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Лабораторная работа №3

по дисциплине

«Технологии машинного обучения»

на тему

«Обработка пропусков в данных, кодирование категориальных признаков, масштабирование данных»

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1. Лабораторная работа 3

2. Обработка пропусков в данных, кодирование категориальных признаков, масштабирование данных.

2.1. Цель

изучение способов предварительной обработки данных для дальнейшего формирования моделей.

2.2. Задание:

1. Выбрать набор данных (датасет), содержащий категориальные признаки и пропуски в данных. Для выполнения следующих пунктов можно использовать несколько различных наборов данных (один для обработки пропусков, другой для категориальных признаков и т.д.)
2. Для выбранного датасета (датасетов) на основе материалов лекции решить следующие задачи: обработку пропусков в данных; кодирование категориальных признаков; масштабирование данных.

[1]:
```
import numpy as np
import pandas as pd
import sklearn as sk
```

2.3. Загрузка и первичный анализ данных

[2]:
```
data = pd.read_csv('fake_job_postings.csv')
```

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

[3]:
```
   job_id                                     title            location  \
0       1                          Marketing Intern    US, NY, New York
1       2  Customer Service - Cloud Video Production       NZ, , Auckland
2       3    Commissioning Machinery Assistant (CMA)        US, IA, Wever
3       4          Account Executive - Washington DC   US, DC, Washington
4       5                       Bill Review Manager   US, FL, Fort Worth

  department salary_range                                    company_profile  \
0  Marketing          NaN  We're Food52, and we've created a groundbreaki…
1    Success          NaN  90 Seconds, the worlds Cloud Video Production …
2        NaN          NaN  Valor Services provides Workforce Solutions th…
3      Sales          NaN  Our passion for improving quality of life thro…
4        NaN          NaN  SpotSource Solutions LLC is a Global Human Cap…

                                         description  \
0  Food52, a fast-growing, James Beard Award-winn…
1  Organised - Focused - Vibrant - Awesome!Do you…
2  Our client, located in Houston, is actively se…
3  THE COMPANY: ESRI – Environmental Systems Rese…
```

```
4  JOB TITLE: Itemization Review ManagerLOCATION:…

                                        requirements  \
0  Experience with content management systems a m…
1  What we expect from you:Your key responsibilit…
2  Implement pre-commissioning and commissioning …
3  EDUCATION: Bachelor’s or Master’s in GIS, busi…
4  QUALIFICATIONS:RN license in the State of Texa…

                                            benefits  telecommuting  \
0                                                NaN              0
1  What you will get from usThrough being part of…              0
2                                                NaN              0
3  Our culture is anything but corporate—we have …              0
4                              Full Benefits Offered              0

   has_company_logo  has_questions employment_type required_experience  \
0                 1              0           Other          Internship
1                 1              0       Full-time      Not Applicable
2                 1              0             NaN                 NaN
3                 1              0       Full-time    Mid-Senior level
4                 1              1       Full-time    Mid-Senior level

  required_education                   industry              function  \
0                NaN                        NaN             Marketing
1                NaN  Marketing and Advertising      Customer Service
2                NaN                        NaN                   NaN
3  Bachelor's Degree          Computer Software                 Sales
4  Bachelor's Degree     Hospital & Health Care  Health Care Provider

   fraudulent
0           0
1           0
2           0
3           0
4           0
```

[4]:
```
data.shape
```

[4]:
```
(17880, 18)
```

[6]:
```
# проверим есть ли пропущенные значения
data.isnull().sum()
```

[6]:
```
job_id                     0
title                      0
location                 346
department             11547
salary_range           15012
company_profile         3308
description                1
```

```
requirements          2695
benefits              7210
telecommuting            0
has_company_logo         0
has_questions            0
employment_type       3471
required_experience   7050
required_education    8105
industry              4903
function              6455
fraudulent               0
dtype: int64
```

