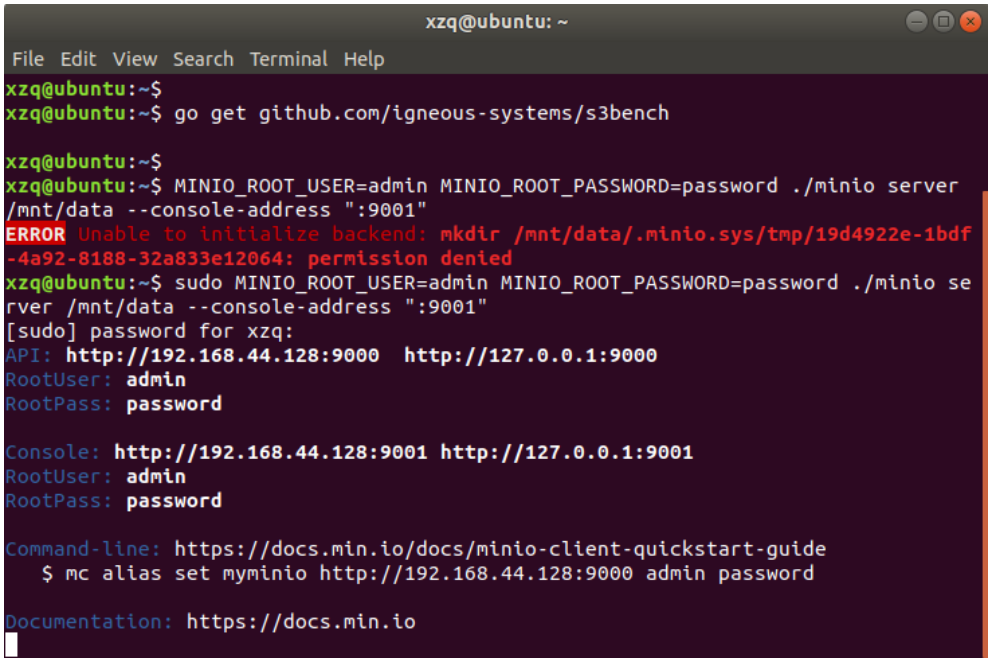
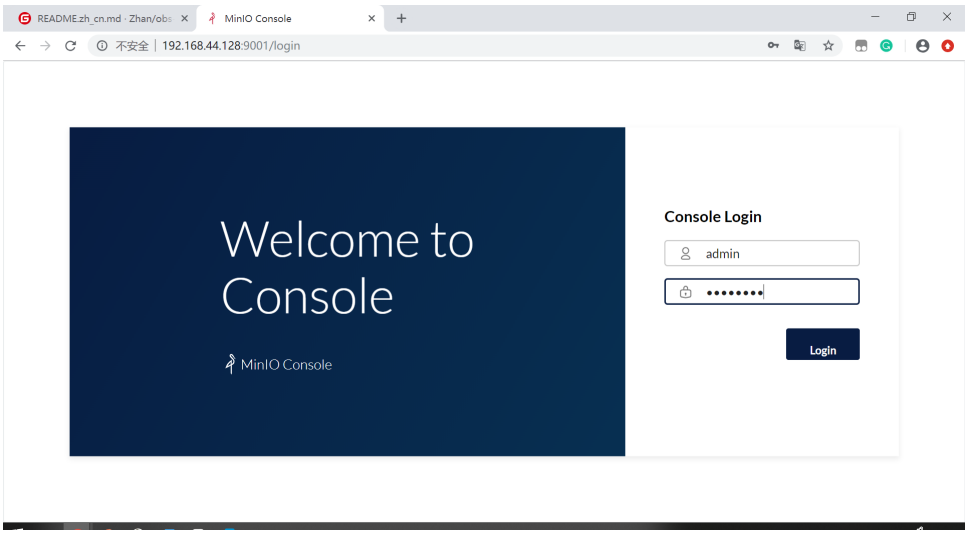
实验一：系统搭建

