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Кафедра «Автоматизированные системы обработки информации и управления»

“Методы машинного обучения”

Отчет по лабораторной работе №3

“Обработка пропусков в данных, кодирование категориальных признаков, масштабирование данных”

Выполнил:

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Лабораторная работа №3

Цель: изучение способов предварительной обработки данных для дальнейшего формирования моделей.

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.)

1. Для выбранного датасета (датасетов) на основе материалов лекции решить следующие задачи:

- обработку пропусков в данных;

- кодирование категориальных признаков;

- масштабирование данных.

Ход выполнения лабораторной работы

In [0]:

```
!pip install -U -q PyDrive
import os
from pydrive.auth import GoogleAuth
from pydrive.drive import GoogleDrive
from google.colab import auth
from oauth2client.client import GoogleCredentials
```

In [0]:

```
# 1. Authenticate and create the PyDrive client.
auth.authenticate_user()
gauth = GoogleAuth()
gauth.credentials = GoogleCredentials.get_application_default()
drive = GoogleDrive(gauth)
```

In [0]:

```
# choose a local (colab) directory to store the data.
local_download_path = os.path.expanduser('~/data')
try:
  os.makedirs(local_download_path)
except: pass
```

In [0]:

```
# 2. Auto-iterate using the query syntax
#    https://developers.google.com/drive/v2/web/search-parameters
file_list = drive.ListFile(
    {'q': "title='dc-wikia-data.csv'"}).GetList()
```

In [0]:

```
for f in file_list:
  # 3. Create & download by id.
  print('title: %s, id: %s' % (f['title'], f['id']))
  fname = os.path.join(local_download_path, f['title'])
  print('downloading to {}'.format(fname))
  f_ = drive.CreateFile({'id': f['id']})
  f_.GetContentFile(fname)
```

```
title: dc-wikia-data.csv, id: 1mp_Y-6OLZLTtpzYI8UA7-_EulThJZK-o
downloading to /root/data/dc-wikia-data.csv
```

In [0]:

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
sns.set(style="ticks")
```

In [0]:

```
data = pd.read_csv(fname, sep=",")
```

In [0]:

```
data.head()
```

Out[0]:

	page_id	name	urlslug	ID	ALIGN	EYE	HAIR	SEX	GS
0	1422	Batman (Bruce Wayne)	\/wiki\/Batman_(Bruce_Wayne)	Secret Identity	Good Characters	Blue Eyes	Black Hair	Male Characters	Na
1	23387	Superman (Clark Kent)	\/wiki\/Superman_(Clark_Kent)	Secret Identity	Good Characters	Blue Eyes	Black Hair	Male Characters	Na
2	1458	Green Lantern (Hal Jordan)	\/wiki\/Green_Lantern_(Hal_Jordan)	Secret Identity	Good Characters	Brown Eyes	Brown Hair	Male Characters	Na
3	1659	James Gordon (New Earth)	\/wiki\/James_Gordon_(New_Earth)	Public Identity	Good Characters	Brown Eyes	White Hair	Male Characters	Na
4	1576	Richard Grayson (New Earth)	\/wiki\/Richard_Grayson_(New_Earth)	Secret Identity	Good Characters	Blue Eyes	Black Hair	Male Characters	Na

In [0]:

```
data.shape
```

Out[0]:

```
(6896, 13)
```

In [0]:

```
data.dtypes
```

Out[0]:

```
page_id               int64
name                 object
urlslug              object
ID                   object
ALIGN                object
EYE                  object
HAIR                 object
SEX                  object
GSM                  object
ALIVE                object
APPEARANCES         float64
FIRST APPEARANCE     object
YEAR                float64
dtype: object
```

In [0]:

```
data.isnull().sum()
```

Out[0]:

```
page_id                0
name                   0
urlslug                0
ID                  2013
ALIGN                601
EYE                 3628
HAIR                2274
SEX                  125
GSM                 6832
ALIVE                  3
APPEARANCES          355
FIRST APPEARANCE      69
YEAR                  69
dtype: int64
```

Удаление

In [0]:

```
# Удаление колонок
data_new_1 = data.dropna(axis=1, how='any')
(data.shape, data_new_1.shape)
```

Out[0]:

```
((6896, 13), (6896, 3))
```

In [0]:

```
# Удаление строк
data_new_2 = data.dropna(axis=0, how='any')
(data.shape, data_new_2.shape)
```

Out[0]:

```
((6896, 13), (38, 13))
```

Заполнение нулями

In [0]:

```
# Заполнение всех пропущенных значений нулями
data_new_3 = data.fillna(0)
data_new_3.head()
```

Out[0]:

	page_id	name	urlslug	ID	ALIGN	EYE	HAIR	SEX	GS
0	1422	Batman (Bruce Wayne)	\/wiki\/Batman_(Bruce_Wayne)	Secret Identity	Good Characters	Blue Eyes	Black Hair	Male Characters	0
1	23387	Superman (Clark Kent)	\/wiki\/Superman_(Clark_Kent)	Secret Identity	Good Characters	Blue Eyes	Black Hair	Male Characters	0
2	1458	Green Lantern (Hal Jordan)	\/wiki\/Green_Lantern_(Hal_Jordan)	Secret Identity	Good Characters	Brown Eyes	Brown Hair	Male Characters	0
3	1659	James Gordon (New Earth)	\/wiki\/James_Gordon_(New_Earth)	Public Identity	Good Characters	Brown Eyes	White Hair	Male Characters	0
4	1576	Richard Grayson (New Earth)	\/wiki\/Richard_Grayson_(New_Earth)	Secret Identity	Good Characters	Blue Eyes	Black Hair	Male Characters	0

Внедрение значений (числовые данные)

In [0]:

