COEN 241
Cloud Computing
HOMEWORK-1
SYSTEM VS OS VIRTUALIZATION
REPORT

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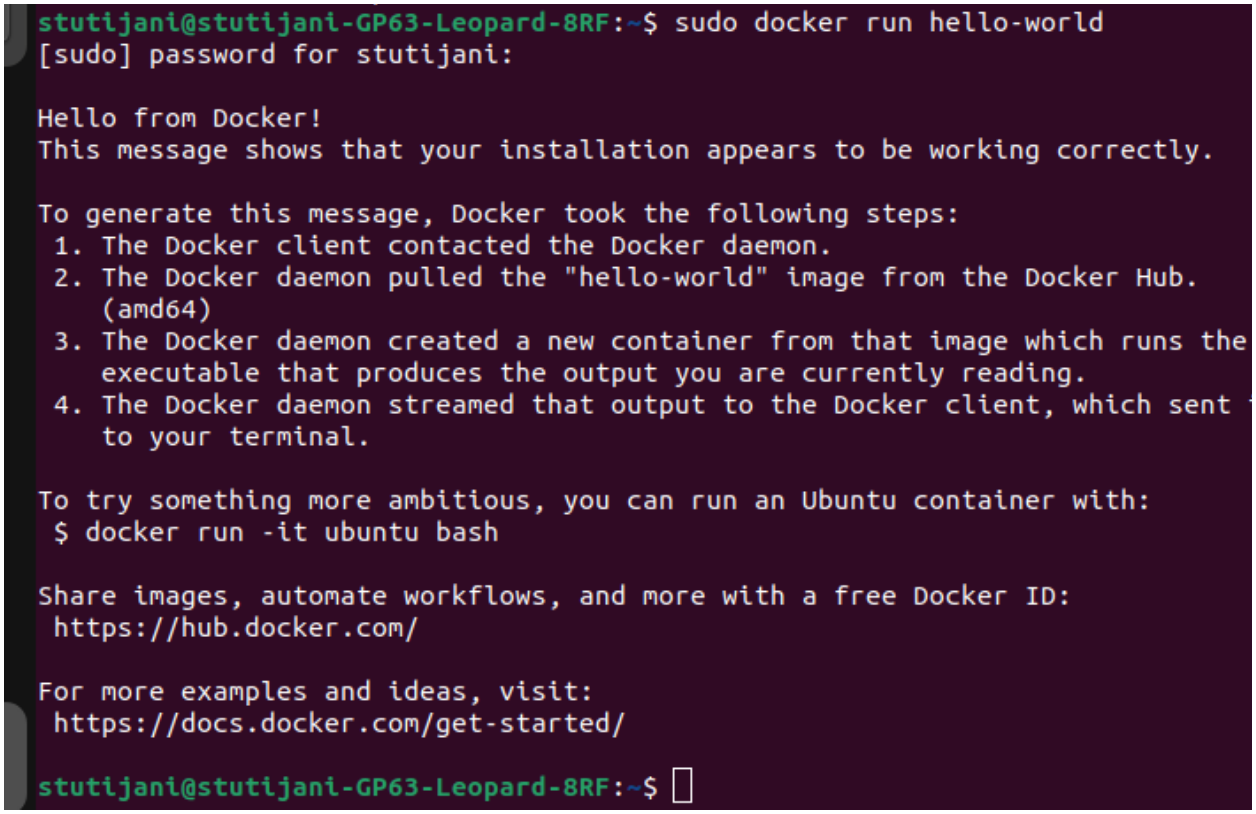
Installing QEMU on ubuntu:
For this step, I first dual booted my windows PC to a linux and windows PC. On Linux I downloaded QEMU and iso image of ubuntu 22.04.
After installing docker, the following commands I pulled the ubuntu docker image from dockerhub.
docker run -it ubuntu bash
apt-get update
Sysbench installation:
apt install sysbench
To save the modified image, the following commands were used.
sudo docker ps -a
sudo docker commit <image-id> <new-image-name>
After installing Docker on my machine I checked the version with the command
Docker –version

Docker run hello-world



Docker Case 2000:
Iterations->

```
stutijani@stutijani-GP63-Leopard-8RF:~$ sudo ./DOCKER_2000_CPU.sh
[sudo] password for stutijani:
Unable to find image 'zyclonite/sysbench:latest' locally
latest: Pulling from zyclonite/sysbench
1c03554ad6ac: Pull complete
b03501e82efa: Pull complete
Digest: sha256:016020c3b53c7e65cdb58e7d4a98afd14f8a3e2f5781cf4c368596b2e448602b
Status: Downloaded newer image for zyclonite/sysbench:latest
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 10635.28

General statistics:
    total time:                          30.0001s
    total number of events:              319074

Latency (ms):
         min:                                    0.09
         avg:                                    0.09
         max:                                    0.66
         95th percentile:                        0.10
         sum:                                29962.22

Threads fairness:
    events (avg/stddev):           319074.0000/0.00
    execution time (avg/stddev):   29.9622/0.00

sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
Threads started!

CPU speed:
    events per second: 10577.98
```

```
CPU speed:
    events per second: 10577.98

General statistics:
    total time:                          30.0001s
    total number of events:              317356

Latency (ms):
         min:                                    0.09
         avg:                                    0.09
         max:                                    0.67
         95th percentile:                        0.10
         sum:                                29961.61

Threads fairness:
    events (avg/stddev):           317356.0000/0.00
    execution time (avg/stddev):   29.9616/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 10646.78

General statistics:
    total time:                          30.0001s
    total number of events:              319419

Latency (ms):
         min:                                    0.09
         avg:                                    0.09
         max:                                    1.23
         95th percentile:                        0.10
         sum:                                29962.48

Threads fairness:
    events (avg/stddev):           319419.0000/0.00
    execution time (avg/stddev):   29.9625/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
```

```
CPU speed:
    events per second: 10592.81

General statistics:
    total time:                          30.0001s
    total number of events:              317800

Latency (ms):
         min:                                    0.09
         avg:                                    0.09
         max:                                    0.29
         95th percentile:                        0.10
         sum:                                29958.17

Threads fairness:
    events (avg/stddev):           317800.0000/0.00
    execution time (avg/stddev):   29.9582/0.00

sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 2000

Initializing worker threads...

Threads started!

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
CPU speed:
    events per second: 10193.68

General statistics:
    total time:                          30.0001s
    total number of events:              305826

Latency (ms):
         min:                                    0.09
         avg:                                    0.10
         max:                                    0.71
         95th percentile:                        0.11
         sum:                                29937.62

Threads fairness:
    events (avg/stddev):           305826.0000/0.00
    execution time (avg/stddev):   29.9376/0.00

stutijani@stutijani-GP63-Leopard-8RF:~$ nano DOCKER_20000_CPU.sh
stutijani@stutijani-GP63-Leopard-8RF:~$ chmod +x DOCKER_20000_CPU.sh
stutijani@stutijani-GP63-Leopard-8RF:~$ sudo ./DOCKER_20000_CPU.sh
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)
```

For case 2000

Serial number of iteration	Events per second
1	10635.28
2	10577.98
3	10646.78
4	10592.81
5	10193.68

Docker Case 20000:
Iterations->

```
    execution time (avg/stddev):   29.9570/0.00

stutijani@stutijani-GP63-Leopard-8RF:~$ nano DOCKER_20000_CPU.sh
stutijani@stutijani-GP63-Leopard-8RF:~$ chmod +x DOCKER_20000_CPU.sh
stutijani@stutijani-GP63-Leopard-8RF:~$ sudo ./DOCKER_20000_CPU.sh
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   494.23

General statistics:
    total time:                          30.0008s
    total number of events:              14828

Latency (ms):
         min:                                    2.00
         avg:                                    2.02
         max:                                    6.80
         95th percentile:                        2.07
         sum:                                29997.96

Threads fairness:
    events (avg/stddev):           14828.0000/0.00
    execution time (avg/stddev):   29.9980/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   494.71

General statistics:
    total time:                          30.0002s
```

```
CPU speed:
    events per second:   494.71

General statistics:
    total time:                          30.0002s
    total number of events:              14842

Latency (ms):
         min:                                    2.00
         avg:                                    2.02
         max:                                    4.19
         95th percentile:                        2.07
         sum:                                29997.49

Threads fairness:
    events (avg/stddev):           14842.0000/0.00
    execution time (avg/stddev):   29.9975/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   493.60

General statistics:
    total time:                          30.0008s
    total number of events:              14809

Latency (ms):
         min:                                    2.00
         avg:                                    2.03
         max:                                    3.54
         95th percentile:                        2.07
         sum:                                29997.78

Threads fairness:
    events (avg/stddev):           14809.0000/0.00
    execution time (avg/stddev):   29.9978/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
```

```
Initializing worker threads...

Threads started!

CPU speed:
    events per second:   496.14

General statistics:
    total time:                          30.0002s
    total number of events:              14885

Latency (ms):
         min:                                    2.00
         avg:                                    2.02
         max:                                    3.59
         95th percentile:                        2.07
         sum:                                29997.59

Threads fairness:
    events (avg/stddev):           14885.0000/0.00
    execution time (avg/stddev):   29.9976/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   495.76

General statistics:
    total time:                          30.0009s
    total number of events:              14874

Latency (ms):
         min:                                    2.00
         avg:                                    2.02
         max:                                    3.36
         95th percentile:                        2.07
         sum:                                29998.39

Threads fairness:
    events (avg/stddev):           14874.0000/0.00
    execution time (avg/stddev):   29.9984/0.00

stutijani@stutijani-GP63-Leopard-8RF:~$
```

Docker Case 20000:

Serial number of iteration	Events per second
1	494.28
2	494.71
3	493.60
4	496.14
5	495.76

Docker Case 200000:
Iterations->

```
    events (avg/stddev):           14879.0000/0.00
    execution time (avg/stddev):   29.9978/0.00

stutijani@stutijani-GP63-Leopard-8RF:~$ sudo ./DOCKER_200000_CPU.sh
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 200000

Initializing worker threads...

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
Threads started!

CPU speed:
    events per second:    21.25

General statistics:
    total time:                          30.0157s
    total number of events:              638

Latency (ms):
         min:                                   46.65
         avg:                                   47.05
         max:                                   82.06
         95th percentile:                       47.47
         sum:                                30015.10

Threads fairness:
    events (avg/stddev):           638.0000/0.00
    execution time (avg/stddev):   30.0151/0.00

sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 200000

Initializing worker threads...

Threads started!

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
CPU speed:
    events per second:    21.33

General statistics:
    total time:                          30.0095s
```

