```python
import pandas as pd
from mlxtend.preprocessing import TransactionEncoder
from mlxtend.frequent_patterns import apriori, association_rules
from collections import Counter
import matplotlib.pyplot as plt
```

```python
# 1. 数据预处理
# 读取数据集
df = pd.read_csv('anonymous-msweb.data', skiprows=7, header=None)
# 清洗数据，处理缺失值等
# df = df.dropna()
```

```
C:\Users\w2306\AppData\Local\Temp\ipykernel_20600\652027670.py:3: DtypeWarning:
Columns (3,4) have mixed types. Specify dtype option on import or set
low_memory=False.
  df = pd.read_csv('anonymous-msweb.data', skiprows=7, header=None)
```

```python
# 去除引号和逗号
df = df.replace({'"': '', ',': ''}, regex=True)
```

```python
df.head
attribute_lines = df[df[0] == 'A']  # 属性行
other_lines = df[df[0] != 'A']  # 案例行
other_lines.head
```

```
<bound method NDFrame.head of         0      1      2    3    4
294     C  10001  10001  NaN  NaN
295     V   1000      1  NaN  NaN
296     V   1001      1  NaN  NaN
297     V   1002      1  NaN  NaN
298     C  10002  10002  NaN  NaN
...    ..    ...    ...  ...  ...
131654  V   1035      1  NaN  NaN
131655  V   1001      1  NaN  NaN
131656  V   1018      1  NaN  NaN
131657  C  42711  42711  NaN  NaN
131658  V   1008      1  NaN  NaN

[131365 rows x 5 columns]>
```

```python
dic = {x[1]:x[3] for _,x in attribute_lines.iterrows()}
# print(dic)
```

```
cases = []
votes = []
vote = []
case_id = 0
for i, line in other_lines.iterrows():
    if line[0]=='C':
        if len(vote)!=0:
            votes.append(vote)
            cases.append(case_id)
        vote = []
        case_id = line[1]
    else:
        vote.append(dic[line[1]])
votes.append(vote)
cases.append(case_id)
```

```
print(len(cases))
print(len(votes))
