COEN 241 Homework 1 **Name: Preeti Kakuru**
System vs OS virtualization **Student ID: W1632276**

Installing QEMU and making a QEMU disk image

For this report I will list out installation steps for Ubuntu, QEMU, VM, Docker on windows 11

Downloading Ubuntu ISO for Windows

Ubuntu 20.04.4 LTS is the latest version to be downloaded. This is the link for the same.
https://releases.ubuntu.com/16.04/ubuntu-16.04.7-server-amd64.iso

Installing QEMU

You can install qemu by typing the following command in the terminal:

```
$ sudo apt-get install qemu
```

Creating a QEMU image

Once the QEMU installation is done, you can then create the QEMU Image by running the following command.

```
$ sudo qemu-img create ubuntu.img 10G -f qcow2
```

Installing VM

Once the image is created, install the VM using the following command.

```
$ sudo qemu-system-x86_64 -hda ubuntu.img -boot d -cdrom
./[UBUNTU_SERVER_ISO_FILE_NAME] -m 2046 -boot strict=on
```

Experimental Setup

Memory 16GB RAM
OS Windows 11
10th Gen Intel Core i5
Thee test conditions will be considered to compare VM the performance and find the deviation

- 2 cores with 2GB memory allocation
- 4 cores with 4GB memory allocation
- 6 cores with 6GB memory allocation

Same test conditions will be considered for Docker. For Docker sysbench image is used.

Docker installation and import instructions.

Docker is a separate thing to be installed and it’s not inbuilt in the VM. we would just need to install the Docker Engine and the Docker CLI separately.

https://docs.docker.com/desktop/windows/install/

Experiments - Reports and findings

Scenario 1: 2GB RAM and 2 cores

CPU testing QEMU vs Docker

3 test cases are used to test the performance between QEMU and docker.

Max-prime = 2000 and time = 30 seconds

Max-prime = 20.000 and time = 30 seconds

Max-prime = 100,000 and time = 30 seconds

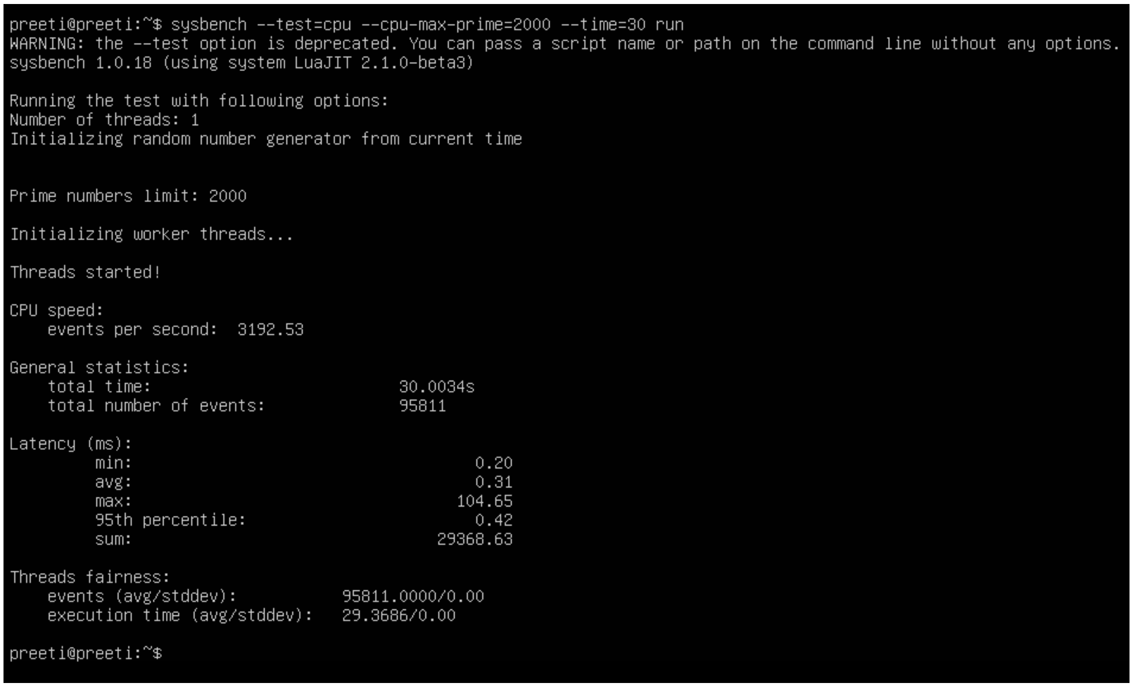
Command for sysbench

sysbench cpu –cpu-max-prime={some_value} –num-threads={some_value} –time={some_value} run

QEMU test results with scenario 1

QEMU test results with scenario 1 (2GB memory allocation and max prime number 2000)

First test case is with max prime number 2000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.



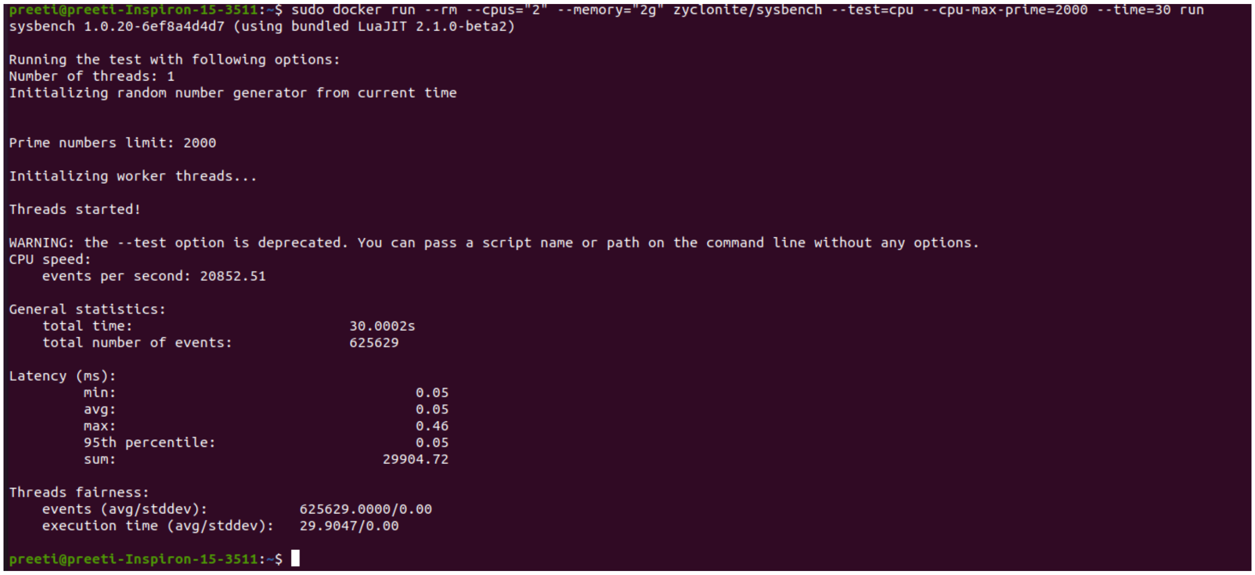
```
preeti@preeti:~$ sysbench --test=cpu --cpu-max-prime=2000 --time=30 run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

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:  3192.53

General statistics:
    total time:                          30.0034s
    total number of events:              95811

Latency (ms):
         min:                                    0.20
         avg:                                    0.31
         max:                                  104.65
         95th percentile:                        0.42
         sum:                                29368.63

Threads fairness:
    events (avg/stddev):           95811.0000/0.00
    execution time (avg/stddev):   29.3686/0.00

preeti@preeti:~$
```

Iteration	Events per second	
1	3167.51	
2	3260.45	Maximum value
3	3198.56	
4	3131.53	Minimum value
5	3192.53	
Average events per second	3190.12	

Docker test results with scenario 1

Docker test results with scenario 1 (2GB memory allocation and max prime number 2000)

First test case is with max prime number 2000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.



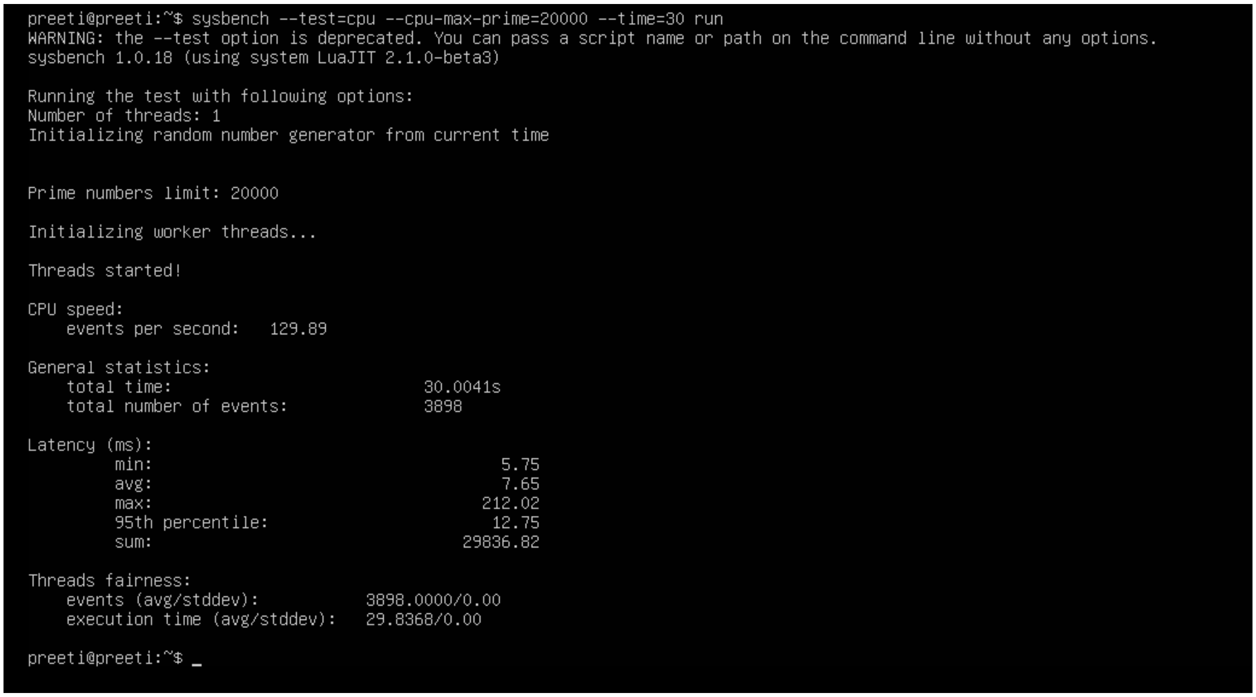
```
preeti@preeti-Inspiron-15-3511:~$ sudo docker run --rm --cpus="2" --memory="2g" zyclonite/sysbench --test=cpu --cpu-max-prime=2000 --time=30 run
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

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: 20852.51

General statistics:
    total time:                          30.0002s
    total number of events:              625629

Latency (ms):
         min:                                    0.05
         avg:                                    0.05
         max:                                    0.46
         95th percentile:                        0.05
         sum:                                29904.72

Threads fairness:
    events (avg/stddev):           625629.0000/0.00
    execution time (avg/stddev):   29.9047/0.00

preeti@preeti-Inspiron-15-3511:~$ 
```

Iteration	Events per second	
1	20961.01	Maximum value
2	20792.08	Minimum value
3	20960.94	

4	20887.81	
5	20852.51	
Average events per second	20890.87	

a. QEMU test results with scenario 2

QEMU test results with scenario 2 (2GB memory allocation and max prime number 20,000)
First test case is with a max prime number 20,000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.

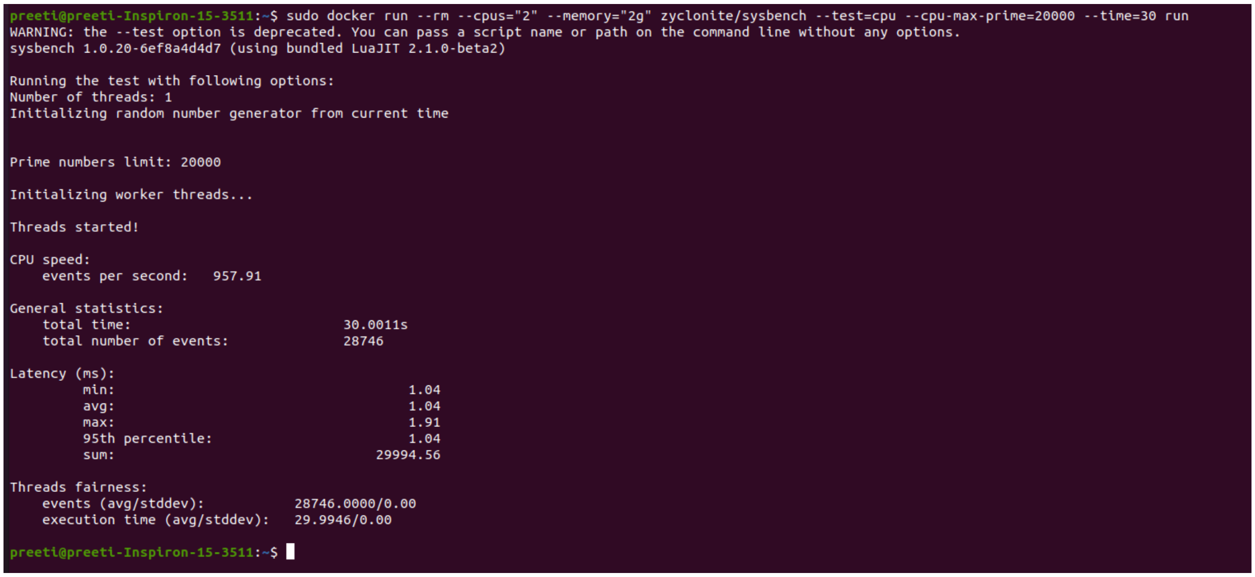


```
preeti@preeti:~$ sysbench --test=cpu --cpu-max-prime=20000 --time=30 run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

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:   129.89

General statistics:
    total time:                          30.0041s
    total number of events:              3898

Latency (ms):
         min:                                    5.75
         avg:                                    7.65
         max:                                  212.02
         95th percentile:                       12.75
         sum:                                29836.82

Threads fairness:
    events (avg/stddev):           3898.0000/0.00
    execution time (avg/stddev):   29.8368/0.00

preeti@preeti:~$ _
```

Iteration	Events per second	
1	119.40	
2	117.98	Minimum value
3	136.67	Maximum value
4	131.79	
5	129.89	
Average events per second	127.15	

Docker test results with scenario 2

Docker test results with scenario 1 (2GB memory allocation and max prime number 20,000) First test case is with a max prime number 20,000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.

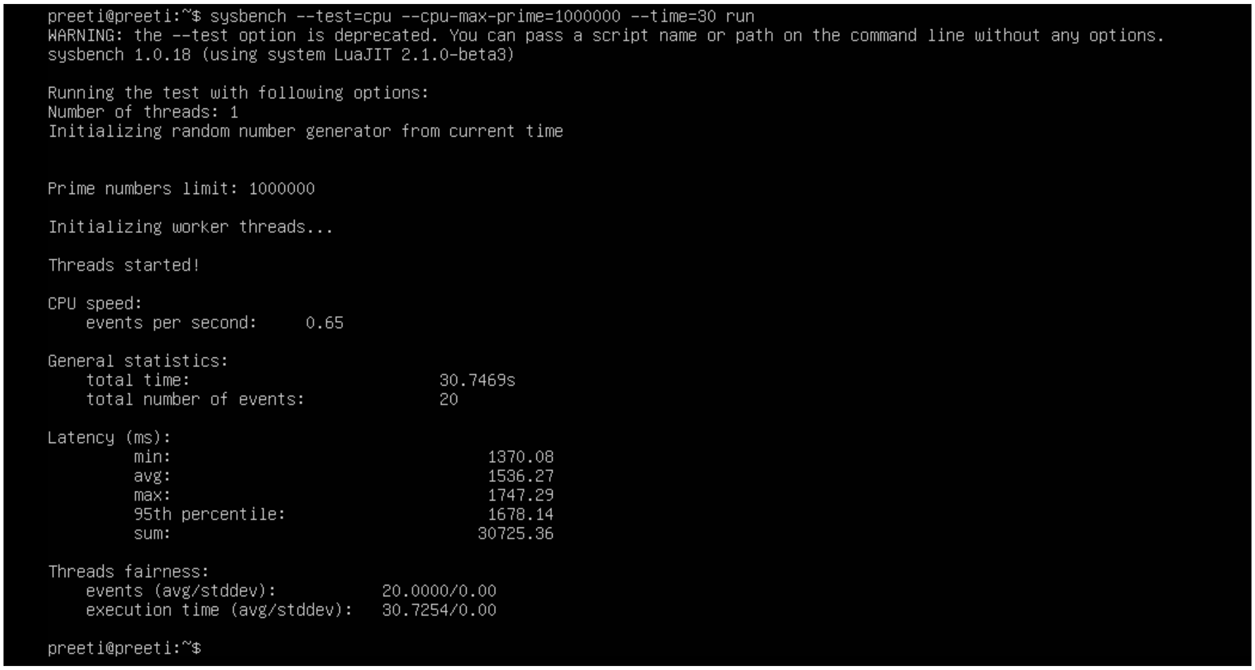


```
preeti@preeti-Inspiron-15-3511:~$ sudo docker run --rm --cpus="2" --memory="2g" zyclonite/sysbench --test=cpu --cpu-max-prime=20000 --time=30 run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20-6ef8a4d4d7 (using 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:   957.91

General statistics:
    total time:                          30.0011s
    total number of events:              28746

Latency (ms):
         min:                                    1.04
         avg:                                    1.04
         max:                                    1.91
         95th percentile:                        1.04
         sum:                                29994.56

Threads fairness:
    events (avg/stddev):           28746.0000/0.00
    execution time (avg/stddev):   29.9946/0.00

preeti@preeti-Inspiron-15-3511:~$ 
```

Iteration	Events per second	
1	958.35	
2	953.13	Minimum value
3	958.55	
4	958.85	Maximum value
5	957.91	
Average events per second	957.36	

b. QEMU test results with scenario 3

QEMU test results with scenario 2 (2GB memory allocation and max prime number 100,000) First test case is with a max prime number 100,000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.



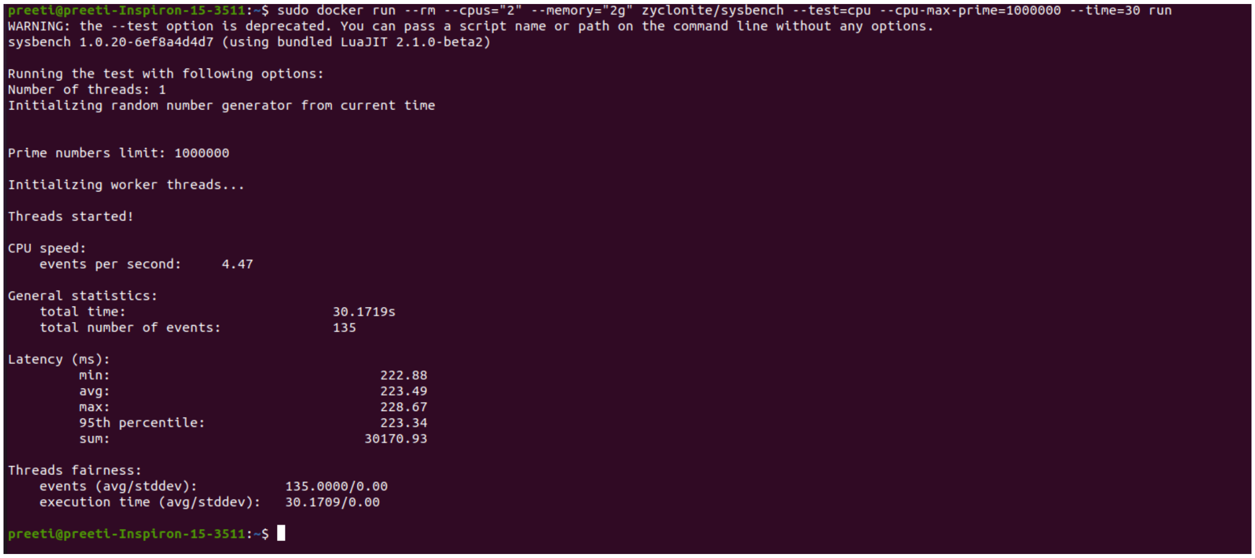
```
preeti@preeti:~$ sysbench --test=cpu --cpu-max-prime=1000000 --time=30 run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

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


Prime numbers limit: 1000000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:     0.65

General statistics:
    total time:                          30.7469s
    total number of events:              20

Latency (ms):
         min:                                 1370.08
         avg:                                 1536.27
         max:                                 1747.29
         95th percentile:                     1678.14
         sum:                                30725.36

Threads fairness:
    events (avg/stddev):           20.0000/0.00
    execution time (avg/stddev):   30.7254/0.00

preeti@preeti:~$
```

Iteration	Events per second	
1	0.60	Minimum value
2	0.60	Minimum value
3	0.61	
4	0.63	
5	0.65	Maximum value
Average events per second	0.62	

Docker test results with scenario 3

Docker test results with scenario 1 (2GB memory allocation and max prime number 100,000)

First test case is with a max prime number 100,000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.



```
preeti@preeti-Inspiron-15-3511:~$ sudo docker run --rm --cpus="2" --memory="2g" zyclonite/sysbench --test=cpu --cpu-max-prime=1000000 --time=30 run
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: 1000000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:     4.47

General statistics:
    total time:                          30.1719s
    total number of events:              135

Latency (ms):
         min:                                  222.88
         avg:                                  223.49
         max:                                  228.67
         95th percentile:                      223.34
         sum:                                30170.93

Threads fairness:
    events (avg/stddev):           135.0000/0.00
    execution time (avg/stddev):   30.1709/0.00

preeti@preeti-Inspiron-15-3511:~$ 
```

Iteration	Events per second	
1	4.47	Maximum value
2	4.44	Minimum value
3	4.47	Maximum value
4	4.46	
5	4.47	Maximum value
Average events per second	4.46	

File I/O testing QEMU vs Docker

For File I/O testing, two modes of sysbench supports

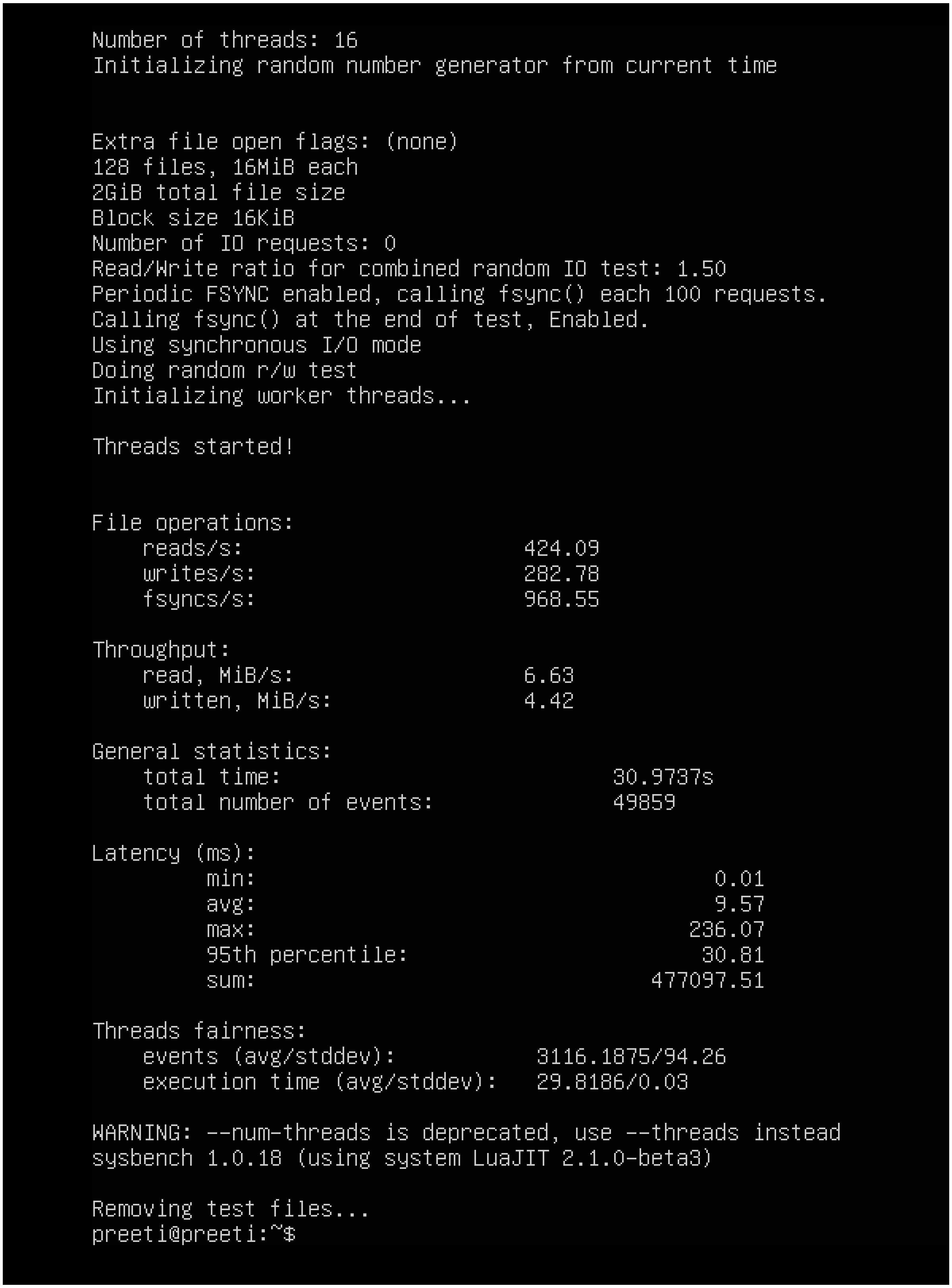
Combined random read/write (rndrw)

Sequential Rewrite (seqrewr)

File size is constant 2GB

QEMU execution

Combined random read/write (rndrw)

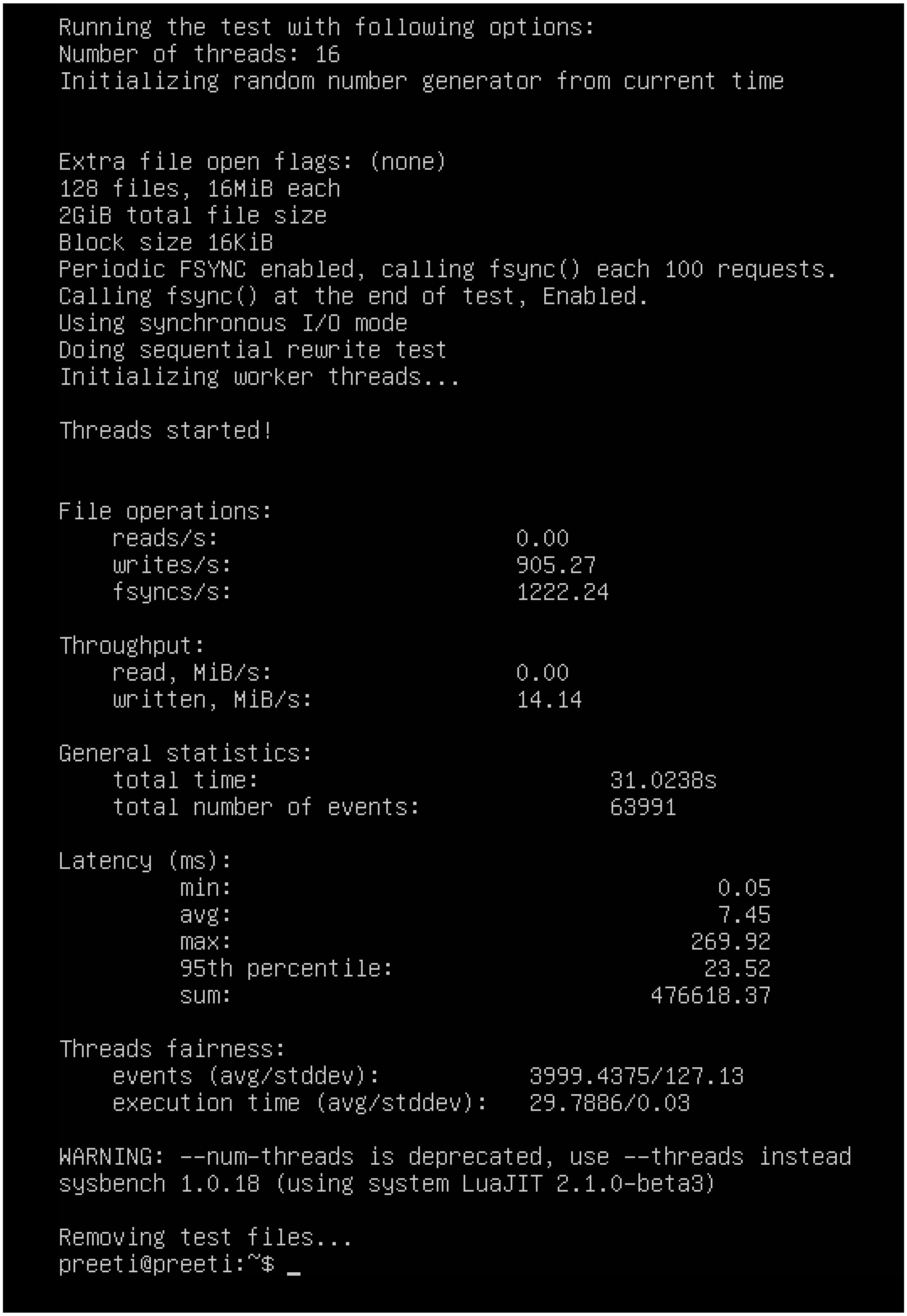


```
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 16MiB each
2GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      424.09
    writes/s:                     282.78
    fsyncs/s:                     968.55

Throughput:
    read, MiB/s:                  6.63
    written, MiB/s:               4.42

General statistics:
    total time:                          30.9737s
    total number of events:              49859

Latency (ms):
         min:                                    0.01
         avg:                                    9.57
         max:                                  236.07
         95th percentile:                       30.81
         sum:                               477097.51

Threads fairness:
    events (avg/stddev):           3116.1875/94.26
    execution time (avg/stddev):   29.8186/0.03

WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
preeti@preeti:~$
```

Iterations	
1	reads/s 435.89 writes/s 290.33 fsyncs/s 991.77 Total events/s 1713.87
2	reads/s 433.12 writes/s 288.72 fsyncs/s 988.74 Total events/s 1695.94
3	reads/s 436.73 writes/s 291.31 fsyncs/s 994.72 Total events/s 1722.23
4	reads/s 488.80 writes/s 325.70 fsyncs/s 1105.55 Total events/s 1911.9
5	reads/s 424.09 writes/s 282.78 fsyncs/s 968.55 Total events/s 1661.97

QEMU execution

Sequential Rewrite (seqrewr)

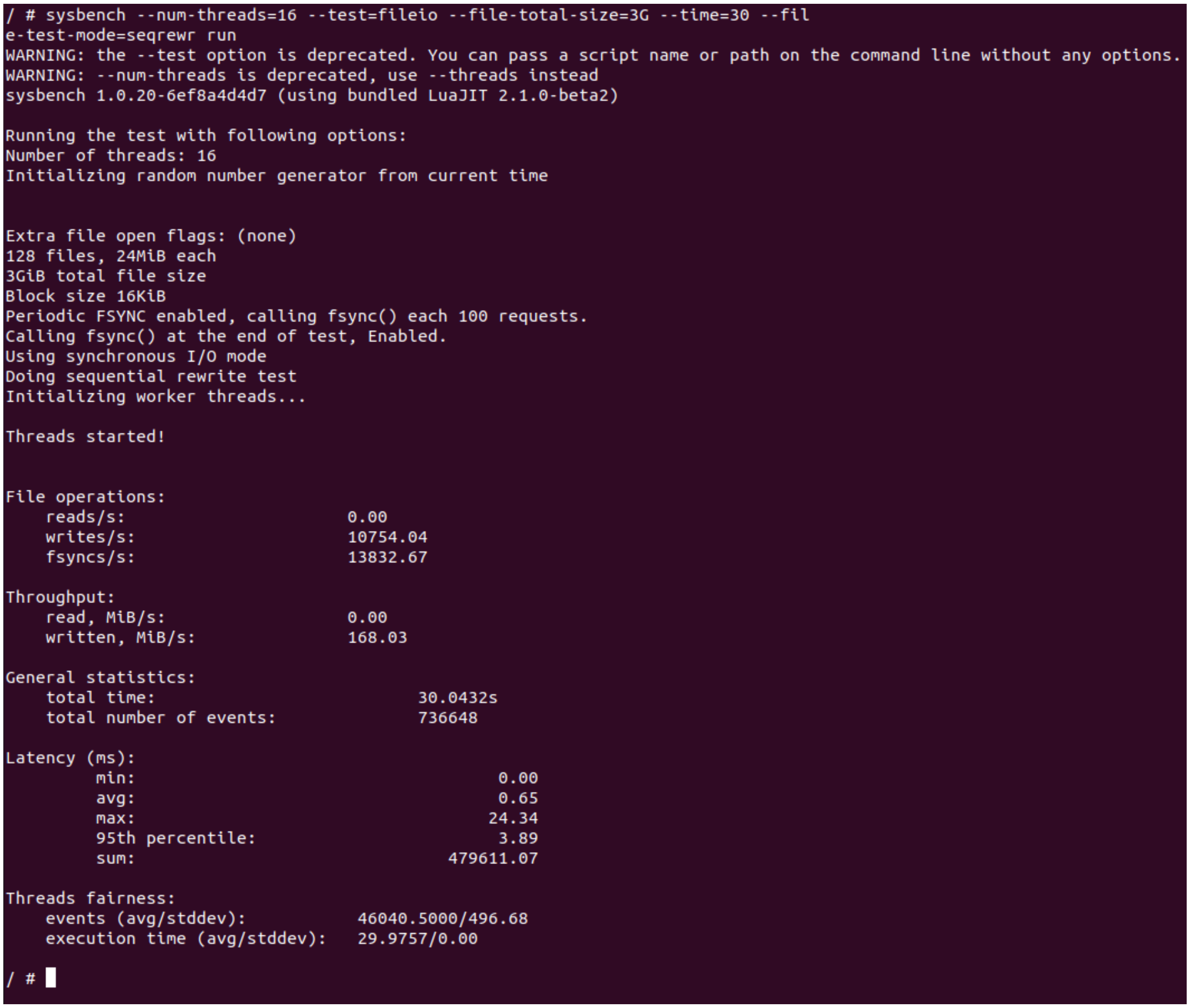


```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 16MiB each
2GiB 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:                     905.27
    fsyncs/s:                     1222.24

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               14.14

General statistics:
    total time:                          31.0238s
    total number of events:              63991

Latency (ms):
         min:                                    0.05
         avg:                                    7.45
         max:                                  269.92
         95th percentile:                       23.52
         sum:                               476618.37

Threads fairness:
    events (avg/stddev):           3999.4375/127.13
    execution time (avg/stddev):   29.7886/0.03

WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
preeti@preeti:~$ _
```

Iterations	
1	reads/s 0.00 writes/s 89.82 fsyncs/s 1209.94 Total events/s 2136.1
2	reads/s 0.00 writes/s 937.80 fsyncs/s 1264.80 Total events/s 2209.97
3	reads/s 0.00 writes/s 924.10 fsyncs/s 1246.97 Total events/s 2175.17
4	reads/s 0.00 writes/s 862.82 fsyncs/s 1167.91 Total events/s 2026.43
5	reads/s 0.00 writes/s 905.27 fsyncs/s 1222.24 Total events/s 2133.03

Docker execution

Sequential Rewrite (seqrewr)



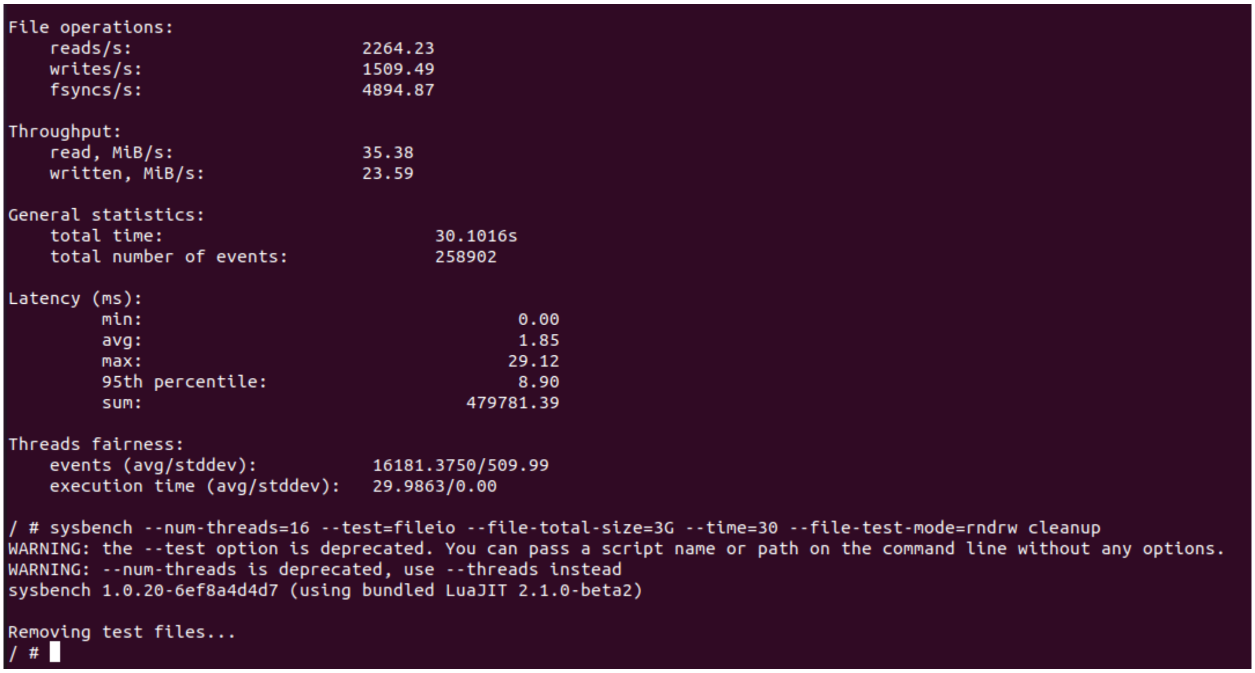
```
/ # sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --fil
e-test-mode=seqrewr run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

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:                     10754.04
    fsyncs/s:                     13832.67

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               168.03

General statistics:
    total time:                          30.0432s
    total number of events:              736648

Latency (ms):
         min:                                    0.00
         avg:                                    0.65
         max:                                   24.34
         95th percentile:                        3.89
         sum:                               479611.07

Threads fairness:
    events (avg/stddev):           46040.5000/496.68
    execution time (avg/stddev):   29.9757/0.00

/ #
```

Iterations	
1	reads/s 0.00 writes/s 15319.89 fsyncs/s 19675.16 Total events/s 34980.33
2	reads/s 0.00 writes/s 12822.58 fsyncs/s 16477.09 Total events/s 29286.43
3	reads/s 0.00 writes/s 12633.92

	fsyncs/s 16222.91 Total events/s 28816.6
4	reads/s 0.00 writes/s 11765.48 fsyncs/s 15127.51 Total events/s 2865.53
5	reads/s 0.00 writes/s 10770.07 fsyncs/s 13852.65 Total events/s 24592.4

Docker execution

Combined random read/write (rndrw)



```
File operations:
    reads/s:                      2264.23
    writes/s:                     1509.49
    fsyncs/s:                     4894.87

Throughput:
    read, MiB/s:                  35.38
    written, MiB/s:               23.59

General statistics:
    total time:                          30.1016s
    total number of events:              258902

Latency (ms):
         min:                                    0.00
         avg:                                    1.85
         max:                                   29.12
         95th percentile:                        8.90
         sum:                               479781.39

Threads fairness:
    events (avg/stddev):           16181.3750/509.99
    execution time (avg/stddev):   29.9863/0.00

/ # sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --file-test-mode=rndrw cleanup
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 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

Removing test files...
/ # 
```

Iterations	
1	reads/s 2742.03 writes/s 1828.02 fsyncs/s 5914.97 Total events/s 10447.23
2	reads/s 2723.50 writes/s 1815.61

	fsyncs/s 5876.87 Total events/s 10372.7
3	reads/s 2964.20 writes/s 1976.13 fsyncs/s 6391.35 Total events/s 11285.6
4	reads/s 3073.24 writes/s 2048.83 fsyncs/s 6623.07 Total events/s 11702.7
5	reads/s 2264.23 writes/s 1509.49 fsyncs/s 4849.87 Total events/s 8630.07

Scenario 2: 4GB RAM and 4 cores

CPU testing QEMU vs Docker

3 test cases are used to test the performance between QEMU and docker.

Max-prime = 2000 and time = 30 seconds

Max-prime = 20.000 and time = 30 seconds

Max-prime = 100,000 and time = 30 seconds

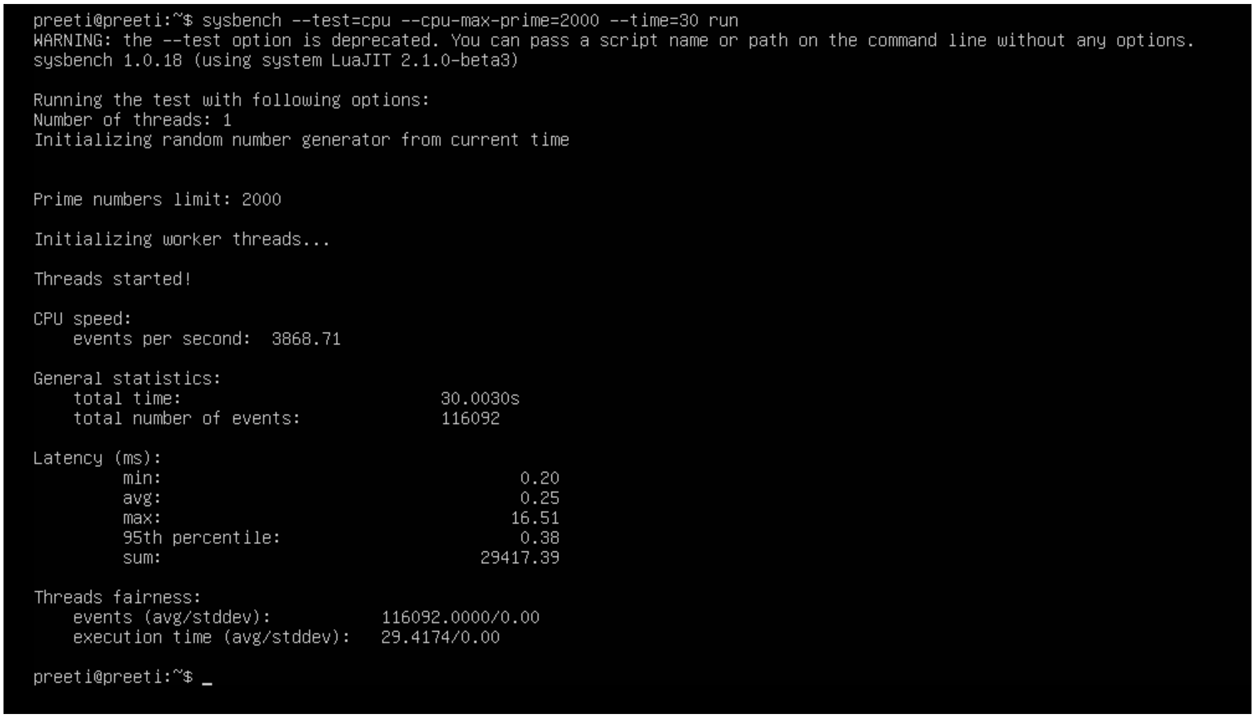
Command for sysbench

```
sysbench cpu –cpu-max-prime={some_value} –num-threads={some_value} –time={some_value} run
```

QEMU test results with scenario 1

QEMU test results with scenario 1 (4GB memory allocation and max prime number 2000)

First test case is with max prime number 2000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.



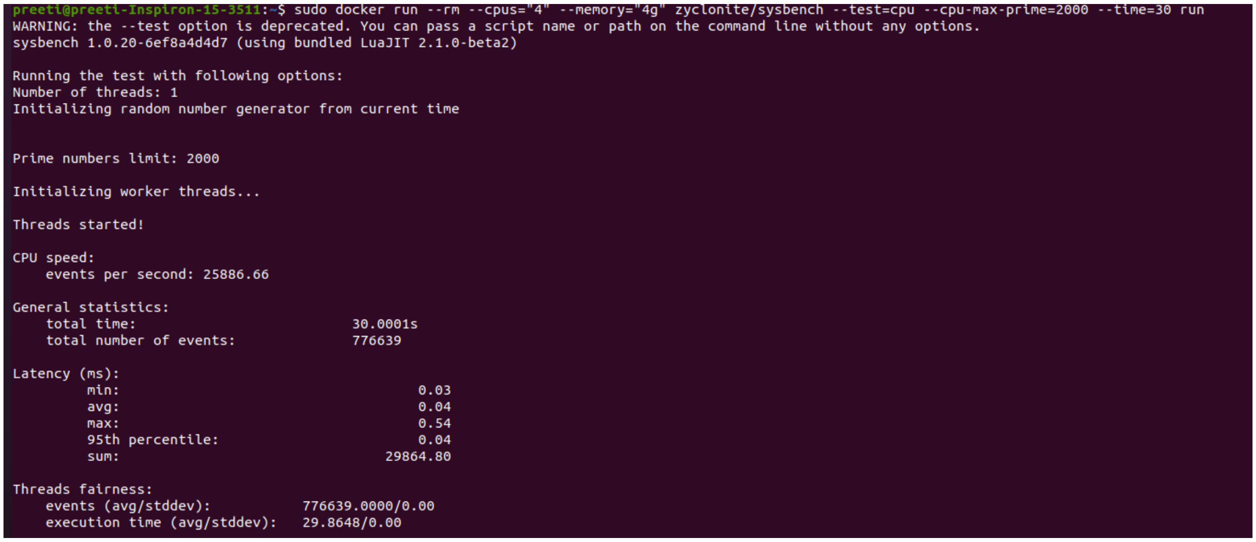
```
preeti@preeti:~$ sysbench --test=cpu --cpu-max-prime=2000 --time=30 run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

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:  3868.71

General statistics:
    total time:                          30.0030s
    total number of events:              116092

Latency (ms):
         min:                                    0.20
         avg:                                    0.25
         max:                                   16.51
         95th percentile:                        0.38
         sum:                                29417.39

Threads fairness:
    events (avg/stddev):           116092.0000/0.00
    execution time (avg/stddev):   29.4174/0.00

preeti@preeti:~$ _
```

Iteration	Events per second	
1	3451.95	
2	3442.40	Minimum value
3	3863.16	
4	3495.67	
5	3868.71	Maximum value
Average events per second	3624.38	

Docker test results with scenario 1

Docker test results with scenario 1 (4GB memory allocation and max prime number 2000)

First test case is with max prime number 2000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.

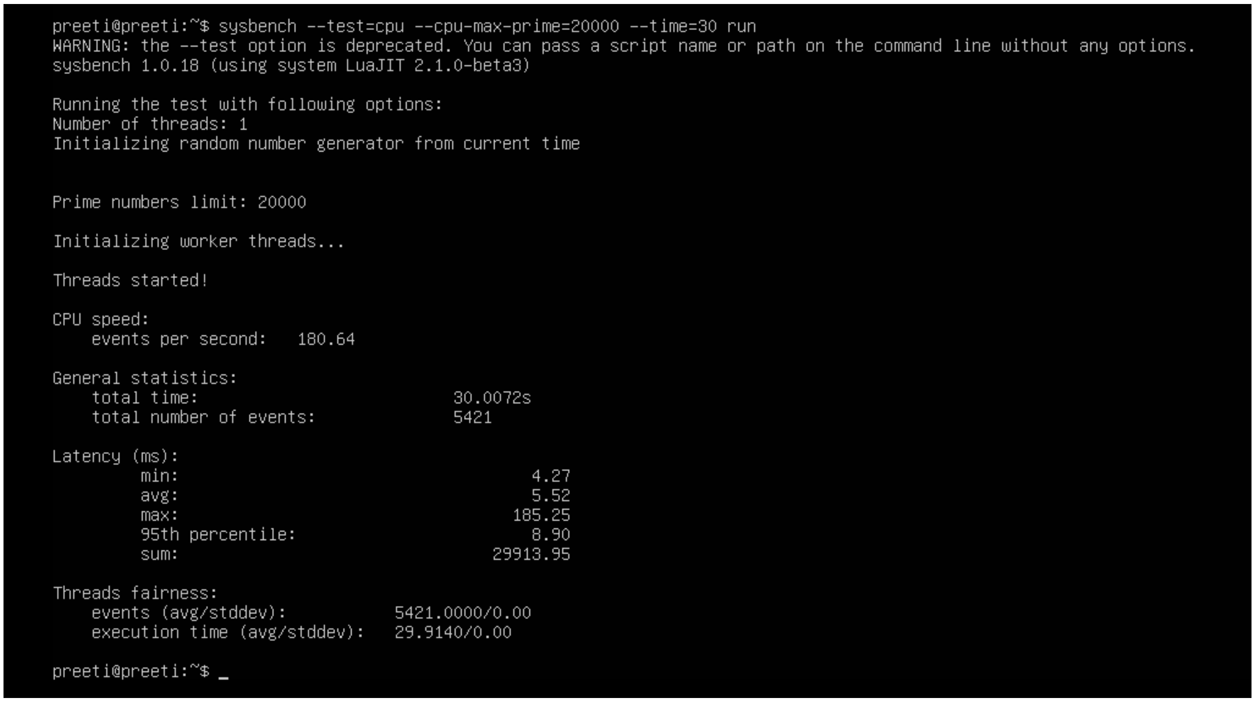


```
preeti@preeti-Inspiron-15-3511:~$ sudo docker run --rm --cpus="4" --memory="4g" zyclonite/sysbench --test=cpu --cpu-max-prime=2000 --time=30 run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20-6ef8a4d4d7 (using 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: 25886.66

General statistics:
    total time:                          30.0001s
    total number of events:              776639

Latency (ms):
         min:                                    0.03
         avg:                                    0.04
         max:                                    0.54
         95th percentile:                        0.04
         sum:                                29864.80

Threads fairness:
    events (avg/stddev):           776639.0000/0.00
    execution time (avg/stddev):   29.8648/0.00
```

Iteration	Events per second	
1	26084.15	Maximum value
2	25988.15	
3	25973.71	
4	25629.78	Minimum value
5	25886.66	
Average events per second	25912.49	

QEMU test results with scenario 2

QEMU test results with scenario 2 (4GB memory allocation and max prime number 20,000) First test case is with a max prime number 20,000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.

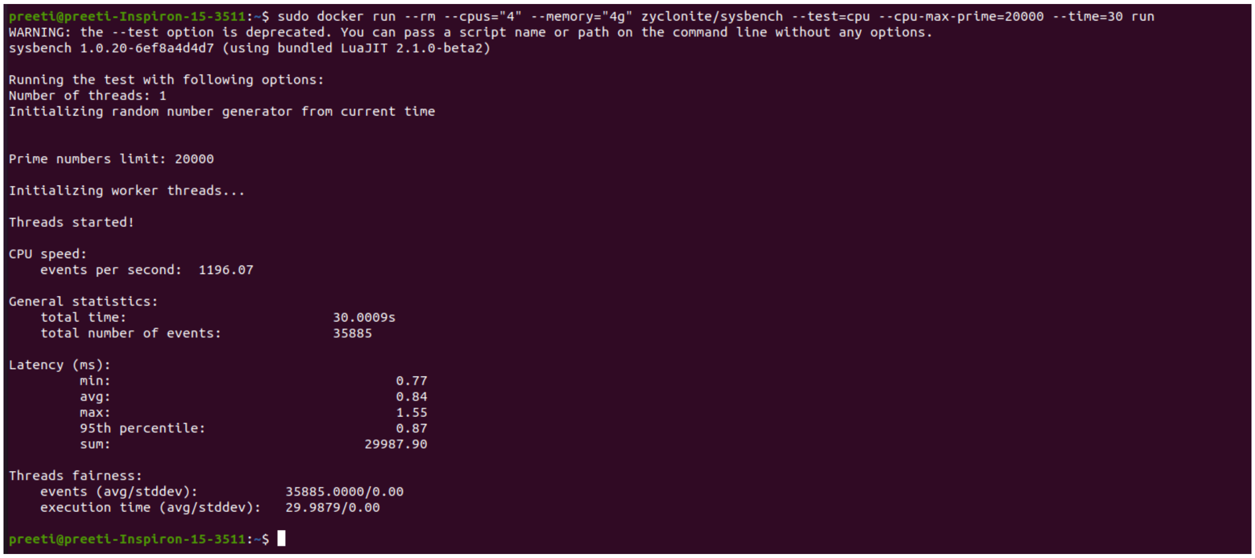


```
preeti@preeti:~$ sysbench --test=cpu --cpu-max-prime=20000 --time=30 run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

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:   180.64

General statistics:
    total time:                          30.0072s
    total number of events:              5421

Latency (ms):
         min:                                    4.27
         avg:                                    5.52
         max:                                  185.25
         95th percentile:                        8.90
         sum:                                29913.95

Threads fairness:
    events (avg/stddev):           5421.0000/0.00
    execution time (avg/stddev):   29.9140/0.00

preeti@preeti:~$ _
```

Iteration	Events per second	
1	193.17	Maximum value
2	182.36	
3	181.84	
4	193.13	
5	180.64	Minimum value
Average events per second	186.22	

Docker test results with scenario 2

Docker test results with scenario 2 (4GB memory allocation and max prime number 20,000) First test case is with a max prime number 20,000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.

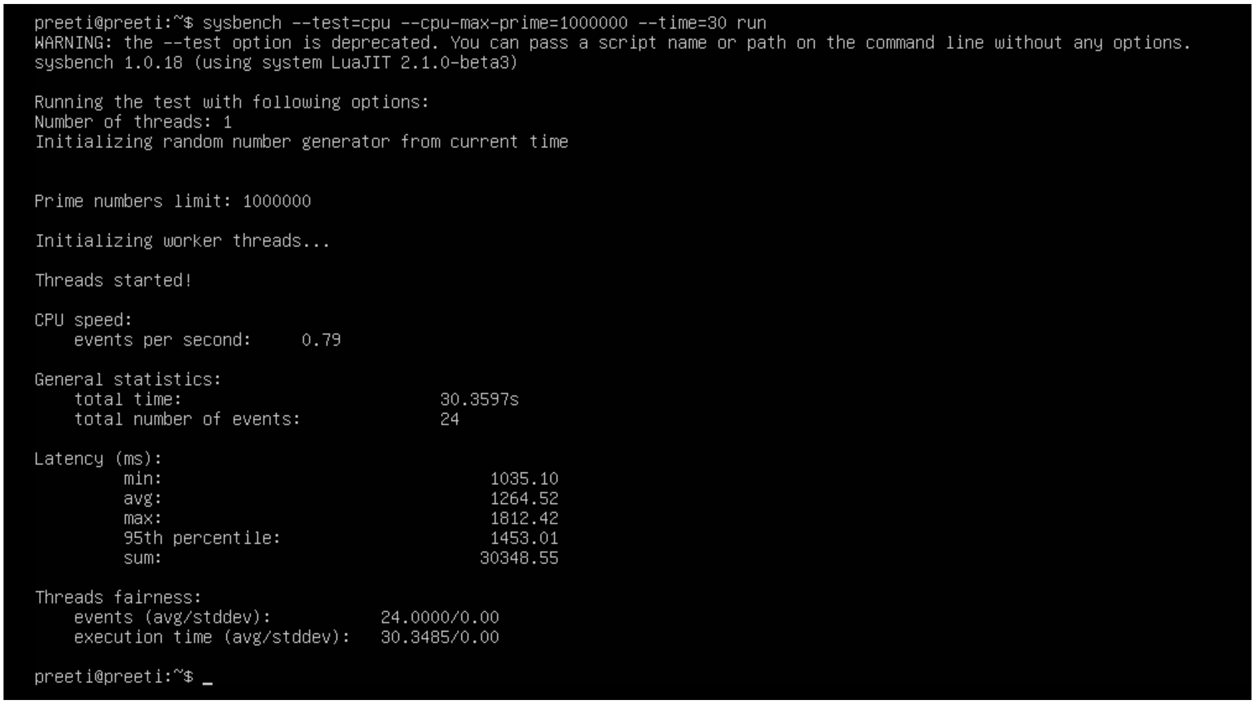


```
preeti@preeti-Inspiron-15-3511:~$ sudo docker run --rm --cpus="4" --memory="4g" zyclonite/sysbench --test=cpu --cpu-max-prime=20000 --time=30 run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20-6ef8a4d4d7 (using 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:  1196.07

General statistics:
    total time:                          30.0009s
    total number of events:              35885

Latency (ms):
         min:                                    0.77
         avg:                                    0.84
         max:                                    1.55
         95th percentile:                        0.87
         sum:                                29987.90

Threads fairness:
    events (avg/stddev):           35885.0000/0.00
    execution time (avg/stddev):   29.9879/0.00

preeti@preeti-Inspiron-15-3511:~$ 
```

Iteration	Events per second	
1	1202.23	Maximum value
2	1175.73	Minimum value
3	1194.21	
4	1195.32	
5	1196.07	
Average events per second	1192.71	

QEMU test results with scenario 3

QEMU test results with scenario 3 (4GB memory allocation and max prime number 100,000) First test case is with a max prime number 100,000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.

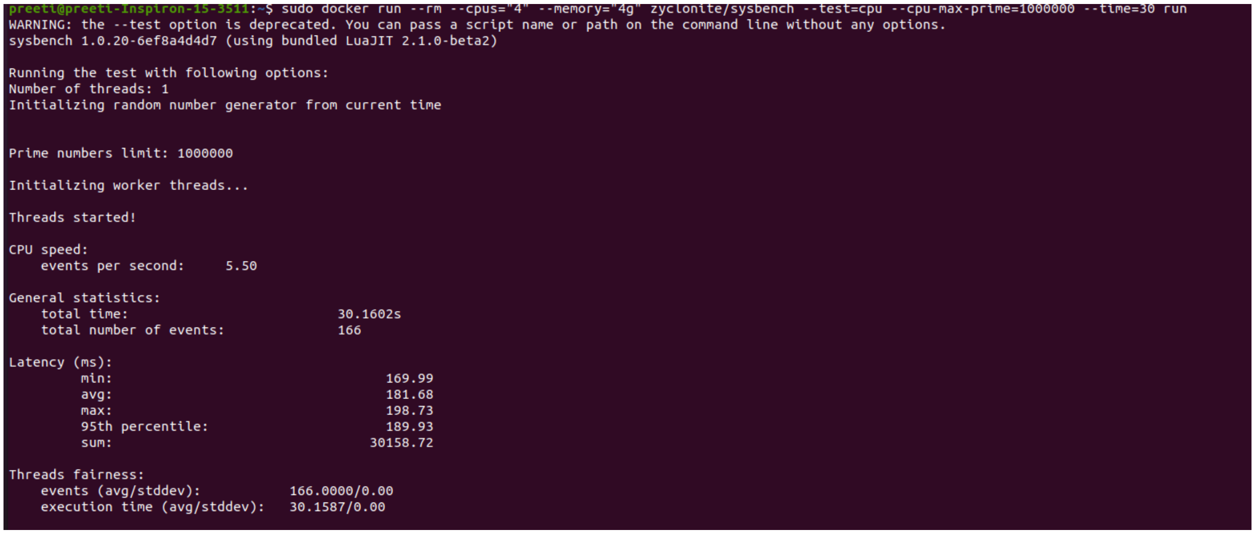


```
preeti@preeti:~$ sysbench --test=cpu --cpu-max-prime=1000000 --time=30 run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

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


Prime numbers limit: 1000000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:     0.79

General statistics:
    total time:                          30.3597s
    total number of events:              24

Latency (ms):
         min:                                 1035.10
         avg:                                 1264.52
         max:                                 1812.42
         95th percentile:                     1453.01
         sum:                                30348.55

Threads fairness:
    events (avg/stddev):           24.0000/0.00
    execution time (avg/stddev):   30.3485/0.00

preeti@preeti:~$ _
```

Iteration	Events per second	
1	0.92	Maximum value
2	0.82	
3	0.81	
4	0.76	Minimum value
5	0.79	
Average events per second	0.82	

Docker test results with scenario 3

Docker test results with scenario 3 (4GB memory allocation and max prime number 100,000) First test case is with a max prime number 100,000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.



```
preeti@preeti-Inspiron-15-3511:~$ sudo docker run --rm --cpus="4" --memory="4g" zyclonite/sysbench --test=cpu --cpu-max-prime=1000000 --time=30 run
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: 1000000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:     5.50

General statistics:
    total time:                          30.1602s
    total number of events:              166

Latency (ms):
         min:                                  169.99
         avg:                                  181.68
         max:                                  198.73
         95th percentile:                      189.93
         sum:                                30158.72

Threads fairness:
    events (avg/stddev):           166.0000/0.00
    execution time (avg/stddev):   30.1587/0.00
```

Iteration	Events per second	
1	5.01	Minimum value
2	5.08	
3	5.23	
4	5.46	
5	5.50	Maximum value
Average events per second	5.25	

File I/O testing QEMU vs Docker

For File I/O testing, two modes of sysbench supports

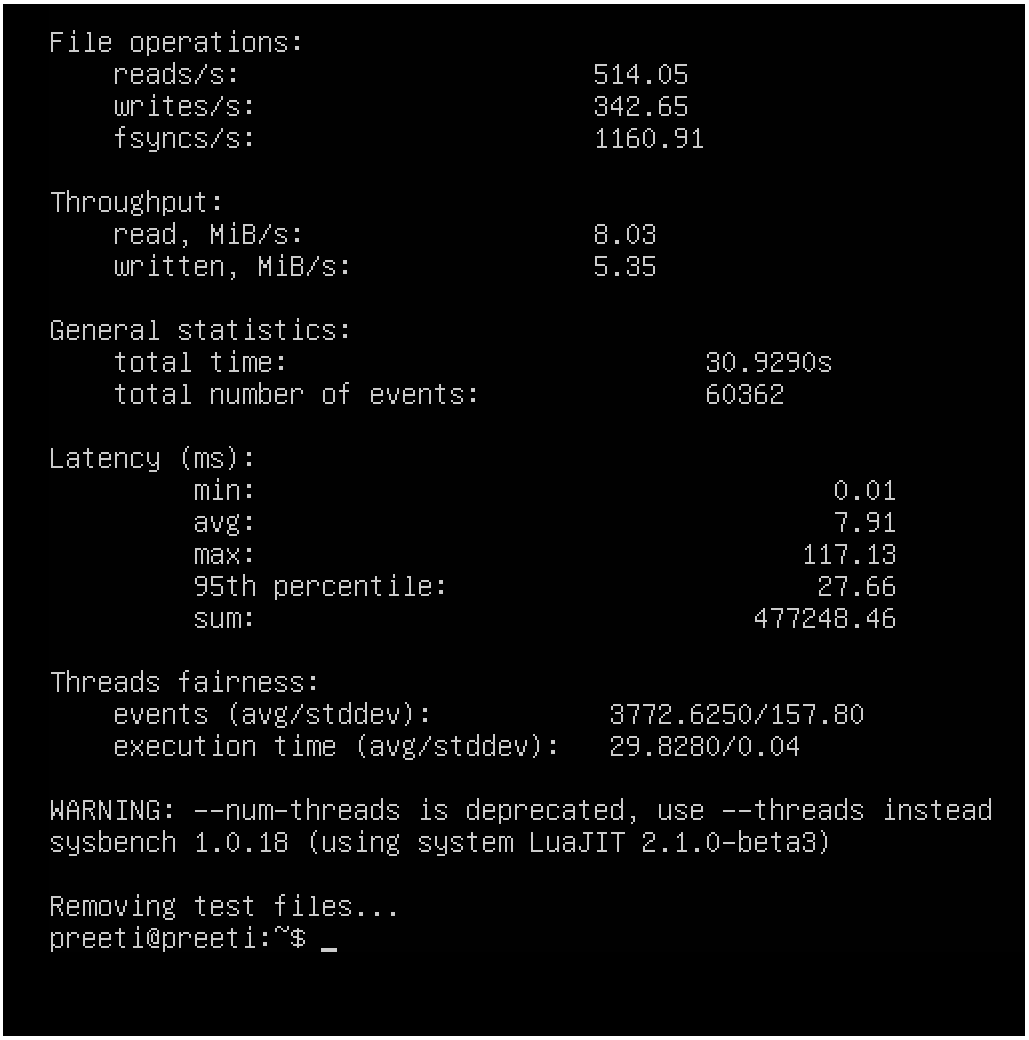
Combined random read/write (rndrw)

Sequential Rewrite (seqrewr)

File size is constant 4GB

QEMU execution

Combined random read/write (rndrw)



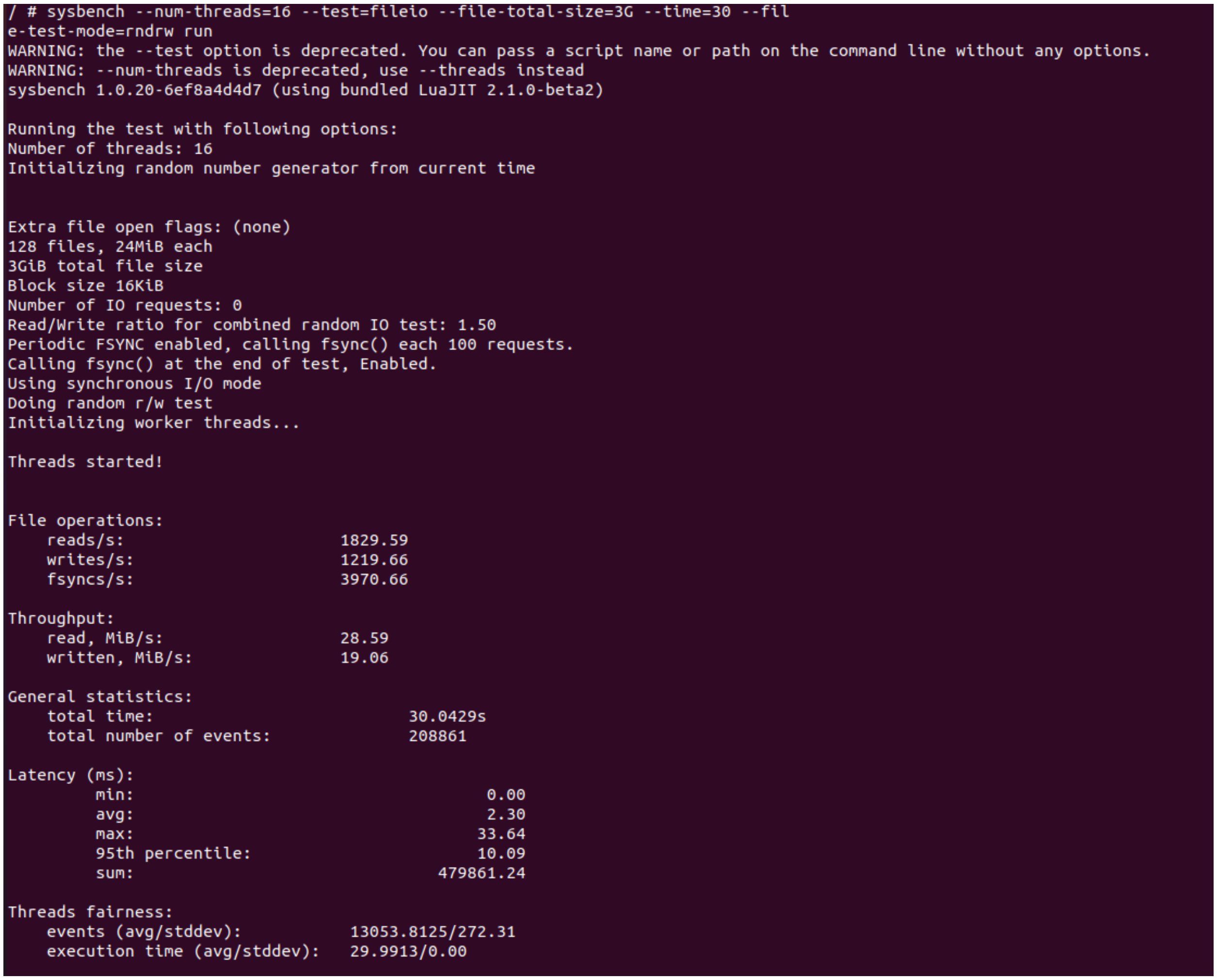
```
File operations:
    reads/s:                      514.05
    writes/s:                     342.65
    fsyncs/s:                     1160.91

Throughput:
    read, MiB/s:                  8.03
    written, MiB/s:               5.35

General statistics:
    total time:                          30.9290s
    total number of events:              60362

Latency (ms):
         min:                                    0.01
         avg:                                    7.91
         max:                                  117.13
         95th percentile:                       27.66
         sum:                               477248.46

Threads fairness:
    events (avg/stddev):           3772.6250/157.80
    execution time (avg/stddev):   29.8280/0.04

WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
preeti@preeti:~$ _
```

Iterations	
1	reads/s 393.04 writes/s 262.03 fsyncs/s 903.47 Total events/s 1525.8
2	reads/s 681.13 writes/s 454.30 fsyncs/s 1518.21 Total events/s 2646.3
3	reads/s 430.90 writes/s 287.27 fsyncs/s 984.09 Total events/s 1677.83

4	reads/s 473.15 writes/s 315.44 fsyncs/s 1073.75 Total events/s 1844.63
5	reads/s 514.05 writes/s 342.65 fsyncs/s 1160.91 Total events/s 2012.06

Docker execution

Combined random read/write (rndrw)

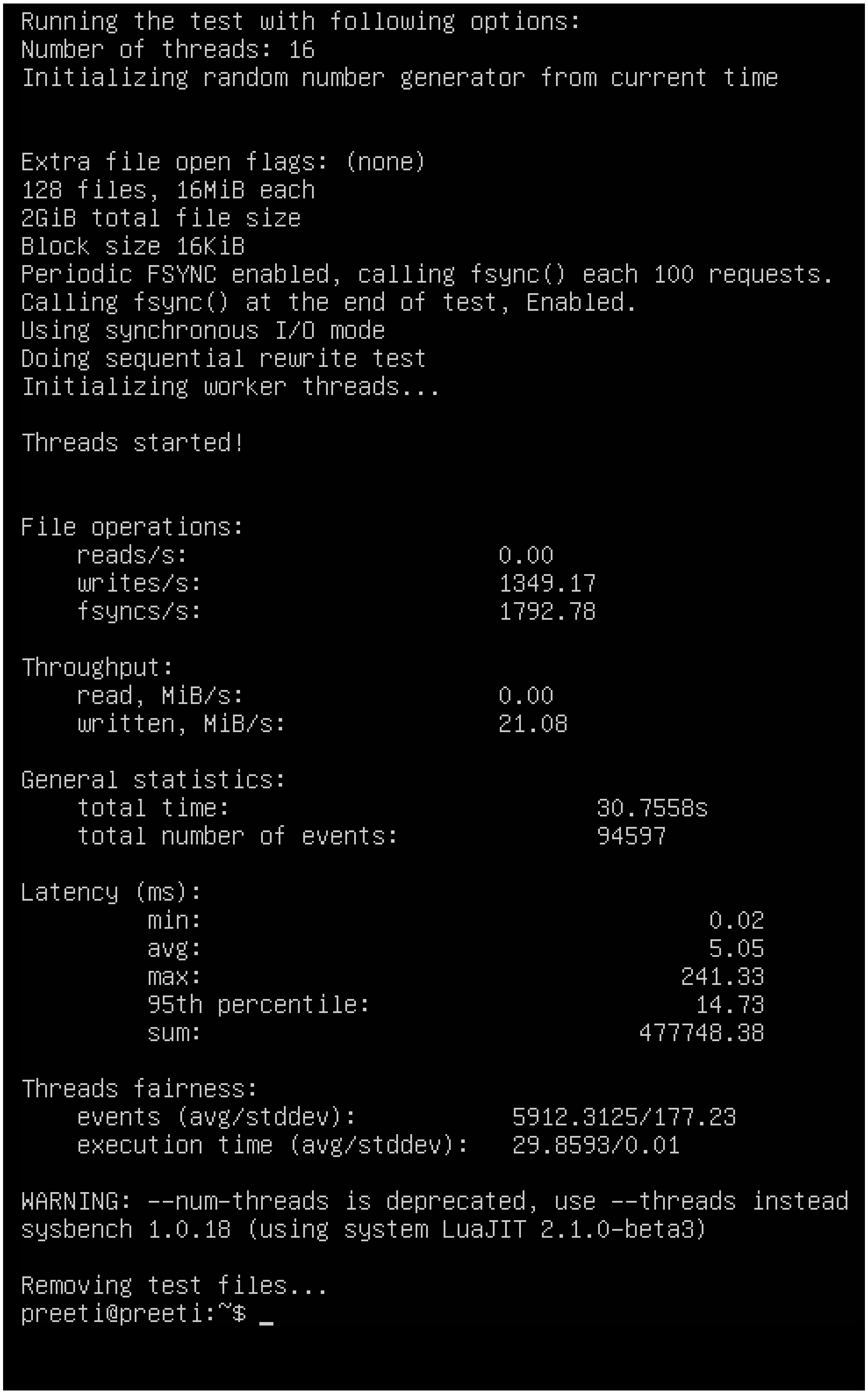


```
/ # sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30 --fil
e-test-mode=rndrw run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

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
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      1829.59
    writes/s:                     1219.66
    fsyncs/s:                     3970.66

Throughput:
    read, MiB/s:                  28.59
    written, MiB/s:               19.06

General statistics:
    total time:                          30.0429s
    total number of events:              208861

Latency (ms):
         min:                                    0.00
         avg:                                    2.30
         max:                                   33.64
         95th percentile:                       10.09
         sum:                               479861.24

Threads fairness:
    events (avg/stddev):           13053.8125/272.31
    execution time (avg/stddev):   29.9913/0.00
```

Iterations	
1	reads/s 2846.01 writes/s 1897.12 fsyncs/s 6137.23 Total events/s 10835.5
2	reads/s 2345.11 writes/s 1563.24 fsyncs/s 5070.02 Total events/s 8929.2
3	reads/s 2643.10 writes/s 1761.95 fsyncs/s 5702.98 Total events/s 10074.06
4	reads/s 1746.44 writes/s 1164.07 fsyncs/s 3792.64 Total events/s 6649.06
5	reads/s 1829.59 writes/s 1219.66 fsyncs/s 3970.66 Total events/s 6962.03

QEMU execution

Sequential Rewrite (seqrewr)

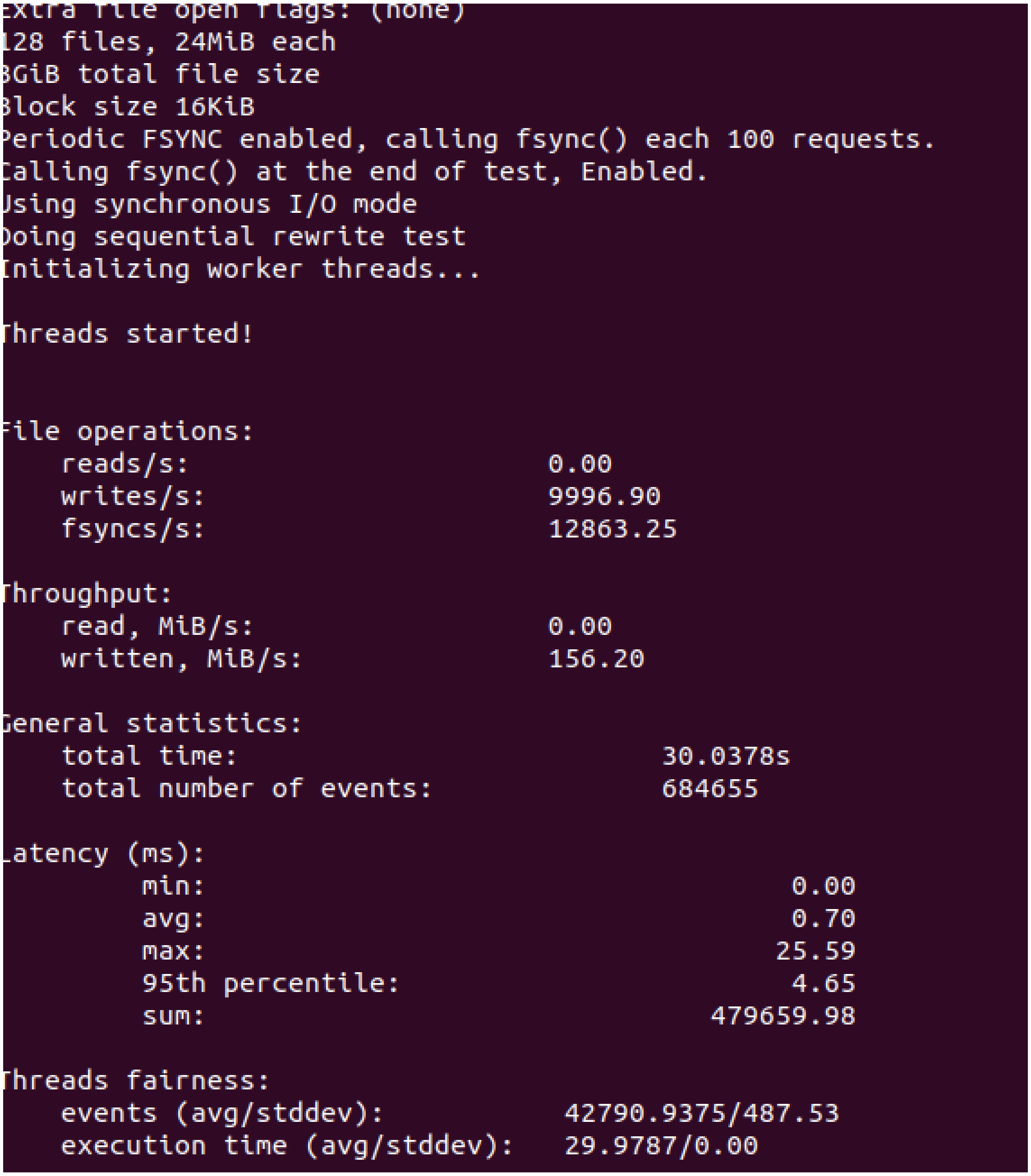


```
Running the test with following options:
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 16MiB each
2GiB 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:                     1349.17
    fsyncs/s:                     1792.78

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               21.08

General statistics:
    total time:                          30.7558s
    total number of events:              94597

Latency (ms):
         min:                                    0.02
         avg:                                    5.05
         max:                                  241.33
         95th percentile:                       14.73
         sum:                               477748.38

Threads fairness:
    events (avg/stddev):           5912.3125/177.23
    execution time (avg/stddev):   29.8593/0.01

WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
preeti@preeti:~$ _
```

Iterations	
1	reads/s 0.00 writes/s 1384.41 fsyncs/s 1837.98 Total events/s 3215.63
2	reads/s 0.00 writes/s 1372.34 fsyncs/s 1819.11 Total events/s 3225.33
3	reads/s 0.00 writes/s 1536.08 fsyncs/s 2033.11 Total events/s 3572
4	reads/s 0.00 writes/s 1562.77 fsyncs/s 2066.59 Total events/s 3663.03
5	reads/s 0.00 writes/s 1349.17 fsyncs/s 1792.78 Total events/s 3153.23

Docker execution

Sequential Rewrite (seqrewr)



```
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:                     9996.90
    fsyncs/s:                     12863.25

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               156.20

General statistics:
    total time:                          30.0378s
    total number of events:              684655

Latency (ms):
         min:                                    0.00
         avg:                                    0.70
         max:                                   25.59
         95th percentile:                        4.65
         sum:                               479659.98

Threads fairness:
    events (avg/stddev):           42790.9375/487.53
    execution time (avg/stddev):   29.9787/0.00
```

Iterations	
1	reads/s 0.00 writes/s 11095.90 fsyncs/s 14270.14 Total events/s 25337.63
2	reads/s 0.00 writes/s 11539.51

	fsyncs/s 14838.17 Total events/s 26384.63
3	reads/s 0.00 writes/s 10621.82 fsyncs/s 13552.28 Total events/s 24249.76
4	reads/s 0.00 writes/s 9996.90 fsyncs/s 12863.25 Total events/s 22821.83
5	reads/s 0.00 writes/s 10718.27 fsyncs/s 13786.53 Total events/s 24470.97

Scenario 3: 6GB RAM and 6 cores

CPU testing QEMU vs Docker

3 test cases are used to test the performance between QEMU and docker.

Max-prime = 2000 and time = 30 seconds

Max-prime = 20.000 and time = 30 seconds

Max-prime = 100,000 and time = 30 seconds

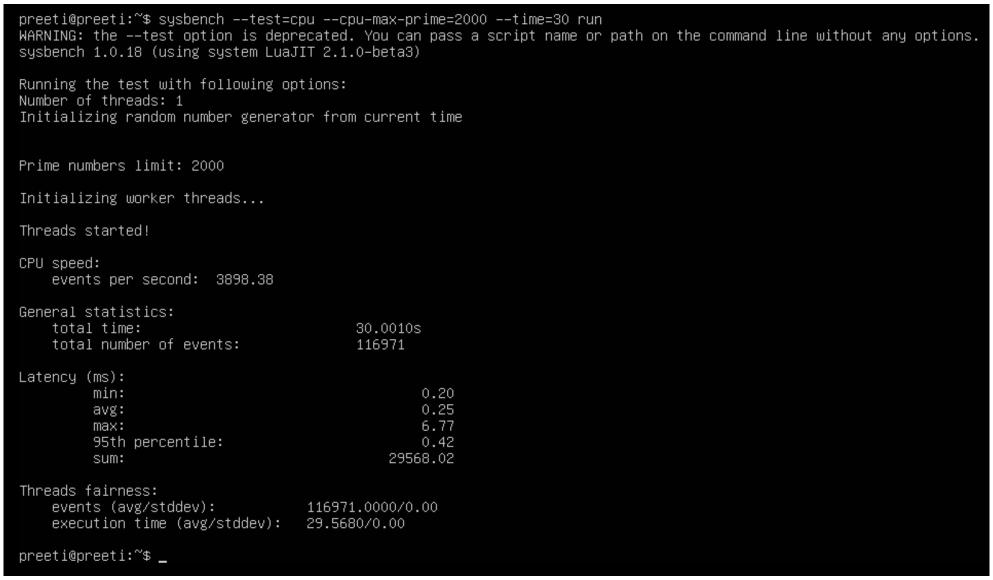
Command for sysbench

```
sysbench cpu –cpu-max-prime={some_value} –num-threads={some_value} –time={some_value} run
```

QEMU test results with scenario 1

QEMU test results with scenario 1 (6GB memory allocation and max prime number 2000)

First test case is with max prime number 2000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.

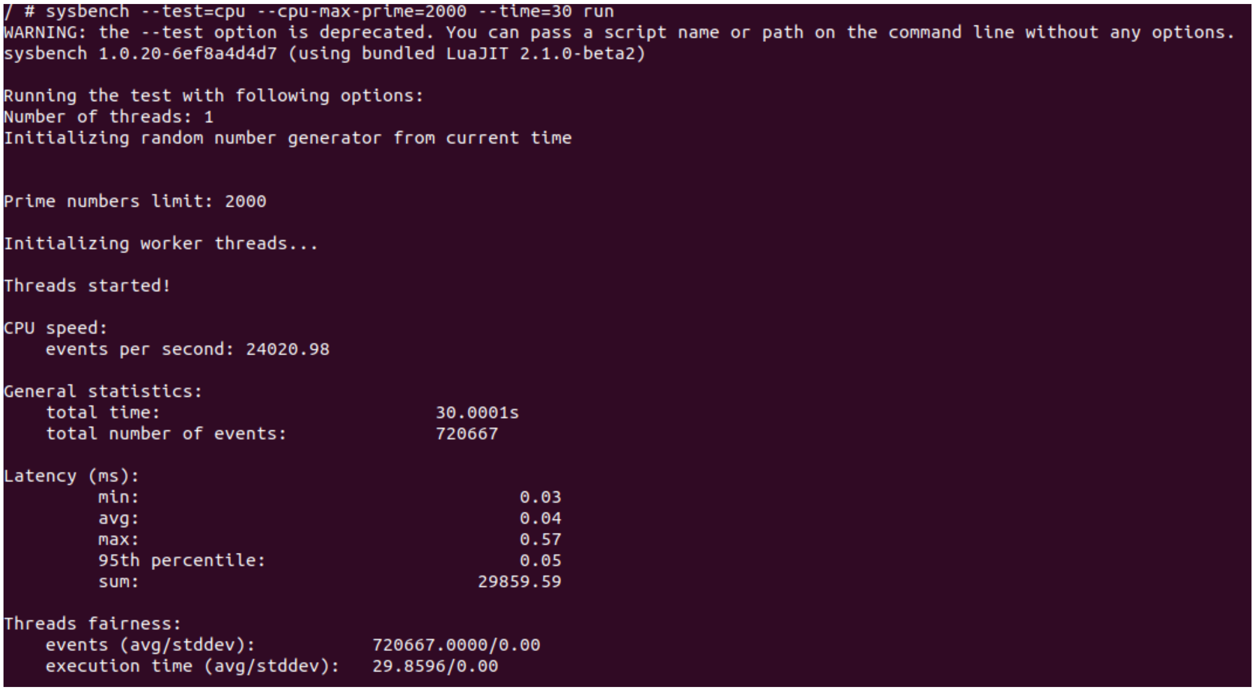


```
preeti@preeti:~$ sysbench --test=cpu --cpu-max-prime=2000 --time=30 run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

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:  3898.38

General statistics:
    total time:                          30.0010s
    total number of events:              116971

Latency (ms):
         min:                                    0.20
         avg:                                    0.25
         max:                                    6.77
         95th percentile:                        0.42
         sum:                                29568.02

Threads fairness:
    events (avg/stddev):           116971.0000/0.00
    execution time (avg/stddev):   29.5680/0.00

preeti@preeti:~$ _
```

Iteration	Events per second	
1	2779.99	Minimum value
2	3753.48	
3	3699.70	
4	3801.98	
5	3898.38	Maximum value
Average events per second	3586.71	

Docker test results with scenario 1

Docker test results with scenario 1 (6GB memory allocation and max prime number 2000)
First test case is with max prime number 2000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.

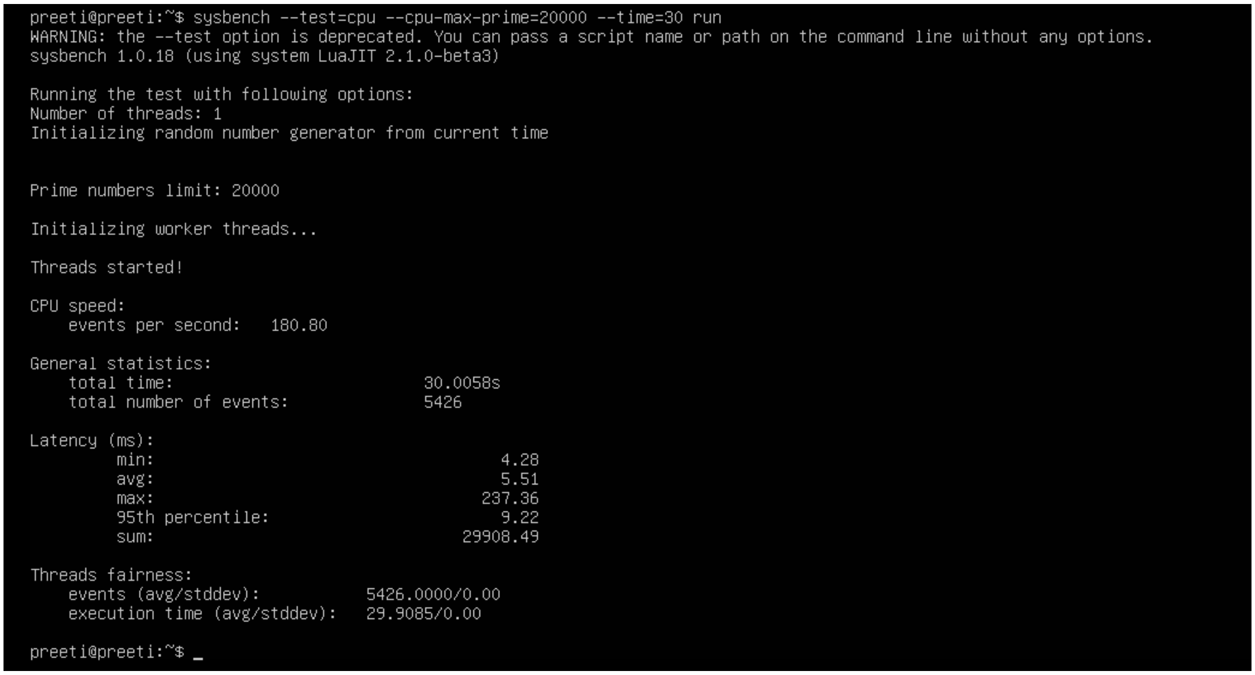


```
/ # sysbench --test=cpu --cpu-max-prime=2000 --time=30 run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

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: 24020.98

General statistics:
    total time:                          30.0001s
    total number of events:              720667

Latency (ms):
         min:                                    0.03
         avg:                                    0.04
         max:                                    0.57
         95th percentile:                        0.05
         sum:                                29859.59

Threads fairness:
    events (avg/stddev):           720667.0000/0.00
    execution time (avg/stddev):   29.8596/0.00
```

Iteration	Events per second	
1	26057.07	
2	26135.38	Maximum value
3	24251.17	
4	24248.98	
5	24020.98	Minimum value
Average events per second	24942.71	

QEMU test results with scenario 2

QEMU test results with scenario 2 (6GB memory allocation and max prime number 20,000) First test case is with a max prime number 20,000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.

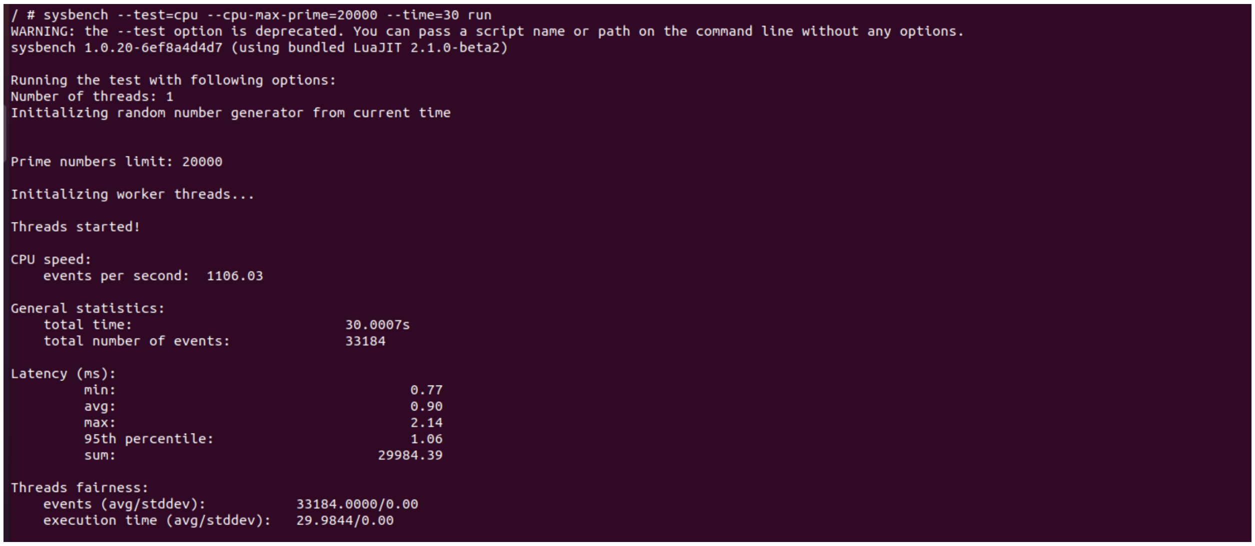


```
preeti@preeti:~$ sysbench --test=cpu --cpu-max-prime=20000 --time=30 run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

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:   180.80

General statistics:
    total time:                          30.0058s
    total number of events:              5426

Latency (ms):
         min:                                    4.28
         avg:                                    5.51
         max:                                  237.36
         95th percentile:                        9.22
         sum:                                29908.49

Threads fairness:
    events (avg/stddev):           5426.0000/0.00
    execution time (avg/stddev):   29.9085/0.00

preeti@preeti:~$ _
```

Iteration	Events per second	
1	170.02	
2	159.71	Minimum value
3	168.30	
4	179.03	
5	180.80	Maximum value
Average events per second	171.57	

Docker test results with scenario 2

Docker test results with scenario 2 (6GB memory allocation and max prime number 20,000) First test case is with a max prime number 20,000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.

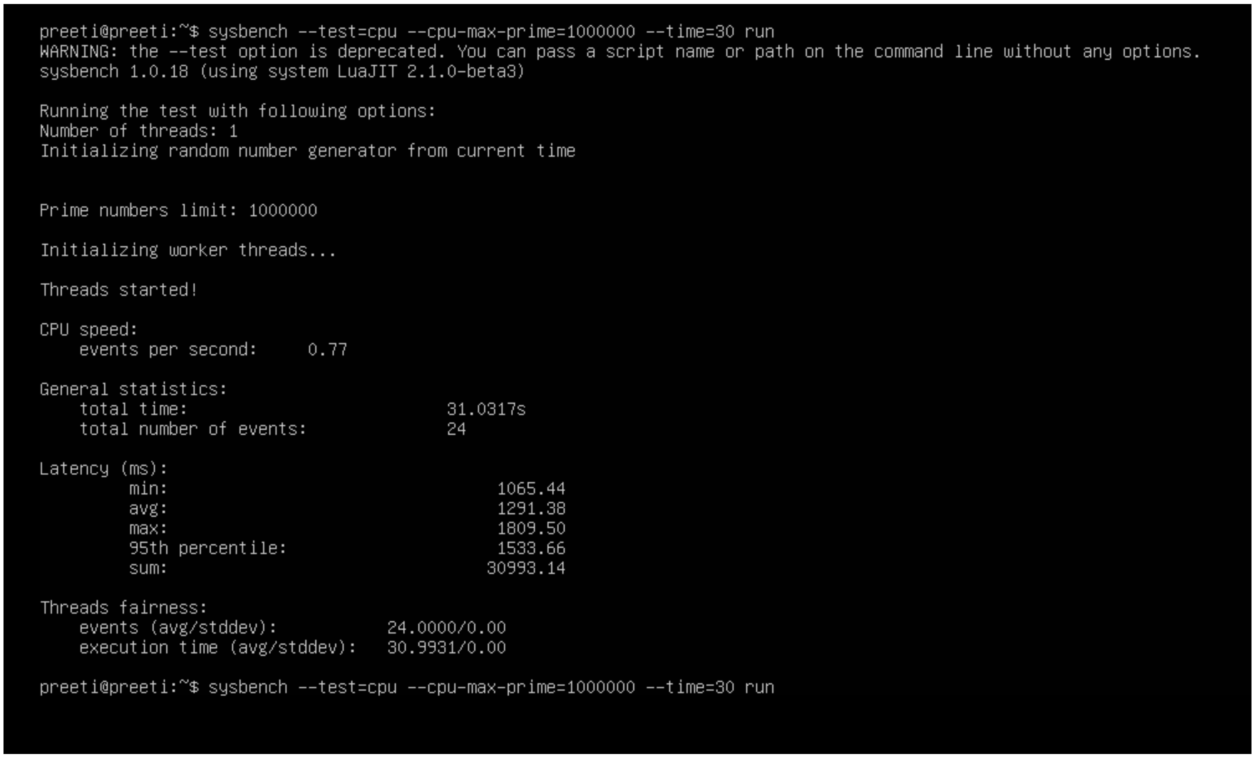


```
/ # sysbench --test=cpu --cpu-max-prime=20000 --time=30 run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

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:  1106.03

General statistics:
    total time:                          30.0007s
    total number of events:              33184

Latency (ms):
         min:                                    0.77
         avg:                                    0.90
         max:                                    2.14
         95th percentile:                        1.06
         sum:                                29984.39

Threads fairness:
    events (avg/stddev):           33184.0000/0.00
    execution time (avg/stddev):   29.9844/0.00
```

Iteration	Events per second	
1	1176.40	
2	1186.29	Maximum value
3	1074.44	Minimum value
4	1106.03	
5	1087.54	
Average events per second	1126.14	

QEMU test results with scenario 3

QEMU test results with scenario 3 (6GB memory allocation and max prime number 100,000) First test case is with a max prime number 100,000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.

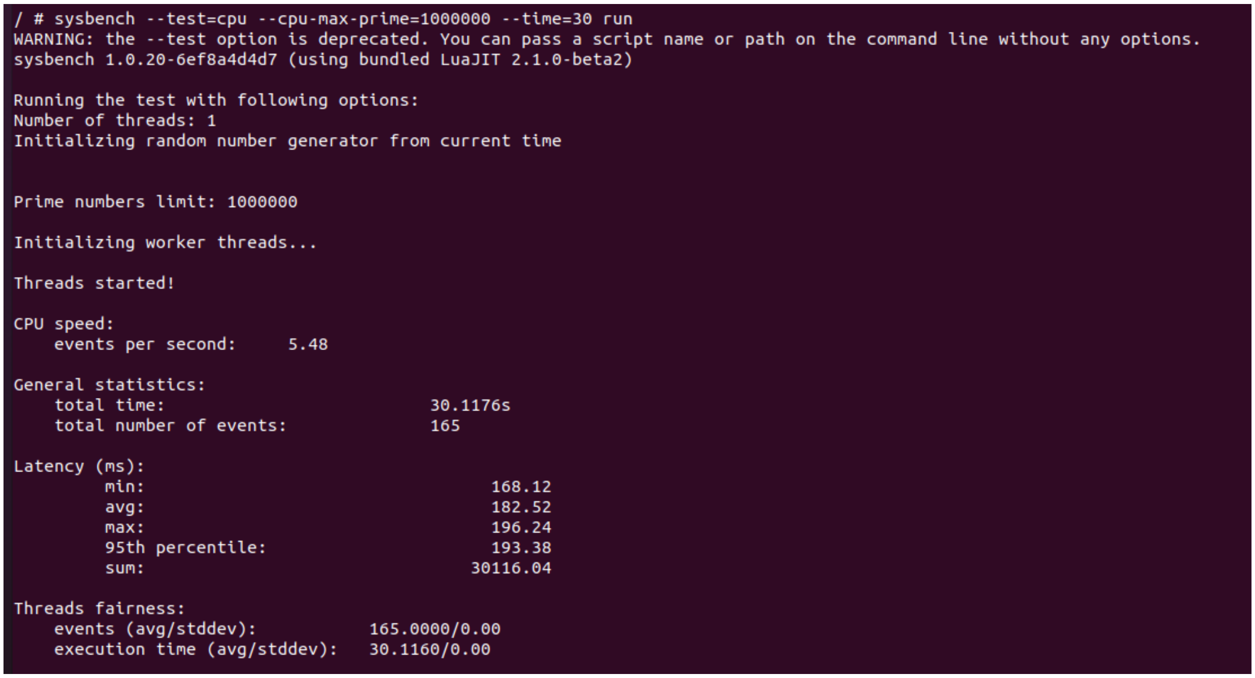


```
preeti@preeti:~$ sysbench --test=cpu --cpu-max-prime=1000000 --time=30 run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

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


Prime numbers limit: 1000000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:     0.77

General statistics:
    total time:                          31.0317s
    total number of events:              24

Latency (ms):
         min:                                 1065.44
         avg:                                 1291.38
         max:                                 1809.50
         95th percentile:                     1533.66
         sum:                                30993.14

Threads fairness:
    events (avg/stddev):           24.0000/0.00
    execution time (avg/stddev):   30.9931/0.00

preeti@preeti:~$ sysbench --test=cpu --cpu-max-prime=1000000 --time=30 run
```

Iteration	Events per second	
1	0.77	Minimum value
2	0.78	Maximum value
3	0.77	Minimum value
4	0.77	Minimum value
5	0.77	Minimum value
Average events per second	0.77	

Docker test results with scenario 3

Docker test results with scenario 3 (6GB memory allocation and max prime number 100,000) First test case is with a max prime number 100,000. The test results for 5 iterations have been listed out. Screenshot for the first iteration is attached.



```
/ # sysbench --test=cpu --cpu-max-prime=1000000 --time=30 run
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: 1000000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:     5.48

General statistics:
    total time:                          30.1176s
    total number of events:              165

Latency (ms):
         min:                                  168.12
         avg:                                  182.52
         max:                                  196.24
         95th percentile:                      193.38
         sum:                                30116.04

Threads fairness:
    events (avg/stddev):           165.0000/0.00
    execution time (avg/stddev):   30.1160/0.00
```

Iteration	Events per second	
1	5.31	Minimum value
2	5.59	Maximum value
3	5.47	
4	5.52	
5	5.48	
Average events per second	5.47	

File I/O testing QEMU vs Docker

For File I/O testing, two modes of sysbench supports

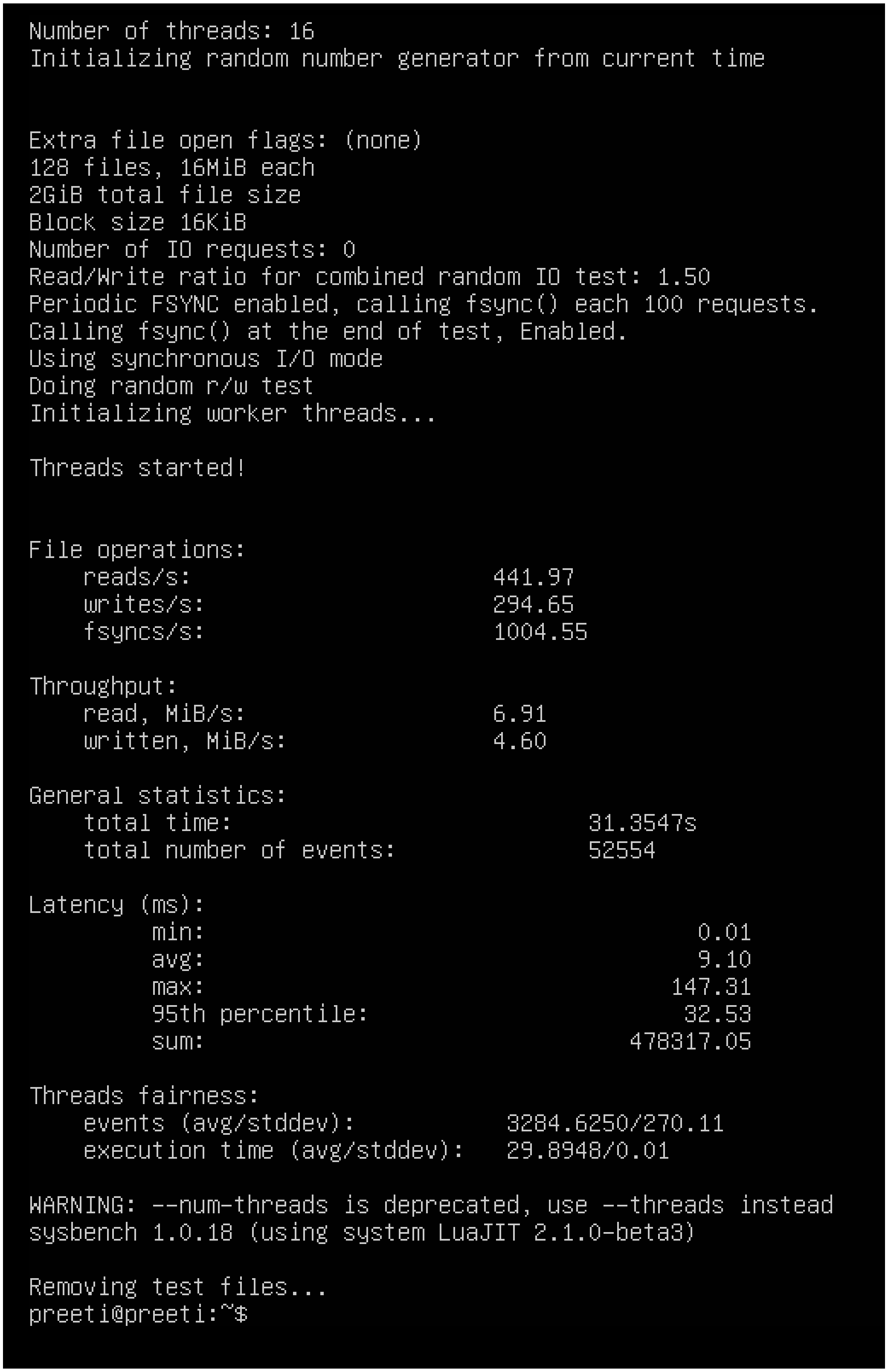
Combined random read/write (rndrw)

Sequential Rewrite (seqrewr)

File size is constant 6GB

QEMU execution

Combined random read/write (rndrw)

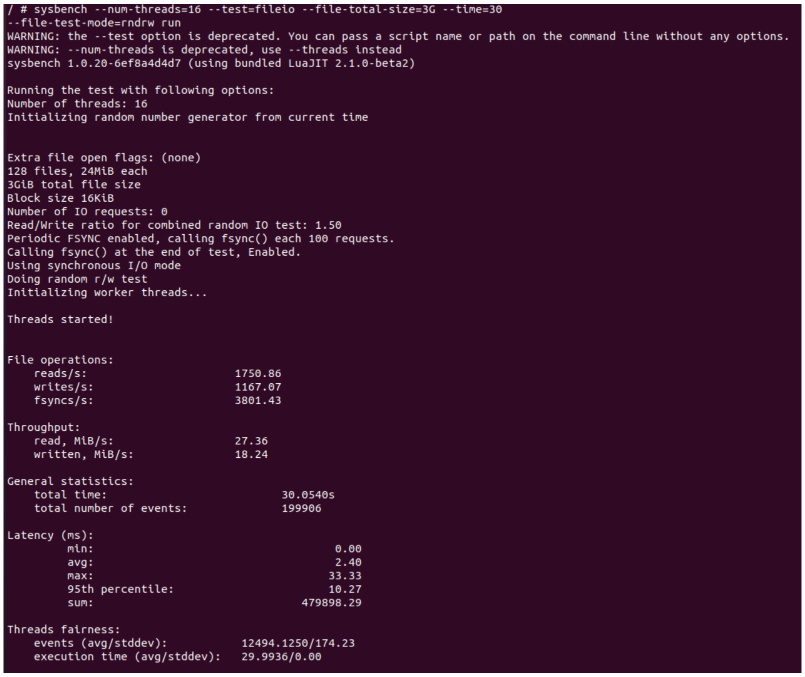


```
Number of threads: 16
Initializing random number generator from current time


Extra file open flags: (none)
128 files, 16MiB each
2GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      441.97
    writes/s:                     294.65
    fsyncs/s:                     1004.55

Throughput:
    read, MiB/s:                  6.91
    written, MiB/s:               4.60

General statistics:
    total time:                          31.3547s
    total number of events:              52554

Latency (ms):
         min:                                    0.01
         avg:                                    9.10
         max:                                  147.31
         95th percentile:                       32.53
         sum:                               478317.05

Threads fairness:
    events (avg/stddev):           3284.6250/270.11
    execution time (avg/stddev):   29.8948/0.01

WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
preeti@preeti:~$
```

Iterations	
1	reads/s 468.26 writes/s 312.39 fsyncs/s 1062.97 Total events/s 1836.83
2	reads/s 497.62 writes/s 331.85 fsyncs/s 1127.65 Total events/s 1921.57
3	reads/s 574.03 writes/s 382.69 fsyncs/s 1287.68 Total events/s 2238.57
4	reads/s 523.57 writes/s 349.05 fsyncs/s 1180.16 Total events/s 2056.77
5	reads/s 441.97 writes/s 294.65 fsyncs/s 1004.55 Total events/s 1751.8

Docker execution

Combined random read/write (rndrw)

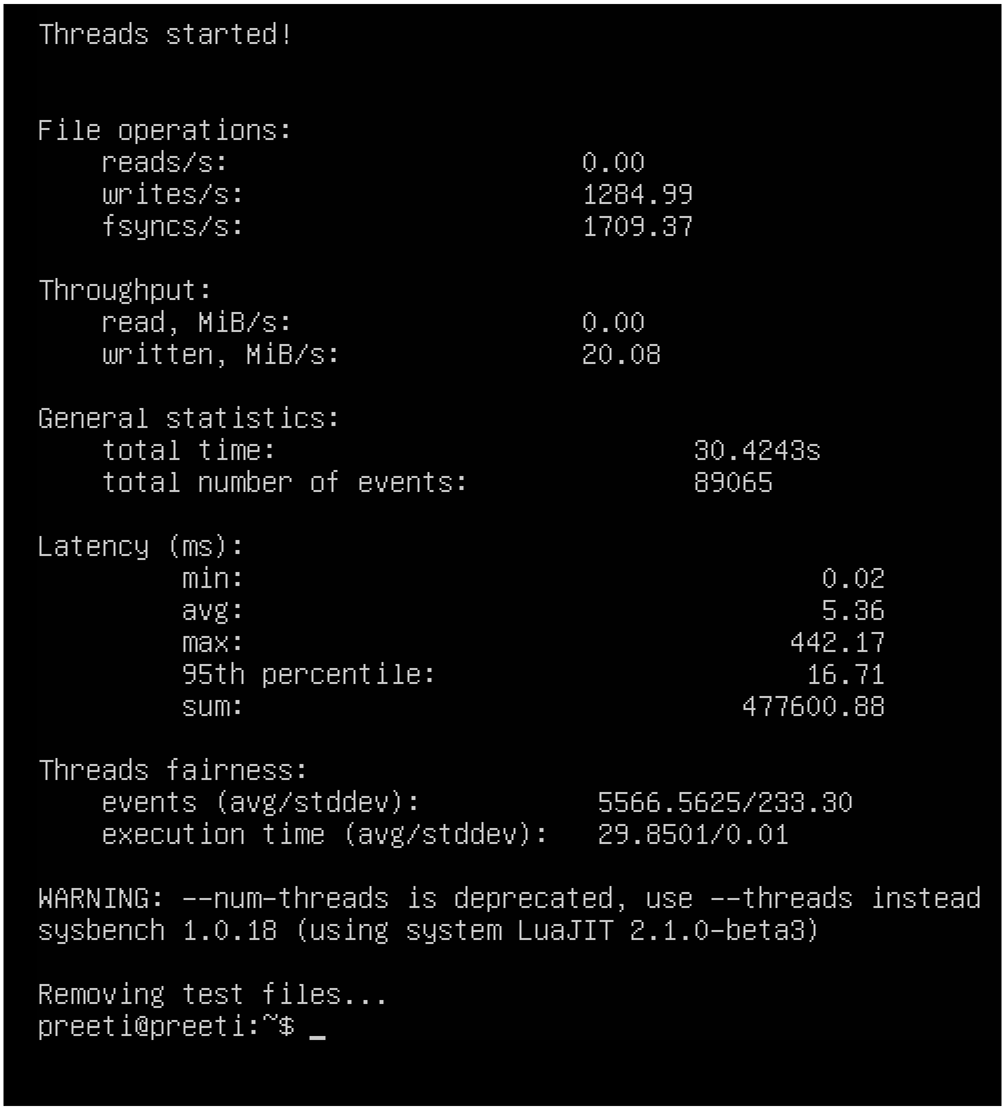


```
/ # sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30
--file-test-mode=rndrw run
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

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
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!


File operations:
    reads/s:                      1750.86
    writes/s:                     1167.07
    fsyncs/s:                     3801.43

Throughput:
    read, MiB/s:                  27.36
    written, MiB/s:               18.24

General statistics:
    total time:                          30.0540s
    total number of events:              199906

Latency (ms):
         min:                                    0.00
         avg:                                    2.40
         max:                                   33.33
         95th percentile:                       10.27
         sum:                               479898.29

Threads fairness:
    events (avg/stddev):           12494.1250/174.23
    execution time (avg/stddev):   29.9936/0.00
```

Iterations	
1	reads/s 2191.43 writes/s 1460.68 fsyncs/s 4742.72 Total events/s 8337.03
2	reads/s 2841.73 writes/s 1894.21 fsyncs/s 6127.60 Total events/s 10827.53
3	reads/s 1867.00 writes/s 1244.39 fsyncs/s 4048.03 Total events/s 7110.96
4	reads/s 1957.58 writes/s 1305.04 fsyncs/s 4243.05 Total events/s 7456.53
5	reads/s 1750.86 writes/s 1167.07 fsyncs/s 3801.43 Total events/s 6663.53

QEMU execution

Sequential Rewrite (seqrewr)



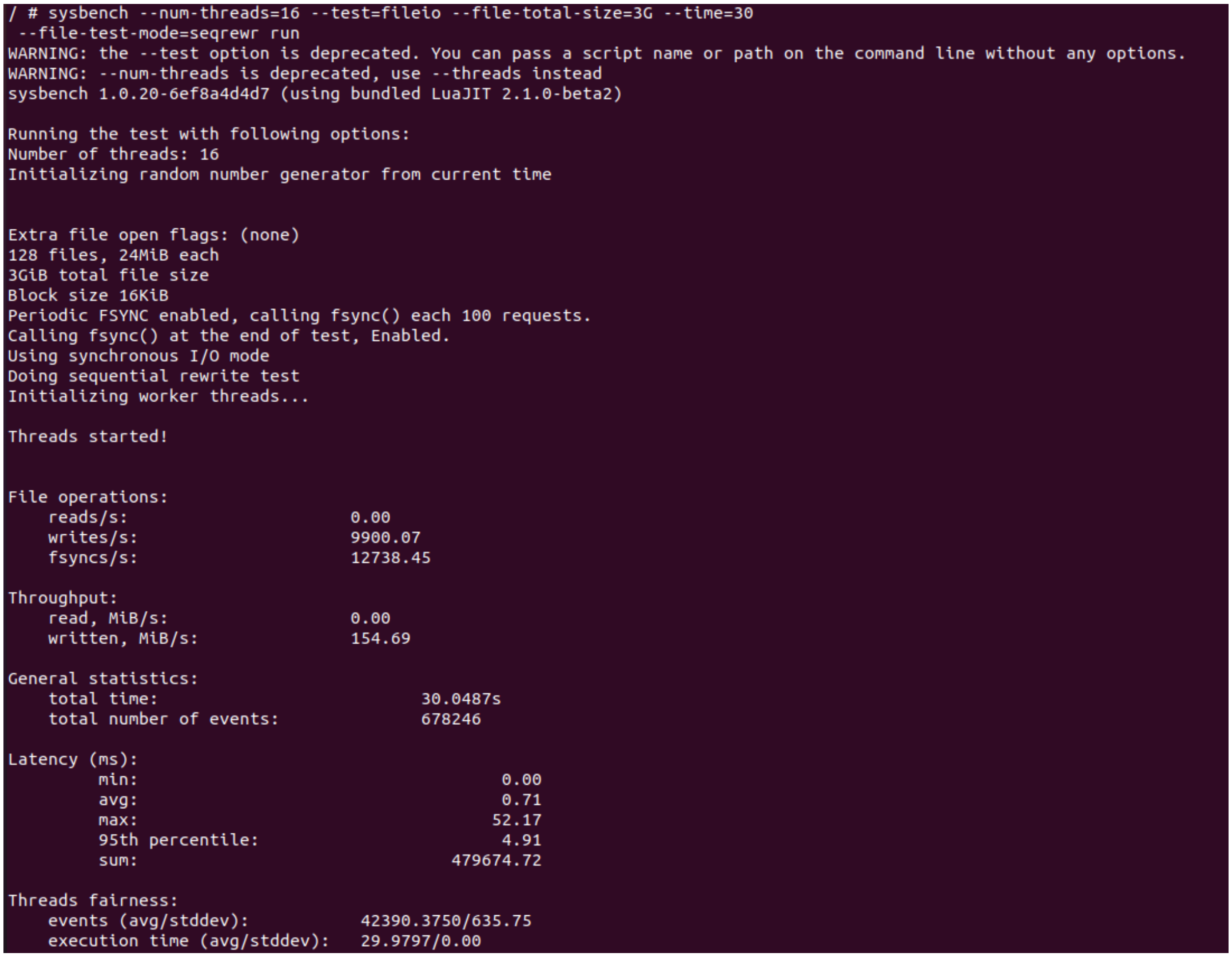
```
Threads started!


File operations:
    reads/s:                      0.00
    writes/s:                     1284.99
    fsyncs/s:                     1709.37

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               20.08

General statistics:
    total time:                          30.4243s
    total number of events:              89065

Latency (ms):
         min:                                    0.02
         avg:                                    5.36
         max:                                  442.17
         95th percentile:                       16.71
         sum:                               477600.88

Threads fairness:
    events (avg/stddev):           5566.5625/233.30
    execution time (avg/stddev):   29.8501/0.01

WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
preeti@preeti:~$ _
```

Iterations	
1	reads/s 0.00 writes/s 1455.90 fsyncs/s 1927.65 Total events/s 3448.76
2	reads/s 0.00 writes/s 1299.96 fsyncs/s 1727.76 Total events/s 3027.16
3	reads/s 0.00 writes/s 1564.60

	fsyncs/s 2066.35 Total events/s 3637.1
4	reads/s 0.00 writes/s 1729.38 fsyncs/s 2277.67 Total events/s 4002
5	reads/s 0.00 writes/s 1284.99 fsyncs/s 1709.37 Total events/s 2968.83

Docker execution

Sequential Rewrite (seqrewr)



```
/ # sysbench --num-threads=16 --test=fileio --file-total-size=3G --time=30
 --file-test-mode=seqrewr run
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 1.0.20-6ef8a4d4d7 (using bundled LuaJIT 2.1.0-beta2)

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:                     9900.07
    fsyncs/s:                     12738.45

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:               154.69

General statistics:
    total time:                          30.0487s
    total number of events:              678246

Latency (ms):
         min:                                    0.00
         avg:                                    0.71
         max:                                   52.17
         95th percentile:                        4.91
         sum:                               479674.72

Threads fairness:
    events (avg/stddev):           42390.3750/635.75
    execution time (avg/stddev):   29.9797/0.00
```

Iterations	
1	reads/s 0.00 writes/s 11649.86 fsyncs/s 14976.15 Total events/s 26588.53
2	reads/s 0.00 writes/s 9223.52 fsyncs/s 11872.82 Total events/s 21088.63
3	reads/s 0.00 writes/s 9428.02 fsyncs/s 12134.64 Total events/s 21521.8
4	reads/s 0.00 writes/s 9906.99 fsyncs/s 12747.89 Total events/s 22616.36
5	reads/s 0.00 writes/s 9900.07 fsyncs/s 12738.45 Total events/s 22608.2

Performance analysis

QEMU disk utilization

2GB RAM 2 cores

Sequential rewrite

read, MiB/s = 0.00

written, MiB/s = 14.14

Combined Random read write

read, MiB/s = 6.63

written, MiB/s = 4.42

4GB RAM 4 cores

Sequential rewrite

read, MiB/s = 0.00

written, MiB/s = 21.08

Combined Random read write

read, MiB/s = 8.03

written, MiB/s = 5.35

6GB RAM 6 cores

Sequential rewrite

read, MiB/s = 0.00

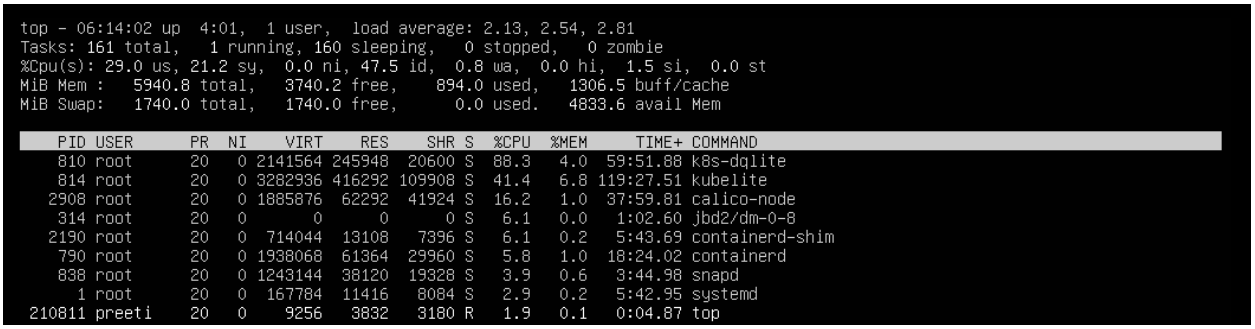
written, MiB/s = 20.08

Combined Random read write

read, MiB/s = 6.91

written, MiB/s = 4.60

QEMU CPU utilization



```
top - 06:14:02 up  4:01,  1 user,  load average: 2.13, 2.54, 2.81
Tasks: 161 total,   1 running, 160 sleeping,   0 stopped,   0 zombie
%Cpu(s): 29.0 us, 21.2 sy,  0.0 ni, 47.5 id,  0.8 wa,  0.0 hi,  1.5 si,  0.0 st
MiB Mem :   5940.8 total,   3740.2 free,    894.0 used,   1306.5 buff/cache
MiB Swap:   1740.0 total,   1740.0 free,      0.0 used.   4833.6 avail Mem

    PID USER      PR  NI    VIRT    RES    SHR S  %CPU  %MEM     TIME+ COMMAND
    810 root      20   0 2141564 245948  20600 S  88.3   4.0  59:51.88 k8s-dqlite
    814 root      20   0 3282936 416292 109908 S  41.4   6.8 119:27.51 kubelite
   2908 root      20   0 1885876  62292  41924 S  16.2   1.0  37:59.81 calico-node
    314 root      20   0       0      0      0 S   6.1   0.0   1:02.60 jbd2/dm-0-8
   2190 root      20   0  714044  13108   7396 S   6.1   0.2   5:43.69 containerd-shim
    790 root      20   0 1938068  61364  29960 S   5.8   1.0  18:24.02 containerd
    838 root      20   0 1243144  38120  19328 S   3.9   0.6   3:44.98 snapd
      1 root      20   0  167784  11416   8084 S   2.9   0.2   5:42.95 systemd
 210811 preeti    20   0    9256   3832   3180 R   1.9   0.1   0:04.87 top
```

CPU percentage used = 88.8%

Kernel usage - user = 29%

System = 21.2%

Idle = 47.5%

Docker disk utilization

2GB RAM 2 cores

Sequential rewrite

read, MiB/s = 0.00

written, MiB/s = 168.03

Combined Random read write

read, MiB/s = 35.38

written, MiB/s = 23.59

4GB RAM 4 cores

Sequential rewrite

read, MiB/s = 0.00

written, MiB/s = 156.20

Combined Random read write

read, MiB/s = 28.59

written, MiB/s = 19.06

6GB RAM 6 cores

Sequential rewrite

read, MiB/s = 0.00

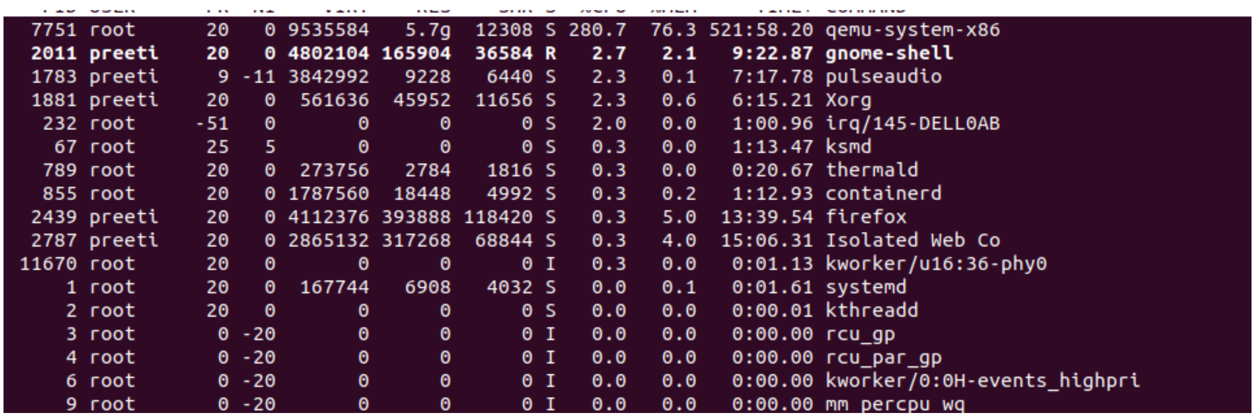
written, MiB/s = 154.09

Combined Random read write

read, MiB/s = 27.36

written, MiB/s = 38.24

Docker CPU utilization



```
 7751 root      20   0 9535584   5.7g  12308 S 280.7  76.3 521:58.20 qemu-system-x86
 2011 preeti    20   0 4802104 165904  36584 R   2.7   2.1   9:22.87 gnome-shell
 1783 preeti     9 -11 3842992   9228   6440 S   2.3   0.1   7:17.78 pulseaudio
 1881 preeti    20   0  561636  45952  11656 S   2.3   0.6   6:15.21 Xorg
  232 root     -51   0       0      0      0 S   2.0   0.0   1:00.96 irq/145-DELL0AB
   67 root      25   5       0      0      0 S   0.3   0.0   1:13.47 ksmd
  789 root      20   0  273756   2784   1816 S   0.3   0.0   0:20.67 thermald
  855 root      20   0 1787560  18448   4992 S   0.3   0.2   1:12.93 containerd
 2439 preeti    20   0 4112376 393888 118420 S   0.3   5.0  13:39.54 firefox
 2787 preeti    20   0 2865132 317268  68844 S   0.3   4.0  15:06.31 Isolated Web Co
11670 root      20   0       0      0      0 I   0.3   0.0   0:01.13 kworker/u16:36-phy0
    1 root      20   0  167744   6908   4032 S   0.0   0.1   0:01.61 systemd
    2 root      20   0       0      0      0 S   0.0   0.0   0:00.01 kthreadd
    3 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 rcu_gp
    4 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 rcu_par_gp
    6 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 kworker/0:0H-events_highpri
    9 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 mm_percpu_wq
```

CPU percentage used = 0.3%

Github Repository Information:

1. Repository Link - https://github.com/PreetiKakuru/COEN-241
2. Repository Name - COEN-241