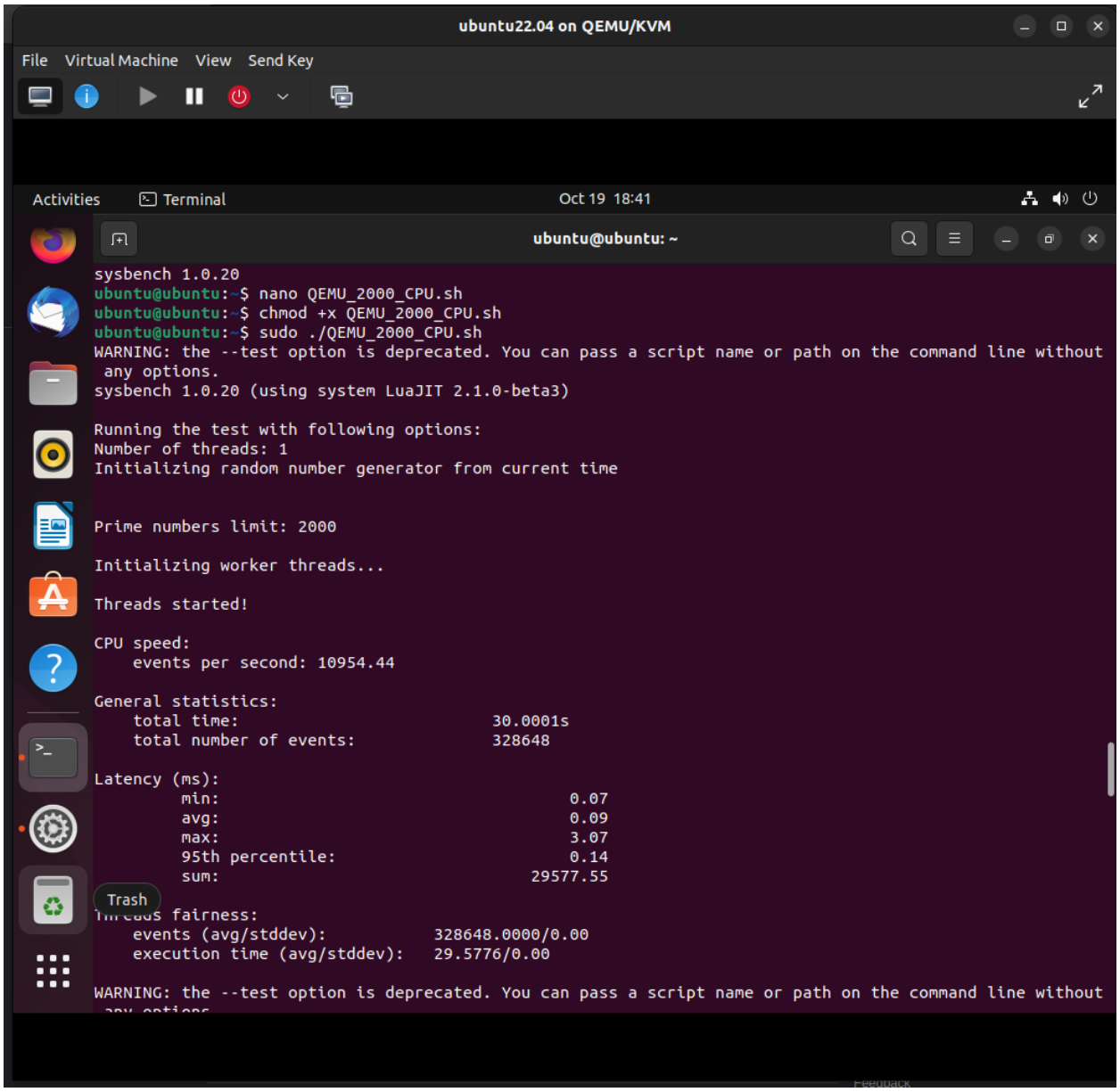
```
    total number of events:              640

Latency (ms):
         min:                                    46.60
         avg:                                    46.89
         max:                                    51.14
         95th percentile:                        47.47
         sum:                                 30008.88

Threads fairness:
    events (avg/stddev):           640.0000/0.00
    execution time (avg/stddev):   30.0089/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 200000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:    21.21

General statistics:
    total time:                          30.0274s
    total number of events:              637

Latency (ms):
         min:                                    46.61
         avg:                                    47.14
         max:                                    58.20
         95th percentile:                        48.34
         sum:                                 30026.74

Threads fairness:
    events (avg/stddev):           637.0000/0.00
    execution time (avg/stddev):   30.0267/0.00

sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 200000

Initializing worker threads...
```

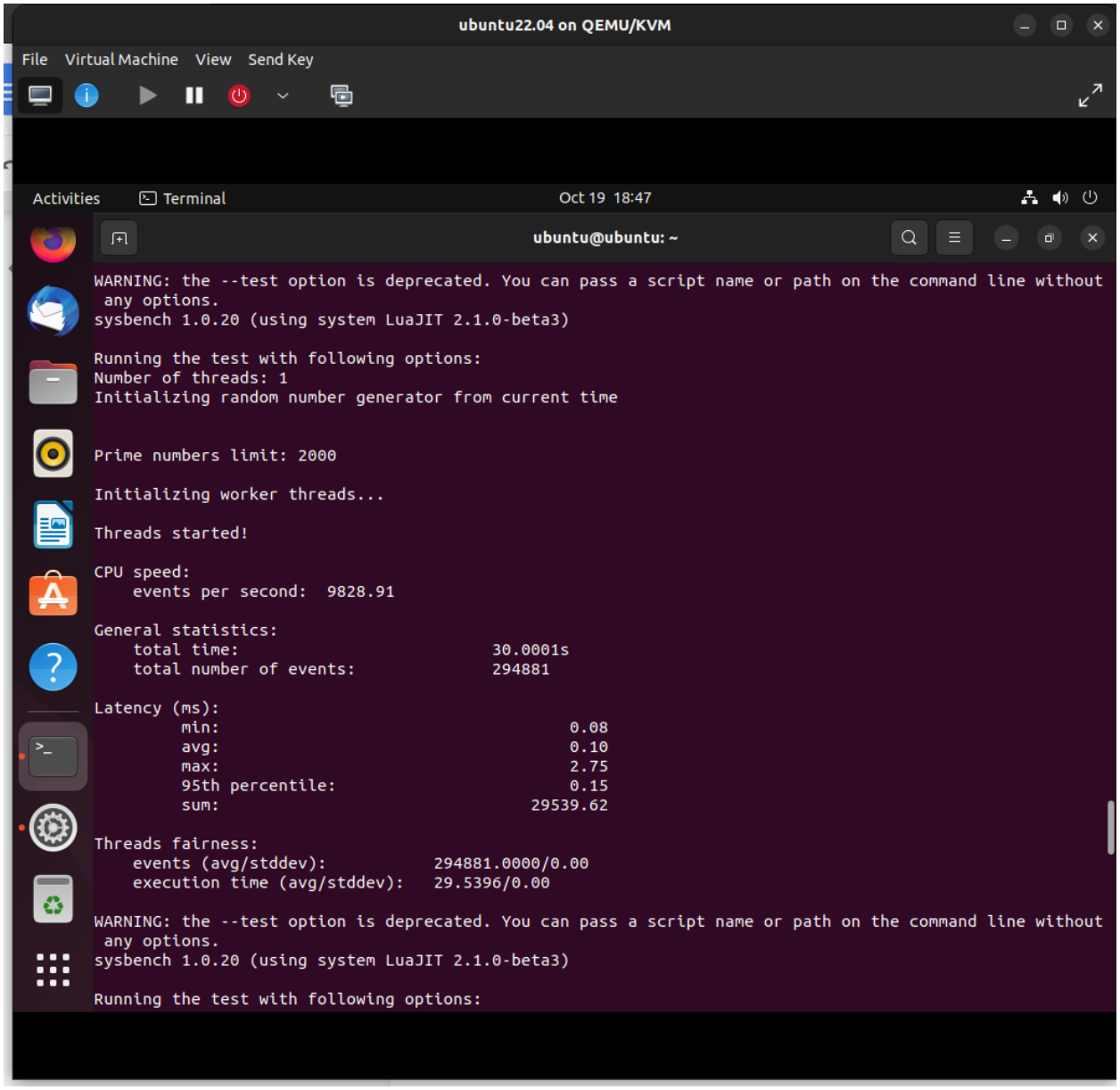
```
Threads started!

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
CPU speed:
    events per second:    21.28

General statistics:
    total time:                          30.0321s
    total number of events:              639

Latency (ms):
         min:                                   46.60
         avg:                                   47.00
         max:                                   61.81
         95th percentile:                       48.34
         sum:                                30031.43

Threads fairness:
    events (avg/stddev):           639.0000/0.00
    execution time (avg/stddev):   30.0314/0.00

sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 200000

Initializing worker threads...

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
Threads started!

CPU speed:
    events per second:    21.31

General statistics:
    total time:                          30.0381s
    total number of events:              640

Latency (ms):
         min:                                   46.60
         avg:                                   46.93
         max:                                   65.13
         95th percentile:                       47.47
         sum:                                30037.44

Threads fairness:
    events (avg/stddev):           640.0000/0.00
    execution time (avg/stddev):   30.0374/0.00

stutijani@stutijani-GP63-Leopard-8RF:~$
```

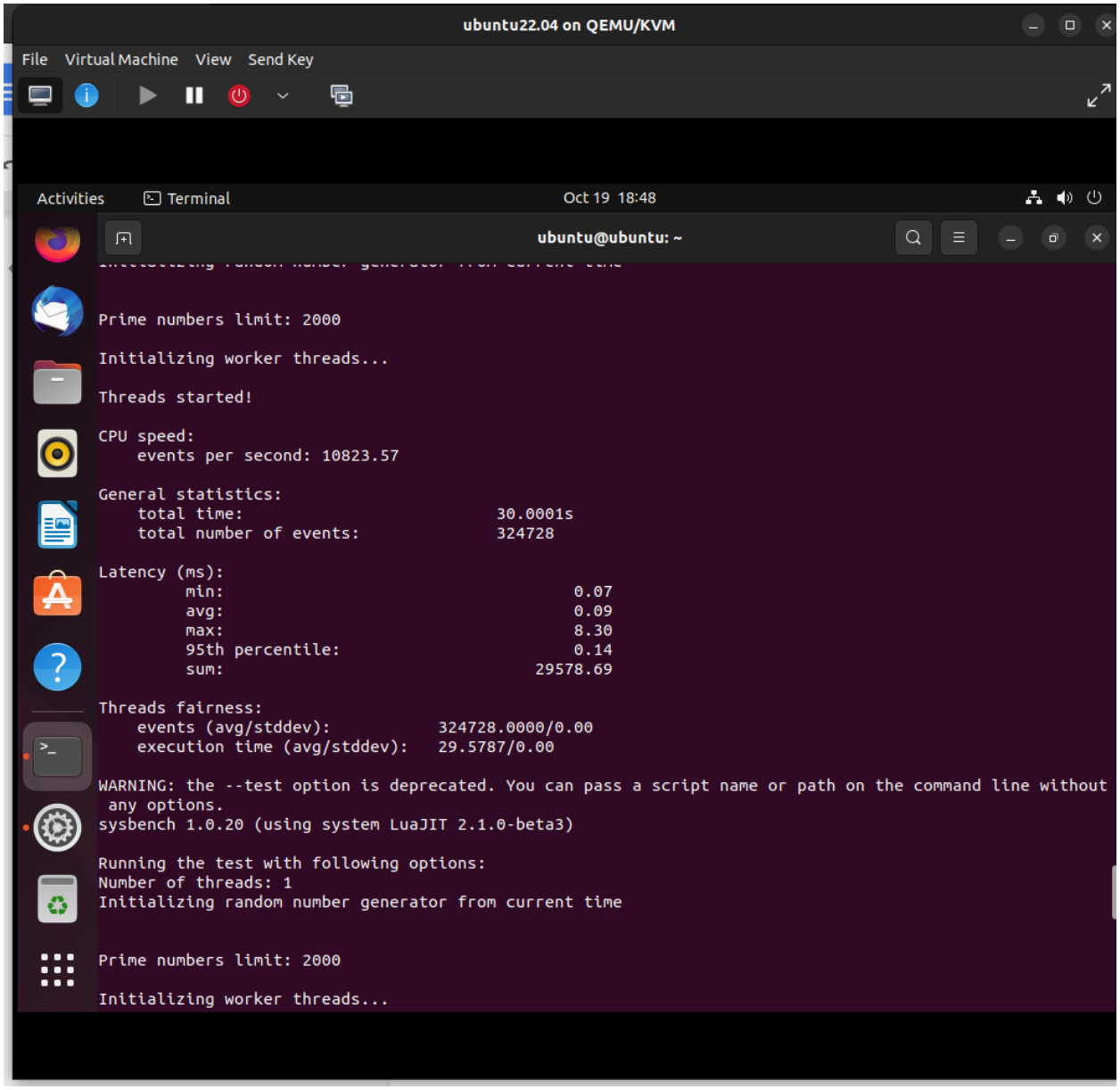
For case 200000:

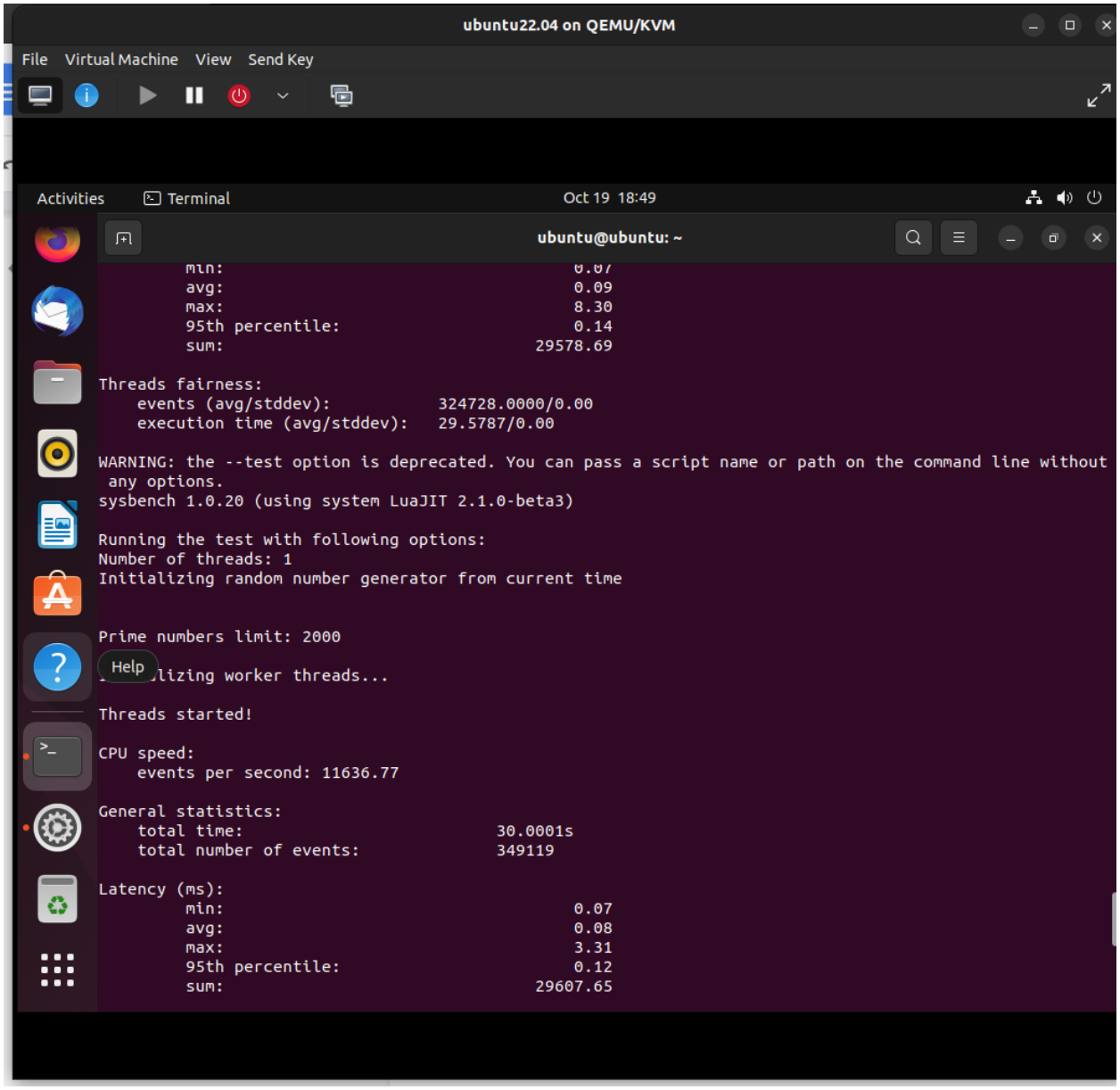
Serial number of iteration	Events per second
1	21.25
2	21.33
3	21.21
4	21.28
5	21.31

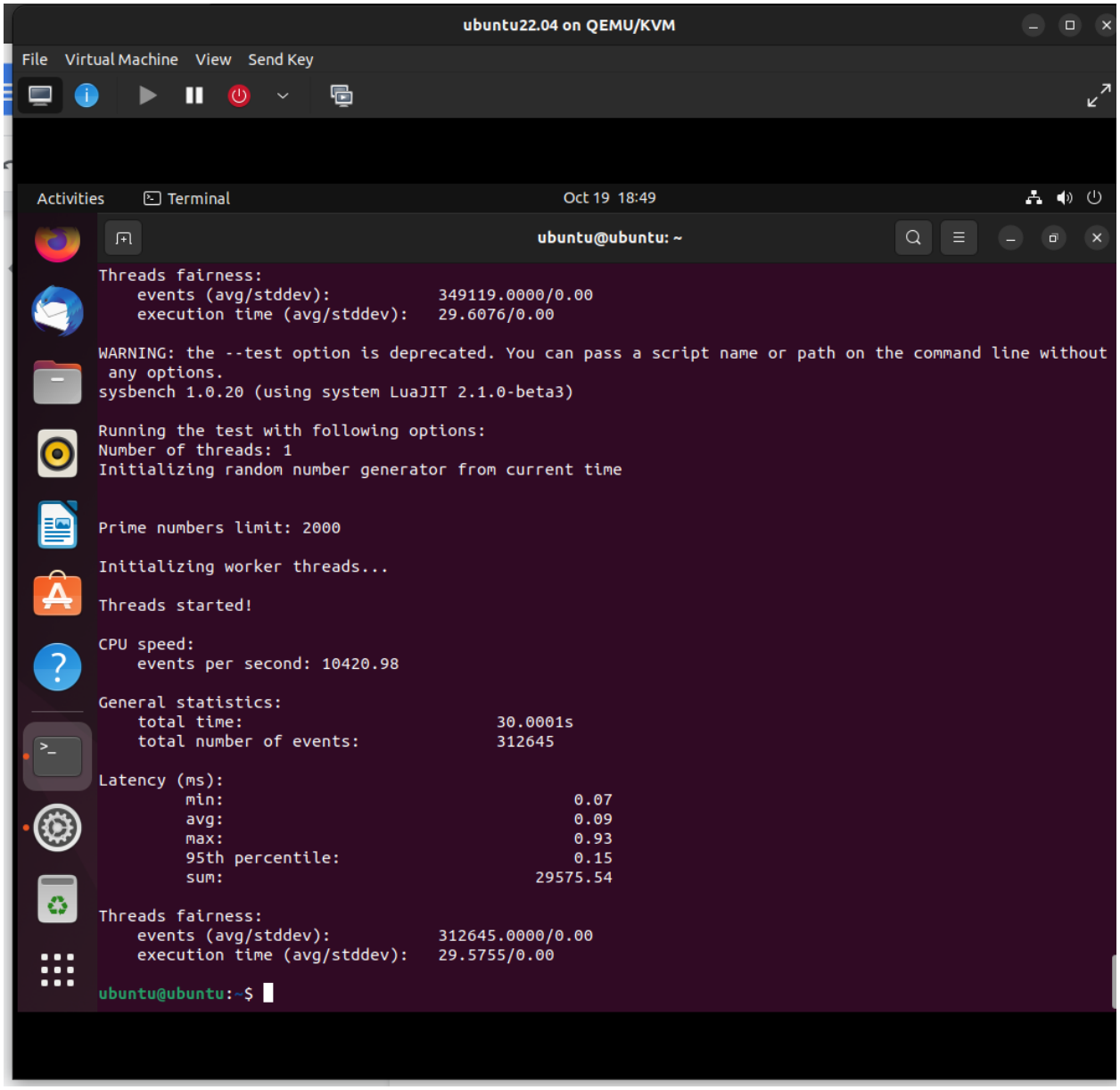
QEMU
Case QEMU 2000:



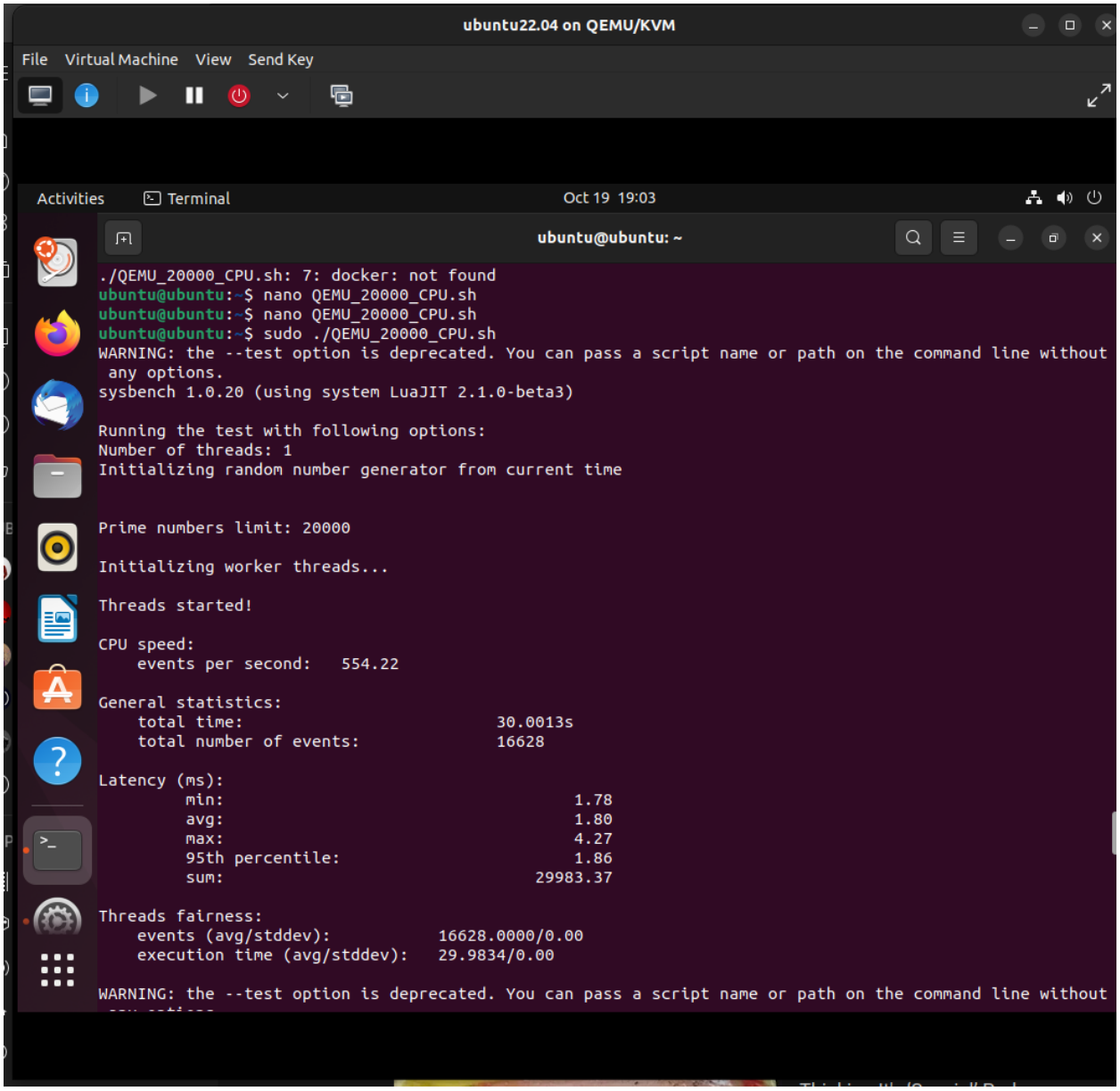

ubuntu22.04 on QEMU/KVM
File Virtual Machine View Send Key
Activities Terminal Oct 19 18:47
ubuntu@ubuntu: ~
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
Prime numbers limit: 2000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 9828.91
General statistics:
total time: 30.0001s
total number of events: 294881
Latency (ms):
min: 0.08
avg: 0.10
max: 2.75
95th percentile: 0.15
sum: 29539.62
Threads fairness:
events (avg/stddev): 294881.0000/0.00
execution time (avg/stddev): 29.5396/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:

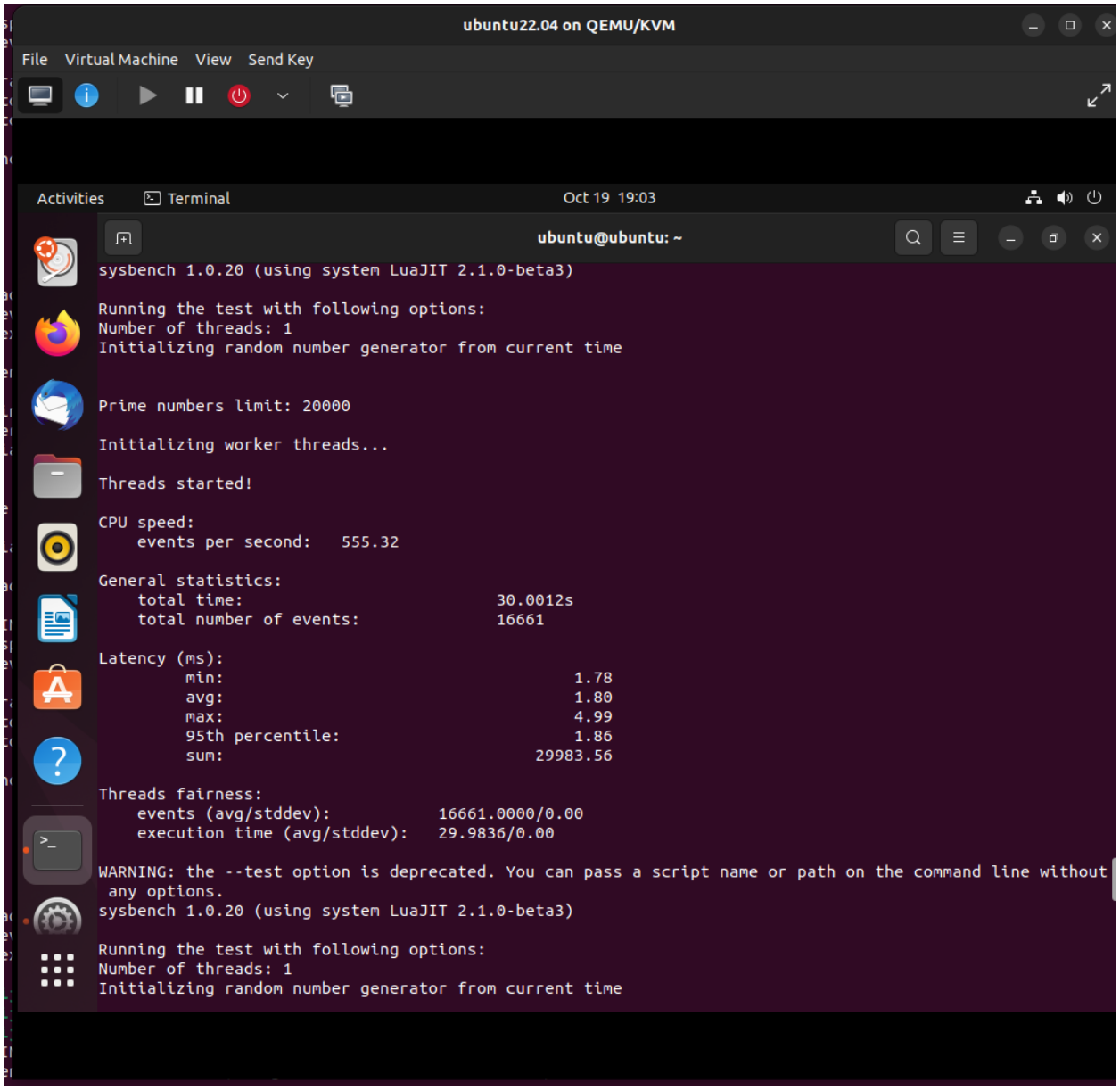

ubuntu22.04 on QEMU/KVM
File Virtual Machine View Send Key
Activities Terminal Oct 19 18:48
ubuntu@ubuntu: ~
Prime numbers limit: 2000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 10823.57
General statistics:
total time: 30.0001s
total number of events: 324728
Latency (ms):
min: 0.07
avg: 0.09
max: 8.30
95th percentile: 0.14
sum: 29578.69
Threads fairness:
events (avg/stddev): 324728.0000/0.00
execution time (avg/stddev): 29.5787/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
Prime numbers limit: 2000
Initializing worker threads...

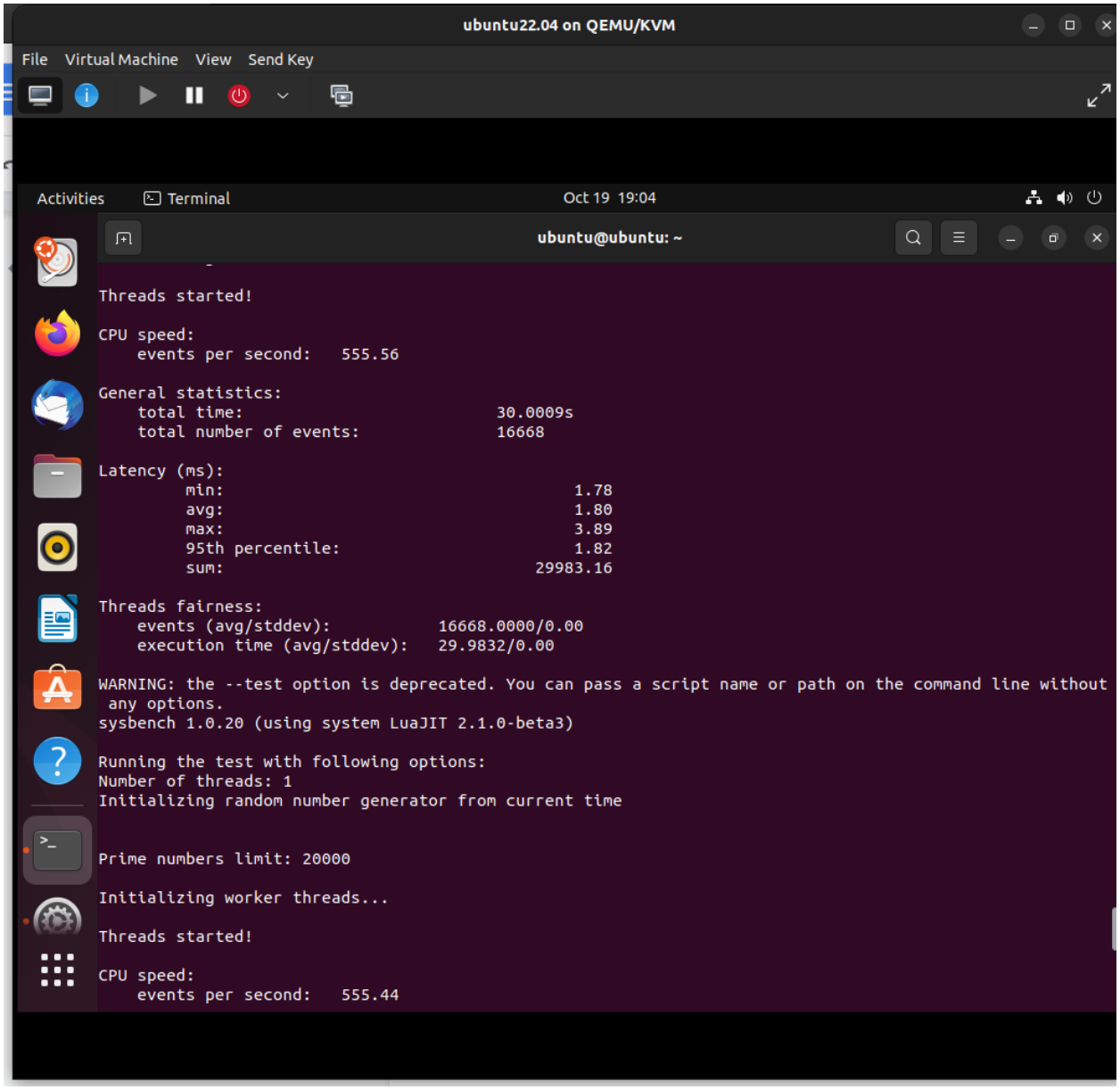

ubuntu22.04 on QEMU/KVM
File Virtual Machine View Send Key
Activities Terminal Oct 19 18:49
ubuntu@ubuntu: ~
min: 0.07
avg: 0.09
max: 8.30
95th percentile: 0.14
sum: 29578.69
Threads fairness:
events (avg/stddev): 324728.0000/0.00
execution time (avg/stddev): 29.5787/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
Prime numbers limit: 2000
Help
lizing worker threads...
Threads started!
CPU speed:
events per second: 11636.77
General statistics:
total time: 30.0001s
total number of events: 349119
Latency (ms):
min: 0.07
avg: 0.08
max: 3.31
95th percentile: 0.12
sum: 29607.65