```

```
32711
32711
```

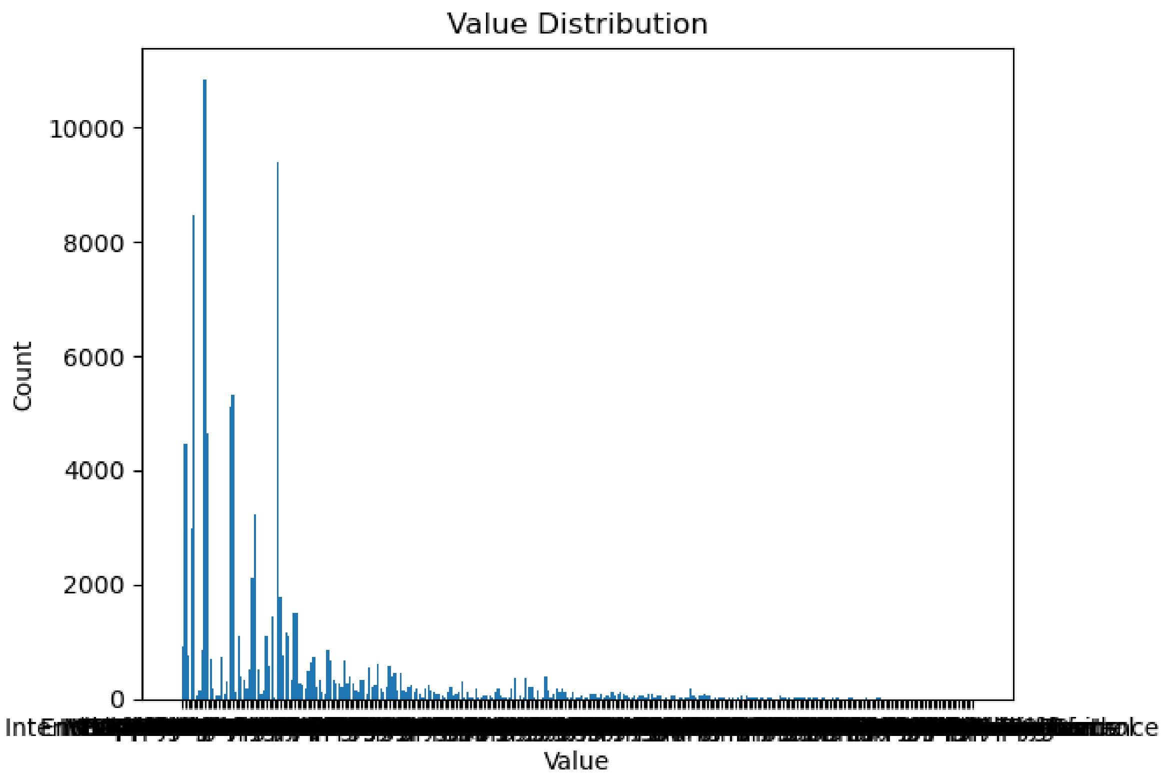
```
print(len(attribute_lines))
# 清洗数据，处理缺失值等
attribute_lines = attribute_lines.dropna()
print(len(attribute_lines))
```

```
294
294
```

```
# 2. 数据探索性分析
# 分析最常被访问的页面

counter = Counter()
# 统计每个子列表中出现的值
for sublist in votes:
    counter.update(sublist)

# 获取出现频率最高的前十个值及其出现次数
most_common_values = counter.most_common(10)

# 打印结果
for value, count in most_common_values:
    print(f"值: {value}, 出现次数: {count}")
```

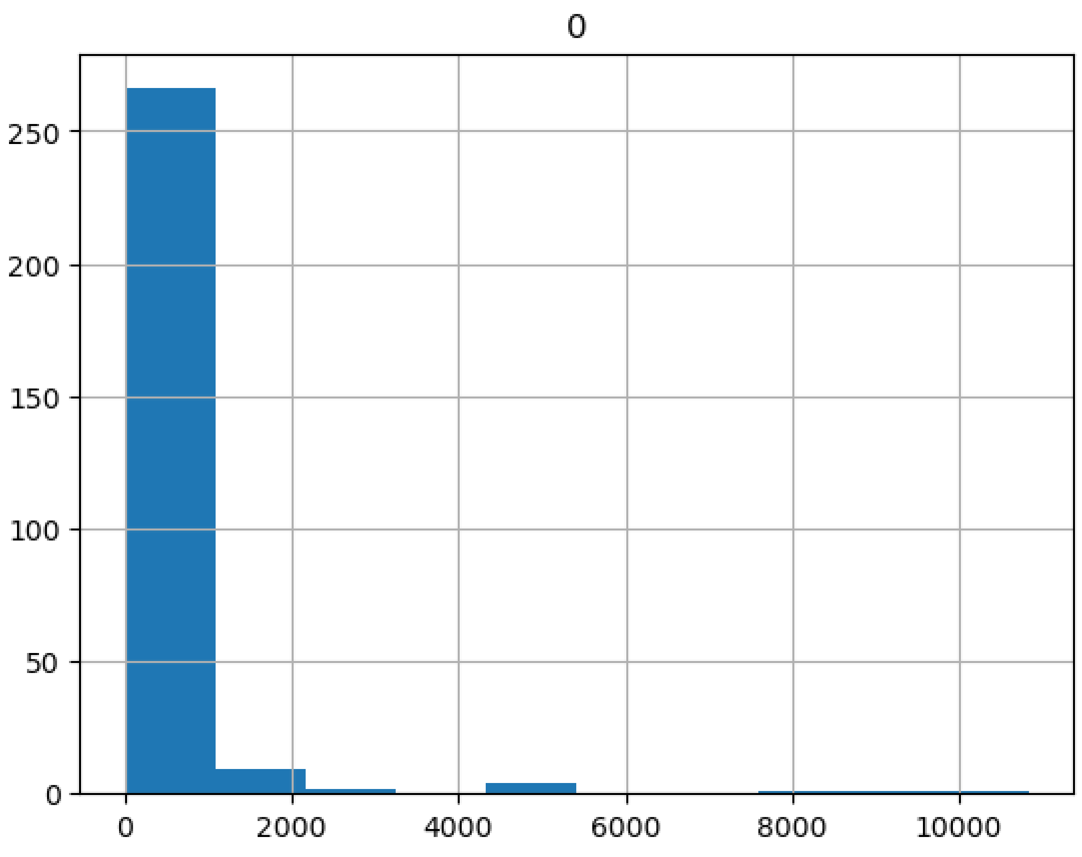
```
值: Free Downloads, 出现次数: 10836
值: Internet Explorer, 出现次数: 9383
值: Microsoft.com Search, 出现次数: 8463
值: isapi, 出现次数: 5330
值: Products , 出现次数: 5108
值: Windows Family of OSs, 出现次数: 4628
值: Support Desktop, 出现次数: 4451
值: Internet Site Construction for Developers, 出现次数: 3220
值: Knowledge Base, 出现次数: 2968
值: Web Site Builder's Gallery, 出现次数: 2123
```

```python
values = counter.keys()
counts = counter.values()

# 绘制柱状图
plt.bar(values, counts)

# 添加标题和轴标签
plt.title('Value Distribution')
plt.xlabel('Value')
plt.ylabel('Count')

# 显示图形
plt.show()
```



```
counts_df = pd.DataFrame(counts)
summary = counts_df.describe()

# 打印统计摘要信息
print(summary)
hist = counts_df.hist()
```

```
                  0
count    284.000000
mean     347.373239
std     1173.084272
min        1.000000
25%       10.000000
50%       46.000000
75%      187.500000
max    10836.000000
```



```
# 3. 关联规则挖掘
# 转换数据格式为TransactionEncoder所需的布尔矩阵形式
te = TransactionEncoder()
te_ary = te.fit_transform(votes)
df_encoded = pd.DataFrame(te_ary, columns=te.columns_)

# 使用Apriori算法计算频繁项集
frequent_itemsets = apriori(df_encoded, min_support=0.03, use_colnames=True)

# 使用关联规则算法计算关联规则
association_results = association_rules(frequent_itemsets, metric="confidence",
