GitHub_Dataset

2023 年 3 月 24 日

1 互评作业 1: 数据探索性分析与数据预处理

1.1 数据集 GitHub Dataset

1.1.1 此数据集包含两个 csv 文件：

- github_dataset.csv 包含 6 列和 1052 行 GitHub 存储库数据
- repository_data.csv 包含 9 列和 2917951 行 GitHub 存储库数据

以 **repository_data.csv** 为例进行数据探索性分析与数据预处理

[1]:
```
# 导入必要的包
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import math
from scipy import stats
from collections import Counter
from math import isnan
%matplotlib inline
```

1.1.2 1. 数据集展示

[2]:
```
# 载入数据
f_data="dataset/GitHub Dataset/repository_data.csv"
data = pd.read_csv(f_data, index_col = False)
data.head()# 默认展示前五行数据
```

[2]:

	name	stars_count	forks_count	watchers	\
0	freeCodeCamp	359805	30814	8448	
1	996.ICU	264811	21470	4298	

```
2       free-programming-books       262380        53302      9544
3  coding-interview-university       244927        65038      8539
4                      awesome       235223        24791      7446

   pull_requests primary_language  \
0          31867       TypeScript
1           1949              NaN
2           8235              NaN
3            867              NaN
4           1859              NaN

                                    languages_used  commit_count  \
0  ['TypeScript', 'JavaScript', 'CSS', 'Shell', '…       32231.0
1                                              NaN        3189.0
2                                              NaN        8286.0
3                                              NaN        2314.0
4                                              NaN        1074.0

             created_at                                          licence
0  2014-12-24T17:49:19Z           BSD 3-Clause "New" or "Revised" License
1  2019-03-26T07:31:14Z                                            Other
2  2013-10-11T06:50:37Z                                            Other
3  2016-06-06T02:34:12Z  Creative Commons Attribution Share Alike 4.0 I…
4  2014-07-11T13:42:37Z              Creative Commons Zero v1.0 Universal
```

[3]:
```
data.dtypes # 每列数据的数据类型
```

[3]:
```
name                object
stars_count          int64
forks_count          int64
watchers             int64
pull_requests        int64
primary_language    object
languages_used      object
commit_count       float64
created_at          object
licence             object
```

```
dtype: object
```

[4]:
```
# 数据集的含义
# 列名----------------含义
# name                仓库的名字（标称）
# stars_count         星数（数值）
# forks_count         分支数（数值）
# watchers            观看者（数值）
# pull_requests       拉取请求计数（数值）
# primary_language    主要语言（标称）
# languages_used      使用的所有语言列表（标称）
# commit_count        仓库提交次数（数值）
# created_at          时间戳（标称）
# licence             许可证（标称）
```

[5]:
```
data.shape # 数据集的大小
```

[5]:
```
(2917951, 10)
```

1.1.3 2. 数据分析

2.1 数据摘要和可视化

2.1.1 数据摘要 • 标称属性，给出每个可能取值的频数
• 数值属性，给出 5 数概括及缺失值的个数

标称属性 由数据集展示可知该数据集标称属性共有 5 个，分别为：
name,primary_language,languages_used,created_at,license
下面给出每个属性取值的频数

[6]:
```
#(1)name
data["name"].value_counts()
```

[6]:
```
dotfiles                                5590
blog                                    2038
docs                                    1350
website                                 1163
scripts                                  649
```

```
                                                    …
markdown-to-presentation                            1
moodle-client                                       1
event-sourcing-graph                                1
react-native-100-Demos                              1
MSI-Z690-Carbon-i7-12700KF-Hackintosh               1
Name: name, Length: 2410863, dtype: int64
```

[7]:
```
#(2)primary_language
data["primary_language"].value_counts()
```

[7]:
```
JavaScript              451954
Python                  451473
Java                    202394
C++                     150066
PHP                     116058
                          …
LoomScript                   1
Ragel in Ruby Host           1
Edje Data Collection         1
Sieve                        1
Ox                           1
Name: primary_language, Length: 497, dtype: int64
```

[8]:
```
#(3)languages_used
data["languages_used"].value_counts()
```

[8]:
```
['Python']                                                          257679
['JavaScript']                                                      157741
['Java']                                                            117624
['C#']                                                               60299
['PHP']                                                              56333
                                                                       …
['Svelte', 'TypeScript', 'JavaScript', 'HTML', 'CSS', 'Rust']            1
['Dockerfile', 'Shell', 'JavaScript', 'PowerShell']                      1
['TypeScript', 'HTML', 'Vue', 'JavaScript', 'Python', 'Shell']           1
['C++', 'C', 'Pascal', 'Batchfile', 'GDB']                               1
```

```
['HTML', 'C++', 'TypeScript', 'JavaScript']                    1
Name: languages_used, Length: 328148, dtype: int64
```

[9]:
```
#(4)created_at
data["created_at"].value_counts()
```

[9]:
```
2017-06-05T20:53:54Z    10
2017-06-05T20:53:58Z     9
2014-01-17T08:00:09Z     8
2010-05-26T23:38:08Z     7
2019-03-29T08:13:35Z     7
                        ..
2017-09-04T07:45:10Z     1
2017-08-21T11:35:16Z     1
2017-08-09T00:50:43Z     1
2017-10-07T13:05:26Z     1
2022-01-22T00:00:12Z     1
Name: created_at, Length: 2837008, dtype: int64
```

[10]:
```
#(5)licence
data["licence"].value_counts()
```

[10]:
```
MIT License                                        784251
Apache License 2.0                                 210698
Other                                              167987
GNU General Public License v3.0                    159443
BSD 3-Clause "New" or "Revised" License             47078
GNU General Public License v2.0                     43297
GNU Affero General Public License v3.0              21554
BSD 2-Clause "Simplified" License                   16819
The Unlicense                                       14400
GNU Lesser General Public License v3.0              14002
Mozilla Public License 2.0                          10668
Creative Commons Zero v1.0 Universal                10353
ISC License                                          8232
GNU Lesser General Public License v2.1               6168
Eclipse Public License 1.0                           3699
```

```
Do What The F*ck You Want To Public License                    3493
Creative Commons Attribution 4.0 International                 3292
Creative Commons Attribution Share Alike 4.0 International     2664
MIT No Attribution                                             2193
zlib License                                                   1512
Boost Software License 1.0                                     1421
Eclipse Public License 2.0                                     1206
BSD Zero Clause License                                         770
SIL Open Font License 1.1                                       761
Artistic License 2.0                                            685
Open Software License 3.0                                       644
Microsoft Public License                                        470
European Union Public License 1.2                               429
BSD 3-Clause Clear License                                      295
LaTeX Project Public License v1.3c                              266
BSD 4-Clause "Original" or "Old" License                        251
Universal Permissive License v1.0                               193
Academic Free License v3.0                                      143
European Union Public License 1.1                                93
University of Illinois/NCSA Open Source License                  90
PostgreSQL License                                               66
Open Data Commons Open Database License v1.0                     57
Educational Community License v2.0                               25
Mulan Permissive Software License, Version 2                     20
Vim License                                                      20
CeCILL Free Software License Agreement v2.1                      19
Microsoft Reciprocal License                                     15
CERN Open Hardware Licence Version 2 - Permissive                 4
CERN Open Hardware Licence Version 2 - Strongly Reciprocal        2
CERN Open Hardware Licence Version 2 - Weakly Reciprocal          2
GNU Free Documentation License v1.3                               1
Name: licence, dtype: int64
```

数值属性　数值属性共有 5 个，分别为：
stars_count,forks_count,watchers,pull_requests,commit_count
下面给出每个属性的 5 数概括及缺失值的个数

[11]:
```
# 用 describe 函数对数值数据的 5 数进行概括
digital_data =␣
 ↪['stars_count','forks_count','watchers','pull_requests','commit_count']
np.set_printoptions(suppress=True)
pd.set_option('display.float_format', lambda x:'%.2f'%x) # 小数点后面保留 2 位小数
data[digital_data].describe()
```

[11]:

	stars_count	forks_count	watchers	pull_requests	commit_count
count	2917951.00	2917951.00	2917951.00	2917951.00	2916030.00
mean	76.41	20.95	7.14	24.31	614.37
std	909.68	302.95	37.62	378.44	16808.01
min	2.00	0.00	0.00	0.00	1.00
25%	7.00	1.00	2.00	0.00	9.00
50%	12.00	4.00	3.00	1.00	27.00
75%	30.00	11.00	6.00	6.00	89.00
max	359805.00	242208.00	9544.00	301585.00	4314502.00

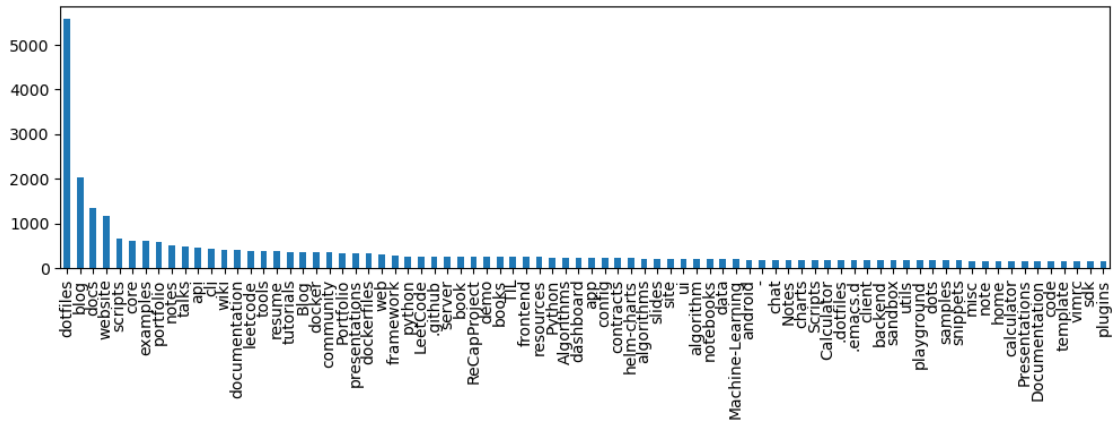
[12]:
```
# 给出数值数据缺失值的个数
data[digital_data].isnull().sum()
```

