分　数：	
评卷人：	

華中科技大學

研究生（数据中心技术）课程实验（报告）

学　　号　M202173482

姓　　名　张婧

专　　业　电子信息

课程指导教师　施展 童薇

院（系、所）　武汉光电国家研究中心

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1. 实验一：系统搭建

启动 minio：如图所示。

```
Last login: Tue Jan  4 10:54:29 on ttys000
[zhangjing@zhangjingdeMacBook-Pro ~ % cd /Users/zhangjing/Desktop/MInio
[zhangjing@zhangjingdeMacBook-Pro MInio % ./run-minio.sh

You are running an older version of MinIO released 1 month ago
Update: Run `mc admin update`

API: http://10.19.74.142:9000  http://127.0.0.1:9000
RootUser: hust
RootPass: hust_obs

Console: http://10.19.74.142:9090 http://127.0.0.1:9090
RootUser: hust
RootPass: hust_obs

Command-line: https://docs.min.io/docs/minio-client-quickstart-guide
   $ mc alias set myminio http://10.19.74.142:9000 hust hust_obs

Documentation: https://docs.min.io
```

图 1 启动 MInio

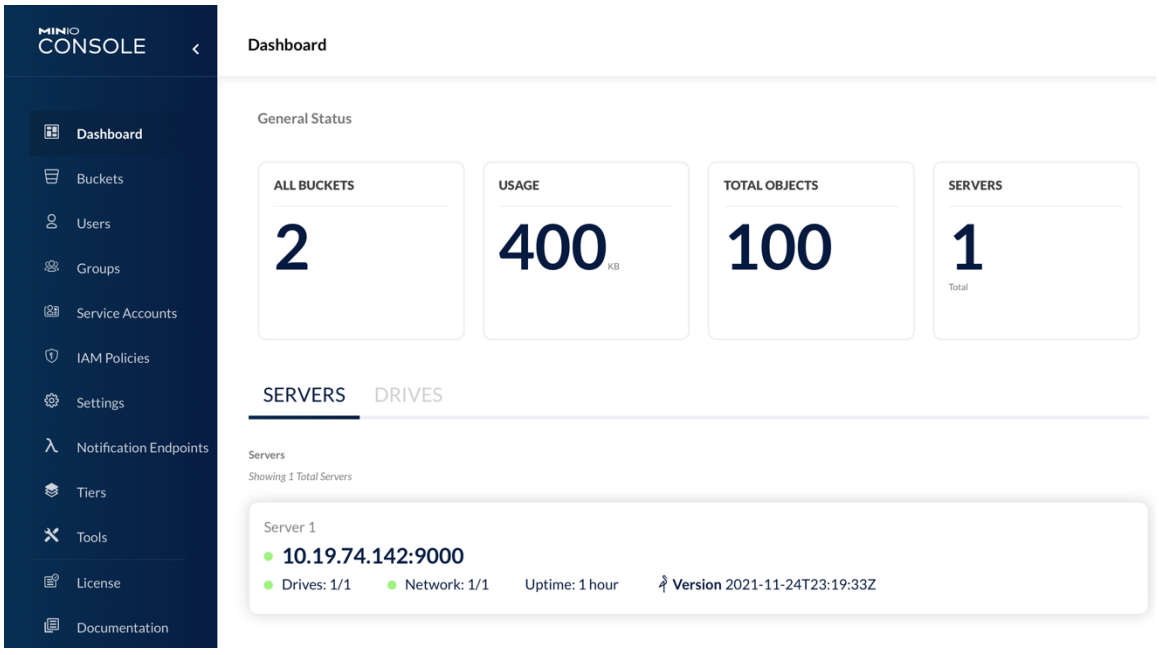

图 2 Minio 客户端

2. 实验二：性能观测

通过 s3bench 向 minio 发送请求

```
[zhangjing@zhangjingdeMacBook-Pro ~ % cd /Users/zhangjing/go/bin                ]
[zhangjing@zhangjingdeMacBook-Pro bin % ././run-s3bench.sh                      ]
Test parameters
endpoint(s):      [http://127.0.0.1:9000]
bucket:           loadgen
objectNamePrefix: loadgen
objectSize:       0.0312 MB
numClients:       8
numSamples:       256
verbose:       %!d(bool=false)


Generating in-memory sample data... Done (217.193µs)

Running Write test...

Running Read test...

Test parameters
endpoint(s):      [http://127.0.0.1:9000]
bucket:           loadgen
objectNamePrefix: loadgen
objectSize:       0.0312 MB
numClients:       8
numSamples:       256
verbose:       %!d(bool=false)


Results Summary for Write Operation(s)
Total Transferred: 0.000 MB
Total Throughput:  0.00 MB/s
Total Duration:    0.105 s
Number of Errors:  256


Results Summary for Read Operation(s)
Total Transferred: 0.000 MB
Total Throughput:  0.00 MB/s
Total Duration:    0.063 s
Number of Errors:  256


Cleaning up 256 objects...
Deleting a batch of 256 objects in range {0, 255}... Failed (NoSuchBucket: The s
pecified bucket does not exist
        status code: 404, request id: 16BD788996E930B0, host id: )
Successfully deleted 0/256 objects in 3.007342ms
```

图 3 未创建 loadgen Buckets 导致的带宽为 0

```
zhangjing@zhangjingdeMacBook-Pro bin % ././run-s3bench.sh
Test parameters
endpoint(s):      [http://127.0.0.1:9000]
bucket:           loadgen
objectNamePrefix: loadgen
objectSize:       0.0312 MB
numClients:       8
numSamples:       256
verbose:       %!d(bool=false)


Generating in-memory sample data... Done (343.352µs)