min_threshold=0.4)
```

```
print(association_results.head())
```

```
                     antecedents                                consequents  \
0             (Internet Explorer)                          (Free Downloads)
1                (Free Downloads)                       (Internet Explorer)
2          (Windows Family of OSs)                          (Free Downloads)
3                         (isapi)                          (Free Downloads)
4   (Web Site Builder's Gallery)  (Internet Site Construction for Developers)

   antecedent support  consequent support   support  confidence      lift  \
0            0.286845            0.331265  0.160802    0.560588  1.692267
1            0.331265            0.286845  0.160802    0.485419  1.692267
2            0.141481            0.331265  0.077925    0.550778  1.662652
3            0.162942            0.331265  0.073064    0.448405  1.353616
4            0.064902            0.098438  0.035309    0.544041  5.526752

   leverage  conviction  zhangs_metric
0  0.065780    1.521888       0.573616
1  0.065780    1.385894       0.611717
2  0.031057    1.488652       0.464231
3  0.019087    1.212367       0.312091
4  0.028920    1.977290       0.875910
```

```
# 4. 结果评估
# 打印关联规则的支持度、置信度、提升度和确信度
print("关联规则：")
association_results = association_results[['antecedents', 'consequents',
'support', 'confidence', 'lift','conviction']]
print(association_results)
```

```
关联规则：
                            antecedents  \
0                   (Internet Explorer)
1                      (Free Downloads)
2                (Windows Family of OSs)
3                               (isapi)
```

```
4        (Web Site Builder's Gallery)