[12]:
```
stars_count         0
forks_count         0
watchers            0
pull_requests       0
commit_count     1921
dtype: int64
```

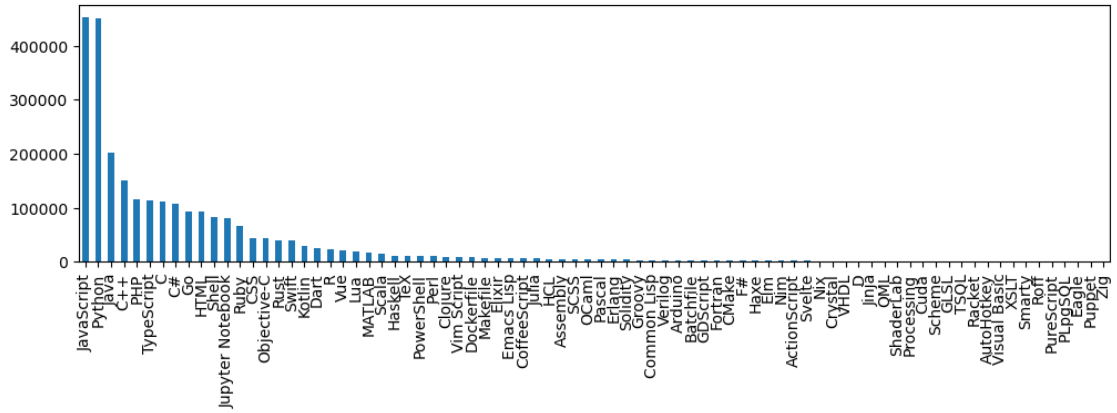
2.1.1 数据可视化 • 使用直方图、盒图等检查数据分布及离群点

[13]:
```
# 定义标称属性可视化函数
def nom_attri_vis(attri):
    data[attri].value_counts()[:80].plot(kind="bar",figsize=(12,3))
```

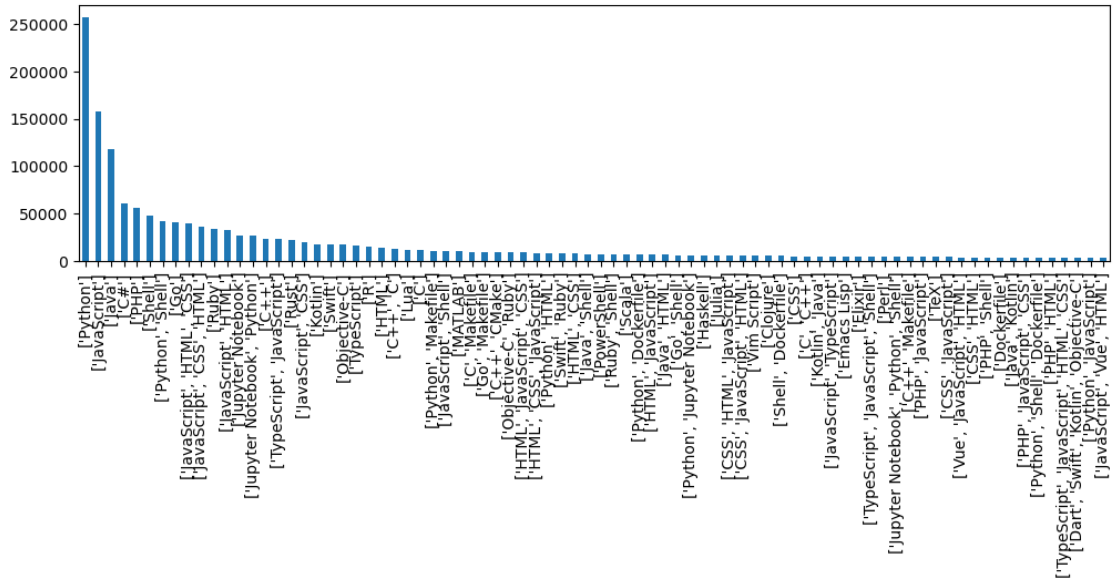
[14]:
```
#(1)name
attri = 'name'
nom_attri_vis(attri)
```



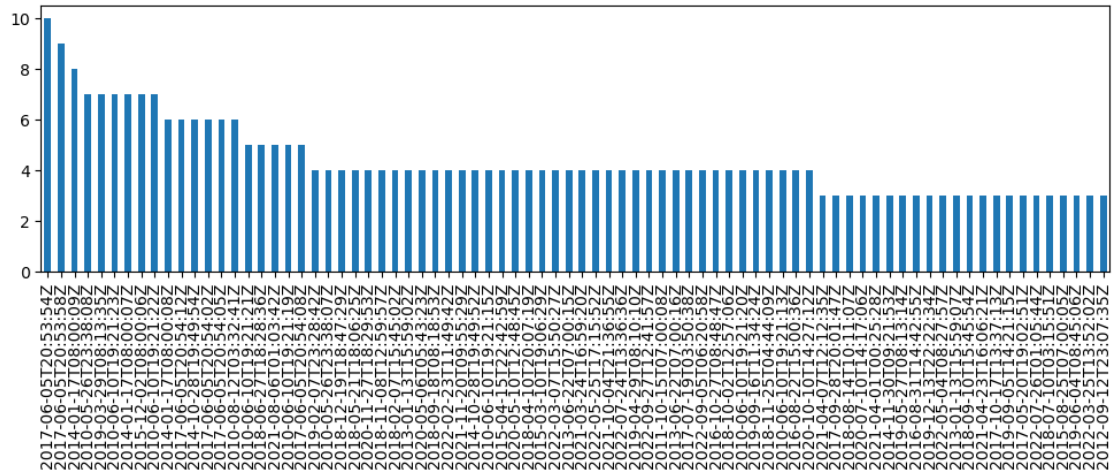
[15]:
```
#(2)primary_language
attri = 'primary_language'
nom_attri_vis(attri)
```



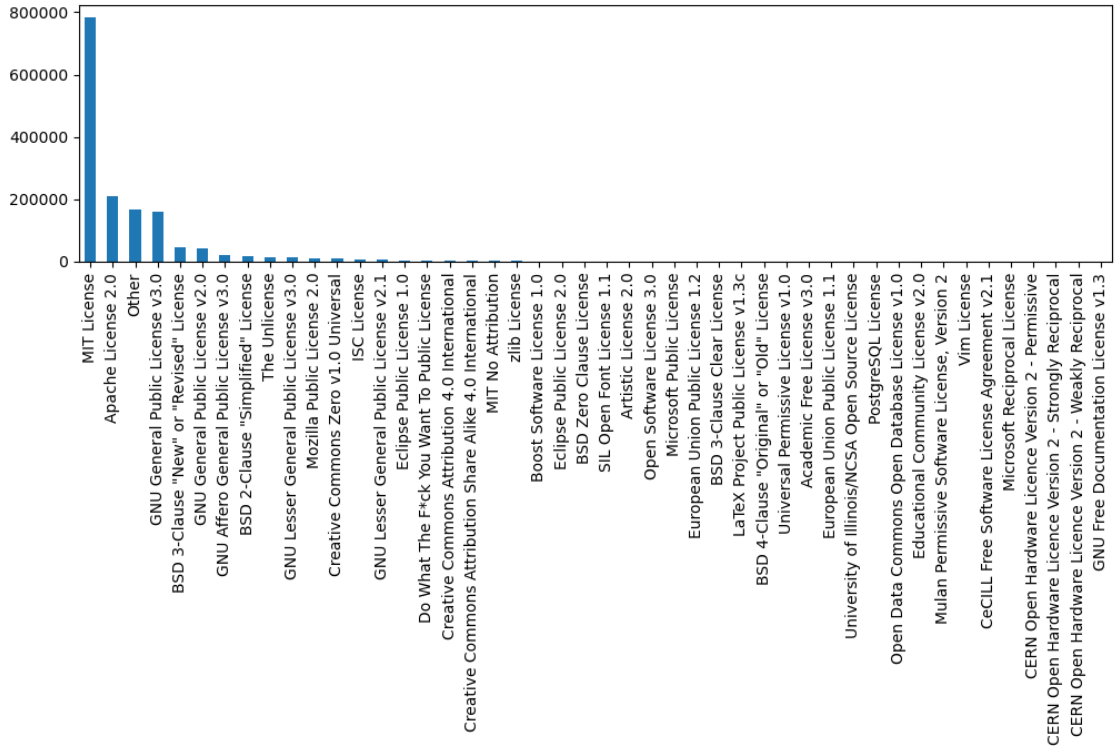
[16]:
```
#(3)languages_used
attri = 'languages_used'
nom_attri_vis(attri)
```