Running Write test...

Running Read test...

Test parameters
endpoint(s):      [http://127.0.0.1:9000]
bucket:           loadgen
objectNamePrefix: loadgen
objectSize:       0.0312 MB
numClients:       8
numSamples:       256
verbose:       %!d(bool=false)


Results Summary for Write Operation(s)
Total Transferred: 8.000 MB
Total Throughput:  40.31 MB/s
Total Duration:    0.198 s
Number of Errors:  0
------------------------------------
Write times Max:       0.036 s
Write times 99th %ile: 0.029 s
Write times 90th %ile: 0.009 s
Write times 75th %ile: 0.007 s
Write times 50th %ile: 0.005 s
Write times 25th %ile: 0.004 s
Write times Min:       0.002 s


Results Summary for Read Operation(s)
Total Transferred: 8.000 MB
Total Throughput:  68.58 MB/s
Total Duration:    0.117 s
Number of Errors:  0
------------------------------------
Read times Max:       0.034 s
Read times 99th %ile: 0.016 s
Read times 90th %ile: 0.006 s
Read times 75th %ile: 0.004 s
Read times 50th %ile: 0.003 s
Read times 25th %ile: 0.002 s
Read times Min:       0.001 s


Cleaning up 256 objects...
Deleting a batch of 256 objects in range {0, 255}... Succeeded
Successfully deleted 256/256 objects in 330.606613ms
zhangjing@zhangjingdeMacBook-Pro bin %
```

图 4

3. 不同负载下指标、延迟的分布

更改负载，修改对象大小：1024，2048，4096以及对象数量256，512，1024，通过s3bench向minio发送请求，观测延迟分布

```
Test parameters
endpoint(s):      [http://127.0.0.1:9000]
bucket:           loadgen
objectNamePrefix: loadgen
objectSize:       0.0625 MB
numClients:       8
numSamples:       512
verbose:       %!d(bool=false)


Results Summary for Write Operation(s)
Total Transferred: 32.000 MB
Total Throughput:  72.40 MB/s
Total Duration:    0.442 s
Number of Errors:  0
-----------------------------------
Write times Max:       0.127 s
Write times 99th %ile: 0.098 s
Write times 90th %ile: 0.010 s
Write times 75th %ile: 0.006 s
Write times 50th %ile: 0.005 s
Write times 25th %ile: 0.003 s
Write times Min:       0.002 s


Results Summary for Read Operation(s)
Total Transferred: 32.000 MB
Total Throughput:  180.86 MB/s
Total Duration:    0.177 s
Number of Errors:  0
-----------------------------------
Read times Max:       0.034 s
Read times 99th %ile: 0.013 s
Read times 90th %ile: 0.005 s
Read times 75th %ile: 0.003 s
Read times 50th %ile: 0.002 s
Read times 25th %ile: 0.001 s
Read times Min:       0.001 s


Cleaning up 512 objects...
Deleting a batch of 512 objects in range {0, 511}... Succeeded
Successfully deleted 512/512 objects in 508.883988ms
```

