', verbose=0)
```

In [57]: cl_rfc_gs.best_params_

Out[57]: {'max_features': 3}

In [58]: plt.plot(n_range, cl_rfc_gs.cv_results_['mean_test_score'])

Out[58]: [<matplotlib.lines.Line2D at 0x1d8eae2f860>]



0.1.8. GradientBoostingClassifier

In [59]:
```
n_range = np.array(range(4,9,1))
param_grid = {'max_features':n_range}
cl_gbc_gs = GridSearchCV(GradientBoostingClassifier(), param_grid, cv
cl_gbc_gs.fit(X_train, Y_train)
```

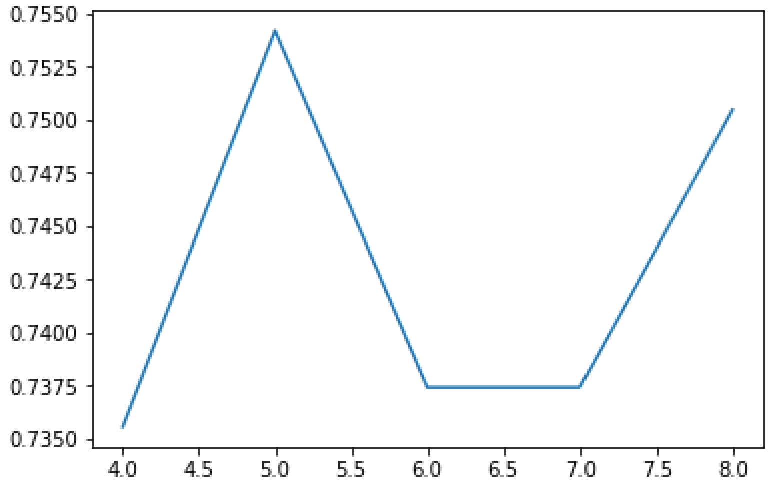
Out[59]:
```
GridSearchCV(cv=3, error_score='raise-deprecating',
       estimator=GradientBoostingClassifier(criterion='friedman_mse',
              learning_rate=0.1, loss='deviance', max_depth=3,
              max_features=None, max_leaf_nodes=None,
              min_impurity_decrease=0.0, min_impurity_split=None,
              min_samples_leaf=1, min_sampl…      subsample=1.0, tol=
              verbose=0, warm_start=False),
       fit_params=None, iid='warn', n_jobs=None,
       param_grid={'max_features': array([4, 5, 6, 7, 8])},
       pre_dispatch='2*n_jobs', refit=True, return_train_score='warn'
       scoring='accuracy', verbose=0)
```

In [60]: cl_gbc_gs.best_params_

Out[60]: {'max_features': 5}

In [61]: plt.plot(n_range, cl_gbc_gs.cv_results_['mean_test_score'])

Out[61]: [<matplotlib.lines.Line2D at 0x1d8eae9b6a0>]



0.1.9. Сравнение моделей

```
In [62]: rfr2 = Classifier(RandomForestClassifier(max_features=3), X_train, Y_
         rfr2.training()
         rfr2.result(mean_squared_error)
```

```
Отклонение на тренируемой выборке: 0.015 отклонение на тестовой выборке: 0.268
```

```
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  "10 in version 0.20 to 100 in 0.22.", FutureWarning)
```

```
In [63]: rfr.result(mean_squared_error)
```

```
Отклонение на тренируемой выборке: 0.017 отклонение на тестовой выборке: 0.294
```

```
In [64]: gbc2 = Classifier(GradientBoostingClassifier(max_features=5), X_train
         gbc2.training()
         gbc2.result(mean_squared_error)
```

```
Отклонение на тренируемой выборке: 0.067 отклонение на тестовой выборке: 0.234
```

```
In [65]: gbc.result(mean_squared_error)
```

```
Отклонение на тренируемой выборке: 0.106 отклонение на тестовой выборке: 0.212
```

Итак, подбор гиперпараметров уменьшил ошибку.