[17]:
```
#(4)created_at
attri = 'created_at'
nom_attri_vis(attri)
```



[18]:
```
#(5)licence
attri = 'licence'
nom_attri_vis(attri)
```

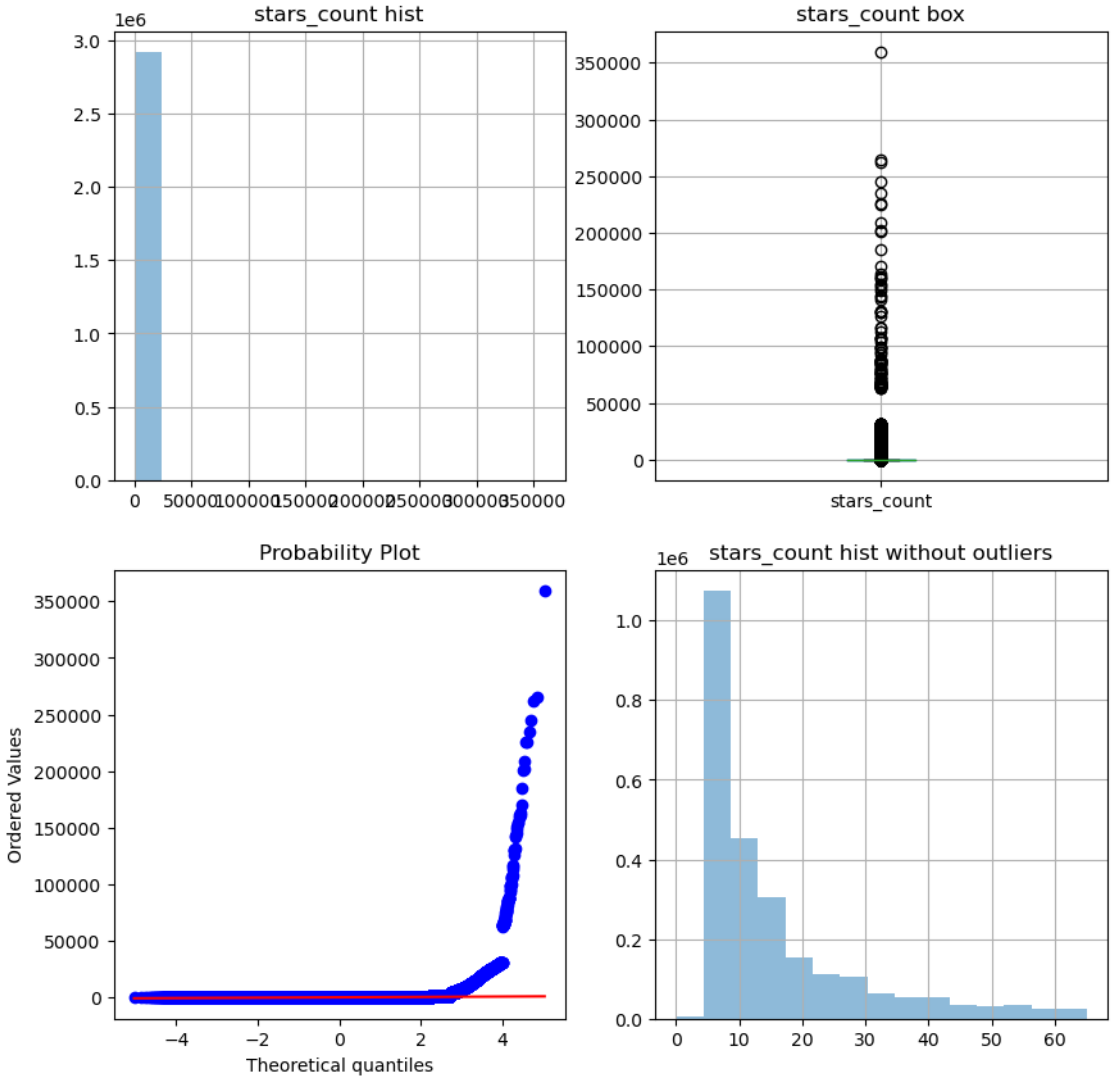


[19]:
```
# 定义数值属性可视化函数
def num_attri_vis(attri):
    # coding=utf-8
    plt.figure(figsize = (10,10))
    # 直方图
    plt.subplot(2,2,1)
    title = attri + " hist"
    plt.title(title)
    data[attri].hist(alpha=0.5,bins=15) #alpha 透明度, bins 竖条数

    # 盒图
    plt.subplot(2,2,2)
    title = attri + " box"
    plt.title(title)
    p = data.boxplot([attri],return_type='dict')

    #q-q 图
```

```
    plt.subplot(2,2,3)
    stats.probplot(data[attri],dist="norm",plot=plt)

    # 若有离群点则输出去除后的直方图
    if p:
        minfliers = min(p['fliers'][0].get_ydata())

        # 去除离群点后重新绘制直方图
        plt.subplot(2,2,4)
        plt.title(attri + " hist without outliers")
        data[attri].hist(alpha=0.5,bins=15,range=(0,minfliers)) #alpha 透明度,
bins 竖条数

    plt.show()

    if p:
        # 检查离群点
        print("离群点如下: \n",p['fliers'][0].get_ydata())
```