图5 数量：512，大小2048KB

```
Test parameters
endpoint(s):      [http://127.0.0.1:9000]
bucket:           loadgen
objectNamePrefix: loadgen
objectSize:       0.0625 MB
numClients:       8
numSamples:       512
verbose:       %!d(bool=false)


Results Summary for Write Operation(s)
Total Transferred: 32.000 MB
Total Throughput:  84.68 MB/s
Total Duration:    0.378 s
Number of Errors:  0
------------------------------------
Write times Max:       0.034 s
Write times 99th %ile: 0.022 s
Write times 90th %ile: 0.009 s
Write times 75th %ile: 0.007 s
Write times 50th %ile: 0.005 s
Write times 25th %ile: 0.004 s
Write times Min:       0.002 s


Results Summary for Read Operation(s)
Total Transferred: 32.000 MB
Total Throughput:  185.56 MB/s
Total Duration:    0.172 s
Number of Errors:  0
------------------------------------
Read times Max:       0.031 s
Read times 99th %ile: 0.015 s
Read times 90th %ile: 0.005 s
Read times 75th %ile: 0.003 s
Read times 50th %ile: 0.002 s
Read times 25th %ile: 0.001 s
Read times Min:       0.001 s


Cleaning up 512 objects...
Deleting a batch of 512 objects in range {0, 511}... Succeeded
Successfully deleted 512/512 objects in 529.257556ms
```

图6 数量：1024，大小4096KB

从图中可以看出存在一部分的写请求的开销远远超过其他写请求，就是尾延迟现象。

4. 观测尾延迟

运行 obs-tutorial 中的 python 脚本,得到结果如下：

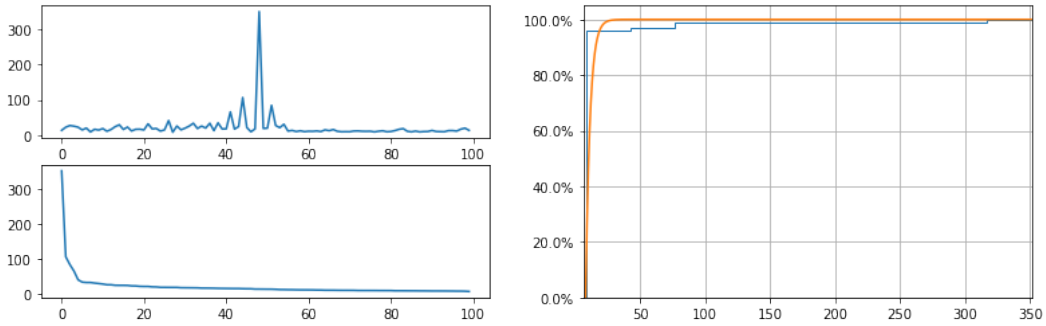

图 7 尾延迟观测

5. 尝试对冲请求

从上图的运行结果来看，大约 95%的数据都可以在 45ms 内完成

因此设置 45ms 作为界限，如果请求的时间超过 45ms，那么就认定为失败，再发送一个相同的请求，实验结果如下：

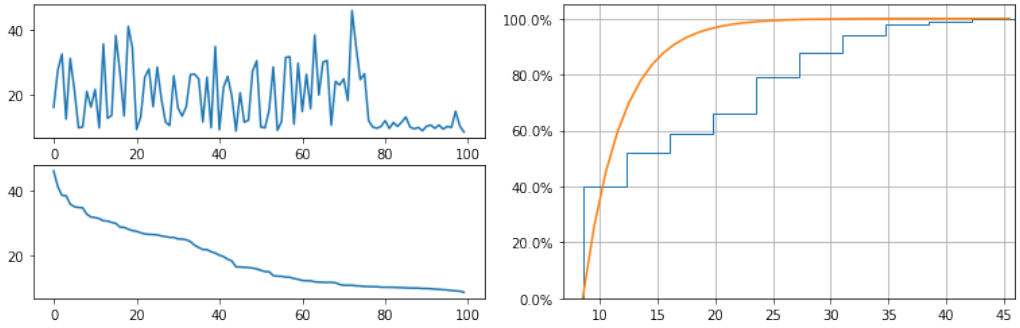

图 8 对冲请求后的尾延迟观测

在本环境中，此方法下 99%的请求都可以在 45ms 内发送出去，比之前的结果好了很多。