5                    (Knowledge Base)
6                    (Knowledge Base)
7                   (Support Desktop)
8                    (Knowledge Base)
9                   (Support Desktop)
10                       (Windows 95)
11                 (Windows95 Support)
12                 (Windows95 Support)
13     (Products , Internet Explorer)
14        (Products , Free Downloads)
15            (isapi, Free Downloads)
16     (isapi, Windows Family of OSs)
17            (isapi, Knowledge Base)
18           (isapi, Support Desktop)
19  (Knowledge Base, Support Desktop)

                                 consequents   support  confidence  \
0                           (Free Downloads)  0.160802    0.560588
1                        (Internet Explorer)  0.160802    0.485419
2                           (Free Downloads)  0.077925    0.550778
3                           (Free Downloads)  0.073064    0.448405
4   (Internet Site Construction for Developers)  0.035309    0.544041
5                     (Microsoft.com Search)  0.039161    0.431604
6                          (Support Desktop)  0.055211    0.608491
7                           (Knowledge Base)  0.055211    0.405752
8                                    (isapi)  0.046896    0.516846
9                                    (isapi)  0.059430    0.436756
10                   (Windows Family of OSs)  0.032436    0.914655
11                   (Windows Family of OSs)  0.032833    0.599665
12                                   (isapi)  0.046070    0.841429
13                          (Free Downloads)  0.031732    0.670110
14                       (Internet Explorer)  0.031732    0.518223
15                   (Windows Family of OSs)  0.030265    0.414226