分别对上述 5 个数值属性绘制直方图、盒图和 q-q 图，并检查离群点

[20]:
```
#(1)stars_count
attri = 'stars_count'
num_attri_vis(attri)
```

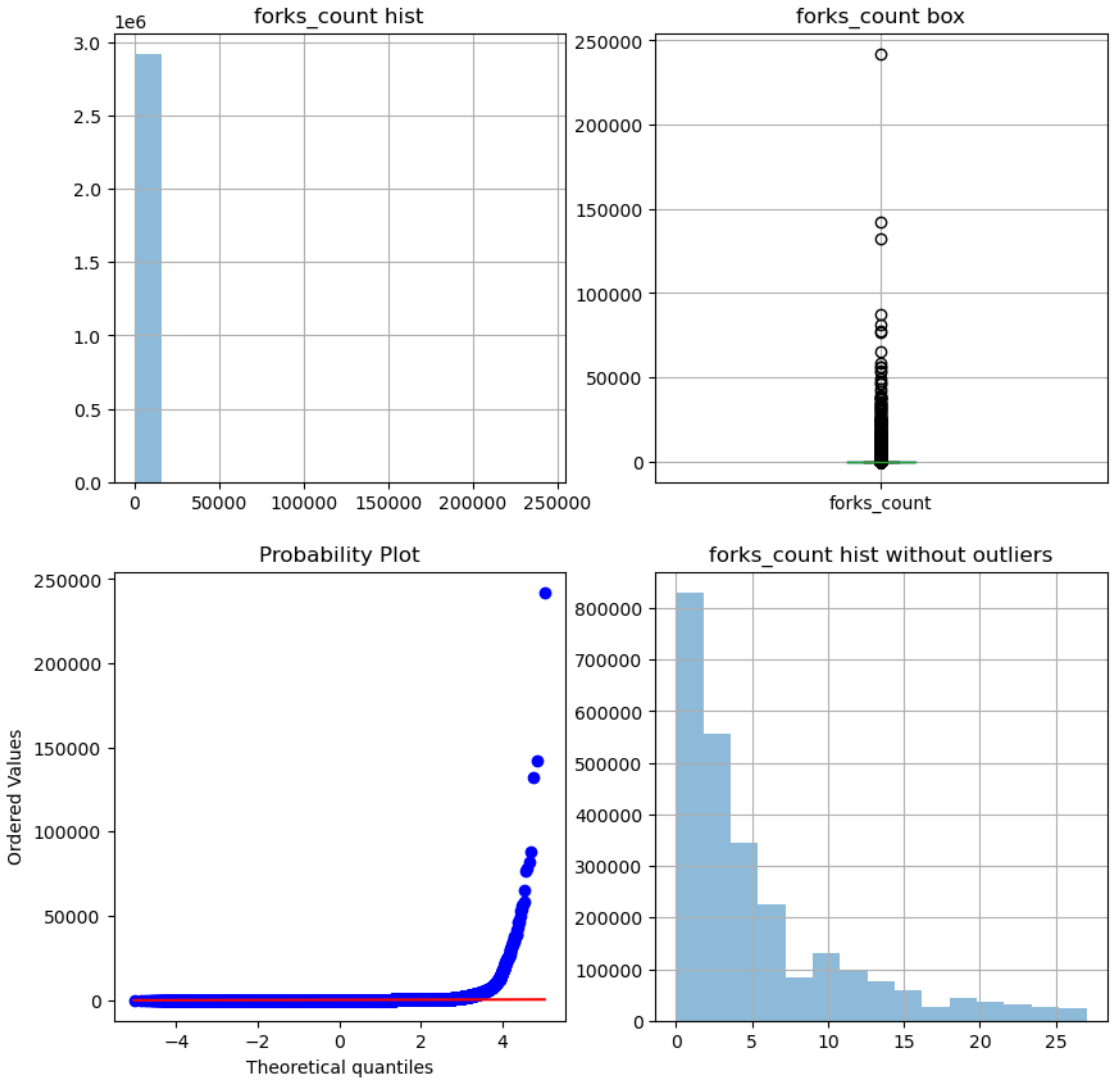


离群点如下：

```
[359805 264811 262380 … 65 66 74]
```

由去除离群点后的直方图可知，stars_count 属性基本服从指数分布

[21]:
```
#(2)forks_count
attri = 'forks_count'
num_attri_vis(attri)
```

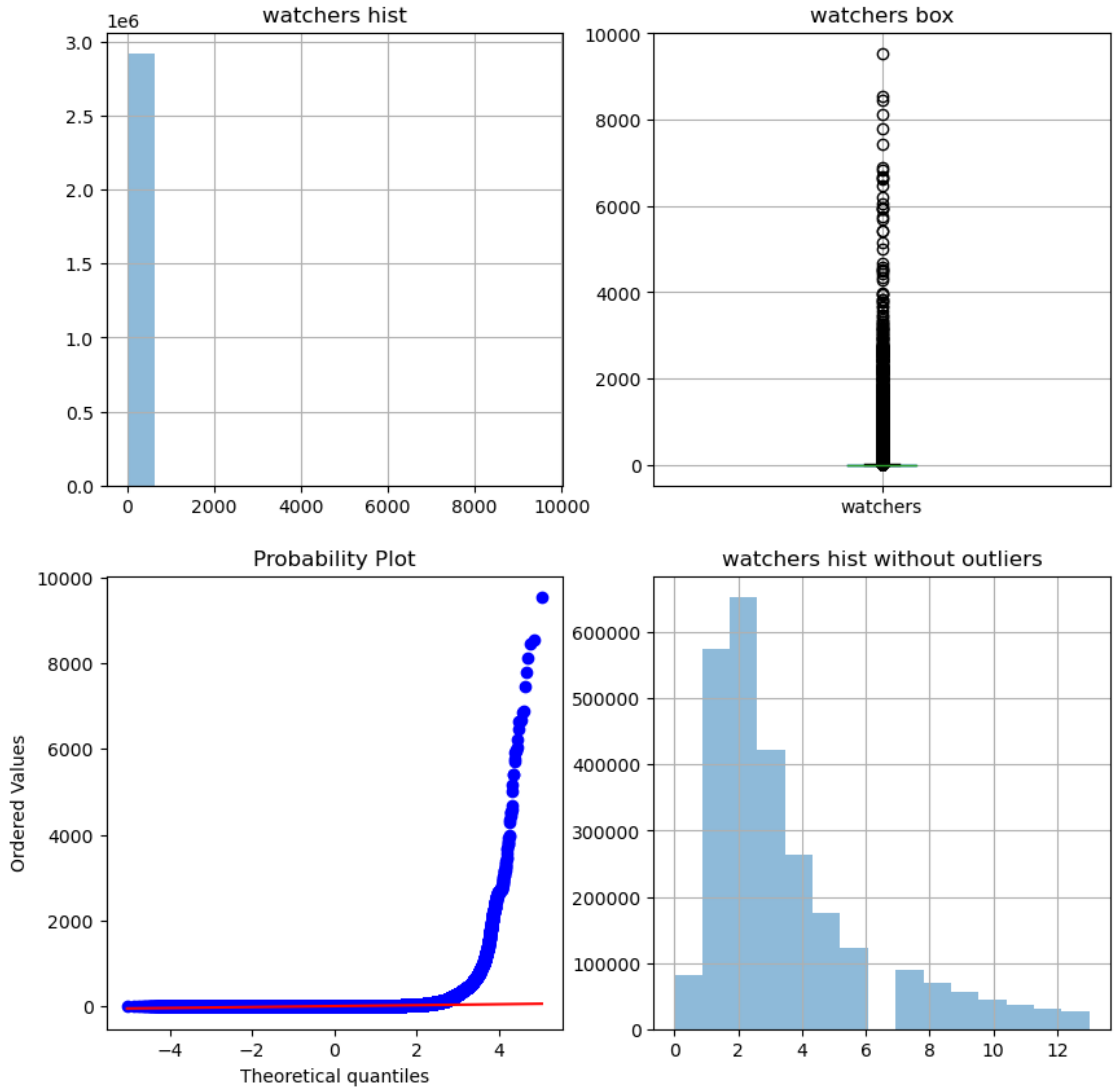


离群点如下：

```
[30814 21470 53302 … 48 31 27]
```

由去除离群点后的直方图可知，forks_count 属性基本服从指数分布

[22]:
```
#(3)watchers
attri = 'watchers'
num_attri_vis(attri)
```

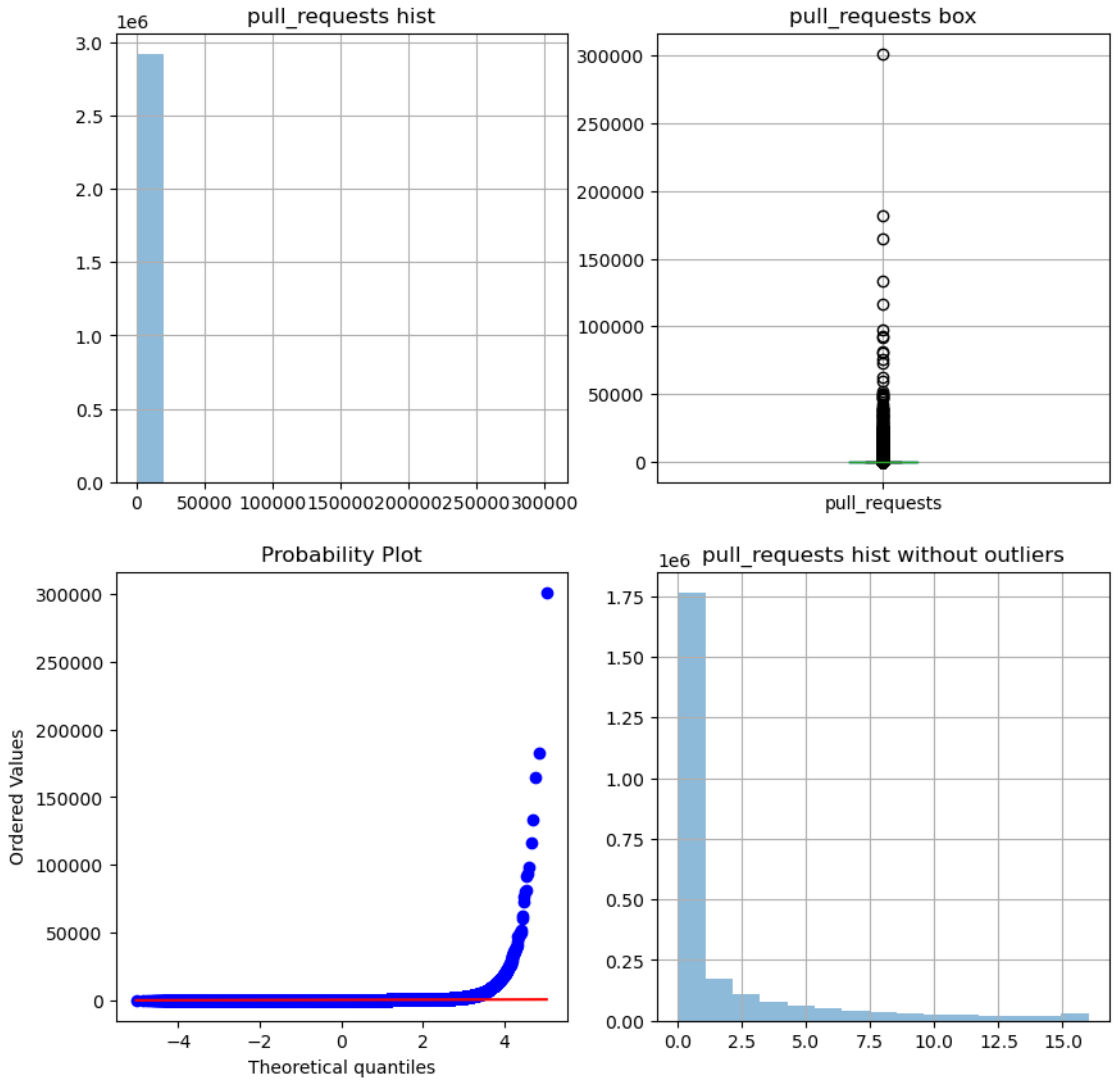


离群点如下：

```
[8448 4298 9544 … 15 13 21]
```

由去除离群点后的直方图可知，watchers 属性基本服从指数分布

[23]:
```
#(4)pull_requests
attri = 'pull_requests'
num_attri_vis(attri)
```

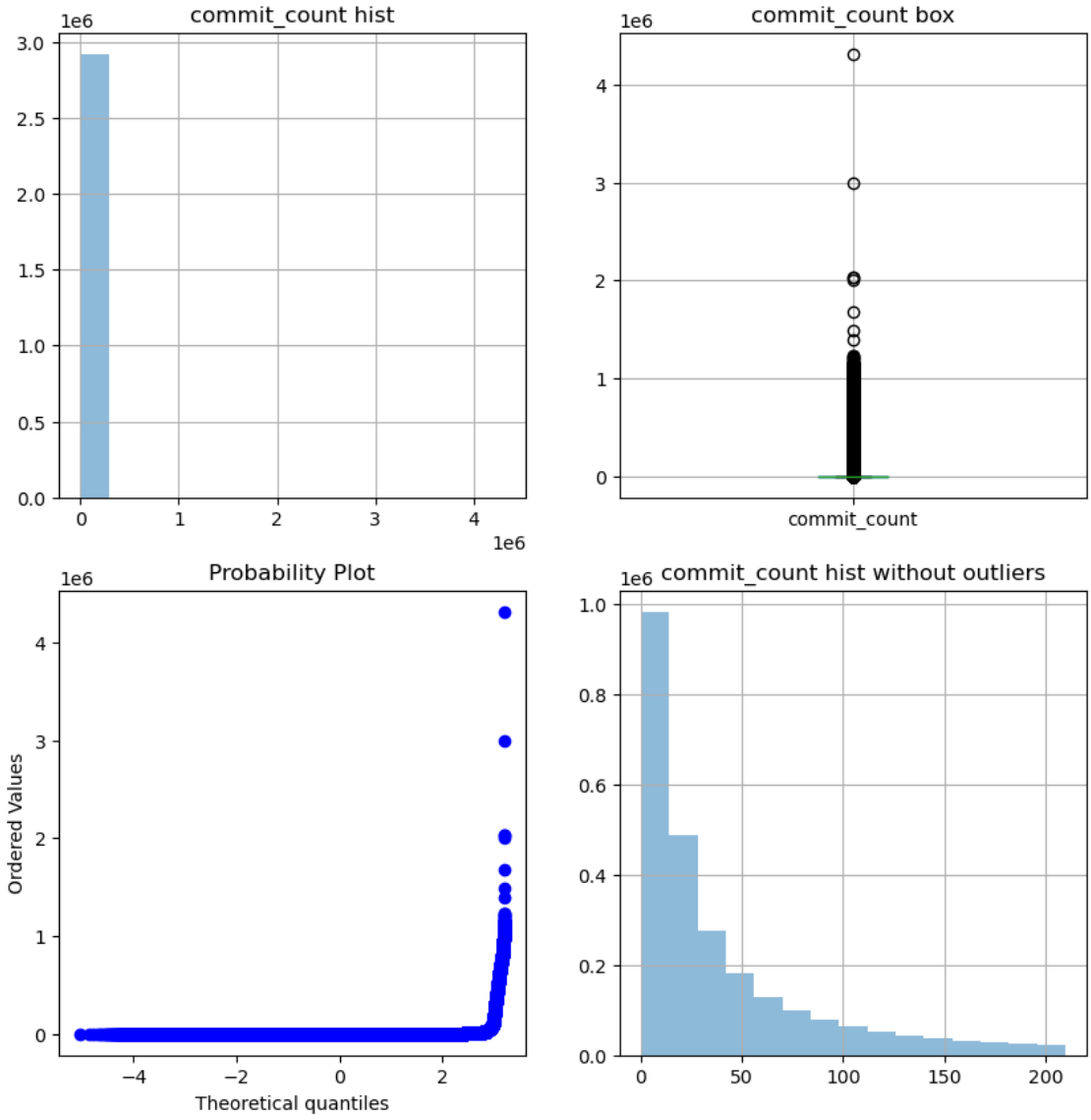


离群点如下：

```
[31867  1949  8235 … 29  16  99]
```

由去除离群点后的直方图可知，pull_requests 属性基本服从指数分布

[24]:
```
#(5)commit_count
attri = 'commit_count'
num_attri_vis(attri)
```



离群点如下：

```
[32231.0 3189.0 8286.0 … 2222.0 312.0 504.0]
```

由去除离群点后的直方图可知，commit_count 属性基本服从指数分布

2.2 数据缺失的处理 观察数据集中缺失数据，分析其缺失的原因。分别使用下列四种策略对缺失值进行处理:

- 将缺失部分剔除
- 用最高频率值来填补缺失值

• 通过属性的相关关系来填补缺失值
• 通过数据对象之间的相似性来填补缺失值
注意：在处理后完成，要对比新旧数据集的差异。

[25]:
```
# 检查数据缺失情况
data.isnull().sum()
```

[25]:
```
name                   12
stars_count             0
forks_count             0
watchers                0
pull_requests           0
primary_language       218573
languages_used         221984
commit_count            1921
created_at              0
licence                1378200
dtype: int64
```

[26]:
```
 # 查看属性的相关关系
data.corr()
```

[26]:

	stars_count	forks_count	watchers	pull_requests	commit_count
stars_count	1.00	0.57	0.71	0.19	0.02
forks_count	0.57	1.00	0.49	0.21	0.02
watchers	0.71	0.49	1.00	0.16	0.02
pull_requests	0.19	0.21	0.16	1.00	0.05
commit_count	0.02	0.02	0.02	0.05	1.00

标称属性中 primary_language, languages_used, licence 存在数据缺失问题.
数值属性中 commit_count 属性存在数据缺失问题。
这里缺失的原因可能是由于未完全记录、遗漏或无法获取。
接下来用四种方案处理数据缺失问题。

[27]:
```
# 定义新旧数据集对比函数
def cmp(attri):
    # 可视化对比新旧数据
    plt.figure(figsize = (10,20))
```

```
    # 直方图
    plt.subplot(4,2,1)
    plt.title(attri + " hist")
    data[attri].hist(alpha=0.5,bins=15) #alpha 透明度，bins 竖条数
    # 直方图
    plt.subplot(4,2,2)
    plt.title("new " + attri + " hist")
    new_data[attri].hist(alpha=0.5,bins=15) #alpha 透明度，bins 竖条数

    # 盒图
    plt.subplot(4,2,3)
    plt.title(attri + " box")
    p = data.boxplot([attri],return_type='dict')
    # 盒图
    plt.subplot(4,2,4)
    plt.title("new " + attri + " box")
    new_p = new_data.boxplot([attri],return_type='dict')

    #q-q 图
    plt.subplot(4,2,5)
    stats.probplot(data[attri],dist="norm",plot=plt)
    plt.subplot(4,2,6)
    stats.probplot(new_data[attri],dist="norm",plot=plt)

    if p and new_p:
        # 检查缺失值处理后的离群点
        minfliers = min(p['fliers'][0].get_ydata())
        dn_minfliers = min(new_p['fliers'][0].get_ydata())
        # 去除离群点后重新绘制直方图
        plt.subplot(4,2,7)