在Linux虚拟机（Ubuntu 18.04.5）中搭建minio服务器

```
wget https://dl.min.io/server/minio/release/linux-amd64/minio
chmod +x minio
MINIO_ROOT_USER=admin MINIO_ROOT_PASSWORD=password ./minio server /mnt/data --
console-address ":9001"
```



在内网中的浏览器地址栏输入地址，访问客户端。

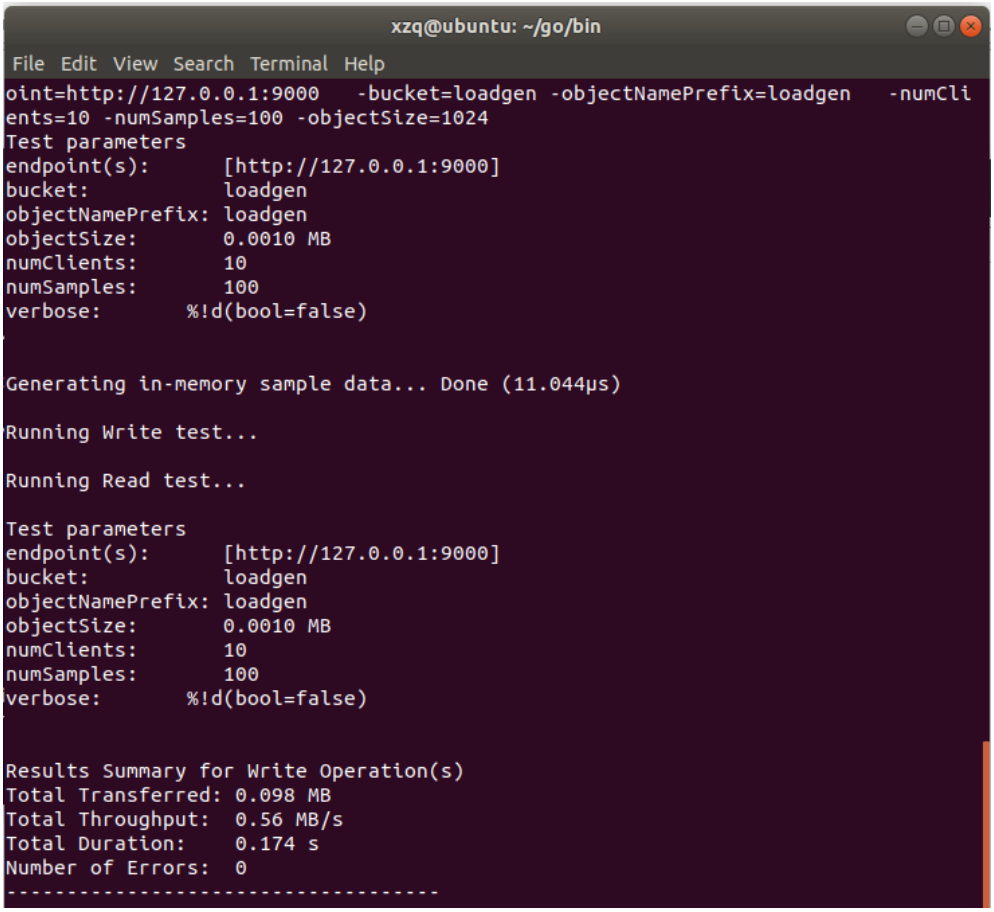


实验二：性能观测

配置go环境，新建一个bucket，使用s3bench作为性能测试工具，配置bucket、objectSize等参数运行命令。

```
s3bench \
    -accessKey=admin \
    -accessSecret=password \
    -bucket=loadgen \
    -endpoint=http://127.0.0.1:9000 \
    -numClients=10 \
    -numSamples=100 \
    -objectNamePrefix=loadgen \
    -objectSize=1024
```

