

华中科技大学

数据中心技术课程实验报告

院 系 计算机科学与技术学院

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1 实验目的

- (1) 熟悉性能指标，包括吞吐率、带宽和延迟；
- (2) 分析不同负载下的指标、延迟的分布；
- (3) 观测尾延迟现象；
- (4) 尝试对冲请求方案。

2 实验环境

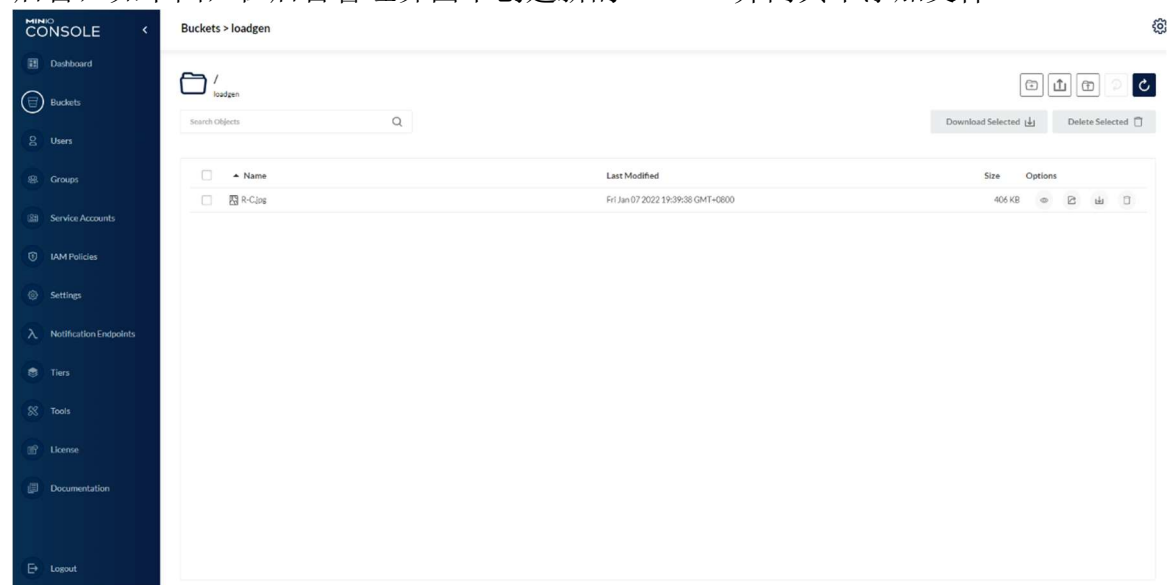
实验所使用的软硬件环境为：

- (1) 处理器：Intel(R) Core(TM) i7-7700 CPU @ 3.60GHz 3.60 GHz
- (2) 操作系统：Windows 10 专业版 21H1

3 实验内容

3.1 Minio 配置

下载最新版本的 Minio，在 cmd 中运行 run-minio 脚本，再从浏览器进入 Minio 后台，如下图，在后台管理界面中创建新的 bucket 并向其中添加文件。



3.2 系统吞吐率和时延测试

利用 s3bench 工具测试系统的相关指标，如吞吐率和时延，结果如下。

```

Test parameters
endpoint(s):      [http://127.0.0.1:9000]
bucket:           loadgen
objectNamePrefix: loadgen
objectSize:       0.0010 MB
numClients:       8
numSamples:       256
verbose:          %!d(bool=false)

Results Summary for Write Operation(s)
Total Transferred: 0.250 MB
Total Throughput:  0.03 MB/s
Total Duration:    9.532 s
Number of Errors:  0
-----
Write times Max:    0.782 s
Write times 99th %ile: 0.719 s
Write times 90th %ile: 0.400 s
Write times 75th %ile: 0.348 s
Write times 50th %ile: 0.277 s
Write times 25th %ile: 0.233 s
Write times Min:    0.077 s

Results Summary for Read Operation(s)
Total Transferred: 0.250 MB
Total Throughput:  3.09 MB/s
Total Duration:    0.081 s
Number of Errors:  0
-----
Read times Max:     0.013 s
Read times 99th %ile: 0.011 s
Read times 90th %ile: 0.004 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

