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Факультет «Информатика и системы управления»

Кафедра ИУ5 «Системы обработки информации и управления»

Отчет

по дисциплине «Технология Машинного обучения»

Выполнил:
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подпись, дата

2019 г.

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 1) одну из линейных моделей, 2) SVM и 3) дерево решений. Оцените качество моделей с помощью трех подходящих для задачи метрик. Сравните качество полученных моделей.
5. Произведите для каждой модели подбор одного гиперпараметра с использованием GridSearchCV и кросс-валидации.
6. Повторите пункт 4 для найденных оптимальных значений гиперпараметров. Сравните качество полученных моделей с качеством моделей, полученных в пункте 4.

Lab5

June 3, 2019

```
In [1]: !pip install seaborn
        !pip install lightgbm
```

```
Requirement already satisfied: seaborn in /srv/conda/lib/python3.6/site-packages (0.9.0)
Requirement already satisfied: pandas>=0.15.2 in /srv/conda/lib/python3.6/site-packages (from s
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Requirement already satisfied: numpy>=1.9.3 in /srv/conda/lib/python3.6/site-packages (from sea
Requirement already satisfied: scipy>=0.14.0 in /srv/conda/lib/python3.6/site-packages (from se
Requirement already satisfied: python-dateutil>=2.5.0 in /srv/conda/lib/python3.6/site-packages
Requirement already satisfied: pytz>=2011k in /srv/conda/lib/python3.6/site-packages (from pand
Requirement already satisfied: cycler>=0.10 in /srv/conda/lib/python3.6/site-packages (from mat
Requirement already satisfied: kiwisolver>=1.0.1 in /srv/conda/lib/python3.6/site-packages (fro
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in /srv/conda/lib/pytho
Requirement already satisfied: six>=1.5 in /srv/conda/lib/python3.6/site-packages (from python-
Requirement already satisfied: setuptools in /srv/conda/lib/python3.6/site-packages (from kiwis
Requirement already satisfied: lightgbm in /srv/conda/lib/python3.6/site-packages (2.2.3)
Requirement already satisfied: numpy in /srv/conda/lib/python3.6/site-packages (from lightgbm)
Requirement already satisfied: scipy in /srv/conda/lib/python3.6/site-packages (from lightgbm)
Requirement already satisfied: scikit-learn in /srv/conda/lib/python3.6/site-packages (from lig
```

```
In [2]: import numpy as np
        import pandas as pd
        from sklearn import datasets
        import matplotlib.pyplot as plt
        import seaborn as sns
        import lightgbm


        from sklearn.metrics import accuracy_score, balanced_accuracy_score
        from sklearn.metrics import precision_score, recall_score, f1_score, classification_rep
        from sklearn.metrics import confusion_matrix
        from sklearn.metrics import mean_absolute_error, mean_squared_error, mean_squared_log_e
        from sklearn.metrics import roc_curve, roc_auc_score
        from sklearn.model_selection import train_test_split, GridSearchCV
        from sklearn.neighbors import KNeighborsRegressor, KNeighborsClassifier
        from sklearn.model_selection import learning_curve, validation_curve
        %matplotlib inline

In [3]: df = pd.read_csv('heart.csv', sep=",")
        import warnings
        warnings.filterwarnings("ignore")
```

1 Data Set Information:

This database contains 76 attributes, but all published experiments refer to using a subset of 14 of them. In particular, the Cleveland database is the only one that has been used by ML researchers to this date. The "goal" field refers to the presence of heart disease in the patient. It is integer valued from 0 (no presence) to 4.

1.1 Attribute Information:

1. age
2. sex
3. chest pain type (4 values)
4. resting blood pressure
5. serum cholestoral in mg/dl
6. fasting blood sugar > 120 mg/dl
7. resting electrocardiographic results (values 0,1,2)
8. maximum heart rate achieved
9. exercise induced angina
10. oldpeak = ST depression induced by exercise relative to rest
11. the slope of the peak exercise ST segment
12. number of major vessels (0-3) colored by flourosopy
13. thal: 3 = normal; 6 = fixed defect; 7 = reversable defect

```
In [4]: df.shape

Out[4]: (303, 14)

In [5]: df.head()

Out[5]:    age  sex  cp  trestbps  chol  fbs  restecg  thalach  exang  oldpeak  slope  \
        0   63    1   3       145   233    1        0      150      0      2.3      0
        1   37    1   2       130   250    0        1      187      0      3.5      0
        2   41    0   1       130   204    0        0      172      0      1.4      2
        3   56    1   1       120   236    0        1      178      0      0.8      2
        4   57    0   0       120   354    0        1      163      1      0.6      2

           ca  thal  target
        0   0     1       1
        1   0     2       1
        2   0     2       1
        3   0     2       1
        4   0     2       1
```

```
In [6]: df.dtypes
```

```
Out[6]: age            int64
        sex            int64
        cp             int64
        trestbps       int64
        chol           int64
        fbs            int64
        restecg        int64
        thalach        int64
        exang          int64
        oldpeak      float64
        slope          int64
        ca             int64
        thal           int64
        target         int64
        dtype: object
```

, :

```
In [7]: df.isnull().sum()
```

```
Out[7]: age         0
        sex         0
        cp          0
        trestbps    0
        chol        0
        fbs         0
        restecg     0
        thalach     0
        exang       0
        oldpeak     0
        slope       0
        ca          0
        thal        0
        target      0
        dtype: int64
```

.