        plt.title(attri + " hist without outliers")
        data[attri].hist(alpha=0.5,bins=15,range=(0,minfliers)) #alpha 透明度,
bins 竖条数
        # 去除离群点后重新绘制缺失值处理后的直方图
        plt.subplot(4,2,8)
        plt.title("new" + attri + " hist without outliers")
```

```
        new_data[attri].hist(alpha=0.5,bins=15,range=(0,dn_minfliers)) #alpha 透明度，bins 竖条数

    plt.show()

    if p and new_p:
        # 检查离群点
        print("原离群点如下: \n",p['fliers'][0].get_ydata())
        print("新离群点如下: \n",new_p['fliers'][0].get_ydata())
```

方案一将缺失部分剔除 **name** 属性和 **commit_count** 属性缺失值占总体样本数比例较小，直接剔除后对数据集影响不大，因此直接剔除处理。
primary_language, languages_used 等属性缺失值占一定的总体样本比例，可以尝试直接剔除并观察效果
licence 属性缺失值占总体样本比例的一半左右，直接剔除对数据集影响很大，不采用将缺失数据剔除方案

直接剔除 **name** 和 **commit_count** 属性缺失的数据

[28]:
```
new_data = data.copy(deep=True)
new_data = new_data.dropna(subset=['name'])
new_data = new_data.dropna(subset=['commit_count'])
new_data.isnull().sum()
```

[28]:
```
name                   0
stars_count            0
forks_count            0
watchers               0
pull_requests          0
primary_language     216652
languages_used       220063
commit_count           0
created_at             0
licence              1376272
dtype: int64
```

[29]:
```
# 对比新旧数据
digital_data =␣
 ↪['stars_count','forks_count','watchers','pull_requests','commit_count']
data[digital_data].describe()
```

[29]:

	stars_count	forks_count	watchers	pull_requests	commit_count
count	2917951.00	2917951.00	2917951.00	2917951.00	2916030.00
mean	76.41	20.95	7.14	24.31	614.37
std	909.68	302.95	37.62	378.44	16808.01
min	2.00	0.00	0.00	0.00	1.00
25%	7.00	1.00	2.00	0.00	9.00
50%	12.00	4.00	3.00	1.00	27.00
75%	30.00	11.00	6.00	6.00	89.00
max	359805.00	242208.00	9544.00	301585.00	4314502.00

[30]:
```
new_data[digital_data].describe()
```

[30]:

	stars_count	forks_count	watchers	pull_requests	commit_count
count	2916018.00	2916018.00	2916018.00	2916018.00	2916018.00
mean	76.45	20.96	7.14	24.32	614.37
std	909.98	303.05	37.63	378.57	16808.04
min	2.00	0.00	0.00	0.00	1.00
25%	7.00	1.00	2.00	0.00	9.00
50%	12.00	4.00	3.00	1.00	27.00
75%	30.00	11.00	6.00	6.00	89.00
max	359805.00	242208.00	9544.00	301585.00	4314502.00

处理前后数值数据的五数没有变化

尝试剔除 primary_language, languages_used 属性缺失的数据并比较数据集变化

[31]:
```
new_data_language = new_data.copy(deep=True)
new_data_language = new_data_language.dropna(subset=['primary_language'])
new_data_language = new_data_language.dropna(subset=['languages_used'])
new_data_language.isnull().sum()
```

[31]:
```
name                0
stars_count         0
forks_count         0
```

```
watchers                  0
pull_requests             0
primary_language          0
languages_used            0
commit_count              0
created_at                0
licence             1224338
dtype: int64
```

[32]:
```
# 对比新旧数据
digital_data =␣
 ↪['stars_count','forks_count','watchers','pull_requests','commit_count']
data[digital_data].describe()
```