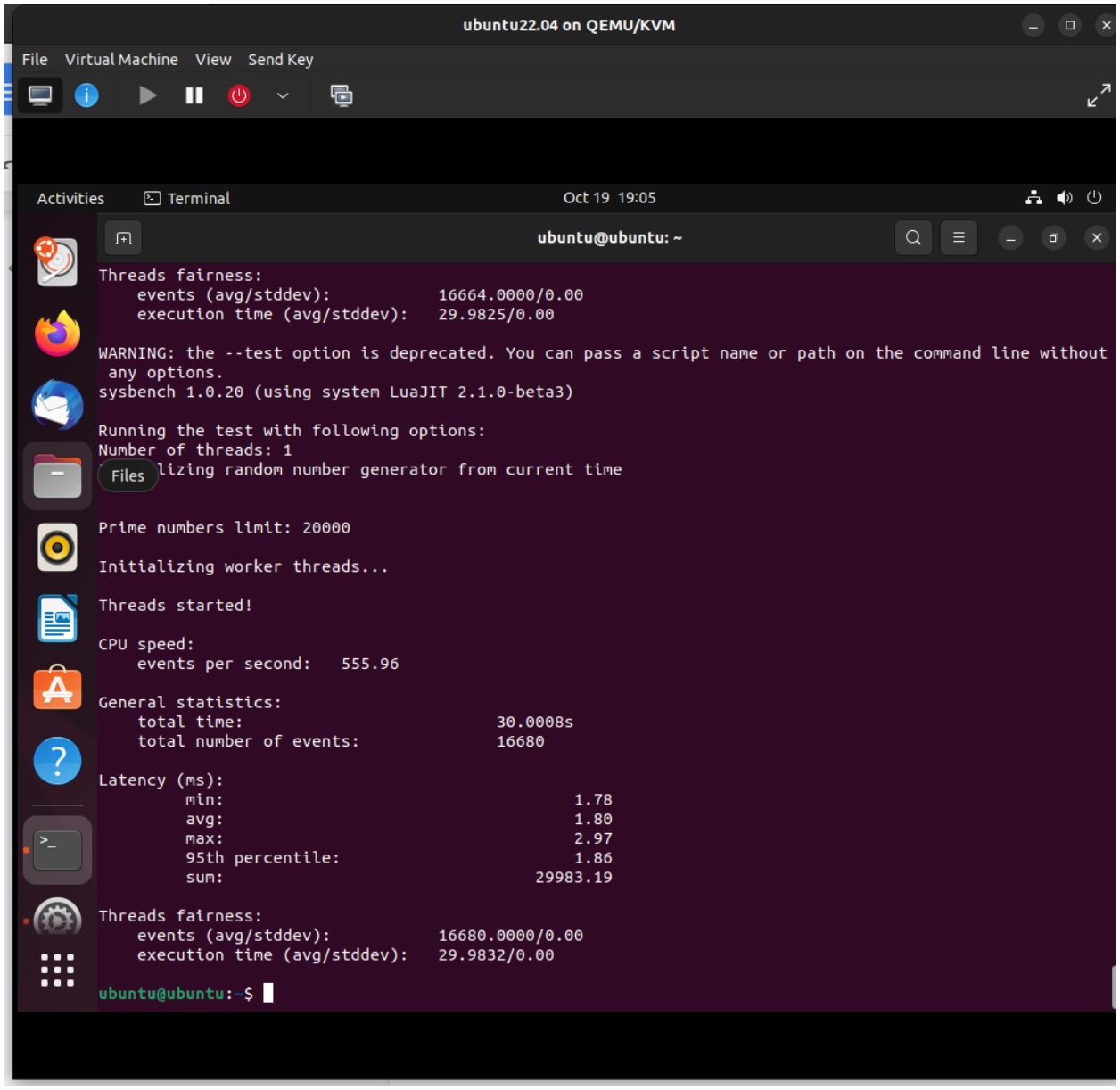


Serial number of iteration	Events per second
1	10954.44
2	9828.91
3	10823.57
4	11636.77
5	10420.98

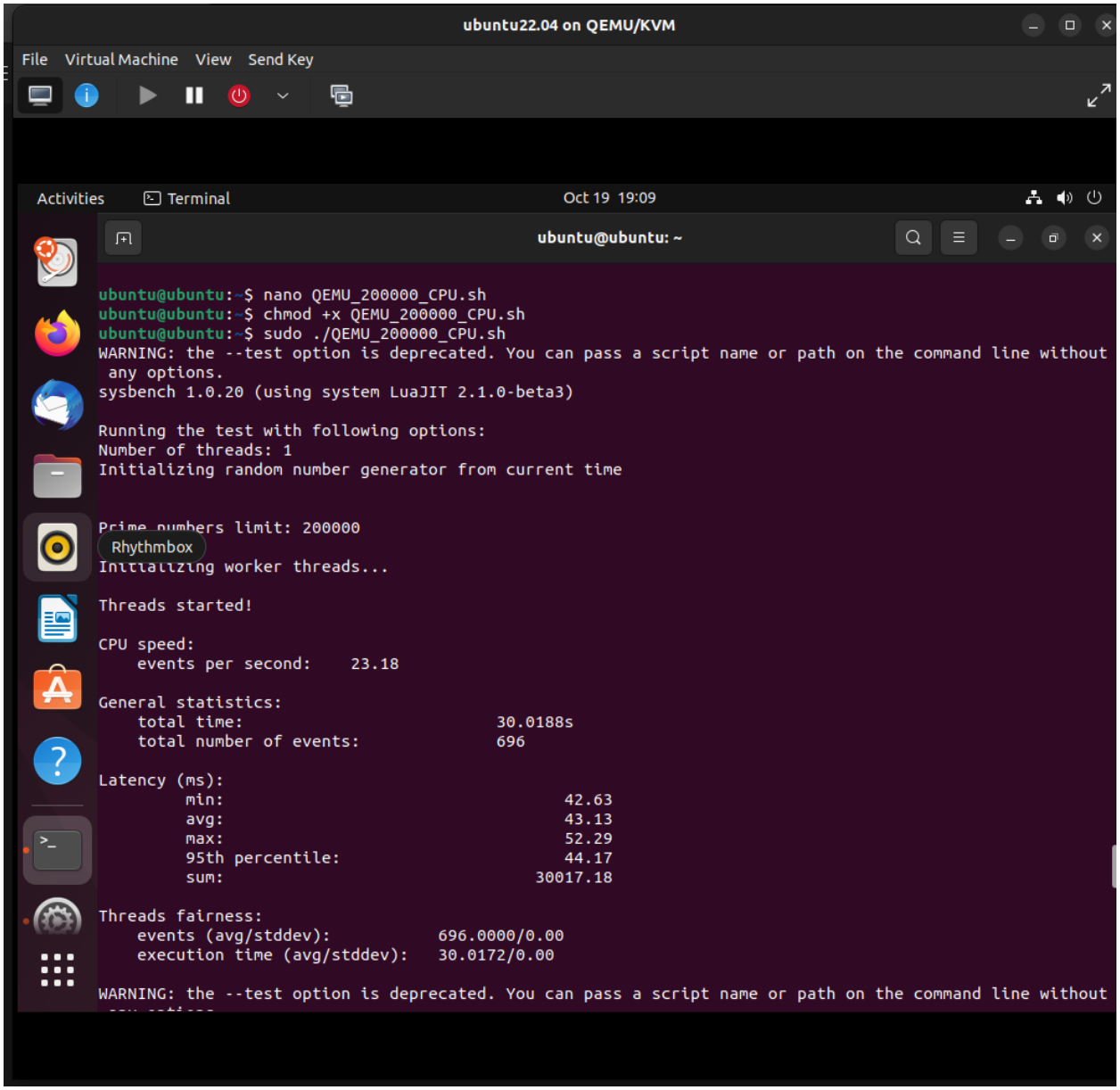

ubuntu22.04 on QEMU/KVM
File Virtual Machine View Send Key
Activities Terminal Oct 19 19:03
ubuntu@ubuntu: ~
./QEMU_20000_CPU.sh: 7: docker: not found
ubuntu@ubuntu:~$ nano QEMU_20000_CPU.sh
ubuntu@ubuntu:~$ nano QEMU_20000_CPU.sh
ubuntu@ubuntu:~$ sudo ./QEMU_20000_CPU.sh
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
Prime numbers limit: 20000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 554.22
General statistics:
total time: 30.0013s
total number of events: 16628
Latency (ms):
min: 1.78
avg: 1.80
max: 4.27
95th percentile: 1.86
sum: 29983.37
Threads fairness:
events (avg/stddev): 16628.0000/0.00
execution time (avg/stddev): 29.9834/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without