```

3.3 不同负载下的测试结果

当 objectSize 固定为 0.001MB 时，测试 numSamples 分别为 128、256、512 时的结果，如下所示。

Test parameters	Test parameters	Test parameters
endpoint(s): [http://127.0.0.1:9000]	endpoint(s): [http://127.0.0.1:9000]	endpoint(s): [http://127.0.0.1:9000]
bucket: loadgen	bucket: loadgen	bucket: loadgen
objectNamePrefix: loadgen	objectNamePrefix: loadgen	objectNamePrefix: loadgen
objectSize: 0.0010 MB	objectSize: 0.0010 MB	objectSize: 0.0010 MB
numClients: 8	numClients: 8	numClients: 8
numSamples: 128	numSamples: 256	numSamples: 512
verbose: %!d(bool=false)	verbose: %!d(bool=false)	verbose: %!d(bool=false)
Results Summary for Write Operation(s)	Results Summary for Write Operation(s)	Results Summary for Write Operation(s)
Total Transferred: 0.125 MB	Total Transferred: 0.250 MB	Total Transferred: 0.500 MB
Total Throughput: 0.03 MB/s	Total Throughput: 0.03 MB/s	Total Throughput: 0.03 MB/s
Total Duration: 4.157 s	Total Duration: 9.532 s	Total Duration: 17.706 s
Number of Errors: 0	Number of Errors: 0	Number of Errors: 0
Write times Max: 0.445 s	Write times Max: 0.782 s	Write times Max: 0.508 s
Write times 99th %ile: 0.425 s	Write times 99th %ile: 0.719 s	Write times 99th %ile: 0.445 s
Write times 90th %ile: 0.364 s	Write times 90th %ile: 0.400 s	Write times 90th %ile: 0.360 s
Write times 75th %ile: 0.287 s	Write times 75th %ile: 0.348 s	Write times 75th %ile: 0.315 s
Write times 50th %ile: 0.249 s	Write times 50th %ile: 0.277 s	Write times 50th %ile: 0.266 s
Write times 25th %ile: 0.208 s	Write times 25th %ile: 0.233 s	Write times 25th %ile: 0.229 s
Write times Min: 0.039 s	Write times Min: 0.077 s	Write times Min: 0.086 s
Results Summary for Read Operation(s)	Results Summary for Read Operation(s)	Results Summary for Read Operation(s)
Total Transferred: 0.125 MB	Total Transferred: 0.250 MB	Total Transferred: 0.500 MB
Total Throughput: 1.50 MB/s	Total Throughput: 3.09 MB/s	Total Throughput: 4.07 MB/s
Total Duration: 0.083 s	Total Duration: 0.081 s	Total Duration: 0.123 s
Number of Errors: 0	Number of Errors: 0	Number of Errors: 0
Read times Max: 0.026 s	Read times Max: 0.013 s	Read times Max: 0.015 s
Read times 99th %ile: 0.025 s	Read times 99th %ile: 0.011 s	Read times 99th %ile: 0.010 s
Read times 90th %ile: 0.011 s	Read times 90th %ile: 0.004 s	Read times 90th %ile: 0.003 s
Read times 75th %ile: 0.006 s	Read times 75th %ile: 0.003 s	Read times 75th %ile: 0.002 s
Read times 50th %ile: 0.003 s	Read times 50th %ile: 0.002 s	Read times 50th %ile: 0.001 s
Read times 25th %ile: 0.002 s	Read times 25th %ile: 0.001 s	Read times 25th %ile: 0.001 s
Read times Min: 0.001 s	Read times Min: 0.001 s	Read times Min: 0.000 s

当 numSamples 固定为 256 时，测试 objectSize 分别为 0.0005MB、0.001MB、0.002MB 时的结果，如下图所示。

```

Test parameters
endpoint(s): [http://127.0.0.1:9000]
bucket: loadgen
objectNamePrefix: loadgen
objectSize: 0.0005 MB
numClients: 8
numSamples: 256
verbose: %!d(bool=false)

Results Summary for Write Operation(s)
Total Transferred: 0.125 MB
Total Throughput: 0.01 MB/s
Total Duration: 11.682 s
Number of Errors: 0

Write times Max: 0.608 s
Write times 99th %ile: 0.576 s
Write times 90th %ile: 0.475 s
Write times 75th %ile: 0.424 s
Write times 50th %ile: 0.369 s
Write times 25th %ile: 0.300 s
Write times Min: 0.096 s

Results Summary for Read Operation(s)
Total Transferred: 0.125 MB
Total Throughput: 2.18 MB/s
Total Duration: 0.057 s
Number of Errors: 0

Read times Max: 0.005 s
Read times 99th %ile: 0.005 s
Read times 90th %ile: 0.003 s
Read times 75th %ile: 0.002 s
Read times 50th %ile: 0.002 s
Read times 25th %ile: 0.001 s
Read times Min: 0.001 s

```

```

Test parameters
endpoint(s): [http://127.0.0.1:9000]
bucket: loadgen
objectNamePrefix: loadgen
objectSize: 0.0010 MB
numClients: 8
numSamples: 256
verbose: %!d(bool=false)

Results Summary for Write Operation(s)
Total Transferred: 0.250 MB
Total Throughput: 0.03 MB/s
Total Duration: 9.532 s
Number of Errors: 0

Write times Max: 0.782 s
Write times 99th %ile: 0.719 s
Write times 90th %ile: 0.400 s
Write times 75th %ile: 0.348 s
Write times 50th %ile: 0.277 s
Write times 25th %ile: 0.233 s
Write times Min: 0.077 s

Results Summary for Read Operation(s)
Total Transferred: 0.250 MB
Total Throughput: 3.09 MB/s
Total Duration: 0.081 s
Number of Errors: 0

Read times Max: 0.013 s
Read times 99th %ile: 0.011 s
Read times 90th %ile: 0.004 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