> go的编译需要在连得上github的网络环境下进行。

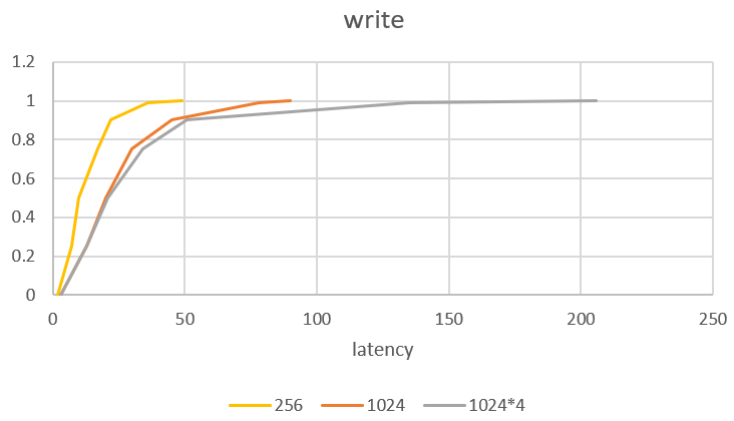


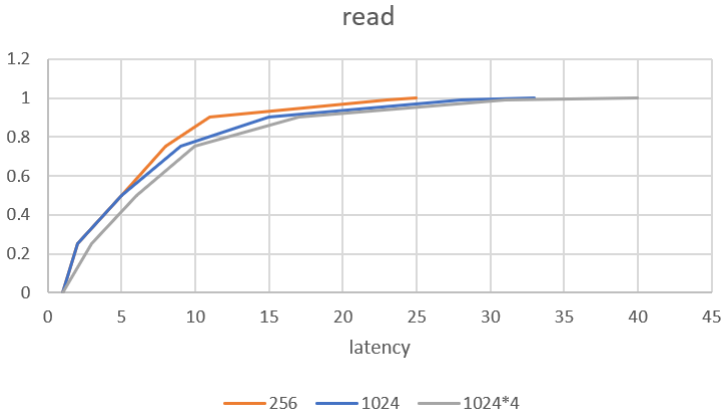
写操作最大的耗时为44ms，最小仅为4ms；90%的写操作在29ms内完成，吞吐量为56MB/s，可以看出一定的长尾效应。同理，读操作结果如下图所示。

```
xzq@ubuntu: ~/go/bin
File  Edit  View  Search  Terminal  Help
numClients:       10
numSamples:       100
verbose:       %!d(bool=false)


Results Summary for Write Operation(s)
Total Transferred: 0.098 MB
Total Throughput:  0.56 MB/s
Total Duration:    0.174 s
Number of Errors:  0
------------------------------------
Write times Max:       0.044 s
Write times 99th %ile: 0.044 s
Write times 90th %ile: 0.029 s
Write times 75th %ile: 0.021 s
Write times 50th %ile: 0.015 s
Write times 25th %ile: 0.010 s
Write times Min:       0.004 s


Results Summary for Read Operation(s)
Total Transferred: 0.098 MB
Total Throughput:  0.92 MB/s
Total Duration:    0.106 s
Number of Errors:  0
------------------------------------
Read times Max:       0.035 s
Read times 99th %ile: 0.035 s
Read times 90th %ile: 0.026 s
Read times 75th %ile: 0.016 s
Read times 50th %ile: 0.006 s
Read times 25th %ile: 0.003 s
Read times Min:       0.001 s


Cleaning up 100 objects...
Deleting a batch of 100 objects in range {0, 99}... Succeeded
Successfully deleted 100/100 objects in 52.388742ms
xzq@ubuntu:~/go/bin$
```