[32]:

	stars_count	forks_count	watchers	pull_requests	commit_count
count	2917951.00	2917951.00	2917951.00	2917951.00	2916030.00
mean	76.41	20.95	7.14	24.31	614.37
std	909.68	302.95	37.62	378.44	16808.01
min	2.00	0.00	0.00	0.00	1.00
25%	7.00	1.00	2.00	0.00	9.00
50%	12.00	4.00	3.00	1.00	27.00
75%	30.00	11.00	6.00	6.00	89.00
max	359805.00	242208.00	9544.00	301585.00	4314502.00

[33]:
```
new_data_language[digital_data].describe()
```

[33]:

	stars_count	forks_count	watchers	pull_requests	commit_count
count	2695950.00	2695950.00	2695950.00	2695950.00	2695950.00
mean	75.51	20.63	7.01	25.50	629.15
std	837.69	254.54	35.29	385.73	16953.19
min	3.00	0.00	0.00	0.00	1.00
25%	7.00	1.00	2.00	0.00	10.00
50%	12.00	4.00	3.00	1.00	29.00
75%	30.00	11.00	6.00	6.00	94.00
max	359805.00	141905.00	8448.00	301585.00	4314502.00

处理前后数值数据五数变化较小，缺失数据的剔除对整体数据集影响较小

方案二用最高频率值来填补缺失值　**name** 属性和 **commit_count** 属性缺失值占总体样本数比例较小，用最高频率值来填补后对数据集影响不大

primary_language, languages_used 等属性缺失值占一定的总体样本比例，可以尝试用最高频率值来填补并观察效果

licence 属性缺失值占总体样本比例的一半左右，用最高频率值来填补对数据集影响很大，不采用最高频率值填补方案

[34]:
```
# 用最高频率来填补 name,commit_count 缺失值
attri = ['name', 'commit_count']
new_data = data.copy(deep=True)

i=0
word_counts = Counter(new_data[attri[i]])
top = word_counts.most_common(1)[0][0]
print("The most frequency value is:",top)
new_data[attri[i]] = new_data[attri[i]].fillna(top)

i=1
word_counts = Counter(new_data[attri[i]])
top = word_counts.most_common(1)[0][0]
print("The most frequency value is:",top)
new_data[attri[i]] = new_data[attri[i]].fillna(top)

new_data.isnull().sum()
```

```
The most frequency value is: dotfiles
The most frequency value is: 2.0
```

[34]:
```
name                   0
stars_count            0
forks_count            0
watchers               0
pull_requests          0
primary_language     218573
languages_used       221984
commit_count           0
created_at             0
licence              1378200
```

```
dtype: int64
```

[35]:
```
# 对比新旧数据
digital_data =␣
 ↪['stars_count','forks_count','watchers','pull_requests','commit_count']
data[digital_data].describe()
```

[35]:

	stars_count	forks_count	watchers	pull_requests	commit_count
count	2917951.00	2917951.00	2917951.00	2917951.00	2916030.00
mean	76.41	20.95	7.14	24.31	614.37
std	909.68	302.95	37.62	378.44	16808.01
min	2.00	0.00	0.00	0.00	1.00
25%	7.00	1.00	2.00	0.00	9.00
50%	12.00	4.00	3.00	1.00	27.00
75%	30.00	11.00	6.00	6.00	89.00
max	359805.00	242208.00	9544.00	301585.00	4314502.00

[36]:
```
new_data[digital_data].describe()
```

[36]:

	stars_count	forks_count	watchers	pull_requests	commit_count
count	2917951.00	2917951.00	2917951.00	2917951.00	2917951.00
mean	76.41	20.95	7.14	24.31	613.97
std	909.68	302.95	37.62	378.44	16802.48
min	2.00	0.00	0.00	0.00	1.00
25%	7.00	1.00	2.00	0.00	9.00
50%	12.00	4.00	3.00	1.00	27.00
75%	30.00	11.00	6.00	6.00	89.00
max	359805.00	242208.00	9544.00	301585.00	4314502.00

处理前后数值数据的五数没有变化

[37]:
```
# 用最高频率来填补 primary_language, languages_used 缺失值
attri = ['primary_language', 'languages_used']
new_data_language = new_data.copy(deep=True)

i=0
word_counts = Counter(new_data_language[attri[i]])
top = word_counts.most_common(1)[0][0]
```

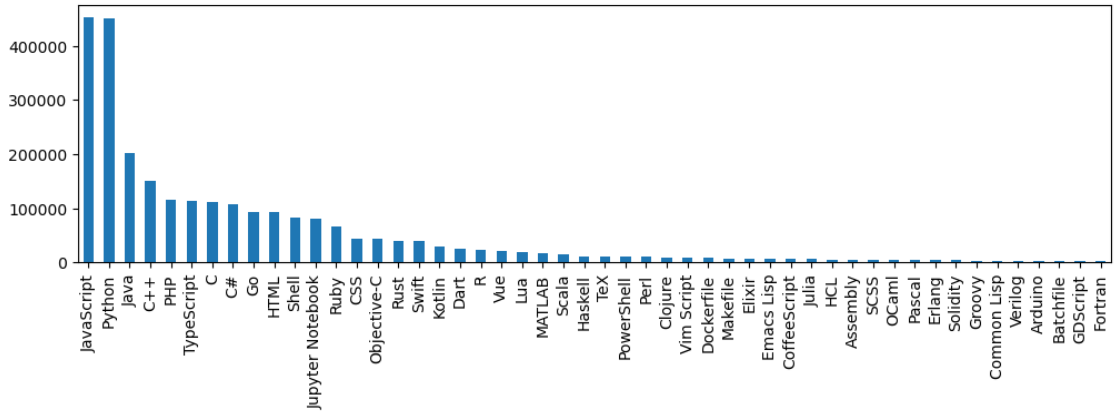
```
print("The most frequency value is:",top)
new_data_language[attri[i]] = new_data_language[attri[i]].fillna(top)

i=1
word_counts = Counter(new_data_language[attri[i]])
top = word_counts.most_common(1)[0][0]
print("The most frequency value is:",top)
new_data_language[attri[i]] = new_data_language[attri[i]].fillna(top)

new_data_language.isnull().sum()
```

```
The most frequency value is: JavaScript
The most frequency value is: ['Python']
```

[37]:
```
name                    0
stars_count             0
forks_count             0
watchers                0
pull_requests           0
primary_language        0
languages_used          0
commit_count            0
created_at              0
licence           1378200
dtype: int64
```

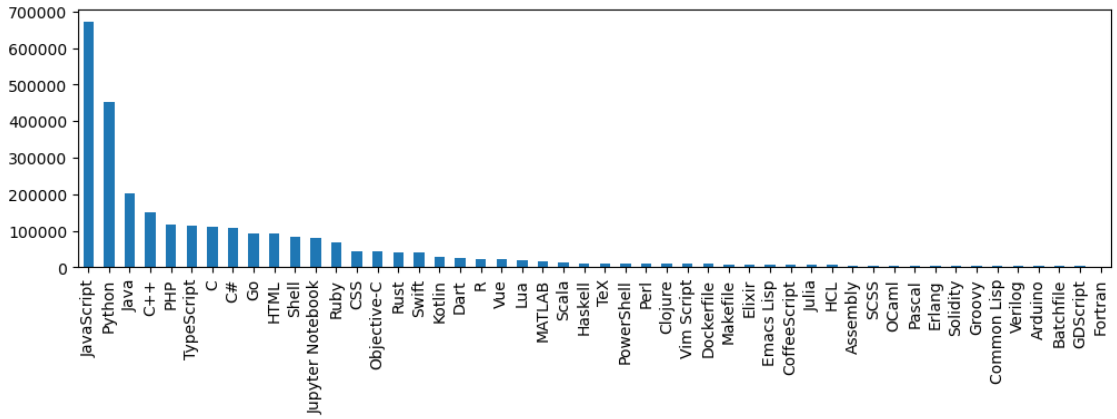
[38]:
```
# 对比处理前后的 primary_language 直方图
data['primary_language'].value_counts()[:50].plot(kind="bar",figsize=(12,3))
```

[38]:
```
<AxesSubplot:>
```



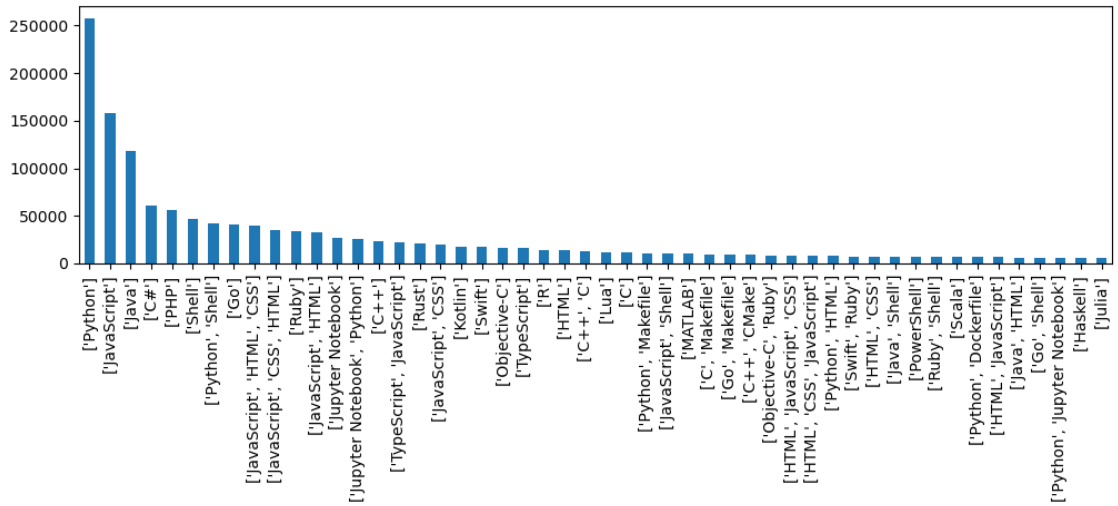
[39]:
```
new_data_language['primary_language'].value_counts()[:50].
↪plot(kind="bar",figsize=(12,3))
```