[7]:
```
# типы колонок
data.dtypes
```

[7]:
```
job_id                  int64
title                  object
location               object
department             object
salary_range           object
company_profile        object
description            object
requirements           object
benefits               object
telecommuting           int64
has_company_logo        int64
has_questions           int64
employment_type        object
required_experience    object
required_education     object
industry               object
function               object
fraudulent              int64
dtype: object
```

2.4. 1. Обработка пропусков в данных

[11]:
```
# Удаление строк, содержащих пустые значения
data_new = data.dropna(axis=0, how='any')
(data.shape, data_new.shape)
```

[11]:
```
((17880, 18), (774, 18))
```

[12]:
```
data_new.isnull().sum()
```

[12]:
```
job_id                 0
title                  0
location               0
department             0
```

```
salary_range           0
company_profile        0
description            0
requirements           0
benefits               0
telecommuting          0
has_company_logo       0
has_questions          0
employment_type        0
required_experience    0
required_education     0
industry               0
function               0
fraudulent             0
dtype: int64
```

2.5. 2. Преобразование категориальных признаков в числовые

[19]:
```python
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
```

[28]:
```python
le = LabelEncoder()
cat_enc_le = le.fit_transform(data_new['required_education'])
cat_enc_le
```

[28]:
```
array([4, 1, 7, 3, 1, 1, 1, 3, 1, 1, 1, 3, 1, 1, 1, 1, 7, 1, 1, 1, 1, 7, 7,
       1, 1, 7, 3, 2, 3, 1, 4, 1, 7, 2, 7, 3, 2, 3, 1, 3, 6, 1, 1, 4, 1, 3,
       4, 1, 1, 1, 1, 1, 1, 1, 3, 1, 3, 7, 1, 3, 7, 1, 1, 1, 3, 1, 1, 0, 1,
       3, 1, 1, 7, 7, 3, 1, 1, 1, 1, 1, 3, 3, 0, 1, 7, 1, 3, 3, 1, 1, 7, 7,
       1, 3, 3, 1, 1, 3, 7, 1, 1, 1, 3, 1, 1, 7, 1, 7, 3, 3, 1, 1, 7, 7, 1,
       1, 8, 7, 3, 3, 1, 1, 3, 7, 3, 7, 1, 1, 7, 1, 1, 1, 1, 6, 3, 7, 0, 7,
       1, 1, 1, 1, 1, 1, 3, 1, 7, 7, 7, 3, 3, 7, 3, 1, 1, 1, 3, 1, 1, 3, 7,
       7, 7, 4, 7, 1, 3, 1, 1, 1, 7, 1, 1, 3, 1, 0, 8, 7, 7, 1, 3, 1, 1, 3,
       7, 1, 7, 1, 3, 3, 3, 3, 2, 4, 1, 3, 3, 3, 3, 3, 1, 3, 3, 1, 3, 3, 1,
       3, 1, 3, 1, 1, 1, 1, 0, 1, 1, 7, 1, 7, 7, 1, 1, 1, 1, 7, 7, 1, 4, 7,
       1, 1, 7, 7, 1, 1, 4, 7, 1, 1, 1, 3, 6, 2, 1, 3, 1, 4, 7, 3, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 7, 1, 1, 7, 3, 3, 1, 7, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 1, 1, 1, 1, 1, 6, 3, 1, 1, 1, 4, 3, 1, 3, 1, 1, 1, 1, 1, 1,
       1, 4, 1, 1, 1, 1, 3, 1, 1, 7, 7, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
       3, 3, 3, 3, 3, 3, 3, 3, 4, 1, 3, 3, 3, 3, 3, 1, 1, 1, 1, 1, 7, 3, 7,
       3, 3, 1, 1, 3, 3, 3, 1, 3, 3, 3, 3, 1, 3, 3, 7, 1, 0, 1, 3, 6, 1, 3,
       1, 3, 1, 1, 6, 1, 6, 1, 1, 1, 4, 1, 3, 1, 3, 3, 1, 3, 1, 1, 1, 1, 8,
       1, 0, 1, 1, 3, 7, 7, 7, 3, 3, 1, 1, 1, 7, 7, 3, 3, 7, 1, 7, 1, 7, 0,
       1, 3, 1, 1, 1, 1, 1, 3, 3, 0, 1, 0, 7, 1, 1, 6, 1, 1, 7, 3, 1, 1, 4,
       1, 1, 1, 1, 3, 1, 3, 0, 1, 3, 7, 1, 3, 1, 3, 1, 1, 1, 7, 1, 7, 0, 7,
       1, 1, 1, 1, 1, 1, 1, 8, 3, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 7, 1, 1,
       1, 1, 1, 1, 0, 0, 1, 2, 7, 1, 7, 7, 7, 0, 1, 3, 1, 3, 1, 1, 7, 1, 1,
       0, 0, 1, 7, 1, 1, 1, 7, 1, 4, 1, 1, 0, 4, 1, 1, 1, 0, 1, 3, 3, 2, 1,
       1, 3, 1, 1, 2, 2, 3, 2, 1, 7, 3, 7, 7, 1, 1, 7, 0, 9, 3, 1, 1, 2, 0,
       1, 1, 3, 5, 1, 0, 7, 0, 1, 1, 4, 3, 1, 1, 1, 3, 1, 1, 1, 7, 3, 0, 1,
```

```
       3, 3, 7, 1, 1, 7, 1, 4, 7, 1, 7, 7, 3, 1, 7, 0, 1, 0, 0, 1, 3, 1, 1,
       0, 1, 1, 1, 0, 1, 1, 1, 3, 1, 7, 7, 1, 2, 7, 7, 3, 7, 3, 1, 3, 1, 1,
       1, 7, 1, 1, 1, 1, 0, 1, 7, 4, 1, 0, 3, 1, 1, 1, 1, 1, 1, 0, 1, 3, 1,
       7, 1, 0, 1, 1, 1, 1, 2, 1, 3, 7, 7, 0, 1, 1, 3, 3, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 7, 3, 7, 1, 0, 1, 3, 7, 1, 1, 7, 7, 5, 7, 2, 3, 1, 1,
       7, 1, 1, 3, 1, 3, 8, 7, 7, 7, 1, 1, 1, 9, 3, 3, 1, 1, 1, 5, 1, 1, 7,
       1, 3, 4, 1, 1, 1, 1, 4, 7, 7, 1, 1, 1, 1, 1, 4, 1, 2, 1, 1, 1, 7, 7,
       1, 1, 3, 1, 4, 3, 1, 7, 1, 1, 1, 7, 1, 1, 6, 1, 3, 1, 1, 7, 1, 1, 4,
       1, 1, 3, 1, 1, 1, 3, 3, 3, 3, 3, 3, 3, 1, 1])
```

