In [1]:
```
import pandas as pd
import numpy as np
from scipy import stats
import plotly.express as px
import plotly.graph_objects as go
from plotly.subplots import make_subplots
from tqdm.notebook import tqdm
import re
pd.set_option('max_columns', None)
pd.options.display.max_colwidth = 100
```

In [2]:
```
df = pd.read_csv('data.csv', index_col=0)
df.shape
```

Out[2]:
```
(6643221, 4)
```

We will begin by tallying the number of requests for each unique CID and group them by this count. From there, we can calculate the size of the files within each group, allowing us to understand the distribution of file sizes for the most requested content.

1 Request time

In [3]:
```
df1 = df[['cid','bytes_returned']].groupby('cid').agg(['count','mean'])
df1.columns = df1.columns.get_level_values(1)
df1 = df1.reset_index()
df1['mean'] = df1['mean'].astype(int)
df1 = df1.rename(columns={"mean": "size"})
df1 = df1.sort_values(by=['size'])
df1.head()
```

Out[3]:

	cid	count	size
135800	QmZiZPaXaT4kSJq6gP3GJ8geNSHxEay8U8EigDhr4x39Gb	1	0
106116	QmXEg9JT6dVPMbmYpY8gWKbeD5fJHdUgcZWTHNLPXM9Vxx	1	0
106115	QmXEfjr121xgyXzU7Uu9U3kFeZh8tmThUvzQXtB94pfuAW	1	0
106105	QmXEdbeckJMpEQbpmsANxK7fPQ8LjYjQJA7ZJFRRPQ24ps	1	0
106103	QmXEc8dmxfTBXrUJaYJJEkiwpGXUDifnKQkrkPwv4cUgkY	1	0

In [4]:
```
df2 = pd.DataFrame(df1['count'].value_counts())
df2 = df2.reset_index()
df2 = df2.rename(columns={"index": "request_time"})
df2 = df2.sort_values(by=['request_time'])
df2.head()
```

Out[4]:

	request_time	count
0	1	163887
1	2	35669
2	3	15839
3	4	8458
4	5	5307

In [5]:
```
df3 = pd.DataFrame(columns = ['request_time', 'count'])

def addRow(df3, l, r):
    df_temp = df1[(df1['count'] >= l) & (df1['count'] < r)]
    c = df_temp.count()[0]
    df3 = df3.append({'request_time':'['+str(l)+','+str(r)+')', 'count':c}, ignore_index = True)
    return df3

df3 = addRow(df3, 1, 2)
df3 = addRow(df3, 2, 10)
df3 = addRow(df3, 10, 100)
df3 = addRow(df3, 100, 1000)
df3 = addRow(df3, 1000, 10000)
df3 = addRow(df3, 10000, 100000)

df3 = df3.replace('[1,2)', '1')
df3 = df3.replace('[10000,100000)', '[10000,+∞)')

total = df3['count'].sum()
df3['percentage'] = df3['count']/total
df3.head()
```

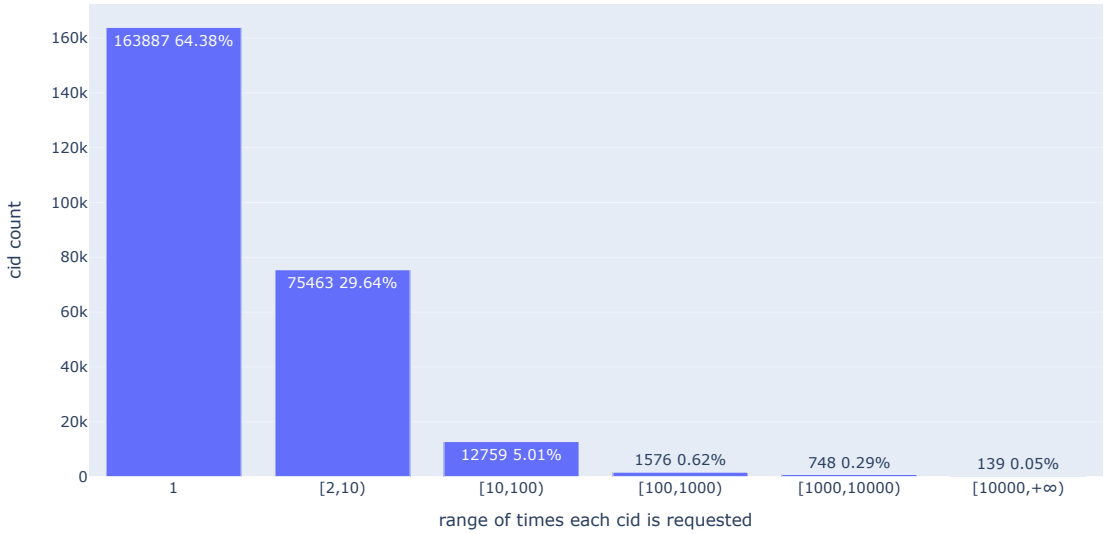
Out[5]:

	request_time	count	percentage
0	1	163887	0.643775
1	[2,10)	75463	0.296431
2	[10,100)	12759	0.050119
3	[100,1000)	1576	0.006191
4	[1000,10000)	748	0.002938

In [6]:
```
fig = px.bar(df3, x='request_time', y='count', text=[str(x[0])+'\n{0:1.2f}%'.format(x[1]*100) for x in zip(df3['count'],df3['p

fig.update_xaxes(title='range of times each cid is requested')
fig.update_yaxes(title='cid count')

fig.show()
```



In [7]:
```
df5 = df1.copy()

df5['type'] = ''

def addType(l, r):
    df5.loc[(df5['count'] >= l) & (df5['count'] < r), 'type'] = '['+str(l)+','+str(r)+')'

df5.loc[df5['count'] == 1, 'type'] = '1'
addType(2, 10)
addType(10, 100)
addType(100, 1000)
addType(1000, 10000)
df5.loc[df5['count'] > 10000, 'type'] = '[10000,+∞)'

df5.head()
```

Out[7]:

	cid	count	size	type
135800	QmZiZPaXaT4kSJq6gP3GJ8geNSHxEay8U8EigDhr4x39Gb	1	0	1
106116	QmXEg9JT6dVPMbmYpY8gWKbeD5fJHdUgcZWTHNLPXM9Vxx	1	0	1
106115	QmXEfjr121xgyXzU7Uu9U3kFeZh8tmThUvzQXtB94pfuAW	1	0	1
106105	QmXEdbeckJMpEQbpmsANxK7fPQ8LjYjQJA7ZJFRRPQ24ps	1	0	1
106103	QmXEc8dmxfTBXrUJaYJJEkiwpGXUDifnKQkrkPwv4cUgkY	1	0	1

In [8]:
```
def q1(x):
    return x.quantile(0.01)

def q10(x):
    return x.quantile(0.1)

def q90(x):
    return x.quantile(0.9)

def q99(x):
    return x.quantile(0.99)


df6 = df5[['type','size']].groupby('type').agg(['min',q1,q10,'median',q90,q99,'max'])
df6_MB = df6/pow(1024,2)
df6_MB
```

Out[8]:

	size						
	min	q1	q10	median	q90	q99	max
type							
1	0.000000	0.000000	0.000000	0.001406	1.003116	12.203519	2639.354151
[10,100)	0.000000	0.000000	0.000277	0.179795	3.091456	17.519571	69.371615
[100,1000)	0.000000	0.000112	0.000517	0.594907	1.800844	6.266561	41.171799
[1000,10000)	0.000003	0.000156	0.003378	0.801641	1.223510	2.195043	11.552380
[10000,+∞)	0.000088	0.000134	0.370026	0.885081	1.384316	2.066542	2.392586
[2,10)	0.000000	0.000000	0.000079	0.110648	2.210935	14.340477	1590.445610

In [9]:
```
data = df5[['type','size']]
data['size'] = data['size']/1024

fig = px.box(data, x="type", y="size", log_y=True)
fig.update_xaxes(title='range of times each cid is requested')
fig.update_yaxes(title='file size in KB (log scale)')
fig.show()
```

```
/var/folders/gh/hc3npzks3hq9y6jtyp23d8jm0000gn/T/ipykernel_3568/1664295758.py:2: SettingWithCopyWarning:


A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)
```