修改参数，绘制曲线，结果如图表所示。可以看出对象尺寸越大，长尾现象越明显，吞吐量越大。

> 指标：吞吐率*Throughput*、延迟*Latency*，以及环境参数：对象尺寸*object size*、并发性、服务器数量。

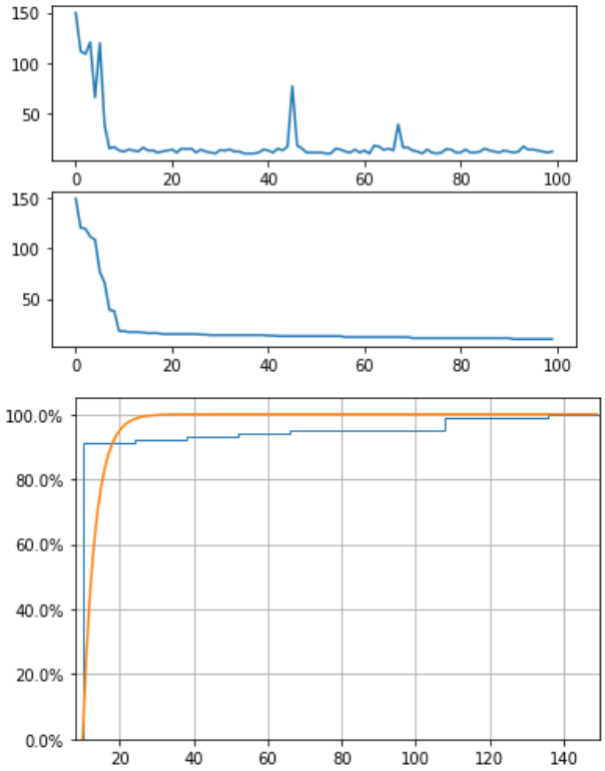




throughput	256	1024	1024*4
write	0.18	0.67	2.00
read	0.062	1.36	2.15

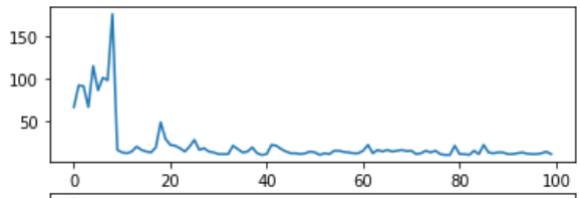
实验三：尾延迟挑战

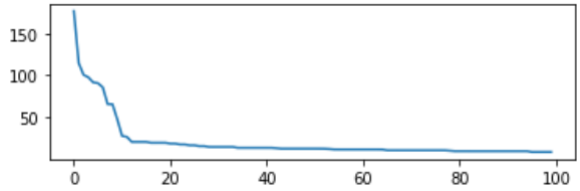
修改并运行python脚本，当有100个上传项时，尾延迟分布数据以及排队论模型拟合如下图所示，小部分的数据的写用时远超其他数据。

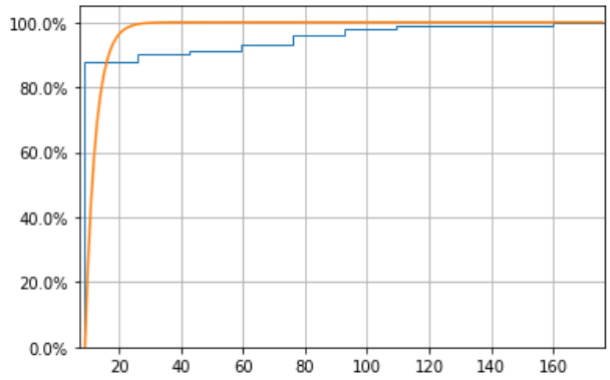


尝试对冲请求，客户端一旦收到第一个结果则取消发送剩余请求，结果如下图所示。

> 依旧存在尾延迟，但延迟有所改善。


150
100
50
0
20
40
60
80
100


150
100
50
0
20
40
60
80
100


100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
20
40
60
80
100
120
140
160