:

```
In [8]: df['target'].unique()
```

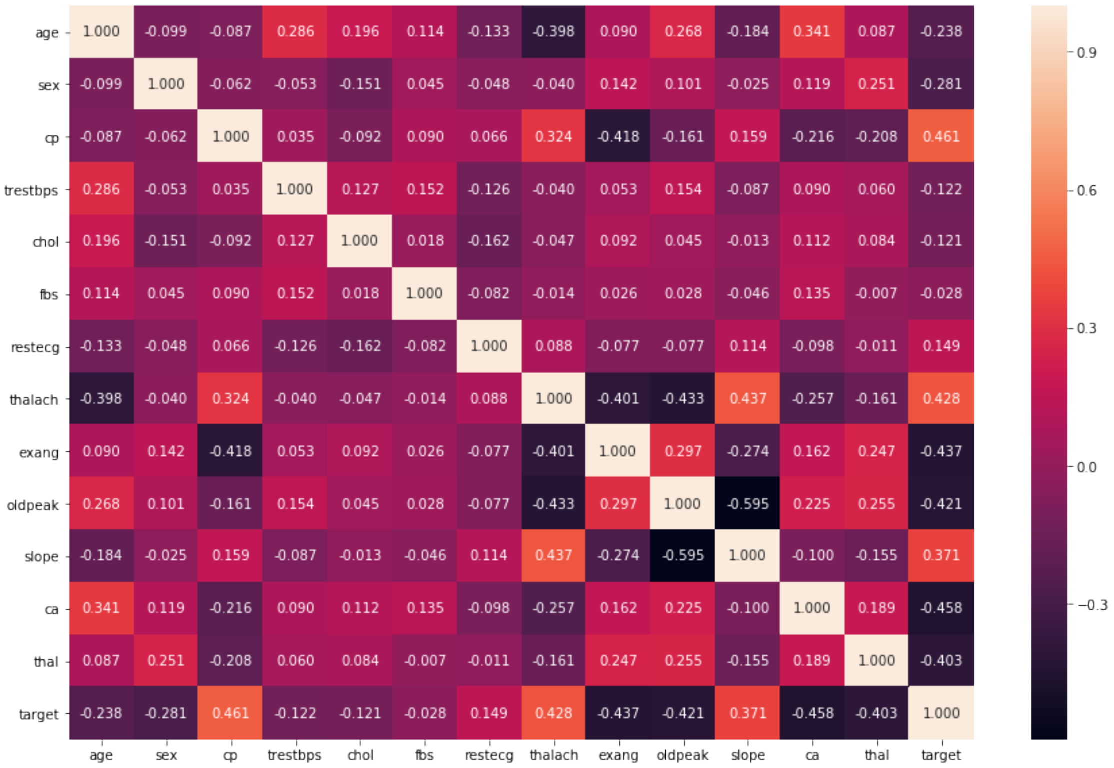
```
Out[8]: array([1, 0])
```

-,

```
In [9]: #sns.pairplot(df, hue= "target")
In [10]: plt.figure(figsize=(15, 10))
         sns.heatmap(df.corr(method='spearman'),annot=True, fmt='.3f')

Out[10]: <matplotlib.axes._subplots.AxesSubplot at 0x7f7c633efd30>

Out[10]:
```



```
In [11]: #lgbm_regressor = lightgbm.LGBMRegressor().fit(df.loc[:, df.columns != 'target'], df[

         #list_of_importances = list(zip(df.loc[:, df.columns != 'target'].columns.tolist(),
                                         #lgbm_regressor.feature_importances_))

         #sorted(list_of_importances, key= lambda x: x[1], reverse= True)

In [12]: ##important_features = [x[0] for x in sorted(list_of_importances, key= lambda x: x[1]
```

1.2 .

```
In [13]: X_train, X_test, y_train, y_test = train_test_split(df.loc[:, df.columns != 'target']
                                                             df['target'],
                                                             test_size= 0.2,
                                                             random_state= 42)
```

```
In [14]: from sklearn.linear_model import SGDClassifier
```

```
In [15]: clas = SGDClassifier().fit(X_train, y_train)
```

```
In [16]: print(accuracy_score(clas.predict(X_test), y_test))
         print(f1_score(clas.predict(X_test), y_test, average='macro'))
         print(precision_score(clas.predict(X_test), y_test, average='macro'))
```

```
0.7704918032786885
0.7704301075268818
0.771551724137931
```

```
In [17]: from sklearn.svm import SVC, NuSVC, LinearSVC, OneClassSVM, SVR, NuSVR, LinearSVR
```

```
In [18]: clas=LinearSVC(C=1.0, max_iter=10000)
         clas.fit(X_train, y_train)
```

```
Out[18]: LinearSVC(C=1.0, class_weight=None, dual=True, fit_intercept=True,
              intercept_scaling=1, loss='squared_hinge', max_iter=10000,
              multi_class='ovr', penalty='l2', random_state=None, tol=0.0001,
              verbose=0)
```

```
In [19]: print(accuracy_score(clas.predict(X_test), y_test))
         print(f1_score(clas.predict(X_test), y_test, average='macro'))
         print(precision_score(clas.predict(X_test), y_test, average='macro'))
```

```
0.8688524590163934
0.8679653679653679
0.8669181034482758
```

```
In [20]: from sklearn.tree import DecisionTreeClassifier
```

```
In [21]: clas = DecisionTreeClassifier(max_depth=3)
         clas.fit(X_train, y_train)
```

```
Out[21]: DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=3,
                     max_features=None, 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, presort=False, random_state=None,
                     splitter='best')
```

```
In [22]: print(accuracy_score(clas.predict(X_test), y_test))
         print(f1_score(clas.predict(X_test), y_test, average='macro'))
         print(precision_score(clas.predict(X_test), y_test, average='macro'))
```

```
0.819672131147541
0.8194780737153617
0.8200431034482758
```

```
In [23]: from sklearn.model_selection import GridSearchCV
```

```
In [36]: clas = SGDClassifier()
         param = {'max_iter':range(1,5000,500)}
         GV = GridSearchCV(clas, param, cv=3)
         GV.fit(X_train, y_train)
```

```
Out[36]: GridSearchCV(cv=3, error_score='raise-deprecating',
                estimator=SGDClassifier(alpha=0.0001, average=False, class_weight=None,
                early_stopping=False, epsilon=0.1, eta0=0.0, fit_intercept=True,
                l1_ratio=0.15, learning_rate='optimal', loss='hinge', max_iter=None,
                n_iter=None, n_iter_no_change=5, n_jobs=None, penalty='l2',
                power_t=0.5, random_state=None, shuffle=True, tol=None,
                validation_fraction=0.1, verbose=0, warm_start=False),
                fit_params=None, iid='warn', n_jobs=None,
                param_grid={'max_iter': range(1, 5000, 50)},
                pre_dispatch='2*n_jobs', refit=True, return_train_score='warn',
                scoring=None, verbose=0)
```

```
In [37]: GV.best_estimator_
```

```
Out[37]: SGDClassifier(alpha=0.0001, average=False, class_weight=None,
                early_stopping=False, epsilon=0.1, eta0=0.0, fit_intercept=True,
                l1_ratio=0.15, learning_rate='optimal', loss='hinge', max_iter=1801,
                n_iter=None, n_iter_no_change=5, n_jobs=None, penalty='l2',
                power_t=0.5, random_state=None, shuffle=True, tol=None,
                validation_fraction=0.1, verbose=0, warm_start=False)
```

```
In [38]: print(accuracy_score(GV.predict(X_test), y_test))
```

```
0.8360655737704918
```

```
In [42]: clas = LinearSVC()
         param = {'max_iter':range(100,20000,1000)}
         GV = GridSearchCV(clas, param, cv=3)
         GV.fit(X_train, y_train)
```

```
Out[42]: GridSearchCV(cv=3, error_score='raise-deprecating',
                estimator=LinearSVC(C=1.0, class_weight=None, dual=True, fit_intercept=True,
              intercept_scaling=1, loss='squared_hinge', max_iter=1000,
              multi_class='ovr', penalty='l2', random_state=None, tol=0.0001,
              verbose=0),
                fit_params=None, iid='warn', n_jobs=None,
                param_grid={'max_iter': range(100, 20000, 1000)},
                pre_dispatch='2*n_jobs', refit=True, return_train_score='warn',
                scoring=None, verbose=0)
```

```
In [43]: GV.best_estimator_
```

```
Out[43]: LinearSVC(C=1.0, class_weight=None, dual=True, fit_intercept=True,
              intercept_scaling=1, loss='squared_hinge', max_iter=16100,
              multi_class='ovr', penalty='l2', random_state=None, tol=0.0001,
              verbose=0)
```

```
In [44]: print(accuracy_score(GV.predict(X_test), y_test))
```

```
0.8852459016393442
```

```
In [30]: clas = DecisionTreeClassifier()
         param = {'max_depth':range(1,30)}
         GV = GridSearchCV(clas, param, cv=3)
         GV.fit(X_train, y_train)
```

```
Out[30]: GridSearchCV(cv=3, error_score='raise-deprecating',
                estimator=DecisionTreeClassifier(class_weight=None, criterion='gini', max_dept
                     max_features=None, 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, presort=False, random_state=None,
                     splitter='best'),
                fit_params=None, iid='warn', n_jobs=None,
                param_grid={'max_depth': range(1, 30)}, pre_dispatch='2*n_jobs',
                refit=True, return_train_score='warn', scoring=None, verbose=0)
```

```
In [31]: GV.best_estimator_
```

```
Out[31]: DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=5,
                     max_features=None, 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, presort=False, random_state=None,
                     splitter='best')
```

```
In [32]: print(accuracy_score(GV.predict(X_test), y_test))
```

```
0.819672131147541
```

```
In [0]:
```