```
# Выберем числовые колонки с пропущенными значениями
# Цикл по колонкам датасета
total_count = data.shape[0]
num_cols = []
for col in data.columns:
    # Количество пустых значений
    temp_null_count = data[data[col].isnull()].shape[0]
    dt = str(data[col].dtype)
    if temp_null_count>0 and (dt=='float64' or dt=='int64'):
        num_cols.append(col)
        temp_perc = round((temp_null_count / total_count) * 100.0, 2)
        print('Колонка {}. Тип данных {}. Количество пустых значений {}, {}%.'
              .format(col, dt, temp_null_count, temp_perc))
```

```
Колонка APPEARANCES. Тип данных float64. Количество пустых значений 355, 5.15%.
Колонка YEAR. Тип данных float64. Количество пустых значений 69, 1.0%.
```

In [0]:

```
data_num = data[num_cols]
data_num
```

Out[0]:

	APPEARANCES	YEAR
0	3093.0	1939.0
1	2496.0	1986.0
2	1565.0	1959.0
3	1316.0	1987.0
4	1237.0	1940.0
5	1231.0	1941.0
6	1121.0	1941.0
7	1095.0	1989.0
8	1075.0	1969.0
9	1028.0	1956.0
10	1028.0	1956.0
11	969.0	1940.0
12	951.0	1967.0
13	951.0	1940.0
14	934.0	1938.0
15	930.0	1943.0
16	803.0	1940.0
17	716.0	1994.0
18	706.0	1961.0
19	677.0	1986.0
20	654.0	1941.0
21	635.0	1976.0
22	605.0	1942.0
23	595.0	1965.0
24	593.0	1968.0
25	584.0	1980.0
26	560.0	1993.0
27	558.0	1960.0
28	557.0	1986.0
29	549.0	1971.0
...	...	...
6866	NaN	1967.0
6867	NaN	1967.0
6868	NaN	1967.0
6869	NaN	1967.0
6870	NaN	1967.0
6871	NaN	1966.0
6872	NaN	1966.0
6873	NaN	1965.0
6874	NaN	1963.0
6875	NaN	1962.0
6876	NaN	1960.0

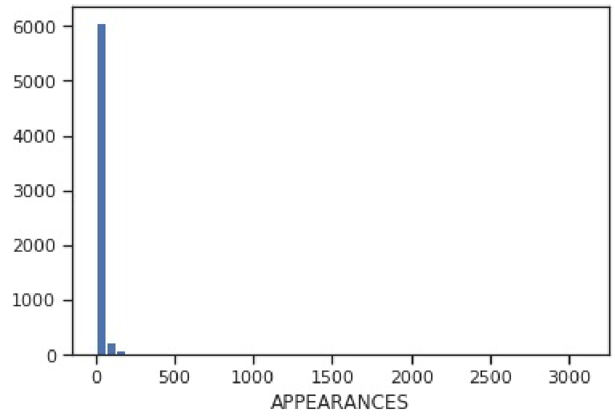
6877	NaN	1955.0
6878	NaN	1948.0
6879	NaN	1946.0
6880	NaN	1946.0
6881	NaN	1944.0
6882	NaN	1941.0
6883	NaN	1941.0
6884	NaN	1940.0
6885	NaN	1940.0
6886	NaN	1936.0
6887	NaN	NaN
6888	NaN	NaN
6889	NaN	NaN
6890	NaN	NaN
6891	NaN	NaN
6892	NaN	NaN
6893	NaN	NaN
6894	NaN	NaN
6895	NaN	NaN

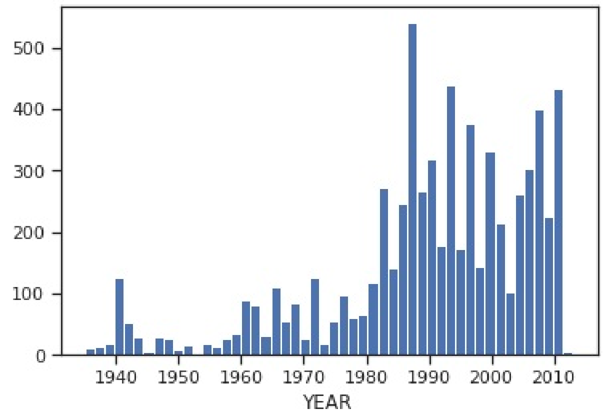
6896 rows × 2 columns

In [0]:

```
# Гистограмма по признакам
for col in data_num:
    plt.hist(data[col], 50)
    plt.xlabel(col)
    plt.show()
```

```
/usr/local/lib/python3.6/dist-packages/numpy/lib/function_base.py:780: RuntimeWarning: invalid
value encountered in greater_equal
  keep = (tmp_a >= first_edge)
/usr/local/lib/python3.6/dist-packages/numpy/lib/function_base.py:781: RuntimeWarning: invalid
value encountered in less_equal
  keep &= (tmp_a <= last_edge)
```





In [0]:

```
# Фильтр по пустым значениям поля YEAR
data[data['YEAR'].isnull()]
```

Out[0]:

	page_id	name	urlslug	ID	ALIGN	EYE	
386	1891	Jakeem Williams (New Earth)	\/wiki\/Jakeem_Williams_(New_Earth)	Secret Identity	NaN	Brown Eyes	NaN
1400	64303	Hadley Jaggar (New Earth)	\/wiki\/Hadley_Jaggar_(New_Earth)	Secret Identity	Good Characters	Blue Eyes	Blon
1401	13097	Nergal (New Earth)	\/wiki\/Nergal_(New_Earth)	NaN	Bad Characters	Yellow Eyes	NaN
1832	65286	Gregory Wolfe (New Earth)	\/wiki\/Gregory_Wolfe_(New_Earth)	Public Identity	Neutral Characters	Brown Eyes	Blac
1937	146333	Clarence Charles Batson V (New Earth)	\/wiki\/Clarence_Charles_Batson_V_(New_Earth)	Public Identity	Good Characters	NaN	Blac
1938	113413	Chad Graham (New Earth)	\/wiki\/Chad_Graham_(New_Earth)	Secret Identity	Bad Characters	NaN	Blon
2065	344513	Jupiter (New Earth)	\/wiki\/Jupiter_(New_Earth)	NaN	Good Characters	NaN	Whi
		Pegasus			Good		

2066	344983	(New Earth)	\/wiki\/Pegasus_(New_Earth)	NaN	Characters	NaN	Blac
2067	286906	Asteroth (New Earth)	\/wiki\/Asteroth_(New_Earth)	Secret Identity	Bad Characters	Yellow Eyes	Blac
2230	155569	Red Panzer IV (New Earth)	\/wiki\/Red_Panzer_IV_(New_Earth)	Secret Identity	Bad Characters	NaN	NaN
2231	19044	Gernsback (New Earth)	\/wiki\/Gernsback_(New_Earth)	NaN	Good Characters	NaN	NaN
2232	202057	Henry Cosgei (New Earth)	\/wiki\/Henry_Cosgei_(New_Earth)	Secret Identity	Good Characters	Black Eyes	Blac
2413	216380	Marilyn Batson (New Earth)	\/wiki\/Marilyn_Batson_(New_Earth)	Public Identity	Good Characters	Brown Eyes	Brov
2414	178197	Michael Tree (New Earth)	\/wiki\/Michael_Tree_(New_Earth)	NaN	NaN	NaN	Blac
2841	383108	Brunhilde (New Earth)	\/wiki\/Brunhilde_(New_Earth)	NaN	Good Characters	NaN	NaN
2842	251517	Kuan Ti (New Earth)	\/wiki\/Kuan_Ti_(New_Earth)	Public Identity	Good Characters	NaN	Blac
3104	383914	Helen of Troy (New Earth)	\/wiki\/Helen_of_Troy_(New_Earth)	NaN	Good Characters	NaN	Blon
3105	256793	Pluto (New Earth)	\/wiki\/Pluto_(New_Earth)	Public Identity	Bad Characters	NaN	NaN
3431	15909	Ammon-Ra (New Earth)	\/wiki\/Ammon-Ra_(New_Earth)	Secret Identity	Neutral Characters	NaN	NaN
3432	348898	Kreaven (New Earth)	\/wiki\/Kreaven_(New_Earth)	Public Identity	Neutral Characters	NaN	NaN
3433	345589	Vulcan (New Earth)	\/wiki\/Vulcan_(New_Earth)	NaN	Good Characters	NaN	NaN
3434	57839	Donna Cavanagh (New Earth)	\/wiki\/Donna_Cavanagh_(New_Earth)	Public Identity	Good Characters	Green Eyes	Blon
3435	68612	Amadeus Arkham (New Earth)	\/wiki\/Amadeus_Arkham_(New_Earth)	Public Identity	Good Characters	NaN	NaN
3819	182833	Scott Spencer (New Earth)	\/wiki\/Scott_Spencer_(New_Earth)	Public Identity	Neutral Characters	NaN	Blac
3820	213354	Maria Montez (New Earth)	\/wiki\/Maria_Montez_(New_Earth)	NaN	NaN	NaN	NaN
3821	345591	Diana, Goddess of the Hunt (New Earth)	\/wiki\/Diana,_Goddess_of_the_Hunt_(New_Earth)	NaN	Good Characters	NaN	NaN
3822	47346	Gregory the Gargoyle (New Earth)	\/wiki\/Gregory_the_Gargoyle_(New_Earth)	NaN	Good Characters	NaN	NaN
3823	345586	Minerva (Roman Goddess) (New Earth)	\/wiki\/Minerva_(Roman_Goddess)_(New_Earth)	NaN	Good Characters	NaN	NaN
3824	66157	Auerbach (New Earth)	\/wiki\/Auerbach_(New_Earth)	Secret Identity	NaN	NaN	Brov

4320	139807	Virgil Adams (New Earth)	\/wiki\/Virgil_Adams_(New_Earth)	Public Identity	Bad Characters	NaN	Blac
...	...	...	...	...	...	...	...
5527	112333	Lisa Morice (New Earth)	\/wiki\/Lisa_Morice_(New_Earth)	Public Identity	Good Characters	Grey Eyes	Stra Blon
5528	189975	Carter Nichols (New Earth)	\/wiki\/Carter_Nichols_(New_Earth)	Public Identity	Good Characters	NaN	Brow
5529	139768	Cupid (New Earth)	\/wiki\/Cupid_(New_Earth)	NaN	Good Characters	NaN	NaN
5530	345585	Juno (New Earth)	\/wiki\/Juno_(New_Earth)	NaN	Good Characters	NaN	NaN
5531	271506	Luki Lo (New Earth)	\/wiki\/Luki_Lo_(New_Earth)	NaN	Good Characters	NaN	Blac
5532	177249	Stanley Wilson (New Earth)	\/wiki\/Stanley_Wilson_(New_Earth)	NaN	Good Characters	NaN	Blac
5533	250224	Elena Leal (New Earth)	\/wiki\/Elena_Leal_(New_Earth)	Public Identity	Good Characters	NaN	Whi
5534	185720	Druid (New Earth)	\/wiki\/Druid_(New_Earth)	Secret Identity	Bad Characters	NaN	Blac
5535	218828	Crone (New Earth)	\/wiki\/Crone_(New_Earth)	Secret Identity	Bad Characters	NaN	Gre
5536	95738	Fancy Feet (New Earth)	\/wiki\/Fancy_Feet_(New_Earth)	NaN	Bad Characters	NaN	NaN
5537	182478	Rico Strada (New Earth)	\/wiki\/Rico_Strada_(New_Earth)	NaN	Bad Characters	Blue Eyes	Blon
5538	31642	Benjamin Hubbard (New Earth)	\/wiki\/Benjamin_Hubbard_(New_Earth)	NaN	NaN	NaN	NaN
6532	159528	Materna Minnx (New Earth)	\/wiki\/Materna_Minnx_(New_Earth)	Public Identity	NaN	NaN	Brow
6533	19799	Frank Baker, Jr. (New Earth)	\/wiki\/Frank_Baker,_Jr._(New_Earth)	Public Identity	Neutral Characters	Blue Eyes	Gre
6534	242167	Prowley (New Earth)	\/wiki\/Prowley_(New_Earth)	Public Identity	Neutral Characters	Yellow Eyes	Blac
6535	95767	Smother (New Earth)	\/wiki\/Smother_(New_Earth)	NaN	Neutral Characters	NaN	NaN
6536	16094	Mark Antaeus (New Earth)	\/wiki\/Mark_Antaeus_(New_Earth)	Public Identity	Good Characters	Blue Eyes	Blac
6537	128000	Jerome Cox (New Earth)	\/wiki\/Jerome_Cox_(New_Earth)	Public Identity	Bad Characters	NaN	NaN
6538	345590	Apollo (Roman God) (New Earth)	\/wiki\/Apollo_(Roman_God)_(New_Earth)	NaN	Good Characters	NaN	NaN
6539	15050	Ben Lo (New Earth)	\/wiki\/Ben_Lo_(New_Earth)	Public Identity	Good Characters	Brown Eyes	Blac
6540	205584	Auctioneer II (New Earth)	\/wiki\/Auctioneer_II_(New_Earth)	Secret Identity	Bad Characters	NaN	Whi
6887	283661	Herbert Hoover (New Earth)	\/wiki\/Herbert_Hoover_(New_Earth)	Public Identity	Good Characters	NaN	NaN

6888	283657	William Howard Taft (New Earth)	\/wiki\/William_Howard_Taft_(New_Earth)	Public Identity	Good Characters	NaN	NaN
6889	21655	Frank Fitzsimmons (New Earth)	\/wiki\/Frank_Fitzsimmons_(New_Earth)	Public Identity	Good Characters	NaN	Gre
6890	283482	James Garfield (New Earth)	\/wiki\/James_Garfield_(New_Earth)	Public Identity	Good Characters	NaN	NaN
6891	66302	Nadine West (New Earth)	\/wiki\/Nadine_West_(New_Earth)	Public Identity	Good Characters	NaN	NaN
6892	283475	Warren Harding (New Earth)	\/wiki\/Warren_Harding_(New_Earth)	Public Identity	Good Characters	NaN	NaN
6893	283478	William Harrison (New Earth)	\/wiki\/William_Harrison_(New_Earth)	Public Identity	Good Characters	NaN	NaN
6894	283471	William McKinley (New Earth)	\/wiki\/William_McKinley_(New_Earth)	Public Identity	Good Characters	NaN	NaN
6895	150660	Mookie (New Earth)	\/wiki\/Mookie_(New_Earth)	Public Identity	Bad Characters	Blue Eyes	Blon

In [0]:

```
# Запоминаем индексы строк с пустыми значениями
flt_index = data[data['YEAR'].isnull()].index
flt_index
```

Out[0]:

```
Int64Index([ 386, 1400, 1401, 1832, 1937, 1938, 2065, 2066, 2067, 2230, 2231,
            2232, 2413, 2414, 2841, 2842, 3104, 3105, 3431, 3432, 3433, 3434,
            3435, 3819, 3820, 3821, 3822, 3823, 3824, 4320, 4321, 4322, 4323,
            4826, 4827, 4828, 4829, 5525, 5526, 5527, 5528, 5529, 5530, 5531,
            5532, 5533, 5534, 5535, 5536, 5537, 5538, 6532, 6533, 6534, 6535,
            6536, 6537, 6538, 6539, 6540, 6887, 6888, 6889, 6890, 6891, 6892,
            6893, 6894, 6895],
           dtype='int64')
```

In [0]:

```
# Проверяем что выводятся нужные строки
data[data.index.isin(flt_index)]
```

Out[0]:

	page_id	name	urlslug	ID	ALIGN	EYE	
386	1891	Jakeem Williams (New Earth)	\/wiki\/Jakeem_Williams_(New_Earth)	Secret Identity	NaN	Brown Eyes	NaN
1400	64303	Hadley Jaggar (New Earth)	\/wiki\/Hadley_Jaggar_(New_Earth)	Secret Identity	Good Characters	Blue Eyes	Blon
1401	13097	Nergal (New Earth)	\/wiki\/Nergal_(New_Earth)	NaN	Bad Characters	Yellow Eyes	NaN
1832	65286	Gregory Wolfe (New Earth)	\/wiki\/Gregory_Wolfe_(New_Earth)	Public Identity	Neutral Characters	Brown Eyes	Blac
1937	146333	Clarence Charles Batson V	\/wiki\/Clarence_Charles_Batson_V_(New_Earth)	Public Identity	Good Characters	NaN	Blac

		(New Earth)					
1938	113413	Chad Graham (New Earth)	\/wiki\/Chad_Graham_(New_Earth)	Secret Identity	Bad Characters	NaN	Blon
2065	344513	Jupiter (New Earth)	\/wiki\/Jupiter_(New_Earth)	NaN	Good Characters	NaN	Whi
2066	344983	Pegasus (New Earth)	\/wiki\/Pegasus_(New_Earth)	NaN	Good Characters	NaN	Blac
2067	286906	Asteroth (New Earth)	\/wiki\/Asteroth_(New_Earth)	Secret Identity	Bad Characters	Yellow Eyes	Blac
2230	155569	Red Panzer IV (New Earth)	\/wiki\/Red_Panzer_IV_(New_Earth)	Secret Identity	Bad Characters	NaN	NaN
2231	19044	Gernsback (New Earth)	\/wiki\/Gernsback_(New_Earth)	NaN	Good Characters	NaN	NaN
2232	202057	Henry Cosgei (New Earth)	\/wiki\/Henry_Cosgei_(New_Earth)	Secret Identity	Good Characters	Black Eyes	Blac
2413	216380	Marilyn Batson (New Earth)	\/wiki\/Marilyn_Batson_(New_Earth)	Public Identity	Good Characters	Brown Eyes	Brov
2414	178197	Michael Tree (New Earth)	\/wiki\/Michael_Tree_(New_Earth)	NaN	NaN	NaN	Blac
2841	383108	Brunhilde (New Earth)	\/wiki\/Brunhilde_(New_Earth)	NaN	Good Characters	NaN	NaN
2842	251517	Kuan Ti (New Earth)	\/wiki\/Kuan_Ti_(New_Earth)	Public Identity	Good Characters	NaN	Blac
3104	383914	Helen of Troy (New Earth)	\/wiki\/Helen_of_Troy_(New_Earth)	NaN	Good Characters	NaN	Blon
3105	256793	Pluto (New Earth)	\/wiki\/Pluto_(New_Earth)	Public Identity	Bad Characters	NaN	NaN
3431	15909	Ammon-Ra (New Earth)	\/wiki\/Ammon-Ra_(New_Earth)	Secret Identity	Neutral Characters	NaN	NaN
3432	348898	Kreaven (New Earth)	\/wiki\/Kreaven_(New_Earth)	Public Identity	Neutral Characters	NaN	NaN
3433	345589	Vulcan (New Earth)	\/wiki\/Vulcan_(New_Earth)	NaN	Good Characters	NaN	NaN
3434	57839	Donna Cavanagh (New Earth)	\/wiki\/Donna_Cavanagh_(New_Earth)	Public Identity	Good Characters	Green Eyes	Blon
3435	68612	Amadeus Arkham (New Earth)	\/wiki\/Amadeus_Arkham_(New_Earth)	Public Identity	Good Characters	NaN	NaN
3819	182833	Scott Spencer (New Earth)	\/wiki\/Scott_Spencer_(New_Earth)	Public Identity	Neutral Characters	NaN	Blac
3820	213354	Maria Montez (New Earth)	\/wiki\/Maria_Montez_(New_Earth)	NaN	NaN	NaN	NaN
3821	345591	Diana, Goddess of the Hunt (New Earth)	\/wiki\/Diana,_Goddess_of_the_Hunt_(New_Earth)	NaN	Good Characters	NaN	NaN