[39]: <AxesSubplot:>



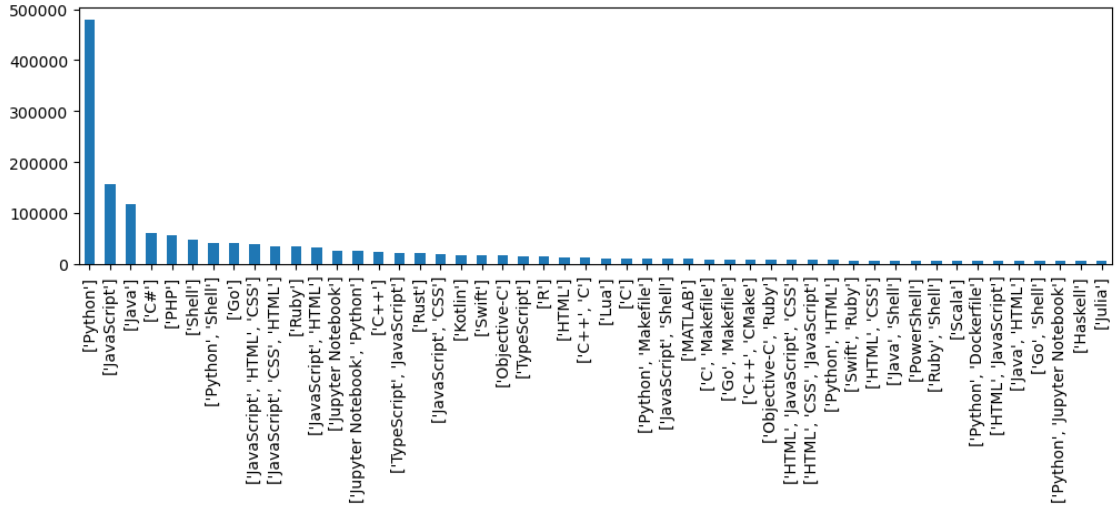
[40]:
```
# 对比处理前后的 languages_used 直方图
data['languages_used'].value_counts()[:50].plot(kind="bar",figsize=(12,3))
```

[40]: <AxesSubplot:>



[41]:
```
new_data_language['languages_used'].value_counts()[:50].
↪plot(kind="bar",figsize=(12,3))
```

[41]: <AxesSubplot:>



处理前后直方图整体形状变化不大，最高频率数据的高度变高。

方案三通过属性的相关关系来填补缺失值

[42]:
```
# 查看相关的属性关系
data.corr()
```

[42]:

	stars_count	forks_count	watchers	pull_requests	commit_count
stars_count	1.00	0.57	0.71	0.19	0.02
forks_count	0.57	1.00	0.49	0.21	0.02
watchers	0.71	0.49	1.00	0.16	0.02
pull_requests	0.19	0.21	0.16	1.00	0.05
commit_count	0.02	0.02	0.02	0.05	1.00

[43]:
```
# 通过属性的相关关系来填补缺失值
attri = ['commit_count']
new_data = data.copy(deep=True)
target_data = new_data['commit_count'].copy(deep=False)
source_data = new_data['pull_requests'].copy(deep=False)

flag1 = target_data.isnull().values
flag2 = source_data.isnull().values

i=0
for _,value in target_data.iteritems():
    if(flag1[i]==True) and (flag2[i]==False):
        target_data[i] = 26 + source_data[i]
    i=i+1
```

[44]:
```
data[attri].describe()# 原数据的 5 数概况
```

[44]:

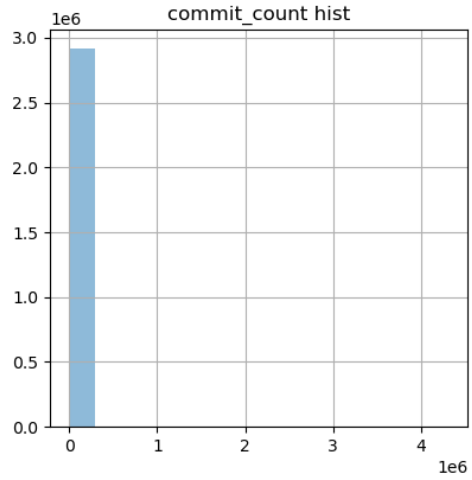
	commit_count
count	2916030.00
mean	614.37
std	16808.01
min	1.00
25%	9.00
50%	27.00
75%	89.00
max	4314502.00

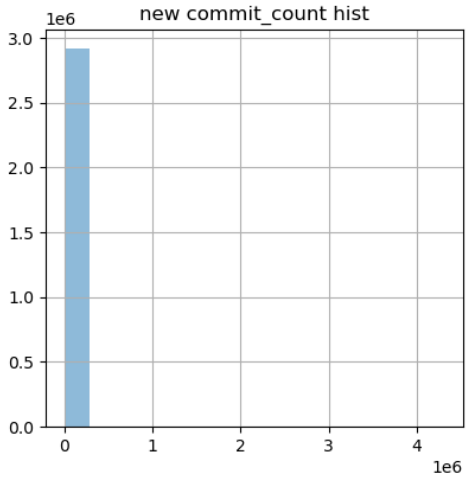
[45]:
```
new_data[attri].describe()# 通过属性的相关关系来填补缺失值后数据的 5 数概况
```

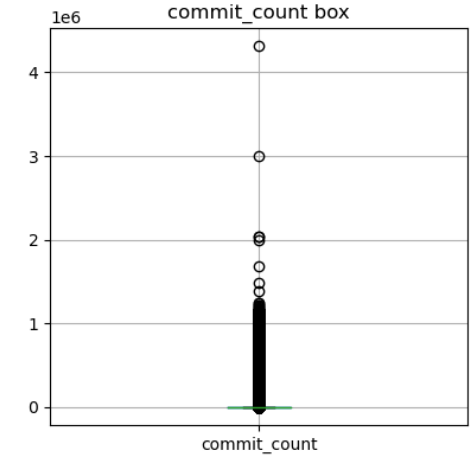
[45]:

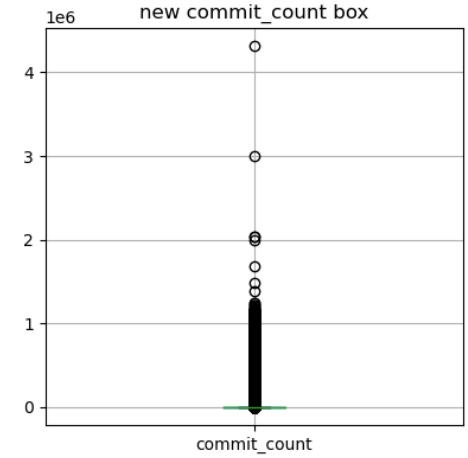
	commit_count
count	2917951.00
mean	613.98
std	16802.48
min	1.00
25%	9.00
50%	27.00
75%	89.00
max	4314502.00

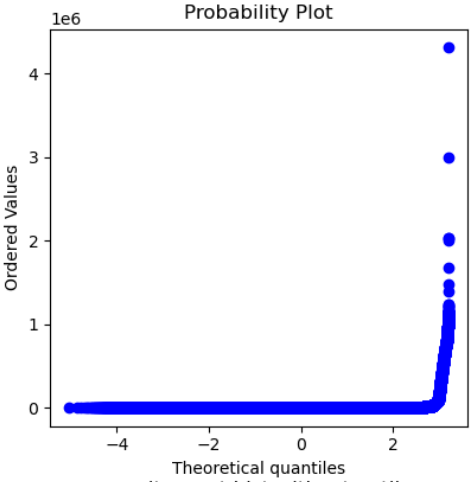
[46]:
```
# 可视化对比新旧数据
cmp(attri[0])
```

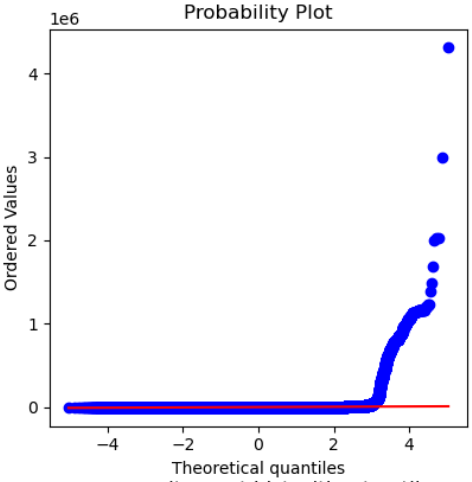

commit_count hist
1e6
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
1
2
3
4
1e6