16                          (Free Downloads)  0.030265    0.672554
17                         (Support Desktop)  0.033230    0.708605
18                          (Knowledge Base)  0.033230    0.559156
19                                   (isapi)  0.033230    0.601883

        lift  conviction
0   1.692267    1.521888
1   1.692267    1.385894
2   1.662652    1.488652
3   1.353616    1.212367
4   5.526752    1.977290
5   1.668225    1.304160
6   4.471879    2.206663
7   4.471879    1.530111
8   3.171963    1.732488
9   2.680435    1.486137
10  6.464841   10.059409
11  4.238471    2.144500
12  5.163977    5.278770
13  2.022883    2.027145
14  1.806627    1.480258
```

```
15   2.927775     1.465614
16   2.030263     2.042279
17   5.207633     2.964805
18   6.162589     2.062559
19   3.693843     2.102540
```

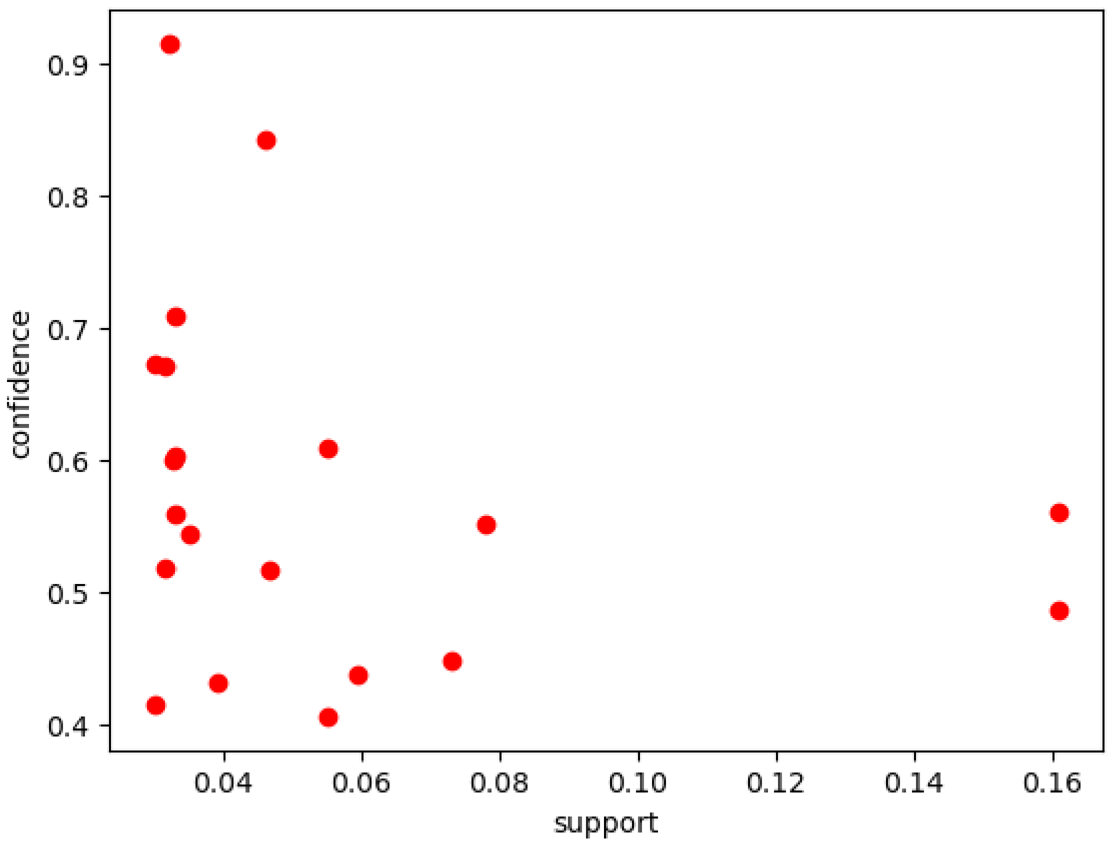
```
# 5. 结果分析与应用
# 根据分析结果提供导航结构优化建议等
```

针对以上实验结果，我们可以得到强相关规则：

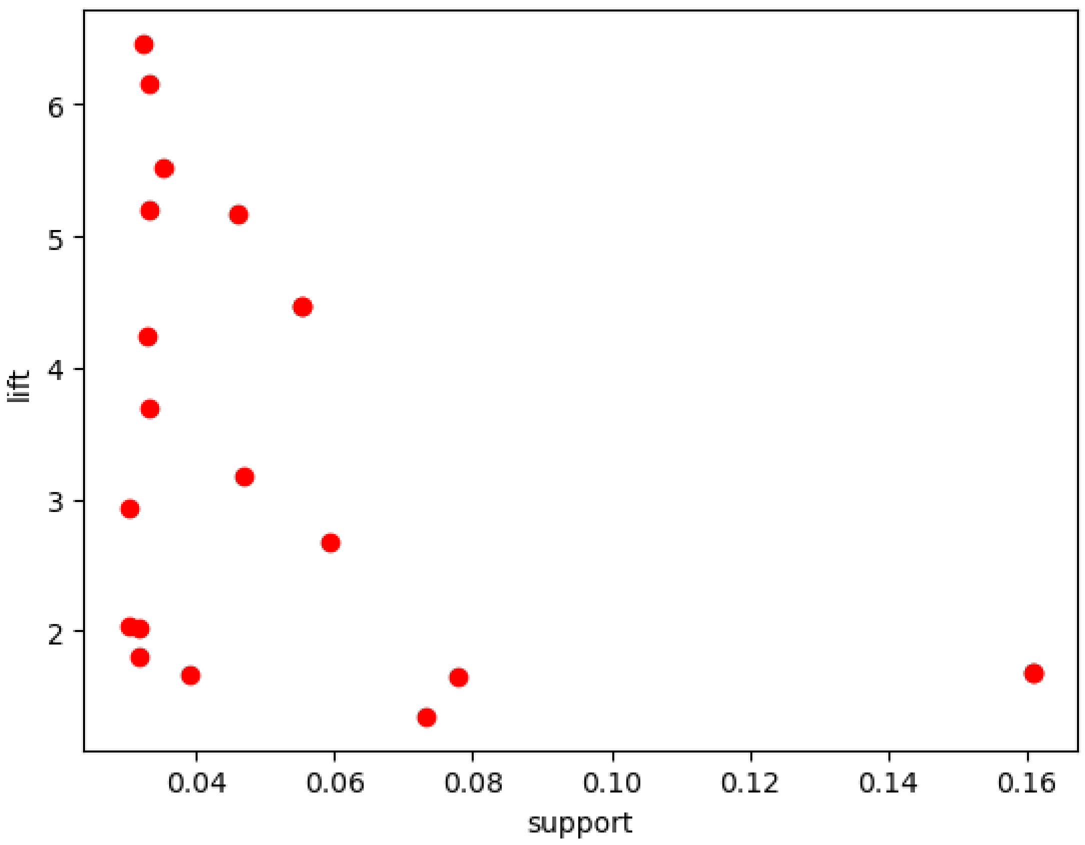
1. Internet Explorer -> Free Downloads
2. Free Downloads -> Internet Explorer
3. Windows Family of OSs -> Free Downloads
4. isapi -> Free Downloads

可以看到Free Downloads的使用度很高，因此可以将其导航设置在更显眼更中心的位置；另外，Free Downloads与Internet Explorer、Support Desktop和Knowledge Base关联度较高，可以将这两个导航设置地更靠近。

```
# 6.可视化展示
# 支持度与置信度关联关系展示
plt.xlabel('support')
plt.ylabel('confidence')
for i in range(association_results.shape[0]):

 plt.scatter(association_results.support[i],association_results.confidence[i],c=
'r')
```



```
# 支持度与lift关联关系展示
plt.xlabel('support')
plt.ylabel('lift')
for i in range(association_results.shape[0]):

 plt.scatter(association_results.support[i],association_results.lift[i],c='r')
```



lift
support
6
5
4
3
2
0.04
0.06
0.08
0.10
0.12
0.14
0.16