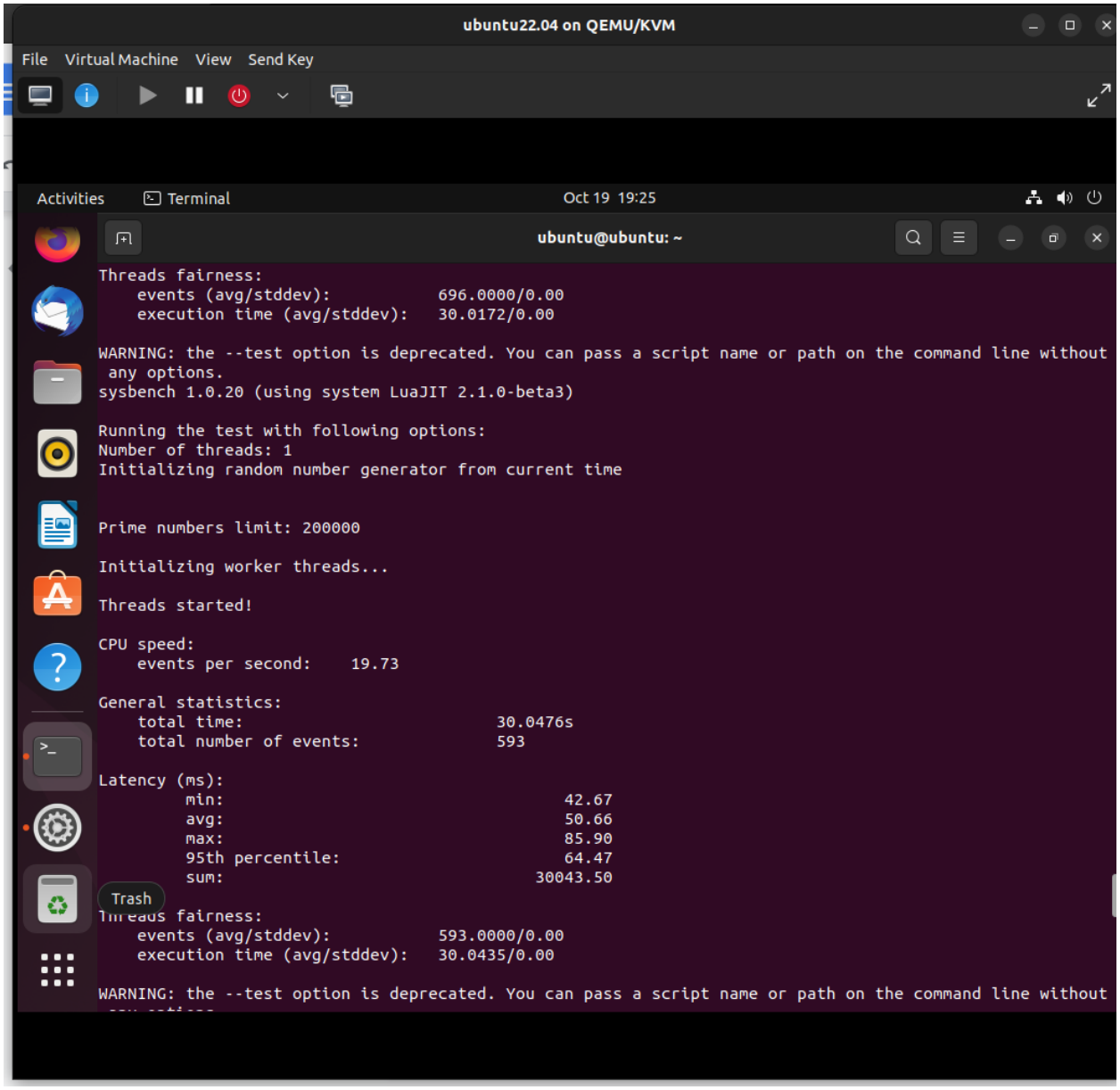

ubuntu22.04 on QEMU/KVM
File Virtual Machine View Send Key
Activities Terminal Oct 19 19:03
ubuntu@ubuntu: ~
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
Prime numbers limit: 20000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 555.32
General statistics:
total time: 30.0012s
total number of events: 16661
Latency (ms):
min: 1.78
avg: 1.80
max: 4.99
95th percentile: 1.86
sum: 29983.56
Threads fairness:
events (avg/stddev): 16661.0000/0.00
execution time (avg/stddev): 29.9836/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

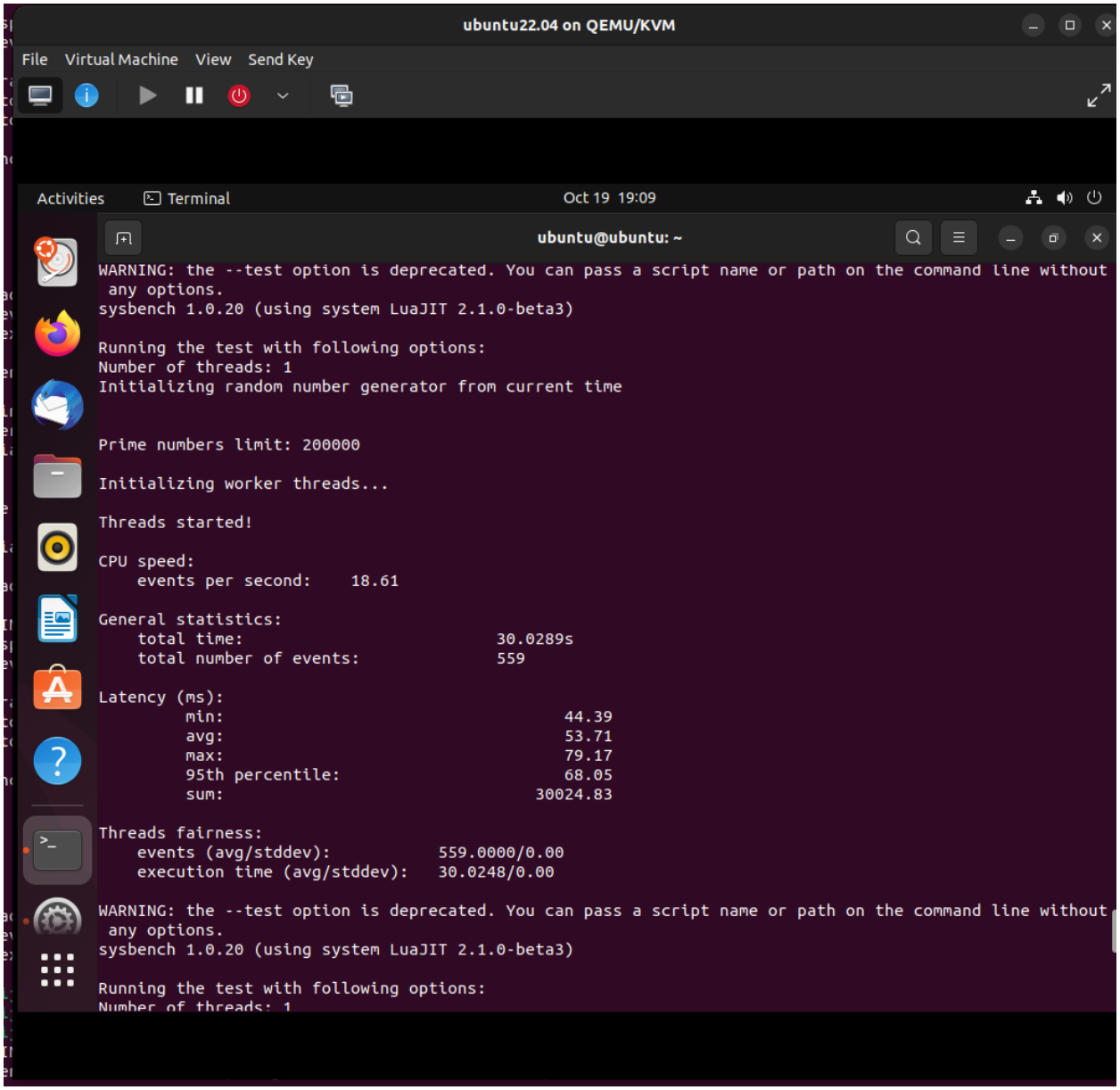

ubuntu22.04 on QEMU/KVM
File Virtual Machine View Send Key
Activities Terminal Oct 19 19:04
ubuntu@ubuntu: ~
Threads started!
CPU speed:
events per second: 555.56
General statistics:
total time: 30.0009s
total number of events: 16668
Latency (ms):
min: 1.78
avg: 1.80
max: 3.89
95th percentile: 1.82
sum: 29983.16
Threads fairness:
events (avg/stddev): 16668.0000/0.00
execution time (avg/stddev): 29.9832/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
Prime numbers limit: 20000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 555.44