```

```

Test parameters
endpoint(s): [http://127.0.0.1:9000]
bucket: loadgen
objectNamePrefix: loadgen
objectSize: 0.0020 MB
numClients: 8
numSamples: 256
verbose: %!d(bool=false)

Results Summary for Write Operation(s)
Total Transferred: 0.500 MB
Total Throughput: 0.05 MB/s
Total Duration: 9.248 s
Number of Errors: 0

Write times Max: 0.625 s
Write times 99th %ile: 0.506 s
Write times 90th %ile: 0.395 s
Write times 75th %ile: 0.339 s
Write times 50th %ile: 0.272 s
Write times 25th %ile: 0.227 s
Write times Min: 0.091 s

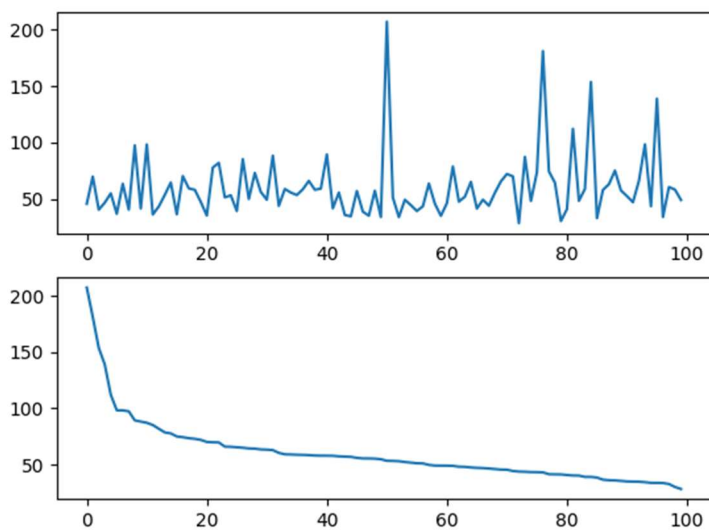
Results Summary for Read Operation(s)
Total Transferred: 0.500 MB
Total Throughput: 8.92 MB/s
Total Duration: 0.056 s
Number of Errors: 0

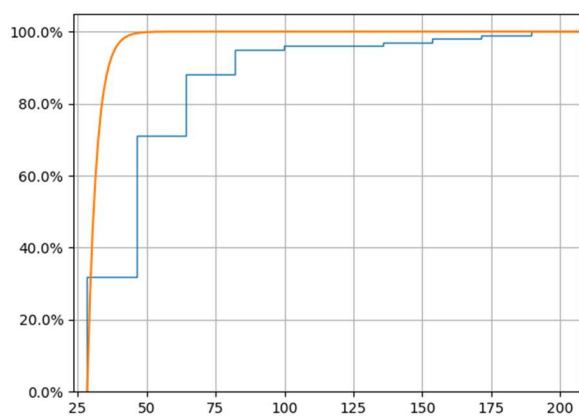
Read times Max: 0.006 s
Read times 99th %ile: 0.006 s
Read times 90th %ile: 0.003 s
Read times 75th %ile: 0.002 s
Read times 50th %ile: 0.001 s
Read times 25th %ile: 0.001 s
Read times Min: 0.001 s

```

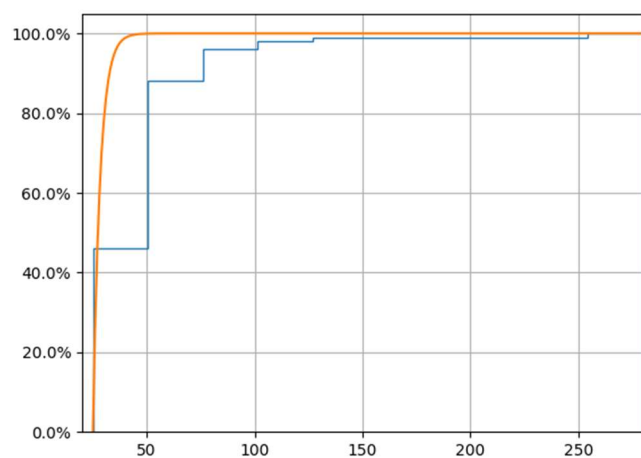
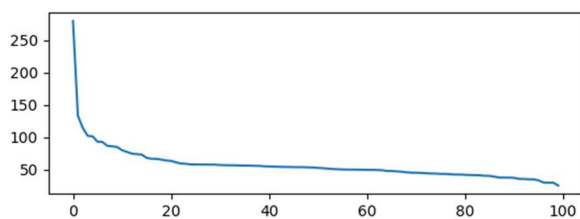
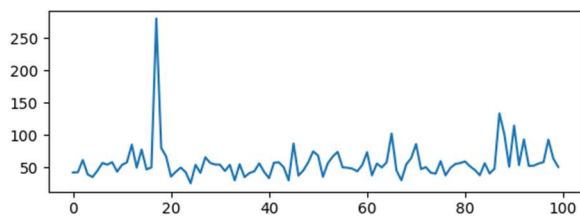
3.4 对冲请求

根据下图所示的结果，在 50ms 内大约有 70%的数据可以完成传输。





设置 50ms 为界限，当请求时间超过 50ms，认定请求失败，再发送一个相同请求，结果如下图。



可以看出 50ms 内接近 90%的请求都能发送，结果好于前者。