[29]:
```
data_new['required_education'].unique()
```

[29]:
```
array(["Master's Degree", "Bachelor's Degree", 'Unspecified',
       'High School or equivalent', 'Certification',
       'Some College Coursework Completed', 'Associate Degree',
       'Vocational', 'Vocational - HS Diploma', 'Professional'], dtype=object)
```

[30]:
```
np.unique(cat_enc_le)
```

[30]:
```
array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

[31]:
```
le.inverse_transform([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

[31]:
```
array(['Associate Degree', "Bachelor's Degree", 'Certification',
       'High School or equivalent', "Master's Degree", 'Professional',
       'Some College Coursework Completed', 'Unspecified', 'Vocational',
       'Vocational - HS Diploma'], dtype=object)
```

2.6. 3. Кодирование категорий наборами бинарных значений - one-hot encoding

[48]:
```
ohe = OneHotEncoder()
data_encoded, data_categories = data_new['required_education'].factorize()
cat_enc_ohe = ohe.fit_transform(data_encoded.reshape(-1, 1))
cat_enc_ohe.shape
```

[48]:
```
(774, 10)
```

[49]:
```
data_encoded.shape
```

[49]:
```
(774,)
```

[50]:
```
cat_enc_ohe
```

[50]:
```
<774x10 sparse matrix of type '<type 'numpy.float64'>'
        with 774 stored elements in Compressed Sparse Row format>
```