3822	47346	Gregory the Gargoyle (New Earth)	\/wiki\/Gregory_the_Gargoyle_(New_Earth)	NaN	Good Characters	NaN	NaN

3823	345586	Minerva (Roman Goddess) (New Earth)	\/wiki\/Minerva_(Roman_Goddess)_(New_Earth)	NaN	Good Characters	NaN	Na
3824	66157	Auerbach (New Earth)	\/wiki\/Auerbach_(New_Earth)	Secret Identity	NaN	NaN	Bro
4320	139807	Virgil Adams (New Earth)	\/wiki\/Virgil_Adams_(New_Earth)	Public Identity	Bad Characters	NaN	Blac
...	...	...	...	...	...	...	...
5527	112333	Lisa Morice (New Earth)	\/wiki\/Lisa_Morice_(New_Earth)	Public Identity	Good Characters	Grey Eyes	Stra Blon
5528	189975	Carter Nichols (New Earth)	\/wiki\/Carter_Nichols_(New_Earth)	Public Identity	Good Characters	NaN	Bro
5529	139768	Cupid (New Earth)	\/wiki\/Cupid_(New_Earth)	NaN	Good Characters	NaN	Na
5530	345585	Juno (New Earth)	\/wiki\/Juno_(New_Earth)	NaN	Good Characters	NaN	Na
5531	271506	Luki Lo (New Earth)	\/wiki\/Luki_Lo_(New_Earth)	NaN	Good Characters	NaN	Blac
5532	177249	Stanley Wilson (New Earth)	\/wiki\/Stanley_Wilson_(New_Earth)	NaN	Good Characters	NaN	Blac
5533	250224	Elena Leal (New Earth)	\/wiki\/Elena_Leal_(New_Earth)	Public Identity	Good Characters	NaN	Whi
5534	185720	Druid (New Earth)	\/wiki\/Druid_(New_Earth)	Secret Identity	Bad Characters	NaN	Blac
5535	218828	Crone (New Earth)	\/wiki\/Crone_(New_Earth)	Secret Identity	Bad Characters	NaN	Gre
5536	95738	Fancy Feet (New Earth)	\/wiki\/Fancy_Feet_(New_Earth)	NaN	Bad Characters	NaN	Na
5537	182478	Rico Strada (New Earth)	\/wiki\/Rico_Strada_(New_Earth)	NaN	Bad Characters	Blue Eyes	Blon
5538	31642	Benjamin Hubbard (New Earth)	\/wiki\/Benjamin_Hubbard_(New_Earth)	NaN	NaN	NaN	Na
6532	159528	Materna Minnx (New Earth)	\/wiki\/Materna_Minnx_(New_Earth)	Public Identity	NaN	NaN	Bro
6533	19799	Frank Baker, Jr. (New Earth)	\/wiki\/Frank_Baker,_Jr._(New_Earth)	Public Identity	Neutral Characters	Blue Eyes	Gre
6534	242167	Prowley (New Earth)	\/wiki\/Prowley_(New_Earth)	Public Identity	Neutral Characters	Yellow Eyes	Blac
6535	95767	Smother (New Earth)	\/wiki\/Smother_(New_Earth)	NaN	Neutral Characters	NaN	Na
6536	16094	Mark Antaeus (New Earth)	\/wiki\/Mark_Antaeus_(New_Earth)	Public Identity	Good Characters	Blue Eyes	Blac
6537	128000	Jerome Cox (New Earth)	\/wiki\/Jerome_Cox_(New_Earth)	Public Identity	Bad Characters	NaN	Na
6538	345590	Apollo (Roman God) (New Earth)	\/wiki\/Apollo_(Roman_God)_(New_Earth)	NaN	Good Characters	NaN	Na
6539	15050	Ben Lo (New Earth)	\/wiki\/Ben_Lo_(New_Earth)	Public Identity	Good Characters	Brown Eyes	Blac

6540	205584	Auctioneer II (New Earth)	\/wiki\/Auctioneer_II_(New_Earth)	Secret Identity	Bad Characters	NaN	Whi
6887	283661	Herbert Hoover (New Earth)	\/wiki\/Herbert_Hoover_(New_Earth)	Public Identity	Good Characters	NaN	NaN
6888	283657	William Howard Taft (New Earth)	\/wiki\/William_Howard_Taft_(New_Earth)	Public Identity	Good Characters	NaN	NaN
6889	21655	Frank Fitzsimmons (New Earth)	\/wiki\/Frank_Fitzsimmons_(New_Earth)	Public Identity	Good Characters	NaN	Gre
6890	283482	James Garfield (New Earth)	\/wiki\/James_Garfield_(New_Earth)	Public Identity	Good Characters	NaN	NaN
6891	66302	Nadine West (New Earth)	\/wiki\/Nadine_West_(New_Earth)	Public Identity	Good Characters	NaN	NaN
6892	283475	Warren Harding (New Earth)	\/wiki\/Warren_Harding_(New_Earth)	Public Identity	Good Characters	NaN	NaN
6893	283478	William Harrison (New Earth)	\/wiki\/William_Harrison_(New_Earth)	Public Identity	Good Characters	NaN	NaN
6894	283471	William McKinley (New Earth)	\/wiki\/William_McKinley_(New_Earth)	Public Identity	Good Characters	NaN	NaN
6895	150660	Mookie (New Earth)	\/wiki\/Mookie_(New_Earth)	Public Identity	Bad Characters	Blue Eyes	Blon

In [0]:

```
data_num_Year = data_num[['YEAR']]
data_num_Year.head()
```

Out[0]:

	YEAR
0	1939.0
1	1986.0
2	1959.0
3	1987.0
4	1940.0

In [0]:

```
from sklearn.impute import SimpleImputer
from sklearn.impute import MissingIndicator
```

In [0]:

```
# Фильтр для проверки заполнения пустых значений
indicator = MissingIndicator()
mask_missing_values_only = indicator.fit_transform(data_num_Year)
mask_missing_values_only
```

Out[0]:

```
array([[False],
       [False],
       [False],
       ...,
       [ True],
       [ True],
       [ True]])
```

In [0]:

```
strategies=['mean', 'median','most_frequent']
```

In [0]:

```
def test_num_impute(strategy_param):
    imp_num = SimpleImputer(strategy=strategy_param)
    data_num_imp = imp_num.fit_transform(data_num_Year)
    return data_num_imp[mask_missing_values_only]
```

In [0]:

```
strategies[0], test_num_impute(strategies[0])
```

Out[0]:

```
('mean', array([1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178, 1989.76666178, 1989.76666178, 1989.76666178,
        1989.76666178]))
```

In [0]:

```
strategies[1], test_num_impute(strategies[1])
```

Out[0]:

```
('median',
 array([1992., 1992., 1992., 1992., 1992., 1992., 1992., 1992., 1992.,
        1992., 1992., 1992., 1992., 1992., 1992., 1992., 1992., 1992.,
        1992., 1992., 1992., 1992., 1992., 1992., 1992., 1992., 1992.,
        1992., 1992., 1992., 1992., 1992., 1992., 1992., 1992., 1992.,
        1992., 1992., 1992., 1992., 1992., 1992., 1992., 1992., 1992.,
        1992., 1992., 1992., 1992., 1992., 1992., 1992., 1992., 1992.,
        1992., 1992., 1992., 1992., 1992., 1992., 1992., 1992., 1992.,
        1992., 1992., 1992., 1992., 1992., 1992.]))
```

In [0]:

```
strategies[2], test_num_impute(strategies[2])
```

Out[0]:

```
('most_frequent',
 array([2006., 2006., 2006., 2006., 2006., 2006., 2006., 2006., 2006.,
        2006., 2006., 2006., 2006., 2006., 2006., 2006., 2006., 2006.,
        2006., 2006., 2006., 2006., 2006., 2006., 2006., 2006., 2006.,
        2006., 2006., 2006., 2006., 2006., 2006., 2006., 2006., 2006.,
        2006., 2006., 2006., 2006., 2006., 2006., 2006., 2006., 2006.,
        2006., 2006., 2006., 2006., 2006., 2006., 2006., 2006., 2006.,
        2006., 2006., 2006., 2006., 2006., 2006., 2006., 2006., 2006.,
        2006., 2006., 2006., 2006., 2006., 2006.]))
```

Внедрение значений (категориальные данные)

In [0]:

```
# Выберем категориальные колонки с пропущенными значениями
# Цикл по колонкам датасета
cat_cols = []
for col in data.columns:
    # Количество пустых значений
    temp_null_count = data[data[col].isnull()].shape[0]
    dt = str(data[col].dtype)
    if temp_null_count>0 and (dt=='object'):
        cat_cols.append(col)
        temp_perc = round((temp_null_count / total_count) * 100.0, 2)
        print('Колонка {}. Тип данных {}. Количество пустых значений {}, {}%.'
              .format(col, dt, temp_null_count, temp_perc))
```

```
Колонка ID. Тип данных object. Количество пустых значений 2013, 29.19%.
Колонка ALIGN. Тип данных object. Количество пустых значений 601, 8.72%.
Колонка EYE. Тип данных object. Количество пустых значений 3628, 52.61%.
Колонка HAIR. Тип данных object. Количество пустых значений 2274, 32.98%.
Колонка SEX. Тип данных object. Количество пустых значений 125, 1.81%.
Колонка GSM. Тип данных object. Количество пустых значений 6832, 99.07%.
Колонка ALIVE. Тип данных object. Количество пустых значений 3, 0.04%.
Колонка FIRST APPEARANCE. Тип данных object. Количество пустых значений 69, 1.0%.
```

In [0]:

```
cat_temp_data = data[['HAIR']]
cat_temp_data.tail(10)
```

Out[0]:

	HAIR
6886	NaN
6887	NaN
6888	NaN
6889	Grey Hair
6890	NaN
6891	NaN
6892	NaN
6893	NaN
6894	NaN
6895	Blond Hair

In [0]:

```
cat_temp_data['HAIR'].unique()
```

Out[0]:

```
array(['Black Hair', 'Brown Hair', 'White Hair', 'Blond Hair', 'Red Hair',
       nan, 'Green Hair', 'Strawberry Blond Hair', 'Grey Hair',
       'Silver Hair', 'Orange Hair', 'Purple Hair', 'Gold Hair',
       'Blue Hair', 'Reddish Brown Hair', 'Pink Hair', 'Violet Hair',
       'Platinum Blond Hair'], dtype=object)
```

In [0]:

```
cat_temp_data[cat_temp_data['HAIR'].isnull()].shape
```

Out[0]:

```
(2274, 1)
```

In [0]:

```
# Импьютация наиболее частыми значениями
imp2 = SimpleImputer(missing_values=np.nan, strategy='most_frequent')
data_imp2 = imp2.fit_transform(cat_temp_data)
data_imp2
```

Out[0]:

```
array([['Black Hair'],
       ['Black Hair'],
       ['Brown Hair'],
       ...,
       ['Black Hair'],
       ['Black Hair'],
       ['Blond Hair']], dtype=object)
```

In [0]:

```
# Пустые значения отсутствуют
np.unique(data_imp2)
```

Out[0]:

```
array(['Black Hair', 'Blond Hair', 'Blue Hair', 'Brown Hair', 'Gold Hair',
       'Green Hair', 'Grey Hair', 'Orange Hair', 'Pink Hair',
       'Platinum Blond Hair', 'Purple Hair', 'Red Hair',
       'Reddish Brown Hair', 'Silver Hair', 'Strawberry Blond Hair',
       'Violet Hair', 'White Hair'], dtype=object)
```

Преобразование категориальных признаков в числовые

In [0]:

```
cat_enc = pd.DataFrame({'c1':data_imp2.T[0]})
cat_enc
```

Out[0]:

	c1
0	Black Hair
1	Black Hair
2	Brown Hair
3	White Hair
4	Black Hair
5	Black Hair
6	Blond Hair
7	Black Hair
8	Blond Hair
9	Blond Hair
10	Blond Hair
11	Blond Hair
12	Red Hair
13	Brown Hair
14	Black Hair
15	Black Hair
16	Brown Hair
17	Black Hair
18	Black Hair
19	Black Hair
20	Red Hair
21	Blond Hair
22	Black Hair
23	Green Hair
24	Red Hair
25	Black Hair
26	Black Hair
27	Red Hair
28	Red Hair
29	Black Hair
...	...
6866	Black Hair

6867	Black Hair
6868	Black Hair
6869	Black Hair
6870	Black Hair
6871	Black Hair
6872	Black Hair
6873	Black Hair
6874	Black Hair
6875	Black Hair
6876	Red Hair
6877	Black Hair
6878	Blond Hair
6879	Black Hair
6880	Black Hair
6881	Red Hair
6882	Brown Hair
6883	Black Hair
6884	Black Hair
6885	Black Hair
6886	Black Hair
6887	Black Hair
6888	Black Hair
6889	Grey Hair
6890	Black Hair
6891	Black Hair
6892	Black Hair
6893	Black Hair
6894	Black Hair
6895	Blond Hair

6896 rows × 1 columns

Label encoding

In [0]:

```
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
```

In [0]:

```
le = LabelEncoder()
cat_enc_le = le.fit_transform(cat_enc['c1'])
```

In [0]:

```
cat_enc['c1'].unique()
```

Out[0]:

```
array(['Black Hair', 'Brown Hair', 'White Hair', 'Blond Hair', 'Red Hair',
       'Green Hair', 'Strawberry Blond Hair', 'Grey Hair', 'Silver Hair',
       'Orange Hair', 'Purple Hair', 'Gold Hair', 'Blue Hair',
       'Reddish Brown Hair', 'Pink Hair', 'Violet Hair',
       'Platinum Blond Hair'], dtype=object)
```

In [0]:

```
np.unique(cat_enc_le)
```

Out[0]:

```
array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16])
```

In [0]:

```
le.inverse_transform([x for x in range(16)])
```

Out[0]:

```
array(['Black Hair', 'Blond Hair', 'Blue Hair', 'Brown Hair', 'Gold Hair',
       'Green Hair', 'Grey Hair', 'Orange Hair', 'Pink Hair',
       'Platinum Blond Hair', 'Purple Hair', 'Red Hair',
       'Reddish Brown Hair', 'Silver Hair', 'Strawberry Blond Hair',
       'Violet Hair'], dtype=object)
```

In [0]:

```
cat_enc_le
```

Out[0]:

```
array([0, 0, 3, ..., 0, 0, 1])
```

One-hot encoding

In [0]:

```
ohe = OneHotEncoder()
cat_enc_ohe = ohe.fit_transform(cat_enc[['c1']])
```

In [0]:

```
cat_enc.shape
```

Out[0]:

```
(6896, 1)
```

In [0]:

```
cat_enc_ohe.shape
```

Out[0]:

```
(6896, 17)
```

In [0]:

```
cat_enc_ohe
```

Out[0]:

```
<6896x17 sparse matrix of type '<class 'numpy.float64'>'
	with 6896 stored elements in Compressed Sparse Row format>
```

In [0]:

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

Out[0]:

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

Или

In [0]:

```
pd.get_dummies(cat_enc).tail()
```

Out[0]:

	c1_Black Hair	c1_Blond Hair	c1_Blue Hair	c1_Brown Hair	c1_Gold Hair	c1_Green Hair	c1_Grey Hair	c1_Orange Hair	c1_Pink Hair	c1_Plat Blond
6891	1	0	0	0	0	0	0	0	0	0
6892	1	0	0	0	0	0	0	0	0	0
6893	1	0	0	0	0	0	0	0	0	0
6894	1	0	0	0	0	0	0	0	0	0
6895	0	1	0	0	0	0	0	0	0	0

In [0]:

```
pd.get_dummies(cat_temp_data, dummy_na=True).tail()
```

Out[0]:

	HAIR_Black Hair	HAIR_Blond Hair	HAIR_Blue Hair	HAIR_Brown Hair	HAIR_Gold Hair	HAIR_Green Hair	HAIR_Grey Hair	HAIR_Ora
6891	0	0	0	0	0	0	0	0
6892	0	0	0	0	0	0	0	0
6893	0	0	0	0	0	0	0	0
6894	0	0	0	0	0	0	0	0
6895	0	1	0	0	0	0	0	0

Масштабирование данных

In [0]:

```
from sklearn.preprocessing import MinMaxScaler, StandardScaler, Normalizer
```

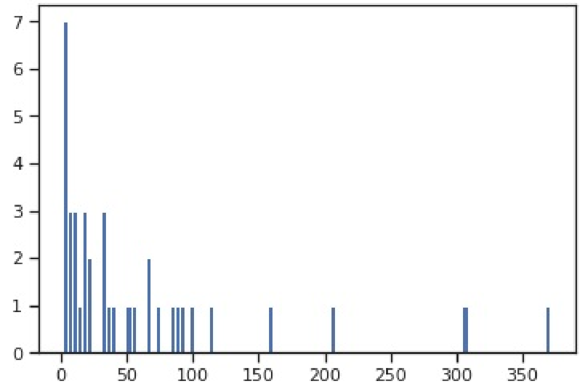
MinMax масштабирование

In [0]:

```
sc1 = MinMaxScaler()
sc1_data = sc1.fit_transform(data_new_2[['APPEARANCES']])
```

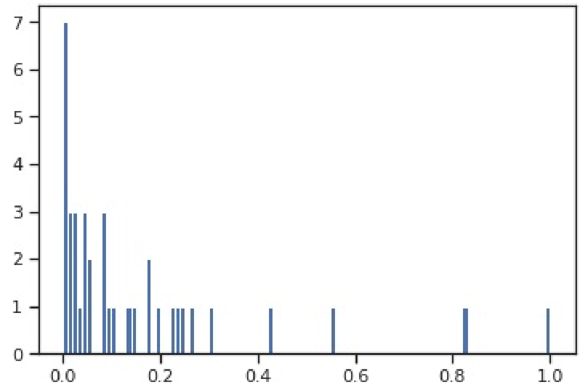
In [0]:

```
plt.hist(data_new_2['APPEARANCES'], 100)
plt.show()
```



In [0]:

```
plt.hist(sc1_data, 100)
plt.show()
```



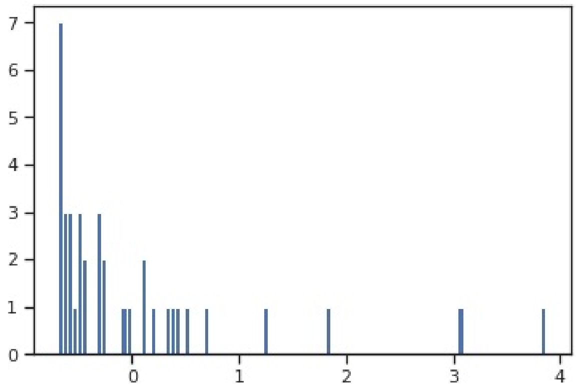
In [0]:

```
sc2 = StandardScaler()
sc2_data = sc2.fit_transform(data_new_2[['APPEARANCES']])
```

Z-оценка

In [0]:

```
plt.hist(sc2_data, 100)
plt.show()
```



Нормализация данных

In [0]:

```
sc3 = Normalizer()
sc3_data = sc3.fit_transform(data_new_2[['APPEARANCES']])
```

In [0]:

```
plt.hist(sc3_data, 50)
plt.show()
```