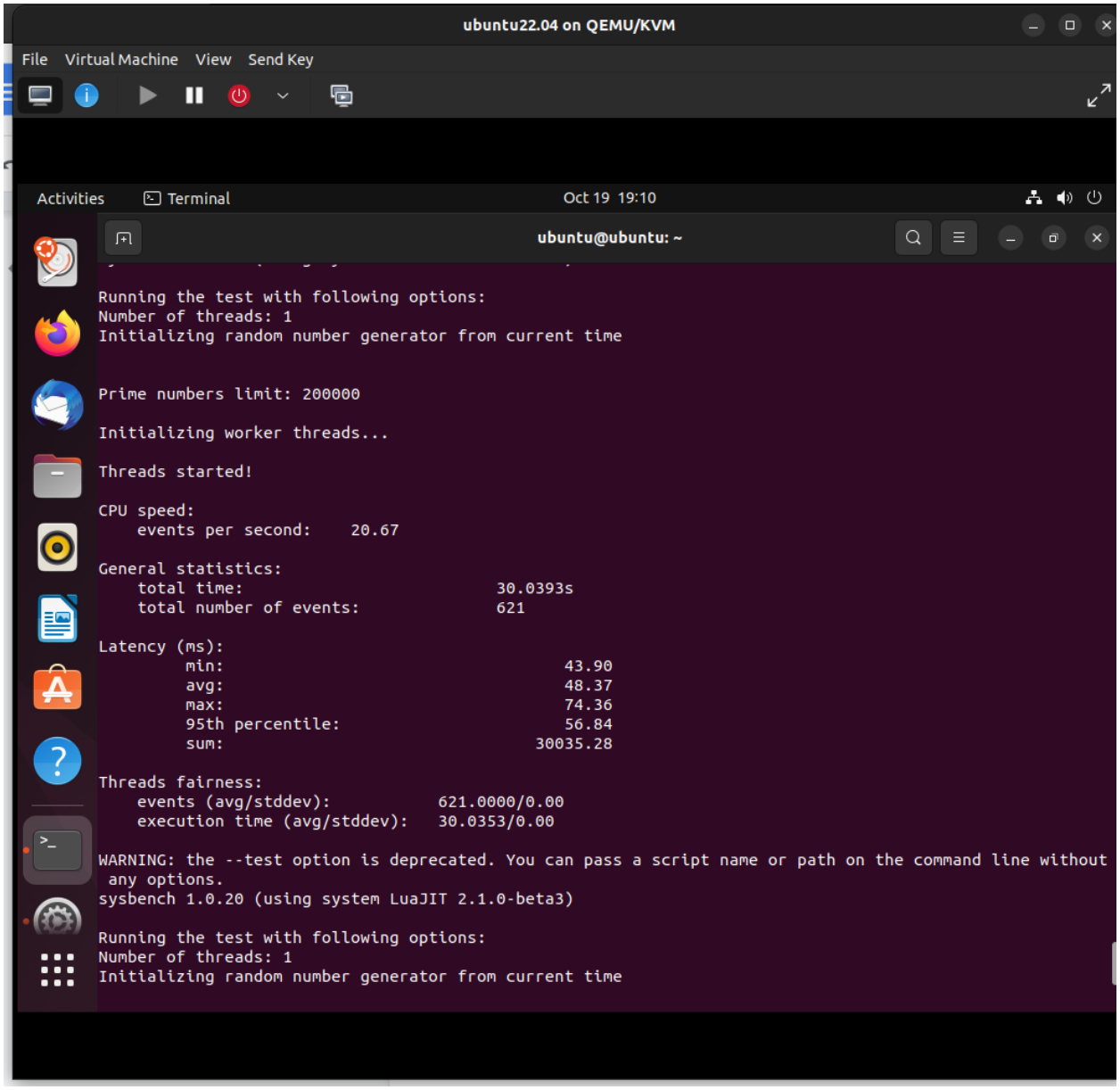


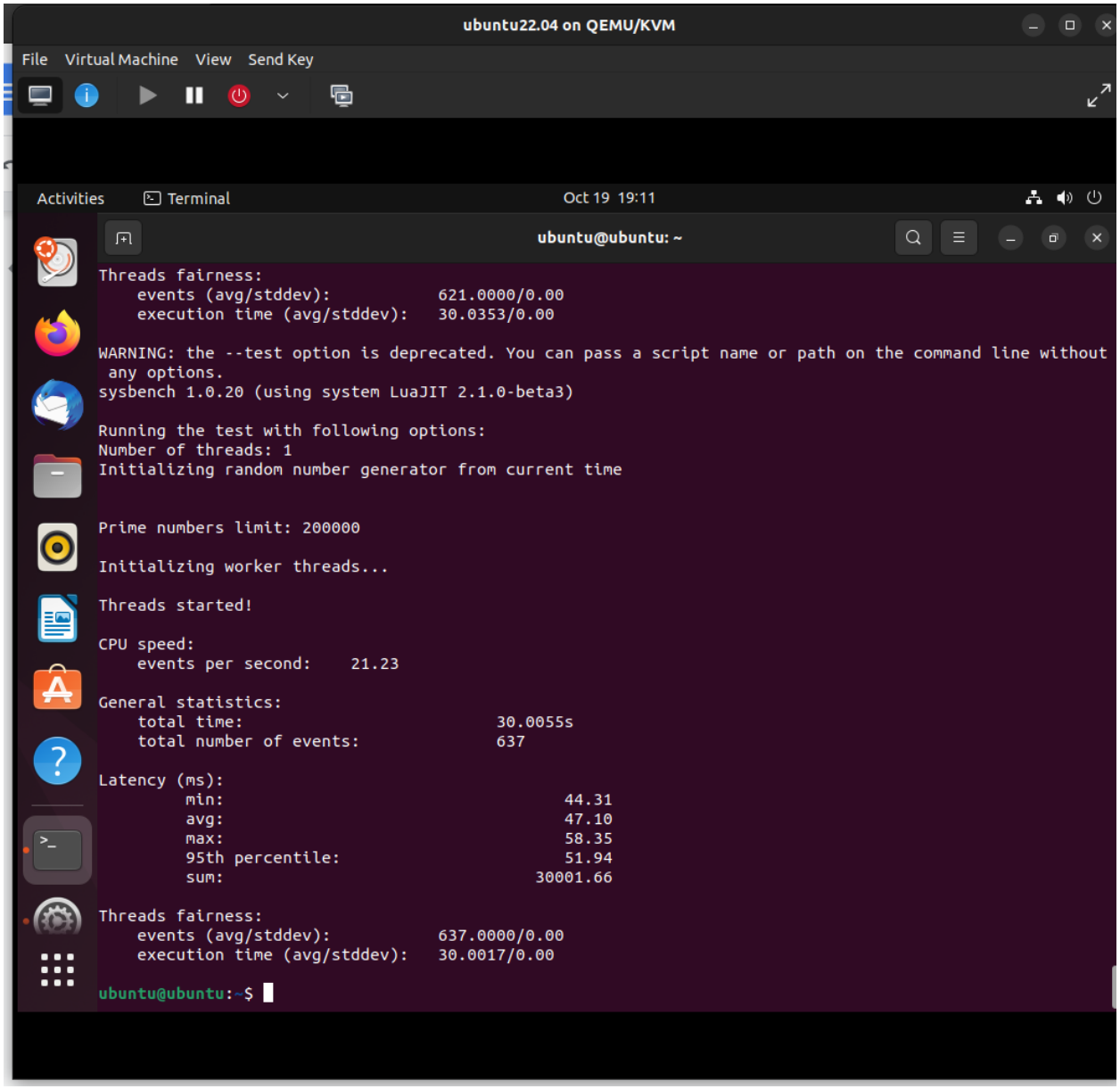
Serial number of iteration	Events per second
1	554.22
2	555.32
3	555.56
4	555.44
5	555.96


ubuntu22.04 on QEMU/KVM
File Virtual Machine View Send Key
Activities Terminal Oct 19 19:09
ubuntu@ubuntu: ~
Rhythmbox
ubuntu@ubuntu:~$ nano QEMU_200000_CPU.sh
ubuntu@ubuntu:~$ chmod +x QEMU_200000_CPU.sh
ubuntu@ubuntu:~$ sudo ./QEMU_200000_CPU.sh
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
Prime numbers limit: 200000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 23.18
General statistics:
total time: 30.0188s
total number of events: 696
Latency (ms):
min: 42.63
avg: 43.13
max: 52.29
95th percentile: 44.17
sum: 30017.18
Threads fairness:
events (avg/stddev): 696.0000/0.00
execution time (avg/stddev): 30.0172/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without


ubuntu22.04 on QEMU/KVM
File Virtual Machine View Send Key
Activities Terminal Oct 19 19:25
ubuntu@ubuntu: ~
Threads fairness:
events (avg/stddev): 696.0000/0.00
execution time (avg/stddev): 30.0172/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
Prime numbers limit: 200000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 19.73
General statistics:
total time: 30.0476s
total number of events: 593
Latency (ms):
min: 42.67
avg: 50.66
max: 85.90
95th percentile: 64.47
sum: 30043.50
Trash
Threads fairness:
events (avg/stddev): 593.0000/0.00
execution time (avg/stddev): 30.0435/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without


ubuntu22.04 on QEMU/KVM
File Virtual Machine View Send Key
Activities Terminal Oct 19 19:09
ubuntu@ubuntu: ~
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
Prime numbers limit: 200000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 18.61
General statistics:
total time: 30.0289s
total number of events: 559
Latency (ms):
min: 44.39
avg: 53.71
max: 79.17
95th percentile: 68.05
sum: 30024.83
Threads fairness:
events (avg/stddev): 559.0000/0.00
execution time (avg/stddev): 30.0248/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1

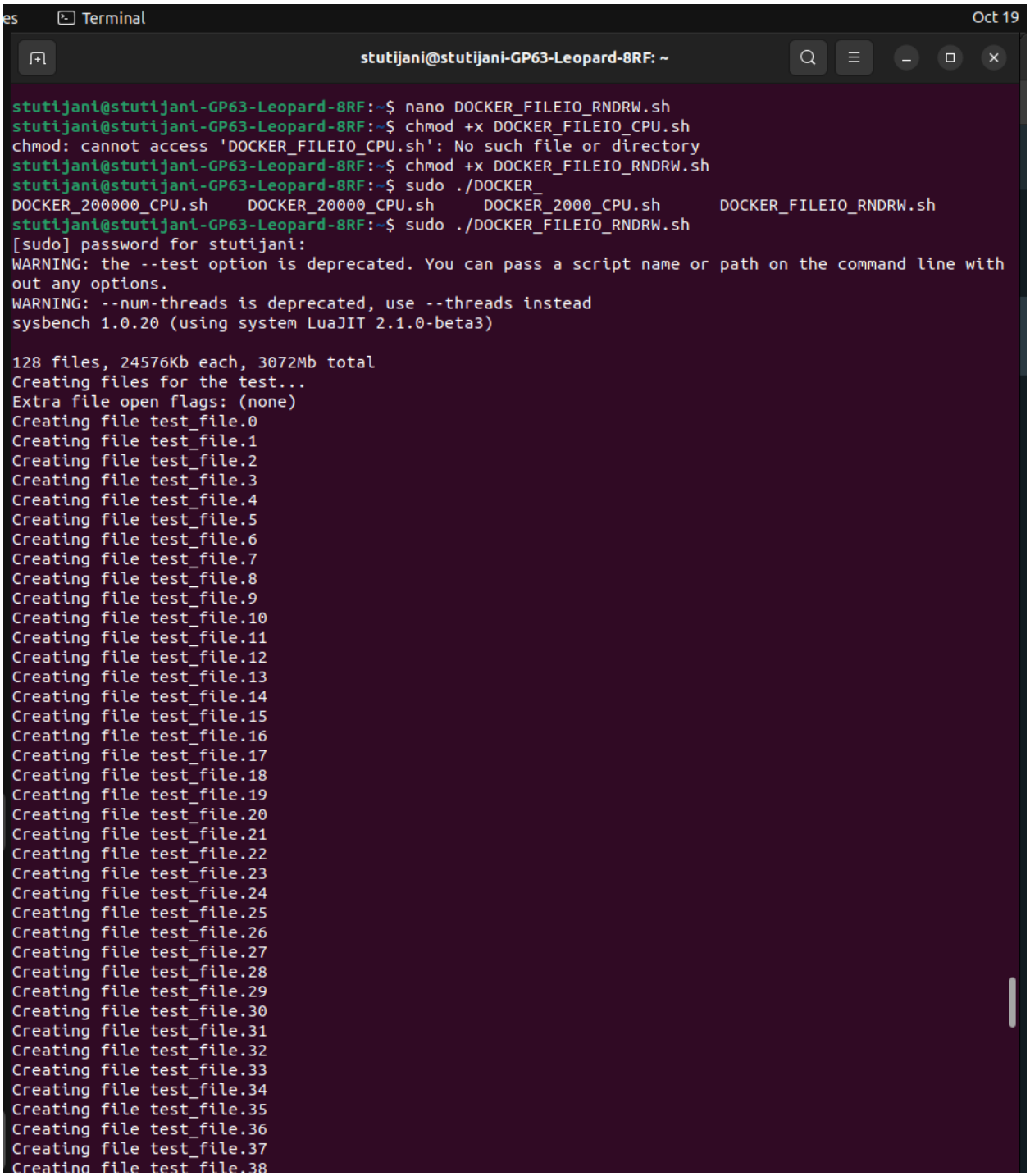

ubuntu22.04 on QEMU/KVM
File Virtual Machine View Send Key
Activities Terminal Oct 19 19:10
ubuntu@ubuntu: ~
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
Prime numbers limit: 200000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 20.67
General statistics:
total time: 30.0393s
total number of events: 621
Latency (ms):
min: 43.90
avg: 48.37
max: 74.36
95th percentile: 56.84
sum: 30035.28
Threads fairness:
events (avg/stddev): 621.0000/0.00
execution time (avg/stddev): 30.0353/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time