[51]:
```
cat_enc_ohe.todense()[0:10]
```

[51]:
```
matrix([[ 1.,  0.,  0.,  0.,  0.,  0.,  0.,  0.,  0.,  0.],
        [ 0.,  1.,  0.,  0.,  0.,  0.,  0.,  0.,  0.,  0.],
```

```
       [ 0.,  0.,  1.,  0.,  0.,  0.,  0.,  0.,  0.,  0.],
       [ 0.,  0.,  0.,  1.,  0.,  0.,  0.,  0.,  0.,  0.],
       [ 0.,  1.,  0.,  0.,  0.,  0.,  0.,  0.,  0.,  0.],
       [ 0.,  1.,  0.,  0.,  0.,  0.,  0.,  0.,  0.,  0.],
       [ 0.,  1.,  0.,  0.,  0.,  0.,  0.,  0.,  0.,  0.],
       [ 0.,  0.,  0.,  1.,  0.,  0.,  0.,  0.,  0.,  0.],
       [ 0.,  1.,  0.,  0.,  0.,  0.,  0.,  0.,  0.,  0.],
       [ 0.,  1.,  0.,  0.,  0.,  0.,  0.,  0.,  0.,  0.]])
```

[52]:
```
data_categories
```

[52]:
```
Index([u'Master's Degree', u'Bachelor's Degree', u'Unspecified',
       u'High School or equivalent', u'Certification',
       u'Some College Coursework Completed', u'Associate Degree',
       u'Vocational', u'Vocational - HS Diploma', u'Professional'],
      dtype='object')
```

2.7. Масштабирование данных

Для масштабирования данных будем использовать другой набор данных

[54]:
```
data = pd.read_csv('winequality-red.csv')
```

[55]:
```
data.shape
```

[55]:
```
(1599, 12)
```

[56]:
```
data.head()
```

[56]:
```
   fixed acidity  volatile acidity  citric acid  residual sugar  chlorides  \
0            7.4              0.70         0.00             1.9      0.076
1            7.8              0.88         0.00             2.6      0.098
2            7.8              0.76         0.04             2.3      0.092
3           11.2              0.28         0.56             1.9      0.075
4            7.4              0.70         0.00             1.9      0.076

   free sulfur dioxide  total sulfur dioxide  density    pH  sulphates  \
0                 11.0                  34.0   0.9978  3.51       0.56
1                 25.0                  67.0   0.9968  3.20       0.68
2                 15.0                  54.0   0.9970  3.26       0.65
3                 17.0                  60.0   0.9980  3.16       0.58
4                 11.0                  34.0   0.9978  3.51       0.56

   alcohol  quality
0      9.4        5
1      9.8        5
2      9.8        5
3      9.8        6
4      9.4        5
```

[57]:
```
data.dtypes
```

[57]:
```
fixed acidity           float64
volatile acidity        float64
citric acid             float64
residual sugar          float64
chlorides               float64
free sulfur dioxide     float64
total sulfur dioxide    float64
density                 float64
pH                      float64
sulphates               float64
alcohol                 float64
quality                   int64
dtype: object
```

