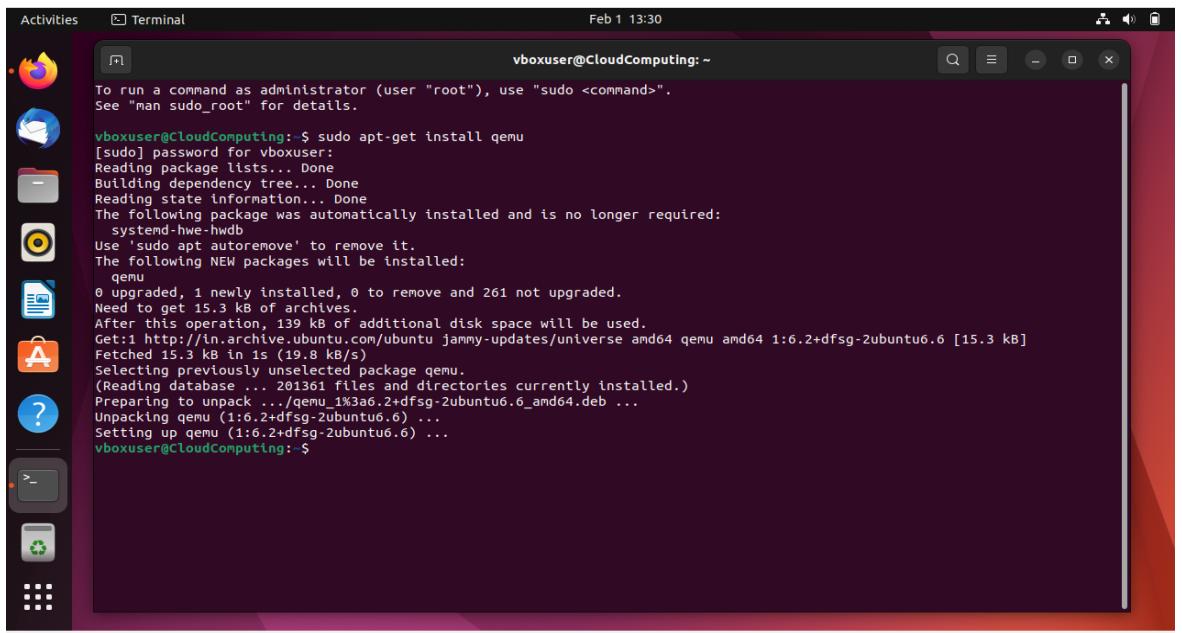


COEN 241
Cloud Computing
HOMEWORK-1
SYSTEM VS OS VIRTUALIZATION
REPORT
Student name: Deep Savla
Id: W1652329

Installing QEMU on ubuntu:

- For this step I first downloaded and installed Oracle VirtualBox running on linux. On linux I downloaded iso image of Ubuntu(64 bit) server.
- I then downloaded and setup QEMU and created a QEMU image on my virtualbox.



The screenshot shows a terminal window titled "vboxuser@CloudComputing: ~" running on a Linux desktop environment. The terminal displays the output of a command to install QEMU. The text in the terminal is as follows:

```
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

vboxuser@CloudComputing:~$ sudo apt-get install qemu
[sudo] password for vboxuser:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following package was automatically installed and is no longer required:
  systemd-hwe-hwdb
Use 'sudo apt autoremove' to remove it.
The following NEW packages will be installed:
  qemu
0 upgraded, 1 newly installed, 0 to remove and 261 not upgraded.
Need to get 15.3 kB of archives.
After this operation, 139 kB of additional disk space will be used.
Get:1 http://in.archive.ubuntu.com/ubuntu jammy-updates/universe amd64 qemu amd64 1:6.2+dfsg-2ubuntu6.6 [15.3 kB]
Fetched 15.3 kB in 0s (19.8 kB/s)
Selecting previously unselected package qemu.
(Reading database ... 201361 files and directories currently installed.)
Preparing to unpack .../qemu_1%3a6.2+dfsg-2ubuntu6.6_amd64.deb ...
Unpacking qemu (1:6.2+dfsg-2ubuntu6.6) ...
Setting up qemu (1:6.2+dfsg-2ubuntu6.6) ...

vboxuser@CloudComputing:~$
```

```

Activities Terminal Feb 1 13:53
vboxuser@CloudComputing: ~
Unpacking librbd1 (17.2.0-0ubuntu0.22.04.2) ...
Selecting previously unselected package liburing2:amd64.
Preparing to unpack .../15-liburing2_2.1-2build1_amd64.deb ...
Unpacking liburing2:amd64 (2.1-2build1) ...
Selecting previously unselected package qemu-utils.
Preparing to unpack .../16-qemu-utils_1%3a6.2+dfsg-2ubuntu6.6_amd64.deb ...
Unpacking qemu-utils (1:6.2+dfsg-2ubuntu6.6) ...
Selecting previously unselected package qemu-block-extra.
Preparing to unpack .../17-qemu-block-extra_1%3a6.2+dfsg-2ubuntu6.6_amd64.deb ...
Unpacking qemu-block-extra (1:6.2+dfsg-2ubuntu6.6) ...
Setting up libibverbs1:amd64 (39.0-1) ...
Setting up libverbs-providers:amd64 (39.0-1) ...
Setting up libibverbs0:amd64 (10.1-1) ...
Setting up libdaxt1i:amd64 (72.1-1) ...
Setting up liburing2:amd64 (2.1-2build1) ...
Setting up liblalo1:amd64 (0.3.112-13build1) ...
Setting up libpmem1:amd64 (1.11.1-3build1) ...
Setting up libqfxdro:amd64 (10.1-1) ...
Setting up librdmacm1:amd64 (39.0-1) ...
Setting up librados2 (17.2.0-0ubuntu0.22.04.2) ...
Setting up libpmemobj1:amd64 (1.11.1-3build1) ...
Setting up librbd1 (17.2.0-0ubuntu0.22.04.2) ...
Setting up qemu-utils (1:6.2+dfsg-2ubuntu6.6) ...
Setting up libtscsi7:amd64 (1.19.0-3build2) ...
Setting up libgfrpc0:amd64 (10.1-1) ...
Setting up libgfap10:amd64 (10.1-1) ...
Setting up qemu-block-extra (1:6.2+dfsg-2ubuntu6.6) ...
Created symlink /etc/systemd/system/multi-user.target.wants/run-qemu.mount → /lib/systemd/system/run-qemu.mount.
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for libbc-bin (2.35-0ubuntu3.1) ...
vboxuser@CloudComputing: $ sudo qemu-img create ubuntu.img 10G -f qcow2
Formatting 'ubuntu.img', fmt=qcow2 cluster_size=65536 extended_l2=off compression_type=zlib size=10737418240 lazy_refcounts=off refcount_bits=16
vboxuser@CloudComputing: $

```

- Booting the QEMU image created with ubuntu iso image loaded into cd-rom so that QEMU runs on ubuntu OS:

```
$ sudo qemu-system-x86_64 -smp 2 -hda ubuntu.img -boot d -cdrom ./Downloads/ubuntu-20.04.5-live-server-amd64.iso -m 2G -boot strict=on
```

```

Activities Terminal Feb 1 14:41
QEMU
[ 182.902971] cloud-init[1191]: SHA256:PqSPXWfha/iBrq9biun0tgUrzjuvdLoLK1RxX949cMkk root@ubuntu-server
[ 182.997376] cloud-init[1191]: The key's randomart image is:
[ 183.103177] cloud-init[1191]: +---[DSA 1024]----+
[ 183.177090] cloud-init[1191]: |
[ 183.266400] cloud-init[1191]: |
[ 183.386271] cloud-init[1191]: . . . . E
[ 183.477766] cloud-init[1191]: . . + . 0 .
[ 183.563800] cloud-init[1191]: + S . . = .
[ 183.625754] cloud-init[1191]: = X + o o *
[ 183.691666] cloud-init[1191]: ..* * . = 0 .
[ 183.622190] cloud-init[1191]: . . +*,*,+,0
[ 183.690470] cloud-init[1191]: o .++B+ooo
[ 183.967073] cloud-init[1191]: +---[SHA256]-----
[ 184.019783] cloud-init[1191]: Generating public/private ecdsa key pair.
[ 184.069870] cloud-init[1191]: Your identification has been saved in /etc/ssh/ssh_host_ecdsa_key
[ 184.110350] cloud-init[1191]: Your public key has been saved in /etc/ssh/ssh_host_ecdsa_key.pub
[ 184.124747] cloud-init[1191]: Your key fingerprint is:
[ 184.132719] cloud-init[1191]: SHA256:9YOh1fNaAvhc9bRXMx4xpLGAu5K0Xj7uLUlKFQuo root@ubuntu-server
[ 184.143518] cloud-init[1191]: The key's randomart image is:
[ 184.225320] cloud-init[1191]: +---[ED25519]-----
[ 184.275703] cloud-init[1191]: | . . . . X |
[ 184.367431] cloud-init[1191]: | . . . . =B@0
[ 184.453442] cloud-init[1191]: | . .000---|
[ 184.510896] cloud-init[1191]: | . . . . ++X+*. .
[ 184.556483] cloud-init[1191]: | . S . . = 0
[ 184.661590] cloud-init[1191]: | . 0 . 0 . .
[ 184.698733] cloud-init[1191]: | . . . 0 . .
[ 184.767871] cloud-init[1191]: | . . . . . .
[ 184.875866] cloud-init[1191]: | . E . . . .
[ 185.021296] cloud-init[1191]: +---[SHA256]-----
[ 185.095509] cloud-init[1191]: Generating public/private ed25519 key pair.
[ 185.191563] cloud-init[1191]: Your identification has been saved in /etc/ssh/ssh_host_ed25519_key
[ 185.286187] cloud-init[1191]: Your public key has been saved in /etc/ssh/ssh_host_ed25519_key.pub
vboxuser@CloudComputing: ~
m 2046 [ 185.370413] cloud-init[1191]: Your key fingerprint is:
[ 185.451266] cloud-init[1191]: SHA256:DFV0SH63NuTqJcgvuOH2k7fYB4qE6BNvrpHC8g6GM root@ubuntu-server
vboxuser@CloudComputing: ~
m 2046 [ 185.516132] cloud-init[1191]: The key's randomart image is:
[ 185.597706] cloud-init[1191]: +---[ED25519 256]---
[ 185.646766] cloud-init[1191]: | . . . . . .
[ 185.727481] cloud-init[1191]: | . . . . . .

```

- Spin up the QEMU VM on a separate terminal:

```
$ sudo qemu-system-x86_64 -smp 2 -hda ubuntu.img -boot c -cdrom ./Downloads/ubuntu-20.04.5-live-server-amd64.iso -m 2G -device e1000,netdev=unet0 -netdev user,id=unet0,hostfwd=tcp::8888-:22 -nographic
```

In the above command:

- m 2G means we have allocated 2G memory
- smp 2 means we have allocated 2 cores
- hda is virtual harddrive

Activities Qemu-system-x86_64 Feb 2 20:43

```

Machine View
[ 4.1741041] x86/mm: Checked W+X mappings: passed, no W+X pages found.
★ Svboxuse[ 4.1771621] Run /init as init process
ntu.imgLoading, please wait...
[sudo] Starting version 245.4-4ubuntu3.17
[ 5.6226231] Floppy drives(s): f40 is 2.88M AMI BIOS
[ 5.6513521] FDC 0 is a SB2078B
[ 5.7931061] piix4_smbus 0000:00:01.3: SMBus Host Controller at 0x200, revision 5
[ 5.8830911] e1000: Intel(R) PRO/1000 MT Network Driver - version 7.3.21-k8-MaPI
[ 5.8933521] e1000: Copyright (c) 1999-2006 Intel Corporation.
[ 6.1340891] bochs-drm 0000:00:02.0: remove_conflicting_pci_framebuffers: bar dfffff
[ 6.1395511] bochs-drm 0000:00:02.0: remove_conflicting_pci_framebuffers: bar ebh0ff
[ 6.1802351] fb0: switching to bochsdrmfb from EFI VGA
[ 6.2512691] Console: switching to colour dummy device 80x25
[ 6.2615841] bochs-drm 0000:00:02.0: ugaarb: deactivate vga console
[ 6.2630501] [drm] Found bochs VGA, ID 0xb0c5
[ 6.2631131] [drm] Framebuffer size: 16384 kB @ 0xfdb00000, mmio @ 0xfcbb0000.
[ 6.2798491] [TTM] Zone kernel: Available graphics memory: 1015350 KiB
[ 6.2798643] [TTM] Initializing pool allocator
[ 6.2799381] [TTM] Initializing DMA pool allocator
[ 6.2839281] [drm] Found EDID data blob
[ 6.3226721] [drm] Initialized bochs-drm 1.0.0 20130925 for 0000:00:02.0 on mi nor 0
[ 6.4785921] fbcon: bochs-drmdrmfb (fb0) is primary device
[ 6.5726581] Console: switching to colour frame buffer device 128x48
[ 6.7303071] bochs-drm 0000:00:02.0: fb0: bochs-drmdrmfb frame buffer device
[ 7.0714441] input: ImExPS/2 Generic Explorer Mouse as /devices/platform/i8042/serio1/input/input3
nor 0

```

Activities Qemu-system-x86_64 Feb 2 20:54

```

QEMU - Press Ctrl+Alt+G to release grab
Machine View
★ Svboxuse[ 166.3299471] blk_update_request: I/O error, dev fd0, sector 0 op 0x0:(READ) flags 0x0 phys_seg 1 prio class 0
ntu.img[ 199.0258291] blk_update_request: I/O error, dev fd0, sector 0 op 0x0:(READ) flags 0x0 phys_seg 1 prio class 0
[sudo] [ 205.8904011] blk_update_request: I/O error, dev fd0, sector 0 op 0x0:(READ) flags 0x0 phys_seg 1 prio class 0
[ 220.1780081] blk_update_request: I/O error, dev fd0, sector 0 op 0x0:(READ) flags 0x0 phys_seg 1 prio class 0
[ 225.2221831] blk_update_request: I/O error, dev fd0, sector 0 op 0x0:(READ) flags 0x0 phys_seg 1 prio class 0
[ 303.4093121] blk_update_request: I/O error, dev fd0, sector 0 op 0x0:(READ) flags 0x0 phys_seg 1 prio class 0

gemuserver login:
gemuserver login: deep
Password:

Welcome to Ubuntu 20.04.5 LTS (GNU/Linux 5.4.0-137-generic x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/advantage

System information as of Fri 03 Feb 2023 04:53:59 AM UTC

System load:          0.08
Usage of /:           50.1% of 8.02GB
Memory usage:         10%
Swap usage:           0%
Processes:            103
Users logged in:     0
IPv4 address for ens3: 10.0.2.15
IPv6 address for ens3: fec0::5054::ff:fe12:3456

25 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

New release '22.04.1 LTS' available.
Run 'do-release-upgrade' to upgrade to it.

```

- For running QEMU from terminal after spinning up we use the following command:
`$ ssh -p 8888 deep@localhost`

The screenshot shows a terminal window with two tabs. The left tab is titled 'vboxuser@CloudComputing:~' and the right tab is titled 'deep@qemuserver:~'. The right tab is active and displays the following terminal session:

```
vboxuser@CloudComputing:~$ ssh -p 8888 deep@localhost
deep@localhost's password:
Welcome to Ubuntu 20.04.5 LTS (GNU/Linux 5.4.0-137-generic x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/advantage

System information disabled due to load higher than 2.0

25 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

New release '22.04.1 LTS' available.
Run 'do-release-upgrade' to upgrade to it.

Last login: Fri Feb  3 13:03:18 2023 from 10.0.2.2
deep@qemuserver:~$
```

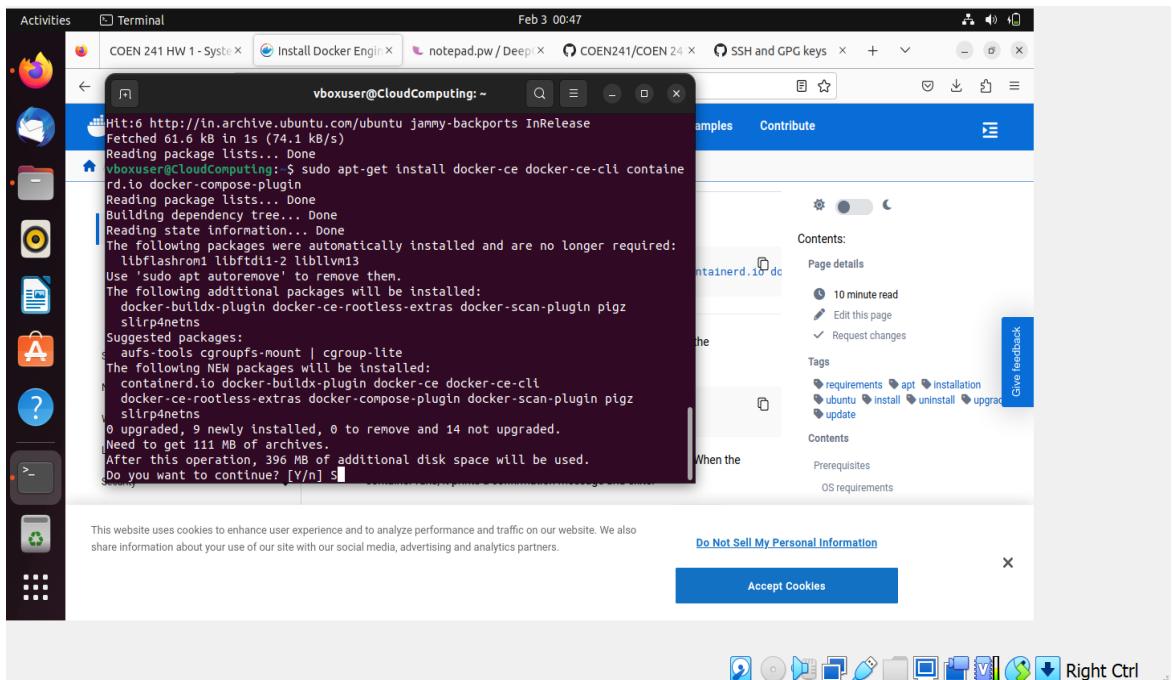
- **Sysbench installation:**

```
$ sudo apt update
$ sudo apt install sysbench
```

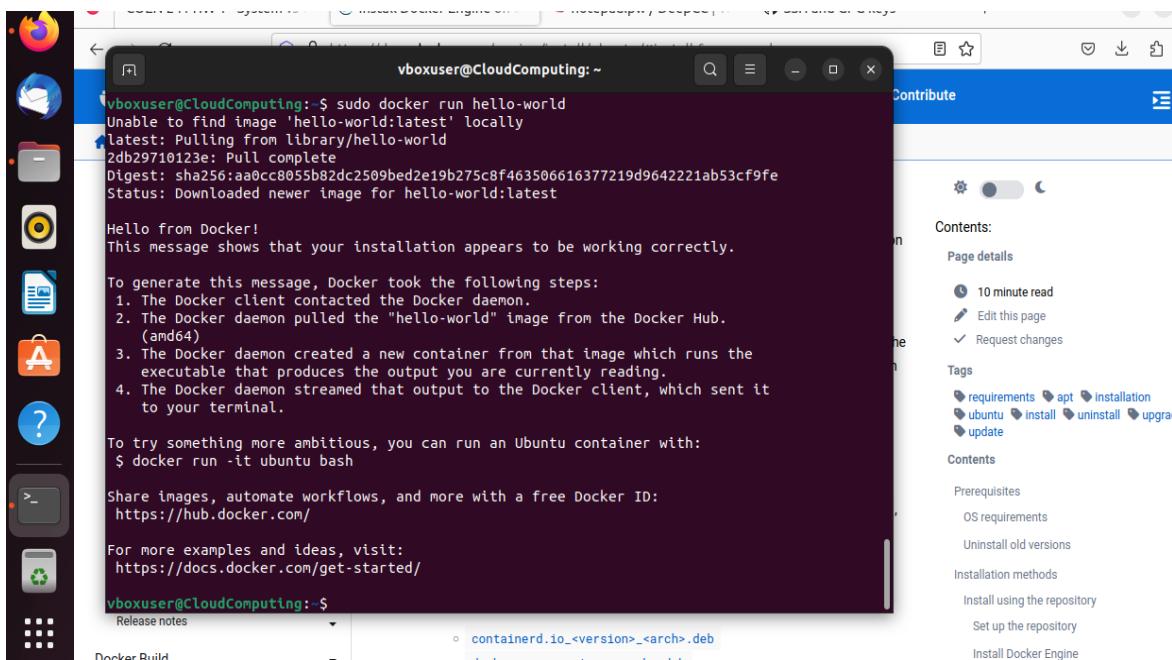
Installing Docker on ubuntu:

- Installed Docker in ubuntu using the documentation provided.

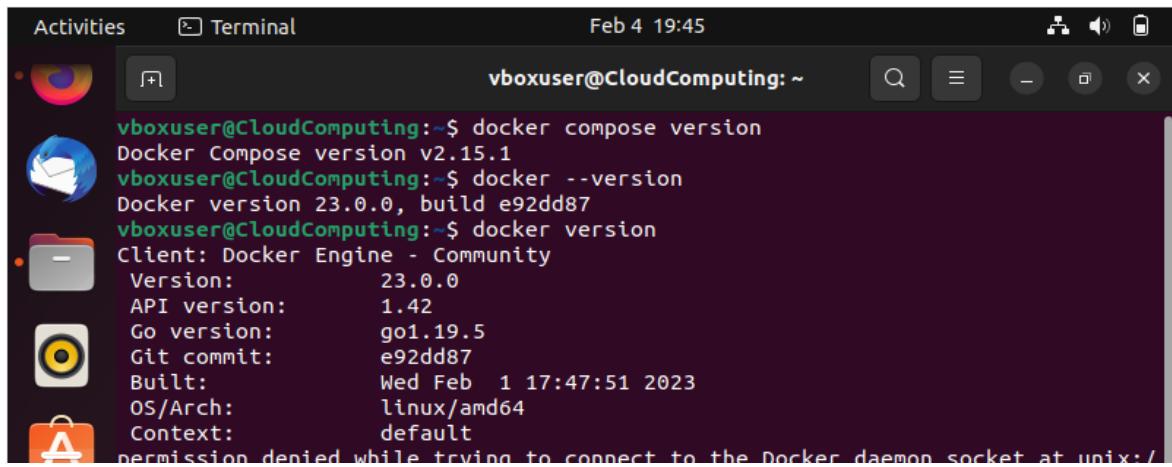
```
$ sudo apt-get install docker-ce docker-ce-cli containerd.io docker-compose-plugin
```



- After installing docker we test if it is running properly.
`$ sudo docker run hello-world`



- Once docker is installed we can check version using following commands:
`$ docker version`

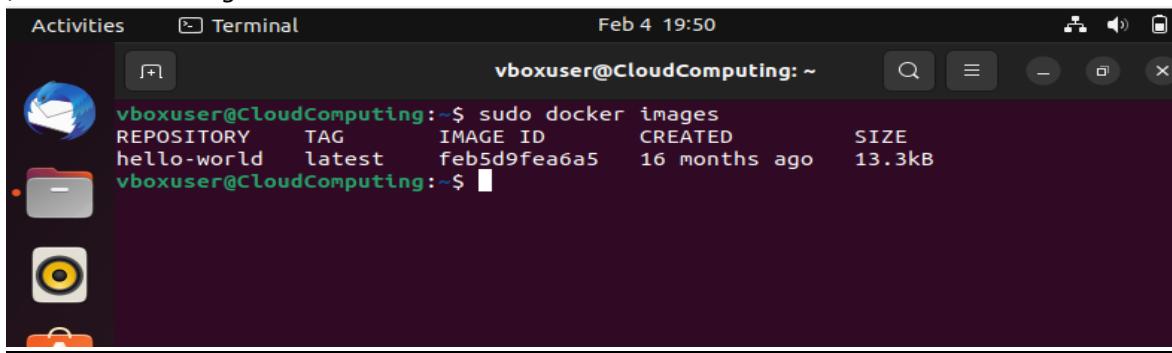


```

Activities Terminal Feb 4 19:45
vboxuser@CloudComputing:~$ docker compose version
Docker Compose version v2.15.1
vboxuser@CloudComputing:~$ docker --version
Docker version 23.0.0, build e92dd87
vboxuser@CloudComputing:~$ docker version
Client: Docker Engine - Community
  Version:          23.0.0
  API version:     1.42
  Go version:      go1.19.5
  Git commit:      e92dd87
  Built:           Wed Feb 1 17:47:51 2023
  OS/Arch:         linux/amd64
  Context:         default
vboxuser@CloudComputing:~$ permission denied while trying to connect to the Docker daemon socket at unix:/var/run/docker.sock

```

- Once we know that the docker is running, we check the docker containers
`$ sudo docker images`

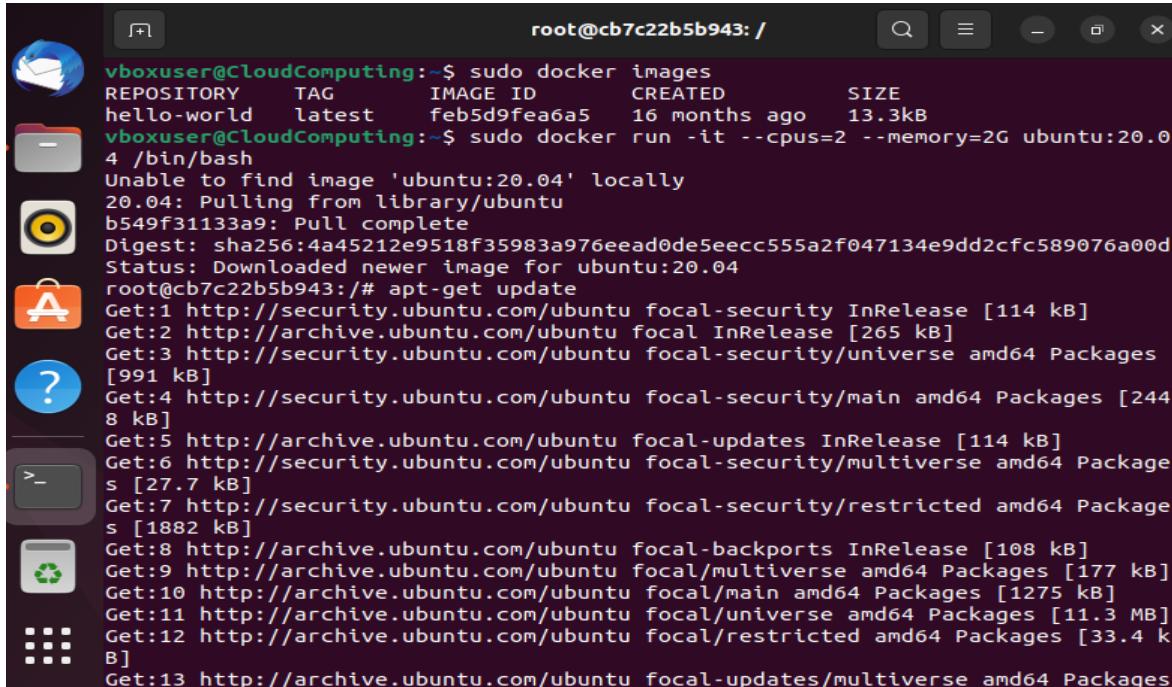


```

Activities Terminal Feb 4 19:50
vboxuser@CloudComputing:~$ sudo docker images
REPOSITORY      TAG      IMAGE ID      CREATED      SIZE
hello-world    latest   feb5d9fea6a5  16 months ago  13.3kB
vboxuser@CloudComputing:~$ 

```

- Now we need to pull the image from Docker repository of Ubuntu 20.04 and spin-up the container.
`$ docker run -it --cpus=2 --memory=2G ubuntu:20.04 /bin/bash`



```

root@cb7c22b5b943:~$ sudo docker images
REPOSITORY      TAG      IMAGE ID      CREATED      SIZE
hello-world    latest   feb5d9fea6a5  16 months ago  13.3kB
root@cb7c22b5b943:~$ sudo docker run -it --cpus=2 --memory=2G ubuntu:20.04 /bin/bash
Unable to find image 'ubuntu:20.04' locally
20.04: Pulling from library/ubuntu
b549f31133a9: Pull complete
Digest: sha256:4a45212e9518f35983a976ead0de5ecc555a2f047134e9dd2cfcc589076a00d
Status: Downloaded newer image for ubuntu:20.04
root@cb7c22b5b943:~# apt-get update
Get:1 http://security.ubuntu.com/ubuntu focal-security InRelease [114 kB]
Get:2 http://archive.ubuntu.com/ubuntu focal InRelease [265 kB]
Get:3 http://security.ubuntu.com/ubuntu focal-security/universe amd64 Packages [991 kB]
Get:4 http://security.ubuntu.com/ubuntu focal-security/main amd64 Packages [244 8 kB]
Get:5 http://archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Get:6 http://security.ubuntu.com/ubuntu focal-security/multiverse amd64 Packages [27.7 kB]
Get:7 http://security.ubuntu.com/ubuntu focal-security/restricted amd64 Packages [1882 kB]
Get:8 http://archive.ubuntu.com/ubuntu focal-backports InRelease [108 kB]
Get:9 http://archive.ubuntu.com/ubuntu focal/multiverse amd64 Packages [177 kB]
Get:10 http://archive.ubuntu.com/ubuntu focal/main amd64 Packages [1275 kB]
Get:11 http://archive.ubuntu.com/ubuntu focal/universe amd64 Packages [11.3 MB]
Get:12 http://archive.ubuntu.com/ubuntu focal/restricted amd64 Packages [33.4 kB]
Get:13 http://archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 Packages

```

QEMU TESTCASES

1. QEMU (2 core, 2gb ram):

a. 2000 prime numbers:

```
deep@qemuserver:~$ ./QEMU_2000_CPU.sh
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (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: 5992.03

General statistics:
total time: 30.0021s
total number of events: 179806

Latency (ms):
min: 0.12
avg: 0.16
max: 20.69
95th percentile: 0.25
sum: 29244.13

Threads fairness:
events (avg/stddev): 179806.0000/0.00
execution time (avg/stddev): 29.2441/0.00
```

```
deep@qemuserver:~$ ./QEMU_2000_CPU.sh
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (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: 5028.64

General statistics:
total time: 30.0019s
total number of events: 150904

Latency (ms):
min: 0.14
avg: 0.19
max: 18.71
95th percentile: 0.29
sum: 29171.25

Threads fairness:
events (avg/stddev): 150904.0000/0.00
execution time (avg/stddev): 29.1713/0.00

Prime numbers limit: 2000
Initializing worker threads...

Threads started!

CPU speed:
events per second: 5028.64

General statistics:
total time: 30.0019s
total number of events: 150904

Latency (ms):
min: 0.14
avg: 0.19
max: 18.71
95th percentile: 0.29
sum: 29171.25

Threads fairness:
events (avg/stddev): 150904.0000/0.00
execution time (avg/stddev): 29.1713/0.00

Prime numbers limit: 2000
Initializing worker threads...

Threads started!

CPU speed:
events per second: 5028.64

General statistics:
total time: 30.0019s
total number of events: 150904

Latency (ms):
min: 0.14
avg: 0.19
max: 18.71
95th percentile: 0.29
sum: 29171.25

Threads fairness:
events (avg/stddev): 150904.0000/0.00
execution time (avg/stddev): 29.1713/0.00
```

```
deep@qemuserver: ~
vboxuser@CloudComputing: ~
deep@qemuserver: ~

Prime numbers limit: 2000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 5161.04
General statistics:
total time: 30.0017s
total number of events: 154885
Latency (ms):
min: 0.14
avg: 0.19
max: 17.14
95th percentile: 0.29
sum: 29247.99
Threads fairness:
events (avg/stddev): 154885.0000/0.00
execution time (avg/stddev): 29.2480/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
```

```
deep@qemuserver: ~
vboxuser@CloudComputing: ~
deep@qemuserver: ~

Prime numbers limit: 2000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 5473.17
General statistics:
total time: 30.0017s
total number of events: 164232
Latency (ms):
min: 0.14
avg: 0.18
max: 10.57
95th percentile: 0.27
sum: 29315.38
Threads fairness:
events (avg/stddev): 164232.0000/0.00
execution time (avg/stddev): 29.3154/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
```

```

deep@qemuserver: ~
vboxuser@CloudComputing: ~
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: 5299.49
General statistics:
  total time: 30.0027s
  total number of events: 159079
Latency (ms):
  min: 0.14
  avg: 0.18
  max: 11.38
  95th percentile: 0.28
  sum: 29236.88
Threads fairness:
  events (avg/stddev): 159079.0000/0.00
  execution time (avg/stddev): 29.2369/0.00
deep@qemuserver: ~

```

Result for case 2000:

Serial number of iteration	Events per second
1	5992.03
2	5028.64
3	5161.04
4	5473.17
5	5299.49

Average events per second – 5390.87

b. 20000 prime numbers:

```

deep@qemuserver: ~
vboxuser@CloudComputing: ~
deep@qemuserver: ~
deep@qemuserver: ~
./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 1.0.18 (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: 313.94
General statistics:
  total time: 30.0049s
  total number of events: 9421
Latency (ms):
  min: 2.42
  avg: 3.17
  max: 18.42
  95th percentile: 4.41
  sum: 29876.61
Threads fairness:
  events (avg/stddev): 9421.0000/0.00
  execution time (avg/stddev): 29.8766/0.00
deep@qemuserver: ~

```

```
deep@qemuserver:~  
vboxuser@CloudComputing:~  
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: 230.11  
  
General statistics:  
    total time: 30.0053s  
    total number of events: 6908  
  
Latency (ms):  
    min: 3.20  
    avg: 4.32  
    max: 16.08  
    95th percentile: 6.32  
    sum: 29854.39  
  
Threads fairness:  
    events (avg/stddev): 6908.0000/0.00  
    execution time (avg/stddev): 29.8544/0.00  
deep@qemuserver:~$
```

```
deep@qemuserver:~  
vboxuser@CloudComputing:~  
Prime numbers limit: 20000  
Initializing worker threads...  
Threads started!  
  
CPU speed:  
    events per second: 265.46  
  
General statistics:  
    total time: 30.0026s  
    total number of events: 7966  
  
Latency (ms):  
    min: 3.04  
    avg: 3.75  
    max: 18.14  
    95th percentile: 5.47  
    sum: 29870.72  
  
Threads fairness:  
    events (avg/stddev): 7966.0000/0.00  
    execution time (avg/stddev): 29.8707/0.00  
  
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.  
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)  
Running the test with following options:  
Number of threads: 1  
Initializing random number generator from current time
```

```
deep@qemuserver: ~
vboxuser@CloudComputing: ~
deep@qemuserver: ~

Prime numbers limit: 20000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 258.60

General statistics:
total time: 30.0020s
total number of events: 7760

Latency (ms):
min: 3.04
avg: 3.84
max: 22.46
95th percentile: 5.99
sum: 29834.10

Threads fairness:
events (avg/stddev): 7760.0000/0.00
execution time (avg/stddev): 29.8341/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

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

```
deep@qemuserver: ~
vboxuser@CloudComputing: ~
deep@qemuserver: ~

Prime numbers limit: 20000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 265.85

General statistics:
total time: 30.0042s
total number of events: 7979

Latency (ms):
min: 2.46
avg: 3.74
max: 19.29
95th percentile: 5.28
sum: 29869.44

Threads fairness:
events (avg/stddev): 7979.0000/0.00
execution time (avg/stddev): 29.8694/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

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

Result for case 20000:

Serial number of iteration	Events per second
1	313.94
2	230.11
3	265.48
4	258.60
5	265.85

Average events per second – 266.80

c. 200000 prime numbers:

```
vboxuser@CloudComputing:~          deep@qemuserver:~  
deep@qemuserver:~ ./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 1.0.18 (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: 200000  
Initializing worker threads...  
Threads started!  
  
CPU speed:  
    events per second: 13.13  
  
General statistics:  
    total time: 30.0023s  
    total number of events: 394  
  
Latency (ms):  
    min: 64.21  
    avg: 76.08  
    max: 114.34  
    95th percentile: 89.16  
    sum: 29974.80  
  
Threads fairness:  
    events (avg/stddev): 394.0000/0.00  
    execution time (avg/stddev): 29.9748/0.00
```

```
vboxuser@CloudComputing:~          deep@qemuserver:~  
deep@qemuserver:~  
  
Prime numbers limit: 200000  
Initializing worker threads...  
Threads started!  
  
CPU speed:  
    events per second: 12.44  
  
General statistics:  
    total time: 30.0523s  
    total number of events: 374  
  
Latency (ms):  
    min: 73.11  
    avg: 80.28  
    max: 109.08  
    95th percentile: 90.78  
    sum: 30025.27  
  
Threads fairness:  
    events (avg/stddev): 374.0000/0.00  
    execution time (avg/stddev): 30.0253/0.00  
  
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.  
sysbench 1.0.18 (using system LuAJIT 2.1.0-beta3)  
  
Running the test with following options:  
Number of threads: 1  
Initializing random number generator from current time
```

```
deep@qemuserver:~  
vboxuser@CloudComputing:~  
  
Prime numbers limit: 200000  
Initializing worker threads...  
Threads started!  
CPU speed:  
    events per second: 11.88  
General statistics:  
    total time: 30.0330s  
    total number of events: 357  
Latency (ms):  
    min: 73.61  
    avg: 84.05  
    max: 119.63  
    95th percentile: 95.81  
    sum: 30006.57  
Threads fairness:  
    events (avg/stddev): 357.0000/0.00  
    execution time (avg/stddev): 30.0066/0.00  
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.  
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)  
Running the test with following options:  
Number of threads: 1  
Initializing random number generator from current time
```

```
deep@qemuserver:~  
vboxuser@CloudComputing:~  
  
Prime numbers limit: 200000  
Initializing worker threads...  
Threads started!  
CPU speed:  
    events per second: 12.57  
General statistics:  
    total time: 30.0596s  
    total number of events: 378  
Latency (ms):  
    min: 72.75  
    avg: 79.43  
    max: 102.56  
    95th percentile: 87.56  
    sum: 30023.78  
Threads fairness:  
    events (avg/stddev): 378.0000/0.00  
    execution time (avg/stddev): 30.0238/0.00  
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.  
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)  
Running the test with following options:  
Number of threads: 1  
Initializing random number generator from current time
```

```

deep@qemuserver: ~
vboxuser@CloudComputing: ~
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: 200000
Initializing worker threads...
Threads started!

CPU speed:
  events per second: 12.19

General statistics:
  total time: 30.0274s
  total number of events: 366

Latency (ms):
  min: 72.99
  avg: 81.97
  max: 121.42
  95th percentile: 97.55
  sum: 29999.86

Threads fairness:
  events (avg/stddev): 366.0000/0.00
  execution time (avg/stddev): 29.9999/0.00

```

Result for case 200000:

Serial number of iteration	Events per second
1	13.13
2	12.44
3	11.88
4	12.57
5	12.19

Average events per second – 12.44

2. QEMU (2 core, 3gb ram):

a. 2000 prime numbers:

```

deep@qemuserver: ~
vboxuser@CloudComputing: ~
deep@qemuserserver: ~
./QEMU_2000_CPU.sh
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (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: 6661.97

General statistics:
  total time: 30.0017s
  total number of events: 199908

Latency (ms):
  min: 0.12
  avg: 0.15
  max: 9.44
  95th percentile: 0.22
  sum: 29325.99

Threads fairness:
  events (avg/stddev): 199908.0000/0.00
  execution time (avg/stddev): 29.3260/0.00

```

```
Prime numbers limit: 2000
Initializing worker threads...
Threads started!
CPU speed:
  events per second: 6239.96
General statistics:
  total time:          30.0037s
  total number of events: 187261
Latency (ms):
  min:                 0.12
  avg:                 0.16
  max:                 7.96
  95th percentile:    0.23
  sum:                29325.80
Threads fairness:
  events (avg/stddev): 187261.0000/0.00
  execution time (avg/stddev): 29.3258/0.00
```

```
deep@qemuserver: ~
vboxuser@CloudComputing: ~
deep@qemuserver: ~

Prime numbers limit: 2000
Initializing worker threads...
Threads started!
CPU speed:
  events per second: 6171.96
General statistics:
  total time:          30.0019s
  total number of events: 185208
Latency (ms):
  min:                 0.13
  avg:                 0.16
  max:                 14.00
  95th percentile:    0.23
  sum:                29343.72
Threads fairness:
  events (avg/stddev): 185208.0000/0.00
  execution time (avg/stddev): 29.3437/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

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

```
deep@qemuserver: ~
vboxuser@CloudComputing: ~
deep@qemuserver: ~

Prime numbers limit: 2000
Initializing worker threads...
Threads started!
CPU speed:
  events per second: 6155.19
General statistics:
  total time:          30.0015s
  total number of events: 184699
Latency (ms):
  min:                 0.13
  avg:                 0.16
  max:                 22.65
  95th percentile:    0.23
  sum:                29274.30
Threads fairness:
  events (avg/stddev): 184699.0000/0.00
  execution time (avg/stddev): 29.2743/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

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

```

deep@qemuserver: ~
vboxuser@CloudComputing: ~
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: 6137.19
General statistics:
  total time:          30.0019s
  total number of events: 184173
Latency (ms):
  min:                 0.13
  avg:                 0.16
  max:                15.03
  95th percentile:    0.23
  sum:               29312.92
Threads fairness:
  events (avg/stddev): 184173.0000/0.00
  execution time (avg/stddev): 29.3129/0.00
deep@qemuserver: ~

```

Result for case 2000:

Serial number of iteration	Events per second
1	6661.97
2	6239.96
3	6171.96
4	6155.19
5	6137.19

Average events per second – 6273.25

b. 20000 prime numbers:

```

deep@qemuserver: ~
vboxuser@CloudComputing: ~
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.

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: 334.96
General statistics:
  total time:          30.0033s
  total number of events: 10052
Latency (ms):
  min:                 2.42
  avg:                 2.97
  max:                24.36
  95th percentile:    3.96
  sum:               29900.61
Threads fairness:
  events (avg/stddev): 10052.0000/0.00
  execution time (avg/stddev): 29.9006/0.00
deep@qemuserver: ~

```

```
deep@qemuserver:~  
vboxuser@CloudComputing:~  
  
Prime numbers limit: 20000  
Initializing worker threads...  
Threads started!  
CPU speed:  
    events per second: 323.91  
General statistics:  
    total time: 30.0029s  
    total number of events: 9720  
Latency (ms):  
    min: 2.41  
    avg: 3.08  
    max: 17.45  
    95th percentile: 3.96  
    sum: 29889.24  
Threads fairness:  
    events (avg/stddev): 9720.0000/0.00  
    execution time (avg/stddev): 29.8892/0.00  
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.  
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)  
Running the test with following options:  
Number of threads: 1  
Initializing random number generator from current time
```

```
deep@qemuserver:~  
vboxuser@CloudComputing:~  
  
Prime numbers limit: 20000  
Initializing worker threads...  
Threads started!  
CPU speed:  
    events per second: 315.45  
General statistics:  
    total time: 30.0028s  
    total number of events: 9466  
Latency (ms):  
    min: 2.77  
    avg: 3.16  
    max: 18.43  
    95th percentile: 3.89  
    sum: 29912.83  
Threads fairness:  
    events (avg/stddev): 9466.0000/0.00  
    execution time (avg/stddev): 29.9128/0.00  
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.  
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)  
Running the test with following options:  
Number of threads: 1  
Initializing random number generator from current time
```

```
vboxuser@CloudComputing:~  
deep@qemuserver:~  
  
Prime numbers limit: 20000  
Initializing worker threads...  
Threads started!  
CPU speed:  
    events per second: 315.99  
General statistics:  
    total time: 30.0044s  
    total number of events: 9483  
Latency (ms):  
    min: 2.77  
    avg: 3.15  
    max: 17.34  
    95th percentile: 3.96  
    sum: 29915.31  
Threads fairness:  
    events (avg/stddev): 9483.0000/0.00  
    execution time (avg/stddev): 29.9153/0.00  
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.  
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)  
Running the test with following options:  
Number of threads: 1  
Initializing random number generator from current time
```

```

vboxuser@CloudComputing: ~
deep@qemuserver: ~

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: 312.84

General statistics:
total time: 30.0038s
total number of events: 9388

Latency (ms):
min: 2.77
avg: 3.19
max: 16.05
95th percentile: 4.03
sum: 29905.91

Threads fairness:
events (avg/stddev): 9388.0000/0.00
execution time (avg/stddev): 29.9059/0.00

```

Result for case 20000:

Serial number of iteration	Events per second
1	334.96
2	323.91
3	315.45
4	316
5	312.84

Average events per second – 320.63

c. 200000 prime numbers:

```

vboxuser@CloudComputing: ~
deep@qemuserver: ~

deep@qemuserver: $ ./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 1.0.18 (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: 200000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 14.48

General statistics:
total time: 30.0301s
total number of events: 435

Latency (ms):
min: 61.39
avg: 68.97
max: 102.86
95th percentile: 77.19
sum: 30003.90

Threads fairness:
events (avg/stddev): 435.0000/0.00
execution time (avg/stddev): 30.0039/0.00

```

```
deep@qemuserver: ~
vboxuser@CloudComputing: ~
deep@qemuserver: ~

Prime numbers limit: 200000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 14.01
General statistics:
total time: 30.03695
total number of events: 421
Latency (ms):
min: 62.09
avg: 71.28
max: 101.88
95th percentile: 81.48
sum: 30010.12
Threads fairness:
events (avg/stddev): 421.0000/0.00
execution time (avg/stddev): 30.0101/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

```
deep@qemuserver: ~
vboxuser@CloudComputing: ~
deep@qemuserver: ~

Prime numbers limit: 200000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 13.91
General statistics:
total time: 30.04985
total number of events: 418
Latency (ms):
min: 65.49
avg: 71.82
max: 94.09
95th percentile: 78.60
sum: 30022.85
Threads fairness:
events (avg/stddev): 418.0000/0.00
execution time (avg/stddev): 30.0228/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
```

```
deep@qemuserver: ~
vboxuser@CloudComputing: ~
deep@qemuserver: ~

Prime numbers limit: 200000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 14.02
General statistics:
total time: 30.0225s
total number of events: 421
Latency (ms):
min: 65.76
avg: 71.25
max: 90.32
95th percentile: 78.60
sum: 29997.07
Threads fairness:
events (avg/stddev): 421.0000/0.00
execution time (avg/stddev): 29.9971/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
Running the test with following options:
Number of threads: 1
Initializing random number generator from current time
```

```

vboxuser@CloudComputing: ~
deep@qemuserver: ~

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: 200000
Initializing worker threads...

Threads started!

CPU speed:
    events per second: 13.87

General statistics:
    total time: 30.0666s
    total number of events: 417

Latency (ms):
    min: 66.00
    avg: 72.04
    max: 106.23
    95th percentile: 82.96
    sum: 30039.26

Threads fairness:
    events (avg/stddev): 417.0000/0.00
    execution time (avg/stddev): 30.0393/0.00

deep@qemuserver: ~

```

Result for case 200000:

Serial number of iteration	Events per second
1	14.48
2	14.01
3	13.91
4	14.02
5	13.87

Average events per second – 14.05

3. QEMU IO (2 core, 2gb ram):

a. Sequential Read Write:

Iteration 1:

```

vboxuser@CloudComputing: ~
deep@qemuserver: ~

deep@qemuserver: ~$ ./QEMU_FILEIO_SEQ.sh
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 1.0.18 (using system LuaJIT 2.1.0-beta3)

128 files, 16384Kb each, 2048Mb 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

```

```

deep@qemuserver: ~
vboxuser@CloudComputing: ~ x deep@qemuserver: ~ x v

Creating file test_file.114
Creating file test_file.115
Creating file test_file.116
Creating file test_file.117
Creating file test_file.118
Creating file test_file.119
Creating file test_file.120
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 54.10 seconds (37.85 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 1.0.18 (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 16MiB each

```

```

vboxuser@CloudComputing: ~ x deep@qemuserver: ~ x v

File operations:
  reads/s:          0.00
  writes/s:         813.50
  fsyncs/s:         1106.09

Throughput:
  read, MiB/s:      0.00
  written, MiB/s:   12.71

General statistics:
  total time:        30.7262s
  total number of events: 56944

Latency (ms):
  min:                0.07
  avg:                8.37
  max:               305.46
  95th percentile:   21.50
  sum:            476621.43

Threads fairness:
  events (avg/stddev): 3559.0000/170.96
  execution time (avg/stddev): 29.7888/0.04

WARNING: the --test option is deprecated. You can pass a script name or path on the com
mand line without any options.
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuAJIT 2.1.0-beta3)

Removing test files...
deep@qemuserver: ~

```

Results:

reads/s	0
writes/s	813.50
fsyncs/s	1106.09
events/s	1855

Iteration 2:

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
Creating file test_file.119
Creating file test_file.120
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 23.38 seconds (87.61 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 1.0.18 (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, 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!
```

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
Threads started!

File operations:
  reads/s:                      0.00
  writes/s:                     1202.15
  fsyncs/s:                      1602.68

Throughput:
  read, MiB/s:                  0.00
  written, MiB/s:                18.78

General statistics:
  total time:                   30.6898s
  total number of events:        84046

Latency (ms):
  min:                           0.06
  avg:                           5.68
  max:                           209.09
  95th percentile:               15.55
  sum:                          477037.24

Threads fairness:
  events (avg/stddev):         5252.8750/156.71
  execution time (avg/stddev):  29.8148/0.02

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 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

Results:

reads/s	0
writes/s	1202.15
fsyncs/s	1602.68
events/s	2738

Iteration 3:

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
Creating file test_file.114
Creating file test_file.115
Creating file test_file.116
Creating file test_file.117
Creating file test_file.118
Creating file test_file.119
Creating file test_file.120
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 15.81 seconds (129.53 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 1.0.18 (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, 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.
```

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
Threads started!

File operations:
  reads/s:                      0.00
  writes/s:                     1981.62
  fsyncs/s:                      2601.84

Throughput:
  read, MiB/s:                  0.00
  written, MiB/s:                30.96

General statistics:
  total time:                   30.5768s
  total number of events:        138119

Latency (ms):
  min:                           0.04
  avg:                          3.46
  max:                          85.40
  95th percentile:              10.27
  sum:                         477721.66

Threads fairness:
  events (avg/stddev):         8632.4375/299.69
  execution time (avg/stddev):  29.8576/0.01

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 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

Results:

reads/s	0
writes/s	1981.62
fsyncs/s	2601.84
events/s	4455

b. Random Read Write:

Iteration 1:

```
vboxuser@CloudComputing: ~          x      deep@qemuserver: ~          x      v
deep@qemuserver:~$ ./QEMU_FILEIO_RNDRW.sh
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 1.0.18 (using system LuaJIT 2.1.0-beta3)

128 files, 16384Kb each, 2048Mb 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
```

```
vboxuser@CloudComputing: ~          x      deep@qemuserver: ~          x      v
Creating file test_file.114
Creating file test_file.115
Creating file test_file.116
Creating file test_file.117
Creating file test_file.118
Creating file test_file.119
Creating file test_file.120
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 16.49 seconds (124.17 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 1.0.18 (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, 16MiB each
2GiB total file size
Block size 16KiB
Number of IO requests: 0
ReadWrite ratio for combined random IO test: 1.50
```

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
File operations:
  reads/s:                      753.92
  writes/s:                     502.56
  fsyncs/s:                     1674.83

Throughput:
  read, MiB/s:                  11.78
  written, MiB/s:                7.85

General statistics:
  total time:                   30.3993s
  total number of events:       87071

Latency (ms):
  min:                           0.01
  avg:                           5.49
  max:                           90.39
  95th percentile:              17.95
  sum:                          478343.49

Threads fairness:
  events (avg/stddev):         5441.9375/256.45
  execution time (avg/stddev): 29.8965/0.01

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 1.0.18 (using system LuAJIT 2.1.0-beta3)

Removing test files...
deep@qemuserver:~$
```

Results:

reads/s	753.92
writes/s	502.56
fsyncs/s	1674.83
events/s	2864

Iteration 2:

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 21.54 seconds (95.10 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 1.0.18 (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, 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!
```

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
File operations:
  reads/s:           606.41
  writes/s:          404.24
  fsyncs/s:          1356.09

Throughput:
  read, MiB/s:      9.48
  written, MiB/s:   6.32

General statistics:
  total time:        30.8607s
  total number of events: 71002

Latency (ms):
  min:                0.01
  avg:                6.74
  max:                84.10
  95th percentile:   22.28
  sum:               478208.45

Threads fairness:
  events (avg/stddev): 4437.6250/184.11
  execution time (avg/stddev): 29.8880/0.01

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 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...

```

Results:

reads/s	606.41
writes/s	404.24
fsyncs/s	1356.09
events/s	2300.77

Iteration 3:

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
Creating file test_file.113
Creating file test_file.114
Creating file test_file.115
Creating file test_file.116
Creating file test_file.117
Creating file test_file.118
Creating file test_file.119
Creating file test_file.120
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 23.39 seconds (87.58 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 1.0.18 (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, 16MiB each
2GiB total file size
Block size 16KiB
Number of IO requests: 0
```

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
Threads started!

File operations:
  reads/s:                      646.27
  writes/s:                     430.85
  fsyncs/s:                      1443.05

Throughput:
  read, MiB/s:                  10.10
  written, MiB/s:                6.73

General statistics:
  total time:                   30.5404s
  total number of events:        74929

Latency (ms):
  min:                           0.00
  avg:                          6.38
  max:                          60.57
  95th percentile:              20.74
  sum:                         478084.11

Threads fairness:
  events (avg/stddev):         4683.0625/207.41
  execution time (avg/stddev):  29.8803/0.01

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 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

Results:

reads/s	646.27
writes/s	430.85
fsyncs/s	1443.05
events/s	2456.7

4. QEMU IO (2 core, 3gb ram):

a. Sequential Read Write:

Iteration 1:

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
deep@qemuserver:~$ ./QEMU_FILEIO_SEQ.sh
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 1.0.18 (using system LuaJIT 2.1.0-beta3)

128 files, 16384Kb each, 2048Mb 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
```

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
Creating file test_file.120
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 17.96 seconds (114.05 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 1.0.18 (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, 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!
```

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
File operations:
  reads/s:           0.00
  writes/s:          2446.06
  fsyncs/s:          3195.41

Throughput:
  read, MiB/s:      0.00
  written, MiB/s:   38.22

General statistics:
  total time:        30.4539s
  total number of events: 169775

Latency (ms):
  min:               0.02
  avg:               2.81
  max:               64.76
  95th percentile:   7.17
  sum:              477818.29

Threads fairness:
  events (avg/stddev): 10610.9375/427.81
  execution time (avg/stddev): 29.8636/0.01

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 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
deep@qemuserver:~$
```

Results:

reads/s	0
writes/s	2446.06
fsyncs/s	3195.41
events/s	5575.5

Iteration 2:

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 16.42 seconds (124.73 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 1.0.18 (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, 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
```

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
Threads started!

File operations:
  reads/s:      0.00
  writes/s:    2455.95
  fsyncs/s:    3209.07

Throughput:
  read, MiB/s:   0.00
  written, MiB/s: 38.37

General statistics:
  total time:        30.4933s
  total number of events: 170720

Latency (ms):
  min:            0.02
  avg:           2.80
  max:           55.93
  95th percentile: 7.04
  sum:          478167.26

Threads fairness:
  events (avg/stddev): 10670.0000/402.61
  execution time (avg/stddev): 29.8855/0.01

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 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

Results:

reads/s	0
writes/s	2455.95
fsyncs/s	3209.07
events/s	5597.4

Iteration 3:

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
Creating file test_file.119
Creating file test_file.120
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 22.85 seconds (89.64 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 1.0.18 (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, 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!
```

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
File operations:
  reads/s:                      0.00
  writes/s:                     2277.24
  fsyncs/s:                      2979.71

Throughput:
  read, MiB/s:                  0.00
  written, MiB/s:                35.58

General statistics:
  total time:                   30.4716s
  total number of events:        158160

Latency (ms):
  min:                           0.02
  avg:                           3.02
  max:                           74.42
  95th percentile:               7.70
  sum:                          477920.81

Threads fairness:
  events (avg/stddev):         9885.0000/374.51
  execution time (avg/stddev):  29.8701/0.02

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 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
deep@qemuserver:~
```

Results:

reads/s	0
writes/s	2277.24
fsyncs/s	2979.71
events/s	5190.7

b. Random Read Write:

Iteration 1:

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
deep@qemuserver: $ ./QEMU_FILEIO_RNDRW.sh
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 1.0.18 (using system LuaJIT 2.1.0-beta3)

128 files, 16384Kb each, 2048Mb 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
```

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 16.89 seconds (121.29 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 1.0.18 (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, 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!
```

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
File operations:
  reads/s:                      750.71
  writes/s:                     500.47
  fsyncs/s:                      1664.50

Throughput:
  read, MiB/s:                  11.73
  written, MiB/s:                7.82

General statistics:
  total time:                   30.6071s
  total number of events:        87204

Latency (ms):
  min:                           0.01
  avg:                          5.49
  max:                          66.13
  95th percentile:              18.28
  sum:                         478893.77

Threads fairness:
  events (avg/stddev):         5450.2500/338.31
  execution time (avg/stddev):  29.9309/0.01

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 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
deep@qemuserver: ~
```

Results:

reads/s	750.71
writes/s	500.47
fsyncs/s	1664.50
events/s	2849.8

Iteration 2:

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 16.56 seconds (123.70 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 1.0.18 (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, 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!
```

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
Threads started!

File operations:
  reads/s:                745.23
  writes/s:               496.82
  fsyncs/s:                1653.33

Throughput:
  read, MiB/s:            11.64
  written, MiB/s:          7.76

General statistics:
  total time:              30.5104s
  total number of events:    86302

Latency (ms):
  min:                      0.01
  avg:                      5.55
  max:                     65.84
  95th percentile:           18.28
  sum:                    478821.90

Threads fairness:
  events (avg/stddev):    5393.8750/254.48
  execution time (avg/stddev): 29.9264/0.01

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 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

Results:

reads/s	745.23
writes/s	496.82
fsyncs/s	1653.33
events/s	2828.6

Iteration 3:

```
vboxuser@CloudComputing: ~          deep@qemuserver: ~
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 24.04 seconds (85.20 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 1.0.18 (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, 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!
```

```
vboxuser@CloudComputing: ~          deep@gemuserver: ~
File operations:
  reads/s:                 671.86
  writes/s:                447.96
  fsyncs/s:                1496.48

Throughput:
  read, MiB/s:              10.50
  written, MiB/s:            7.00

General statistics:
  total time:                30.6255s
  total number of events:    78089

Latency (ms):
  min:                         0.00
  avg:                        6.13
  max:                        70.90
  95th percentile:             20.37
  sum:                       478757.01

Threads fairness:
  events (avg/stddev):      4880.5625/237.38
  execution time (avg/stddev): 29.9223/0.01

WARNING: the --test option is deprecated. You can pass a script name or path on the com-
mand line without any options.
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
deep@gemuserver: ~
```

Results:

reads/s	671.86
writes/s	447.96
fsyncs/s	1496.48
events/s	2550.26

DOCKER TESTCASES

1. DOCKER (2 core, 2gb ram):

a. 2000 prime numbers:

```
root@a3b3c7355bb3:/# ./DOCKER_2000_CPU.sh
WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (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: 35962.52

General statistics:
    total time:                      30.0001s
    total number of events:           1078924

    Latency (ms):
        min:                           0.03
        avg:                           0.03
        max:                           13.87
        95th percentile:               0.03
        sum:                           29820.28
```

```
root@a3b3c7355bb3: /
```

```
Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 35505.61

General statistics:
    total time:                      30.0003s
    total number of events:           1065249

    Latency (ms):
        min:                           0.03
        avg:                           0.03
        max:                           181.43
        95th percentile:               0.03
        sum:                           29829.64

    Threads fairness:
        events (avg/stddev):          1065249.0000/0.00
        Latency (ms): (avg/stddev): 29.8296/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

```
Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 35451.41

General statistics:
    total time:                      30.0001s
    total number of events:           1063593

Latency (ms):
    min:                            0.03
    avg:                            0.03
    max:                            11.69
    95th percentile:                0.03
    sum:                           29797.23

Threads fairness:
    events (avg/stddev):          1063593.0000/0.00
    execution time (avg/stddev):   29.7972/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

```
root@a3b3c7355bb3: /
```

```
Prime numbers limit: 2000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 32356.27

General statistics:
    total time:                      30.0001s
    total number of events:           970736

Latency (ms):
    min:                            0.03
    avg:                            0.03
    max:                            11.99
    95th percentile:                0.04
    sum:                           29686.49

Threads fairness:
    events (avg/stddev):          970736.0000/0.00
    execution time (avg/stddev):   29.6865/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

```

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: 35661.22

General statistics:
total time: 30.0002s
total number of events: 1069912

Latency (ms):
min: 0.03
avg: 0.03
max: 8.76
95th percentile: 0.03
sum: 29801.26

Threads fairness:
events (avg/stddev): 1069912.0000/0.00
execution time (avg/stddev): 29.8013/0.00

root@a3b3c7355bb3:/# 
```

Result for case 2000:

Serial number of iteration	Events per second
1	35962.5
2	35505.6
3	35451.4
4	32356.2
5	35661.22

Average events per second – 34987.38

b. 20000 prime numbers:

```

root@a3b3c7355bb3:/# ./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 1.0.18 (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: 1370.06

General statistics:
total time: 30.0003s
total number of events: 41104

Latency (ms):
min: 0.67
avg: 0.73
max: 11.10
95th percentile: 0.94
sum: 29972.42

root@a3b3c7355bb3:/# 
```

```
Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 1397.02

General statistics:
    total time:          30.0003s
    total number of events: 41913

Latency (ms):
    min:                 0.67
    avg:                 0.72
    max:                14.34
    95th percentile:     0.84
    sum:               29974.21

Threads fairness:
    events (avg/stddev): 41913.0000/0.00
    execution time (avg/stddev): 29.9742/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

```
Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 1421.93

General statistics:
    total time:          30.0003s
    total number of events: 42661

Latency (ms):
    min:                 0.67
    avg:                 0.70
    max:                8.54
    95th percentile:     0.78
    sum:               29976.06

Threads fairness:
    events (avg/stddev): 42661.0000/0.00
    execution time (avg/stddev): 29.9761/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

```
root@a3b3c7355bb3: /  
  
Prime numbers limit: 20000  
  
Initializing worker threads...  
  
Threads started!  
  
CPU speed:  
    events per second: 1368.28  
  
General statistics:  
Ubuntu Software          30.00006s  
    total number of events: 41051  
  
Latency (ms):  
    min:                      0.67  
    avg:                      0.73  
    max:                     15.50  
    95th percentile:          0.87  
    sum:                     29968.00  
  
Threads fairness:  
    events (avg/stddev):    41051.0000/0.00  
    execution time (avg/stddev): 29.9680/0.00  
  
WARNING: the --test option is deprecated. You can pass a script name or path on  
the command line without any options.  
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

```
root@a3b3c7355bb3: /#  
  
Prime numbers limit: 20000  
  
Initializing worker threads...  
  
Threads started!  
  
CPU speed:  
    events per second: 1357.97  
  
General statistics:  
total time:           30.00008s  
    total number of events: 40743  
  
Latency (ms):  
    min:                      0.67  
Terminal avg:                      0.74  
    max:                     32.90  
    95th percentile:          0.94  
    sum:                     29969.02  
  
Threads fairness:  
    events (avg/stddev):    40743.0000/0.00  
    execution time (avg/stddev): 29.9690/0.00  
  
root@a3b3c7355bb3: #
```

Result for case 20000:

Serial number of iteration	Events per second
1	1370.06
2	1397.02
3	1421.93
4	1368.28
5	1357.97

Average events per second – 1383.05

c. 200000 prime numbers:

```
root@a3b3c7355bb3:/# ./DOCKER_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 1.0.18 (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: 200000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 58.39

General statistics:
    total time: 30.0034s
    total number of events: 1752

Latency (ms):
    min: 16.23
    avg: 17.12
    max: 49.78
    95th percentile: 19.29
    sum: 30000.00
```

```
Prime numbers limit: 200000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 58.02

General statistics:
    total time: 30.0051s
    total number of events: 1741

Latency (ms):
    min: 16.24
    avg: 17.23
    max: 43.53
    95th percentile: 19.29
    sum: 30001.05

Threads fairness:
    events (avg/stddev): 1741.0000/0.00
    execution time (avg/stddev): 30.0010/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

```
Initializing worker threads...
Threads started!
CPU speed:
  events per second: 57.68

General statistics:
  total time: 30.0065s
  total number of events: 1731

Latency (ms):
  min: 16.22
  avg: 17.33
  max: 43.13
  95th percentile: 19.65
  sum: 30002.26

Threads fairness:
  Terminal s (avg/stddev): 1731.0000/0.00
  execution time (avg/stddev): 30.0023/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
```

```
Prime numbers limit: 200000

Initializing worker threads...
Threads started!
CPU speed:
  events per second: 59.28

General statistics:
  total time: 30.0102s
  total number of events: 1779

Latency (ms):
  min: 16.14
  avg: 16.87
  max: 30.02
  95th percentile: 18.61
  sum: 30006.79

Threads fairness:
  Terminal s (avg/stddev): 1779.0000/0.00
  execution time (avg/stddev): 30.0068/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

```

Prime numbers limit: 200000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:      59.22

General statistics:
    total time:          30.0049s
    total number of events: 1777

Latency (ms):
    min:                  16.14
    avg:                  16.88
    max:                  28.21
    95th percentile:     18.61
    sum:                 30001.53

Threads fairness:
    events (avg/stddev): 1777.0000/0.00
    execution time (avg/stddev): 30.0015/0.00

root@a3b3c7355bb3:/#

```

Result for case 200000:

Serial number of iteration	Events per second
1	58.39
2	58.02
3	57.68
4	59.28
5	59.22

Average events per second – 58.51

2. DOCKER (2 core, 3gb ram):

- a. 2000 prime numbers:

```

root@5c2c88342c92:/# ./DOCKER_2000_CPU.sh
WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (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: 32451.65

General statistics:
    total time:          30.0002s
    total number of events: 973613

Latency (ms):
    min:                  0.03
    avg:                  0.03
    max:                  12.61
    95th percentile:     0.04
    sum:                 29765.93

```

```
root@5c2c88342c92: /  
  
Prime numbers limit: 2000  
  
Initializing worker threads...  
  
Threads started!  
  
CPU speed:  
events per second: 35554.60  
  
General statistics:  
total time: 30.0001s  
total number of events: 1066689  
  
Latency (ms):  
min: 0.03  
avg: 0.03  
max: 14.71  
95th percentile: 0.03  
sum: 29829.38  
  
Threads fairness:  
events (avg/stddev): 1066689.0000/0.00  
execution time (avg/stddev): 29.8294/0.00  
  
WARNING: the --test option is deprecated. You can pass a script name or path on  
the command line without any options.  
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

```
root@5c2c88342c92: /  
  
Prime numbers limit: 2000  
  
Initializing worker threads...  
  
Threads started!  
  
CPU speed:  
events per second: 36900.74  
  
General statistics:  
total time: 30.0002s  
total number of events: 1107075  
  
Latency (ms):  
min: 0.03  
avg: 0.03  
max: 12.73  
95th percentile: 0.03  
sum: 29859.01  
  
Threads fairness:  
events (avg/stddev): 1107075.0000/0.00  
execution time (avg/stddev): 29.8590/0.00  
  
WARNING: the --test option is deprecated. You can pass a script name or path on  
the command line without any options.  
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

```

Prime numbers limit: 2000
Initializing worker threads...
Threads started!
CPU speed:
    events per second: 36711.19

General statistics:
    total time:                      30.0001s
    total number of events:           1101392

Latency (ms):
    min:                            0.03
    avg:                            0.03
    max:                            35.15
    95th percentile:                0.03
    sum:                           29852.26

Threads fairness:
    events (avg/stddev):          1101392.0000/0.00
    execution time (avg/stddev):   29.8523/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

```

```

Prime numbers limit: 2000
Initializing worker threads...
Threads started!
CPU speed:
    events per second: 35369.28

General statistics:
    total time:                      30.0002s
    total number of events:           1061131

Latency (ms):
    min:                            0.03
    avg:                            0.03
    max:                            13.78
    95th percentile:                0.03
    sum:                           29843.74

Threads fairness:
    events (avg/stddev):          1061131.0000/0.00
    execution time (avg/stddev):   29.8437/0.00
root@5c2c88342c92:/#

```

Result for case 2000:

Serial number of iteration	Events per second
1	32451.65
2	35554.6
3	36900.74
4	36711.19
5	35369.28

Average events per second – 35397.5

b. 20000 prime numbers:

```
root@5c2c88342c92:/# ./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 1.0.18 (using system LuaJIT 2.1.0-beta3)

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

Rhythmbox rs limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
  events per second: 1446.81

General statistics:
  total time: 30.0005s
  total number of events: 43407

Latency (ms):
  min: 0.67
  avg: 0.69
  max: 11.42
  95th percentile: 0.72
  sum: 29983.98
```

```
root@5c2c88342c92:/# Prime numbers limit: 20000
Initializing worker threads...
Threads started!
Files feed:
  events per second: 1453.02

General statistics:
  total time: 30.0005s
  total number of events: 43593

Latency (ms):
  min: 0.67
  avg: 0.69
  max: 9.46
  95th percentile: 0.72
  sum: 29984.77

Threads fairness:
  events (avg/stddev): 43593.0000/0.00
  execution time (avg/stddev): 29.9848/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

```
Prime numbers limit: 20000

Initializing worker threads...

Threads started!

CPU speed:
    events per second: 1451.00

General statistics:
    total time:          30.0008s
    total number of events: 43533

Latency (ms):
    min:                 0.67
    avg:                 0.69
    max:                 14.88
    95th percentile:     0.72
    sum:                29985.30

Threads fairness:
    events (avg/stddev): 43533.0000/0.00
    execution time (avg/stddev): 29.9853/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

```
Prime numbers limit: 20000

Initializing worker threads...

Threads started!

Rhythmbox
    events per second: 1452.76

General statistics:
    total time:          30.0003s
    total number of events: 43585

Latency (ms):
    min:                 0.67
    avg:                 0.69
    max:                 9.24
    95th percentile:     0.72
    sum:                29984.68

Threads fairness:
    events (avg/stddev): 43585.0000/0.00
    execution time (avg/stddev): 29.9847/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

```

Prime numbers limit: 20000
Initializing worker threads...
Threads started!
CPU speed:
    events per second: 1453.55

General statistics:
    total time:          30.0005s
    total number of events: 43609

Latency (ms):
    min:                 0.67
    avg:                 0.69
    max:                 8.97
    95th percentile:     0.72
    sum:                29986.23
Trash
Threads fairness:
    events (avg/stddev): 43609.0000/0.00
    execution time (avg/stddev): 29.9862/0.00
root@5c2c88342c92:/#

```

Result for case 20000:

Serial number of iteration	Events per second
1	1446.81
2	1453.02
3	1451
4	1452.76
5	1453.55

Average events per second – 1451.43

c. 200000 prime numbers:

```

root@5c2c88342c92:/# ./DOCKER_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 1.0.18 (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: 200000
Initializing worker threads...
Help's started!
CPU speed:
    events per second: 61.22

General statistics:
    total time:          30.0066s
    total number of events: 1837

Latency (ms):
    min:                 16.15
    avg:                 16.33
    max:                 24.38
    95th percentile:     16.71
    sum:                30004.38

```

```
Prime numbers limit: 200000
Initializing worker threads...
Threads started!
CPU speed:
    events per second:    61.19

General statistics:
    total time:            30.0031s
    total number of events: 1836

Latency (ms):
    min:                  16.14
    avg:                  16.34
    max:                  37.01
    95th percentile:       16.41
    sum:                  30000.86

Threads fairness:
    events (avg/stddev):   1836.0000/0.00
    execution time (avg/stddev): 30.0009/0.00

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

```
Prime numbers limit: 200000
Initializing worker threads...
Threads started!
CPU speed:
    events per second:    61.31

General statistics:
    total time:            30.0102s
    total number of events: 1840

Latency (ms):
    min:                  16.15
    avg:                  16.31
    max:                  28.88
    95th percentile:       16.41
    sum:                  30008.06

Threads fairness:
    events (avg/stddev):   1840.0000/0.00
    execution time (avg/stddev): 30.0081/0.00

WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)
```

```

Prime numbers limit: 200000
Initializing worker threads...
Threads started!
CPU speed:
  events per second:    61.40
General statistics:
  total time:           30.0126s
  total number of events: 1843
Latency (ms):
  min:                  16.14
  avg:                  16.28
  max:                  31.67
  95th percentile:      16.41
  sum:                 30010.47
Threads fairness:
  events (avg/stddev): 1843.0000/0.00
  execution time (avg/stddev): 30.0105/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on
the command line without any options.
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

```

```

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:    60.98
General statistics:
  total time:           30.0090s
  total number of events: 1830
Latency (ms):
  min:                  16.14
  avg:                  16.40
  max:                  30.28
  95th percentile:      16.71
  sum:                 30006.63
Threads fairness:
  events (avg/stddev): 1830.0000/0.00
  execution time (avg/stddev): 30.0066/0.00
root@5c2c88342c92:/#

```

Result for case 200000:

Serial number of iteration	Events per second
1	61.22
2	61.19
3	61.31
4	61.40
5	60.98

Average events per second – 61.22

3. DOCKER IO (2 core, 2gb ram):

a. Sequential Read Write:

Iteration 1:

```
root@a3b3c7355bb3:/# chmod 777 DOCKER_FILEIO_SEQ.sh
root@a3b3c7355bb3:/# ./DOCKER_FILEIO_SEQ.sh
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 1.0.18 (using system LuaJIT 2.1.0-beta3)

128 files, 16384Kb each, 2048Mb 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.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 6.46 seconds (316.98 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 1.0.18 (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, 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.
  Trash synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!
```

```

File operations:
  reads/s:                      0.00
  writes/s:                     3807.94
  fsyncs/s:                      4938.75

Throughput:
  read, MiB/s:                  0.00
  written, MiB/s:                59.50

General statistics:
  total time:                   30.3299s
  total number of events:        263251

Latency (ms):
  min:                           0.00
  avg:                          1.82
  max:                          299.94
  95th percentile:                3.36
  sum:                          479750.54

Threads fairness:
  events (avg/stddev):          16453.1875/461.57
  execution time (avg/stddev):   29.9844/0.00

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 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
root@a3b3c7355bb3:/# █

```

Results:

reads/s	0
writes/s	3807.94
fsyncs/s	4938.75
events/s	8682.4

Iteration 2:

```

Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 3.72 seconds (550.61 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 1.0.18 (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, 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:                     3659.02

```

```

File operations:
  reads/s:                      0.00
  writes/s:                     3659.02
  fsyncs/s:                      4748.27

Throughput:
  read, MiB/s:                  0.00
  written, MiB/s:                57.17

General statistics:
  total time:                   30.5143s
  total number of events:        254505

Latency (ms):
  min:                           0.00
  avg:                            1.89
  max:                           409.98
  95th percentile:                 3.25
  sum:                           480411.59

Threads fairness:
  events (avg/stddev):          15906.5625/486.40
  execution time (avg/stddev):   30.0257/0.09

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 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
root@a3b3c7355bb3:/# 
```

Results:

reads/s	0
writes/s	3659.02
fsyncs/s	4748.27
events/s	8341.69

Iteration 3:

```

Creating file test_file.119
Creating file test_file.120
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 3.66 seconds (559.52 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 1.0.18 (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, 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:                     3898.65
    fsyncs/s:                      5055.05

Throughput:
    read, MiB/s:                  0.00
    written, MiB/s:                60.92

General statistics:
    total time:                   30.4702s
    total number of events:        270790

Latency (ms):
    min:                           0.00
    avg:                          1.77
    max:                          301.71
    95th percentile:                 3.30
    sum:                         479991.69

Threads fairness:
    events (avg/stddev):       16924.3750/679.90
    execution time (avg/stddev): 29.9995/0.07

WARNING: the --test option is deprecated. You can pass a script name or path on the com
mand line without any options.
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
root@a3b3c7355bb3:/#

```

Results:

reads/s	0
writes/s	3898.65
fsyncs/s	5055.05
events/s	8887.1

b. Random Read Write:

Iteration 1:

```

root@a3b3c7355bb3:/# ./DOCKER_FILEIO_RNDRW.sh
WARNING: the --test option is deprecated. You can pass a script name or path on the com
mand line without any options.
WARNING: --num-threads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

128 files, 16384Kb each, 2048Mb 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.117
Creating file test_file.118
Creating file test_file.119
Creating file test_file.120
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 4.07 seconds (503.09 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 1.0.18 (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, 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

```

```

File operations:
  reads/s:                      1173.46
  writes/s:                      782.33
  fsyncs/s:                      2569.48

Throughput:
  read, MiB/s:                  18.34
  written, MiB/s:                12.22

General statistics:
  total time:                   30.3362s
  total number of events:        135238

Latency (ms):
  min:                           0.00
  avg:                           3.55
  max:                           51.92
  95th percentile:              17.01
  sum:                           479935.67

Threads fairness:
  events (avg/stddev):          8452.3750/304.77
  execution time (avg/stddev):   29.9960/0.01

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 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
root@a3b3c7355bb3:/# █

```

Results:

reads/s	1173.46
writes/s	782.33
fsyncs/s	2569.48
events/s	4458.88

Iteration 2:

```
Creating file test_file.112
Creating file test_file.113
Creating file test_file.114
Creating file test_file.115
Creating file test_file.116
Creating file test_file.117
Creating file test_file.118
Creating file test_file.119
Creating file test_file.120
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 3.80 seconds (539.11 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 1.0.18 (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, 16MiB each
2GiB total file size
Block size 16KiB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
```

```
File operations:
  reads/s:          1188.54
  writes/s:         792.31
  fsyncs/s:        2598.97

Throughput:
  read, MiB/s:      18.57
  written, MiB/s:   12.38

General statistics:
  total time:       30.3392s
  total number of events: 136906

Latency (ms):
  min:              0.00
  avg:             3.51
  max:             65.26
  95th percentile: 16.71
  sum:            479925.53

Threads fairness:
  events (avg/stddev):    8556.6250/277.64
  execution time (avg/stddev): 29.9953/0.00

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 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
root@a3b3c7355bb3:/#
```

Results:

reads/s	1188.54
writes/s	792.31
fsyncs/s	2598.97
events/s	4512.4

Iteration 3:

```
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 4.07 seconds (503.28 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 1.0.18 (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, 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:          1238.50
  writes/s:         825.56
  fsyncs/s:        2709.43

Throughput:
  read, MiB/s:      19.35
  written, MiB/s:   12.90

General statistics:
  total time:       30.3271s
  total number of events: 142725

Latency (ms):
  min:              0.00
  avg:             3.36
  max:             59.66
  95th percentile: 16.12
  sum:            479898.29

Threads fairness:
  events (avg/stddev):    8920.3125/291.86
  execution time (avg/stddev): 29.9936/0.01

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 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
root@a3b3c7355bb3:/#
```

Results:

reads/s	1238.5
writes/s	825.56
fsyncs/s	2709.43
events/s	4705.7

4. DOCKER IO (2 core, 3gb ram):

a. Sequential Read Write:

Iteration 1:

```
root@5c2c88342c92:/# ./DOCKER_FILEIO_SEQ.sh
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 1.0.18 (using system LuaJIT 2.1.0-beta3)

128 files, 16384Kb each, 2048Mb 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.114
Creating file test_file.115
Creating file test_file.116
Creating file test_file.117
Creating file test_file.118
Creating file test_file.119
Creating file test_file.120
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 5.66 seconds (362.00 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 1.0.18 (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, 16MiB each
2GiB total file size
Block size 16KiB
```

```

File operations:
  reads/s:          0.00
  writes/s:        5804.70
  fsyncs/s:        7493.86

Throughput:
  read, MiB/s:     0.00
  written, MiB/s: 90.70

General statistics:
  total time:      30.2157s
  total number of events: 399793

Latency (ms):
  min:              0.00
  avg:             1.20
  max:            337.31
  95th percentile: 1.76
  sum:           480002.63

Threads fairness:
  events (avg/stddev): 24987.0625/1111.48
  execution time (avg/stddev): 30.0002/0.01

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 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
root@5c2c88342c92:/# 
```

Results:

reads/s	0
writes/s	5804.7
fsyncs/s	7493.86
events/s	13233.8

Iteration 2:

```

Creating file test_file.115
Creating file test_file.116
Creating file test_file.117
Creating file test_file.118
Creating file test_file.119
Creating file test_file.120
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 3.80 seconds (538.47 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 1.0.18 (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, 16MiB each
2GiB total file size
Block size 16KiB
root@5c2c88342c92:/# 
```

```

File operations:
  reads/s:                      0.00
  writes/s:                     2863.66
  fsyncs/s:                      3732.43

Throughput:
  read, MiB/s:                  0.00
  written, MiB/s:                44.74

General statistics:
  total time:                   30.2043s
  total number of events:        197194

Latency (ms):
  min:                           0.00
  avg:                          2.43
  max:                          479.61
  95th percentile:              5.88
  sum:                          479497.77

Threads fairness:
  events (avg/stddev):         12324.6250/815.20
  execution time (avg/stddev):  29.9686/0.00

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 1.0.18 (using system LuAJIT 2.1.0-beta3)

Removing test files...
root@5c2c88342c92:/#

```

Results:

reads/s	0
writes/s	2863.66
fsyncs/s	3732.43
events/s	6529.6

Iteration 3:

```

Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 2.78 seconds (737.66 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 1.0.18 (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, 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

```

```

File operations:
  reads/s:                      0.00
  writes/s:                     5616.42
  fsyncs/s:                      7254.36

Throughput:
  read, MiB/s:                  0.00
  written, MiB/s:                87.76

General statistics:
  total time:                   30.1956s
  total number of events:        386613

Latency (ms):
  min:                           0.00
  avg:                          1.24
  max:                          329.14
  95th percentile:              1.79
  sum:                          479873.07

Threads fairness:
  events (avg/stddev):         24163.3125/1403.64
  execution time (avg/stddev):  29.9921/0.00

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 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
root@5c2c88342c92:/# 

```

Results:

reads/s	0
writes/s	5616.42
fsyncs/s	7254.36
events/s	12803.6

b. Random Read Write:

Iteration 1:

```

root@5c2c88342c92:/# ./DOCKER_FILEIO_RNDRW.sh
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 1.0.18 (using system LuaJIT 2.1.0-beta3)

128 files, 16384Kb each, 2048Mb 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

```

```

File operations:
  reads/s:          2062.11
  writes/s:         1374.80
  fsyncs/s:        4465.40

Throughput:
  read, MiB/s:      32.22
  written, MiB/s:   21.48

General statistics:
  total time:       30.2876s
  total number of events: 237304

Latency (ms):
  min:              0.00
  avg:              2.03
  max:             103.40
  95th percentile: 10.46
  sum:            480554.54

Threads fairness:
  events (avg/stddev): 14831.5000/723.47
  execution time (avg/stddev): 30.0347/0.04

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 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
root@5c2c88342c92:/# 

```

Results:

reads/s	2062.11
writes/s	1374.80
fsyncs/s	4465.4
events/s	7834.4

Iteration 2:

```

Creating file test_file.116
Creating file test_file.117
Creating file test_file.118
Creating file test_file.119
Creating file test_file.120
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 2.76 seconds (741.28 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 1.0.18 (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, 16MiB each

```

```

File operations:
  reads/s:                2032.86
  writes/s:               1355.35
  fsyncs/s:                4401.00

Throughput:
  read, MiB/s:            31.76
  written, MiB/s:          21.18

General statistics:
  total time:              30.1917s
  total number of events: 233131

Latency (ms):
  min:                      0.00
  avg:                      2.06
  max:                     55.61
  95th percentile:          10.65
  sum:                    479907.64

Threads fairness:
  events (avg/stddev):    14570.6875/565.22
  execution time (avg/stddev): 29.9942/0.00

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 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
root@5c2c88342c92:/#

```

Results:

reads/s	2032.86
writes/s	1355.35
fsyncs/s	4401
events/s	7722.13

Iteration 3:

```

Creating file test_file.119
Creating file test_file.120
Creating file test_file.121
Creating file test_file.122
Creating file test_file.123
Creating file test_file.124
Creating file test_file.125
Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 2.82 seconds (725.62 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 1.0.18 (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, 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
Doind_random_r/w_test

```

```

File operations:
  reads/s:                2054.36
  writes/s:               1369.52
  fsyncs/s:                4449.76

Throughput:
  read, MiB/s:            32.10
  written, MiB/s:          21.40

General statistics:
  total time:              30.2569s
  total number of events:  236193

Latency (ms):
  min:                      0.00
  avg:                     2.04
  max:                     86.49
  95th percentile:          10.46
  sum:                    480941.08

Threads fairness:
  events (avg/stddev):    14762.0625/818.26
  execution time (avg/stddev): 30.0588/0.02

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 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
root@5c2c88342c92:/# █

```

Results:

reads/s	2054.36
writes/s	1369.52
fsyncs/s	4449.76
events/s	7808.45

PORFORMANCE COMPARISONS

We will now compare the results for QEMU and Docker:

- CPU TESTING

	Configuration	Testcase	Average events per second
QEMU	2 core, 2Gb Memory	2000 prime numbers	5390.87
		20000 prime numbers	266.8
		20000 prime numbers	12.44
	2 core, 3Gb Memory	2000 prime numbers	6273.25
		20000 prime numbers	320.63
		20000 prime numbers	14.05
DOCKER	2 core, 2Gb Memory	2000 prime numbers	34987.38
		20000 prime numbers	1383.05
		20000 prime numbers	58.51
	2 core, 3Gb Memory	2000 prime numbers	35397.5
		20000 prime numbers	1451.43
		20000 prime numbers	61.22

- IO FILE TESTING

	Configuration	Testcase	Average of all iterations
QEMU	2 core, 2Gb Memory	Sequential	reads/s - 0 writes/s - 1332.43 fsyncs/s - 1770.2 events/s - 3016
		Combined Random	reads/s - 668.87 writes/s - 445.88 fsyncs/s - 1491.32 events/s - 2540.5
	2 core, 3Gb Memory	Sequential	reads/s - 0 writes/s - 2393.08 fsyncs/s - 3128.06 events/s - 5454.5
		Combined Random	reads/s - 722.35 writes/s - 3481.75 fsyncs/s - 1604.77 events/s - 2742.89
DOCKER	2 core, 2Gb Memory	Sequential	reads/s - 0 writes/s - 3788.54 fsyncs/s - 4913.94 events/s - 8637.13
		Combined Random	reads/s - 1200.16 writes/s - 800.06 fsyncs/s - 2634.96 events/s - 4558.99
	2 core, 3Gb Memory	Sequential	reads/s - 0 writes/s - 4761.58 fsyncs/s - 6160.23 events/s - 10855.66
		Combined Random	reads/s - 2049.78 writes/s - 1366.55 fsyncs/s - 4438.72 events/s - 7788.33

*The individual readings of all iterations and screenshots are attached above in the report.

CONCLUSION

The number of events per second reduces as we increase the cpu-max-prime parameter value from 2000 to 200000, or the maximum prime number limit. The same is true of the test environments for Docker and QEMU. When QEMU and Docker are put side by side, Docker is slightly quicker. There is no discernible performance difference if we increase the system resources.

Based on the number of events per second, writes per second, and file syncs per second, sequential rewrites are faster than combined random read and writes. Even when we increase the system resources, there is no significant difference in the performances.

GIT REPOSITORY

Account Name	DeepSavla
Repository Name	Cloud-Computing
Folder Containing HW	HW1
Link to Repo	https://github.com/DeepSavla/Cloud-Computing