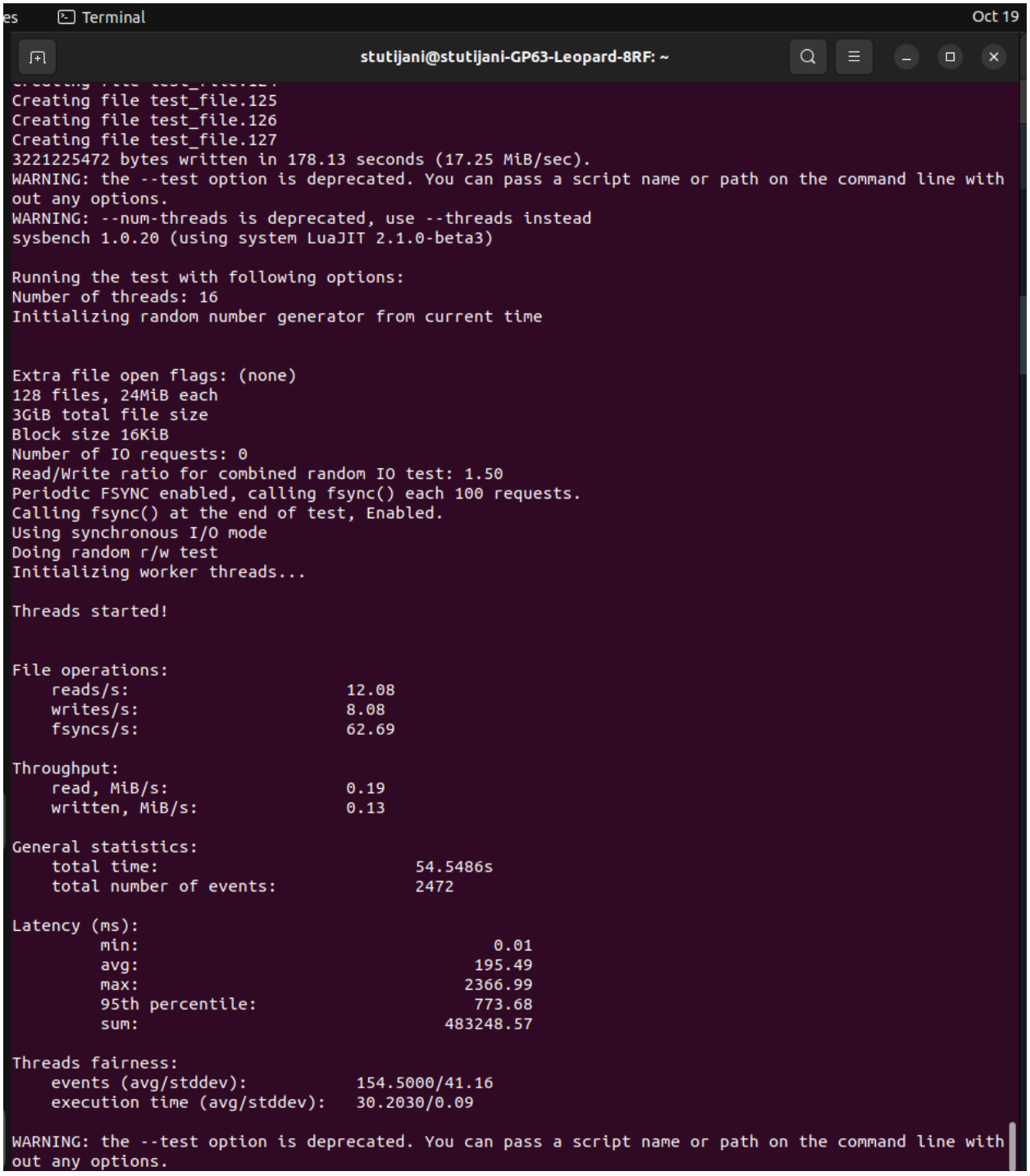


Serial number of iteration	Events per second
1	23.18
2	19.37
3	18.61
4	20.67
5	21.23

Observations:
The performance on QEMU and Docker is almost similar with Docker being slightly faster than QEMU as observed on ubuntu 22.04.
Hence, both environments show similar behaviours.

File input output:
Docker FILEIO_RNDRW:





Docker fileio sequential:

```
         avg:                                  195.49
         max:                                 2366.99
         95th percentile:                      773.68
         sum:                                483248.57

Threads fairness:
    events (avg/stddev):           154.5000/41.16
    execution time (avg/stddev):   30.2030/0.09

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)

Removing test files...
stutijani@stutijani-GP63-Leopard-8RF:~$ nano DOCKER_FILEIO_RND.sh
stutijani@stutijani-GP63-Leopard-8RF:~$ nano DOCKER_FILEIO_SEQ.sh
stutijani@stutijani-GP63-Leopard-8RF:~$ chmod +x DOCKER_FILEIO_SEQ.sh
stutijani@stutijani-GP63-Leopard-8RF:~$ sudo ./DOCKER_FILEIO_SEQ.sh
[sudo] password for stutijani:
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)

128 files, 24576Kb each, 3072Mb total
Creating files for the test...
Extra file open flags: (none)
Creating file test_file.0
Creating file test_file.1
Creating file test_file.2
Creating file test_file.3
Creating file test_file.4
Creating file test_file.5
Creating file test_file.6
Creating file test_file.7
Creating file test_file.8
Creating file test_file.9
Creating file test_file.10
Creating file test_file.11
Creating file test_file.12
Creating file test_file.13
Creating file test_file.14
Creating file test_file.15
Creating file test_file.16
Creating file test_file.17
Creating file test_file.18
Creating file test_file.19
Creating file test_file.20
Creating file test_file.21
Creating file test_file.22
Creating file test_file.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
```

```
Creating file test_file.126
Creating file test_file.127
3221225472 bytes written in 240.75 seconds (12.76 MiB/sec).
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 24MiB each
3GiB total file size
Block size 16KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     22.16
    fsyncs/s:                     58.97

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               0.35

General statistics:
    total time:                          63.1811s
    total number of events:              3078

Latency (ms):
         min:                                    0.03
         avg:                                  157.27
         max:                                 2873.88
         95th percentile:                      530.08
         sum:                                484091.01

Threads fairness:
    events (avg/stddev):           192.3750/29.34
    execution time (avg/stddev):   30.2557/0.20

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)

Removing test files...
stutijani@stutijani-GP63-Leopard-8RF:~$
```

Config 2 : 4GB RAM and 4 cores

a. Cpu testing
    i. QEMU

Case 2000:

Serial Number of Iterations	Events per second
1	113926.26
2	113201.06

3	113018.63
4	114854.19
5	113129.79

ii. With docker

Case 2000:

Serial Number of Iterations	Events per second
1	52698.93
2	52132.09
3	51893.90
4	56403.96
5	56134.25

For all remaining cases, Qemu remains faster than docker in terms of CPU performance.

b. File IO testing
   i. QEMU file IO
      1. Sequential Rewrite (QEMU)

Serial number of iterations	Results
1	reads/s = 0 writes/sec = 38097.14 fsyncs/sec = 48828.63 events/second = 87008.56
2	reads/s = 0 writes/s=39530.62 fsyncs/sec = 50664.21 events/second = 90199.3
3	reads/s = 0 writes/s = 35886.20 f syncs/sec = 46000.81 events/second = 81888.26
4	reads/s = 0

	writes/s = 33329.60 fsyncs/s = 42727.80 events/second = 76088.93
5	reads/s = 0 writes/s = 33704.58 fsyncs/s = 43206.91 events/second = 76908.83

2. Combined random read write

Serial number of iterations	Results
1	reads/s = 14487.51 writes/s = 9898.23 fsyncs/s = 31739.38 events/second = 56464.43
2	reads/s = 13910 writes/s = 9273 fsyncs/s = 29740 events/second = 52915.76
3	reads/s = 14165.54 writes/s = 9443.58 fsyncs/s =30284.24 events/second = 43880.36
4	reads/s = 12349.31 writes/s = 8232.87 fsyncs/s = 26409.53 events/seconds = 46994.56
5	reads/s = 12001.06 writes/s = 8000.63 fsyncs/s = 27669.69 events/seconds =44638.56

ii. Docker

1. Sequential rewrite

Serial number of iterations	Results
1	reads/s = 0 writes/sec = 21687.04

	fsyncs/sec = 27826.67 events/second = 49552.66
2	reads/s = 0 writes/s= 22690.64 fsyncs/sec = 29019.49 events/second = 51806.5
3	reads/s = 0 writes/s = 25688.43 fsyncs/sec = 32946.24 e vents/second = 58659.23
4	reads/s = 0 writes/s = 22382.72 fsyncs/s = 28716.33 events/second = 51146.33
5	reads/s = 0 writes/s = 21880.69 fsyncs/s =28071.27 events/second = 49996.26

2. Combined random read write (docker)

Serial number of iterations	Results
1	rreads/s = 13850.71 writes/sec = 9320.24 fsyncs/sec = 28826.54 events/second = 53032.66
2	reads/s = 14155.49 writes/s=8754.94 fsyncs/sec = 27129.15 events/second = 50045.5
3	reads/s = 14251.83 writes/s = 9545.02 fsyncs/sec = 30457.31 events/second = 54375.26
4	reads/s = 14324.66 writes/s = 9231.83 fsyncs/s = 31432.93 events/second = 55987.33
5	reads/s = 14231.90 writes/s = 9658.14

	fsyncs/s = 30324.53 events/second = 55432.1

Config 3: 6GB 6 cores

a. Cpu testing
    i. QEMU

Case 2000:

Serial Number of Iterations	Events per second
1	113197.63
2	114251.46
3	113318.53
4	114254.59
5	113529.89

    ii. Docker

Serial Number of Iterations	Events per second
1	54026.70
2	52534.09
3	52843.95
4	53403.88
5	56479.38

For all further test cases we see no further significant improvements in CPU performances for both QEMU and docker.

b. File IO testing
    i. QEMU
        1. Sequential Rewrite

Serial number of iterations	Results
1	reads/s = 0 writes/sec = 25473.58 fsyncs/sec = 32673.72 events/second = 58185
2	reads/s = 0 writes/s=27687.54 fsyncs/sec = 33764.65 events/second = 59124.32
3	reads/s = 0 writes/s = 24534.32 fsyncs/sec = 31986.87 events/second = 56126.76
4	reads/s = 0 writes/s = 25765.32 fsyncs/s = 32675.83 events/second = 58234.21
5	reads/s = 0 writes/s = 28675.77 fsyncs/s = 35687.32 events/second = 59543.65

2. Combined Random Read write

Serial number of iterations	Results
1	reads/s = 9938.58 writes/s = 6625.83 fsyncs/s = 21268.98 events/second = 37854.03
2	reads/s = 9845.43 writes/s = 6541.32 fsyncs/s = 20267.32 events/second = 35643.76
3	reads/s = 9876.73 writes/s = 6543.21 fsyncs/s =21124.43 events/second = 35541.28
4	reads/s = 9765.53 writes/s = 7021.32

	fsyncs/s = 30832.11 events/seconds = 39878.32
5	reads/s = 9763.23 writes/s = 6312.63 fsyncs/s = 24569.69 events/seconds =34532.56

ii. Docker IO testing

1. Sequential Rewrite

Serial number of iterations	Results
1	reads/s = 0 writes/sec = 13778.77 fsyncs/sec = 17701.47 events/second = 31506.16
2	reads/s = 0 writes/s= 13543.64 fsyncs/sec = 17634.49 events/second = 30234.5
3	reads/s = 0 writes/s = 12456.32 fsyncs/sec = 16323.87 events/second = 29876.36
4	reads/s = 0 writes/s = 14328.87 fsyncs/s = 18785.62 events/second = 32324.32
5	reads/s = 0 writes/s = 13534.11 fsyncs/s =17431.89 events/second = 31232.21

2. Combined Random Read Write

Serial number of iterations	Results
1	reads/s = 9501.28 writes/sec = 6334.24

	fsyncs/sec = 20336.56 events/second = 36197.8
2	reads/s = 9323.32 writes/s=6213.41 fsyncs/sec = 20223.12 events/second = 36097.87
3	reads/s = 9674.98 writes/s = 6984.73 fsyncs/sec = 20989.89 events/second = 37019.21
4	reads/s = 9594.32 writes/s = 6434.43 fsyncs/s = 20214.43 events/second = 35788.33
5	reads/s = 9287.90 writes/s = 6021.14 fsyncs/s = 18673.53 events/second = 32764.12

Github username : stutijani12
Repository link : https://github.com/stutijani12/COEN_241
Repository name: COEN_241
Folder: HW1