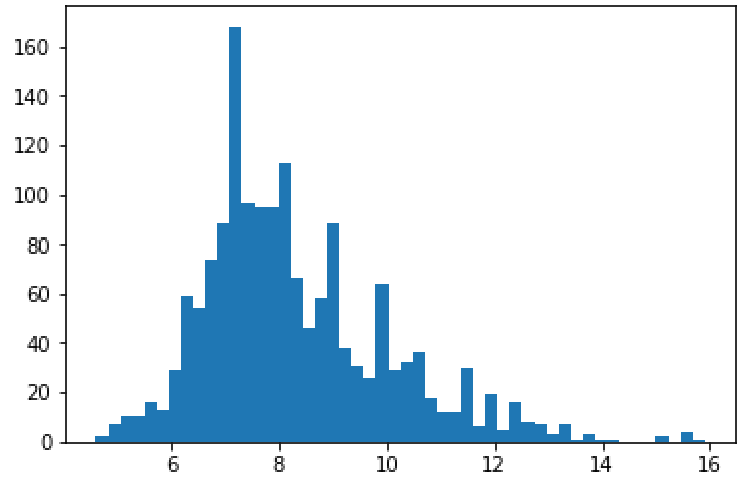
[58]:
```
data.isnull().sum()
```

[58]:
```
fixed acidity           0
volatile acidity        0
citric acid             0
residual sugar          0
chlorides               0
free sulfur dioxide     0
total sulfur dioxide    0
density                 0
pH                      0
sulphates               0
alcohol                 0
quality                 0
dtype: int64
```

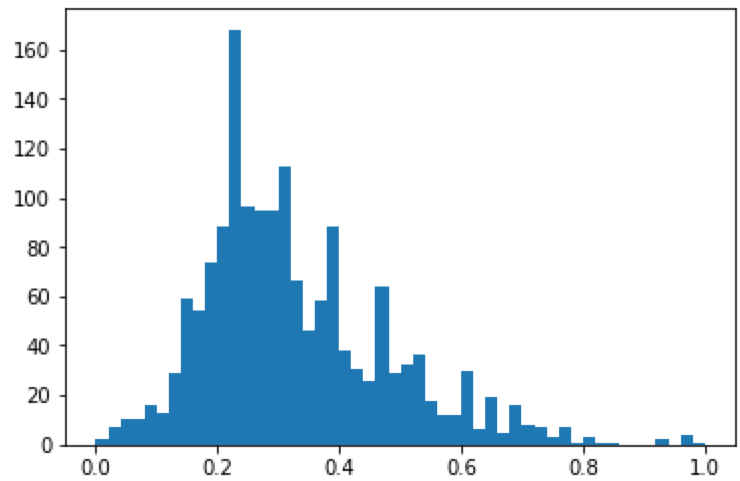
[59]:
```
from sklearn.preprocessing import MinMaxScaler, StandardScaler, Normalizer
```

[60]:
```
sc1 = MinMaxScaler()
sc1_data = sc1.fit_transform(data[['fixed acidity']])
```

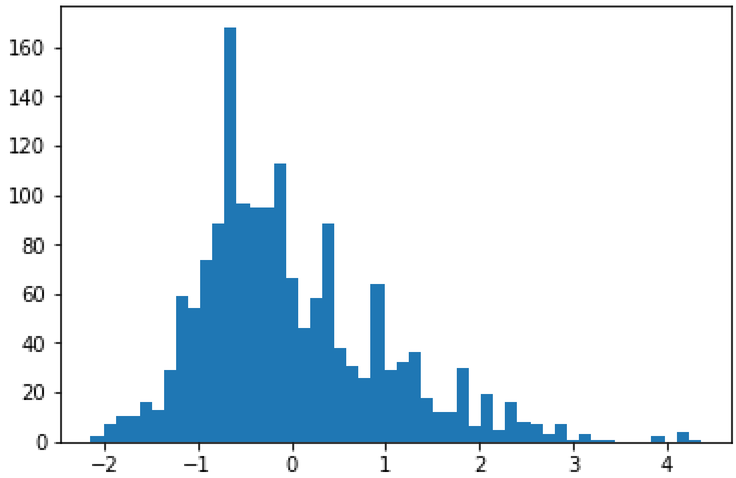
[62]:
```
import matplotlib.pyplot as plt
%matplotlib inline
plt.hist(data['fixed acidity'], 50)
plt.show()
```



[63]:
```
plt.hist(sc1_data, 50)
plt.show()
```



[65]:
```
sc2 = StandardScaler()
sc2_data = sc2.fit_transform(data[['fixed acidity']])
plt.hist(sc2_data, 50)
plt.show()
```



[67]:
```
sc3 = Normalizer()
sc3_data = sc3.fit_transform(data[['fixed acidity']])
plt.hist(sc3_data, 50)
plt.show()
```