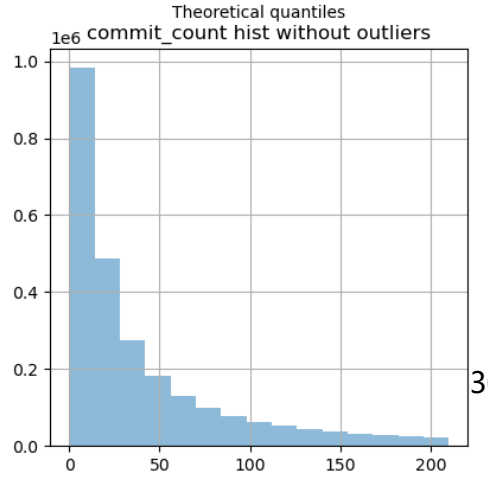

new commit_count hist
1e6
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
1
2
3
4
1e6

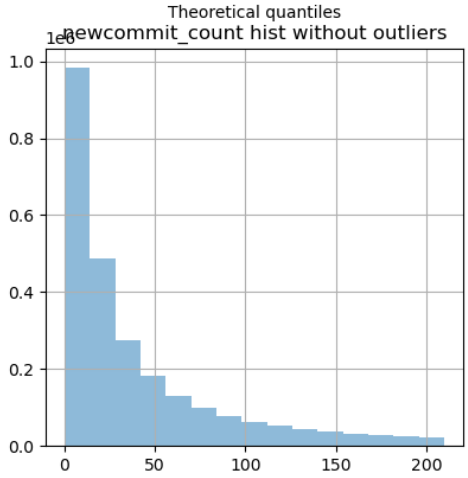

commit_count box
1e6
4
3
2
1
0
commit_count


new commit_count box
1e6
4
3
2
1
0
commit_count


Probability Plot
1e6
Ordered Values
4
3
2
1
0
−4
−2
0
2
Theoretical quantiles


Probability Plot
1e6
Ordered Values
4
3
2
1
0
−4
−2
0
2
4
Theoretical quantiles


commit_count hist without outliers
1e6
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200


newcommit_count hist without outliers
1e6
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200

原离群点如下：

```
[32231.0 3189.0 8286.0 … 2222.0 312.0 504.0]
```

新离群点如下：

```
[32231.0 3189.0 8286.0 … 2222.0 312.0 504.0]
```

用相关性最高的的属性 pull_requests 处理后，均值略微减小，方差略微减小。直方图基本没有变化而 q-q 图改变比较大。

方案四通过数据对象之间的相似性来填补缺失值

[47]:
```
numeric_attr = ['commit_count','pull_requests']
# 查找两个对象间的相似性
# 如果通过暴力法求解耗时耗力
# 所以选择通过二分法查找的方法进行相似性选择

def find_dis_value(dataset, pos, numeric_attr):
    def dis_objs(tar_obj_index, sou_obj_index):
        tar_obj = dataset.iloc[tar_obj_index]
        sou_obj = dataset.iloc[sou_obj_index]
        dis_value = 0
        for column in tar_obj.index:
            if column == 'pull_requests':
                if (not math.isnan(tar_obj[column])) and (not math.
 ↪isnan(sou_obj[column])):
                    dis_value += sou_obj[column] - tar_obj[column]
                else:
                    dis_value += 9998
        return dis_value


    mindis = 9999
    result_pos = -1
    leftindex = 0;
    rightindex = dataset.shape[0]-1
    # 二分查找返回最近距离的一个 result_pos
    while leftindex<=rightindex:
```

```
        midindex = int((leftindex+rightindex)/2)
        tmpdis = dis_objs(pos,midindex)
        if(tmpdis>0):
            rightindex = midindex-1
        elif(tmpdis == 0):
            result_pos = midindex
            break;
        else:
            leftindex = midindex+1
        if(tmpdis<mindis):
            result_pos = midindex
    return result_pos




# 通过数据对象之间的相似性来填补 Data_Value 缺失值
new_data = data.copy(deep=True)
# numical_datasets = pd.DataFrame(new_data[numeric_attr].copy(deep=False))
numical_datasets = new_data[numeric_attr].copy(deep=False)

# 对 numical_datasets 排序
numical_datasets.sort_values("pull_requests",inplace=True)
data_new = numical_datasets['commit_count'].copy(deep=False)

print('空数据数量为:',data_new.isnull().sum())
length = numical_datasets.shape[0]
count=1;
for i in range(length):
    if math.isnan(numical_datasets['commit_count'].iloc[i]):
         result_pos = find_dis_value(numical_datasets, i, numeric_attr)
         data_new.iloc[i] = data_new.iloc[result_pos]
         count+=1

# 填充后的空数据数量
print('填充后的空数据数量为:',data_new.isnull().sum())
```

```
空数据数量为: 1921
填充后的空数据数量为: 0
```

[48]:
```
data[attri].describe()# 原数据的 5 数概况
```

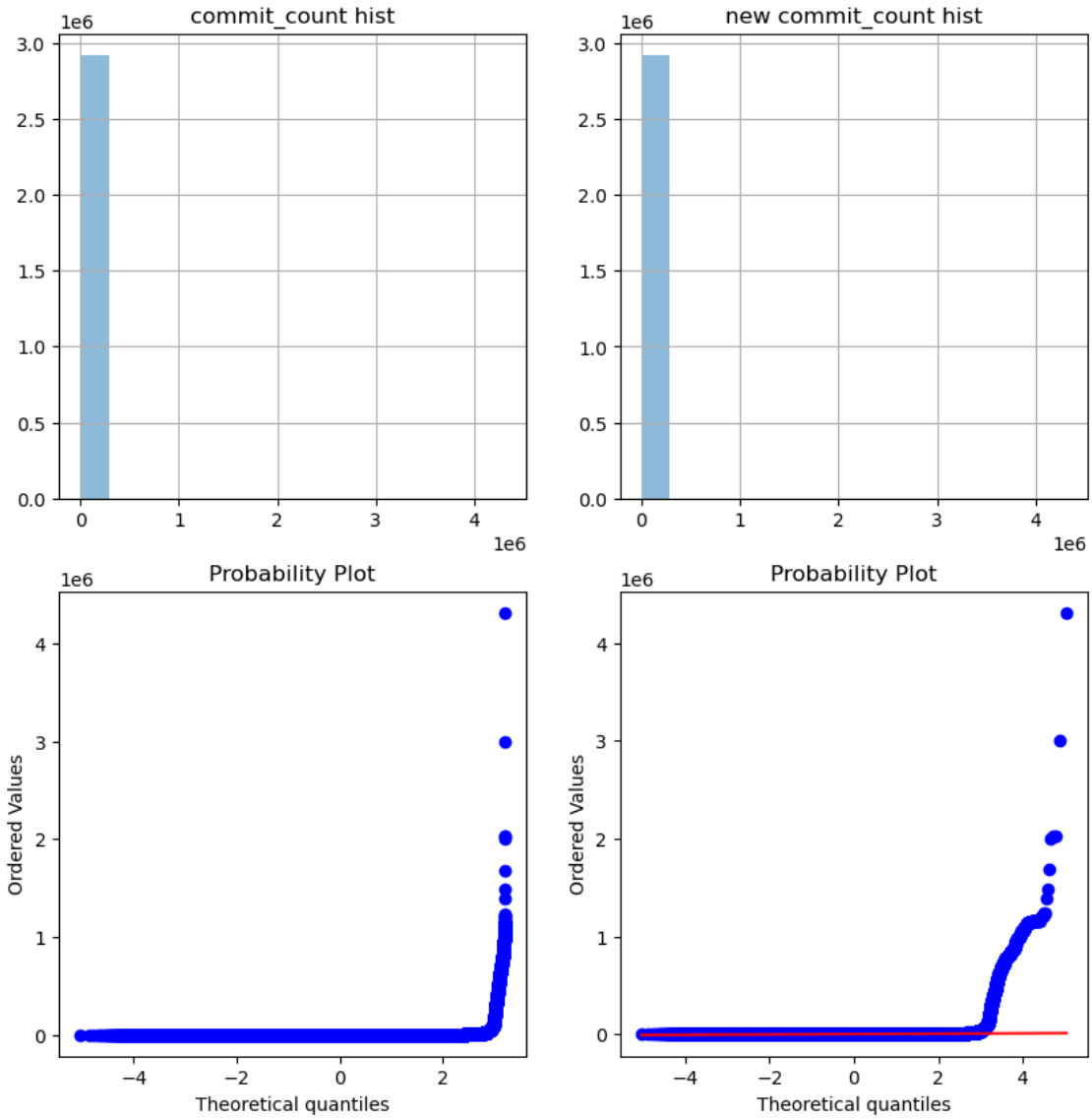
[48]:
```
       commit_count
count    2916030.00
mean         614.37
std        16808.01
min            1.00
25%            9.00
50%           27.00
75%           89.00
max      4314502.00
```

[49]:
```
data_new.describe()# 最高频率来填补缺失值后数据的 5 数概况
```

[49]:
```
count   2917951.00
mean        613.97
std       16802.48
min           1.00
25%           9.00
50%          27.00
75%          89.00
max     4314502.00
Name: commit_count, dtype: float64
```

[50]:
```
# 可视化对比新旧数据
plt.figure(figsize = (10,10))

# 直方图
plt.subplot(2,2,1)
plt.title("commit_count hist")
data['commit_count'].hist(alpha=0.5,bins=15) #alpha 透明度, bins 竖条数
# 直方图
plt.subplot(2,2,2)
plt.title("new commit_count hist")
data_new.hist(alpha=0.5,bins=15) #alpha 透明度, bins 竖条数
```

```
#q-q 图
plt.subplot(2,2,3)
stats.probplot(data['commit_count'],dist="norm",plot=plt)
plt.subplot(2,2,4)
stats.probplot(data_new,dist="norm",plot=plt)

plt.show()
```



[ ]: