

# COEN 241: Homework 1

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## Hardware Setup

For conducting various experiments on OS Virtualization, the configurations can be listed as follows:

1	System	HP ZBook 14 G2
2	Processor	Intel® Core™ i7-5600U CPU @ 2.60GHz
3	Memory	8.0GiB RAM
4	Disk Capacity	1.0 TB
5	Operating System	Ubuntu 22.04.01 LTS

## Installing QEMU

QEMU is a free and open-source type 2 hypervisor. It emulates the machine's process and provides a set of different hardware and device models to be enabled for running variety of guest operating systems.

### Download Ubuntu Guest Virtual Machine

As we are currently testing on 64-bit Linux operating system, we will be using the x86\_64 architecture image for AMD.

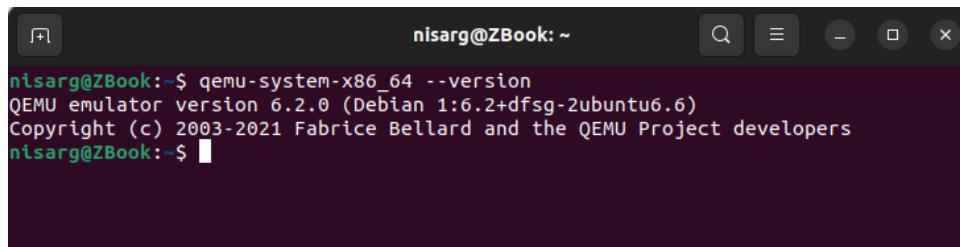
#### [Ubuntu Server 20.04 for AMD](#)

Once the iso image is downloaded, we need to place it in the appropriate directory.

### Install QEMU

From the terminal, we need to run the following commands as a root user.

```
$ sudo apt-get update  
$ sudo apt-get upgrade  
$ sudo apt-get install qemu qemu-utils qemu-system-x86
```



```
nisarg@ZBook:~$ qemu-system-x86_64 --version  
QEMU emulator version 6.2.0 (Debian 1:6.2+dfsg-2ubuntu6.6)  
Copyright (c) 2003-2021 Fabrice Bellard and the QEMU Project developers  
nisarg@ZBook:~$
```

### Create QEMU Image

As we have installed QEMU, now we need to create an image to install guest VM with 10GB of storage using QCOW2 format (QEMU Copy-on-Write).

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

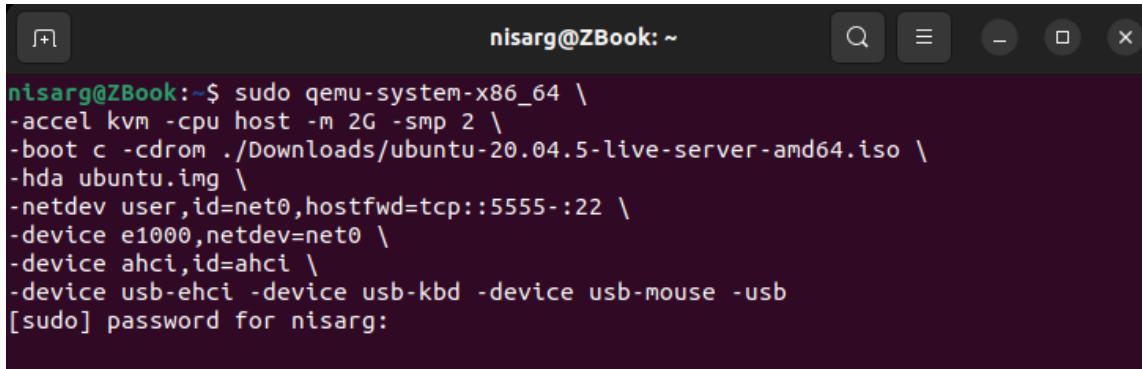
## Installing VM on QEMU image

Now, we need to install the Ubuntu guest OS on the newly created QEMU image. We run the following command:

```
$ sudo qemu-system-x86_64 \
-accel kvm -cpu host -m 2G -smp 2 \
-boot d -cdrom ./Downloads/ubuntu-20.04.5-live-server-amd64.iso \
-hda ubuntu.img \
-netdev user,id=net0,hostfwd=tcp::5555-:22 \
-device e1000,netdev=net0 \
-device ahci,id=ahci \
-device usb-ehci -device usb-kbd -device usb-mouse -usb
```

If we want to spin-up the same VM again, we can change the boot flag from 'd' to 'c' to change the booting order of the OS.

```
$ sudo qemu-system-x86_64 \
-accel kvm -cpu host -m 2G -smp 2 \
-boot c -cdrom ./Downloads/ubuntu-20.04.5-live-server-amd64.iso \
-hda ubuntu.img \
-netdev user,id=net0,hostfwd=tcp::5555-:22 \
-device e1000,netdev=net0 \
-device ahci,id=ahci \
-device usb-ehci -device usb-kbd -device usb-mouse -usb
```



A screenshot of a terminal window titled "nisarg@ZBook: ~". The window contains the following text:

```
nisarg@ZBook:~$ sudo qemu-system-x86_64 \
-accel kvm -cpu host -m 2G -smp 2 \
-boot c -cdrom ./Downloads/ubuntu-20.04.5-live-server-amd64.iso \
-hda ubuntu.img \
-netdev user,id=net0,hostfwd=tcp::5555-:22 \
-device e1000,netdev=net0 \
-device ahci,id=ahci \
-device usb-ehci -device usb-kbd -device usb-mouse -usb
[sudo] password for nisarg:
```

QEMU

Machine View

```
5.901847] systemd[1]: Finished Load Kernel Modules.  
OK [ ] Finished Load Kernel Modules.  
5.910594] systemd[1]: Mounting FUSE Control File System...  
Mounting FUSE Control File System...  
5.925647] systemd[1]: Mounting Kernel Configuration File System...  
Mounting Kernel Configuration File System...  
5.942376] systemd[1]: Starting Apply Kernel Variables...  
Starting Apply Kernel Variables...  
5.954402] systemd[1]: Mounted Kernel Configuration File System.  
OK [ ] Mounted Kernel Configuration File System.  
5.974260] systemd[1]: Mounted FUSE Control File System.  
OK [ ] Mounted FUSE Control File System.  
5.986771] EXT4-fs (dm-0): re-mounted. Opts: (null)  
5.993384] systemd[1]: Finished Remount Root and Kernel File Systems.  
OK [ ] Finished Remount Root and Kernel File Systems.  
6.002437] systemd[1]: Activating swap /swap.img...  
Activating swap /swap.img...  
6.034018] systemd[1]: Condition check resulted in Rebuild Hardware Database being skipped.  
6.036294] systemd[1]: Starting Load/Save Random Seed...  
Starting Load/Save Random Seed...  
6.045768] systemd[1]: Starting Create System Users...  
Starting Create System Users...  
6.052158] systemd[1]: Finished Monitoring of LVM2 mirrors, snapshots etc. using dmeventd or progress polling.  
OK [ ] Finished Monitoring of LVM2 mirrors, snapshots etc. using dmeventd or progress polling.  
6.066616] systemd[1]: modprobe@efi_pstore.service: Succeeded.  
OK [ ] Finished Load Kernel Module efi_pstore.  
OK [ ] Finished Load Kernel Module pstore_blk.  
OK [ ] Finished Load Kernel Module pstore_zone.  
OK [ ] Finished Load Kernel Module chromeos_pstore.  
OK [ ] Finished Load Kernel Module ramoops.  
OK [ ] Finished Apply Kernel Variables.  
OK [ ] Finished Load/Save Random Seed.  
OK [ ] Finished Create System Users.  
Starting Create Static Device Nodes in /dev...  
OK [ ] Finished Create Static Device Nodes in /dev...  
Starting udev Kernel Device Manager...  
OK [ ] Started Journal Service.  
Starting Flush Journal to Persistent Storage...  
OK [ ] Finished Set the console keyboard layout.  
OK [ ] Activated swap /swap.img.  
OK [ ] Reached target Swap.  
OK [ ] Finished udev Coldplug all Devices.  
Starting udev Wait for Complete Device Initialization...  
OK [ ] Started udev Kernel Device Manager.  
OK [ ] Started Dispatch Password Requests to Console Directory Watch.  
OK [ ] Reached target Local Encrypted Volumes.  
OK [ ] Finished Flush Journal to Persistent Storage.
```

QEMU

Machine View

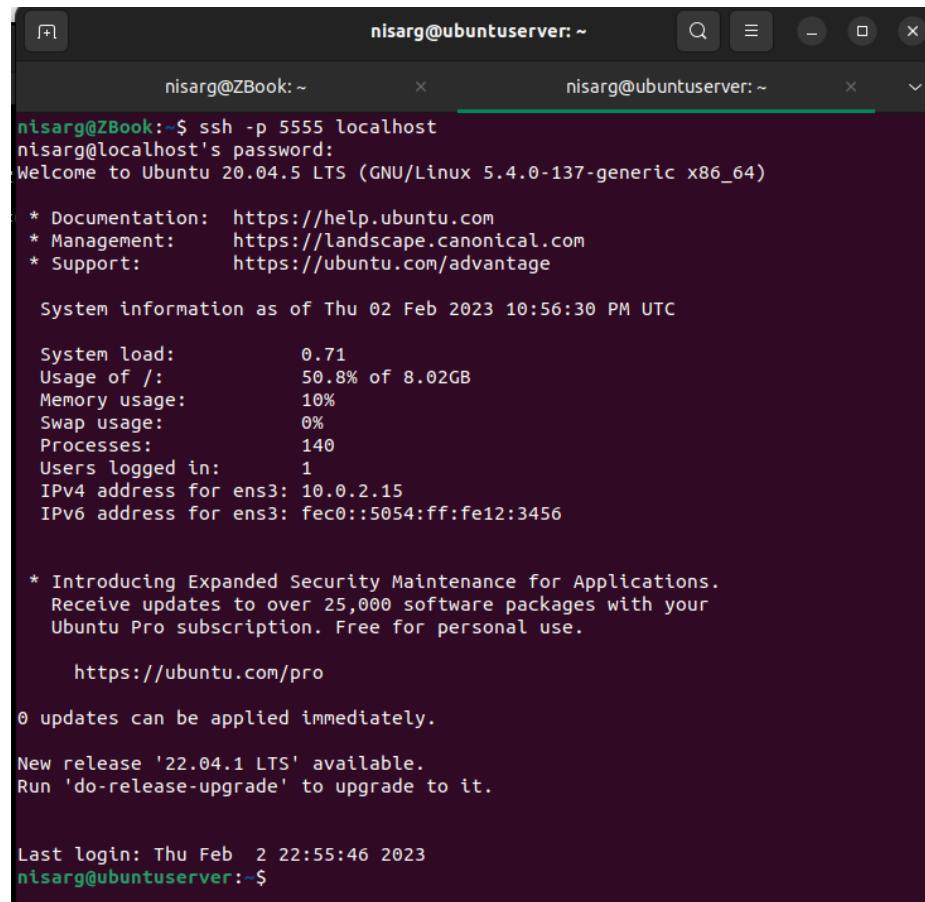
```
Ubuntu 20.04.5 LTS ubuntuserver tty1  
  
ubuntuserver login: [ 21.134247] cloud-init[878]: Cloud-init v. 22.4.2-0ubuntu0~20.04.2 running 'modules:final' at Thu, 02 Feb 2023 22:54:51 +0000. Up 20.85 seconds.  
[ 21.134708] cloud-init[878]: Cloud-init v. 22.4.2-0ubuntu0~20.04.2 finished at Thu, 02 Feb 2023 22:54:51 +0000. Datasource DataSourceNone. Up 21.12 seconds  
[ 21.135217] cloud-init[878]: 2023-02-02 22:54:51,781 - cc_final_message.py[WARNING]: Used fallback datasource  
  
ubuntuserver login:  
ubuntuserver login: nisarg  
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 Thu 02 Feb 2023 10:55:45 PM UTC  
  
System load: 0.55  
Usage of /: 50.8% of 8.02GB  
Memory usage: 9%  
Swap usage: 0%  
Processes: 126  
Users logged in: 0  
IPv4 address for ens3: 10.0.2.15  
IPv6 address for ens3: fec0::5054:ff:fe12:3456  
  
* Introducing Expanded Security Maintenance for Applications.  
Receive updates to over 25,000 software packages with your  
Ubuntu Pro subscription. Free for personal use.  
https://ubuntu.com/pro  
0 updates can be applied immediately.  
  
New release '22.04.1 LTS' available.  
Run 'do-release-upgrade' to upgrade to it.  
  
Last login: Thu Feb 2 03:27:32 UTC 2023 on tty1  
nisarg@ubuntuserver:~$
```

Now, if we want to connect to the same VM from the terminal, we can use following command:

```
$ sudo qemu-system-x86_64 \
-accel kvm -cpu host -m 2G -smp 2 \
-boot c -cdrom ./Downloads/ubuntu-20.04.5-live-server-amd64.iso \
-hda ubuntu.img \
-netdev user,id=net0,hostfwd=tcp::5555-:22 \
-device e1000,netdev=net0 \
-device ahci,id=ahci \
-device usb-ehci -device usb-kbd -device usb-mouse -usb -nographic
```

Since, we are forwarding the SSH port 22 to localhost port 5555, we can also connect to the VM via SSH if it is up and running using following command:

```
$ ssh -p 5555 localhost
```



```
nisarg@ubuntuserver: ~
nisarg@ZBook: ~
nisarg@ZBook:~$ ssh -p 5555 localhost
nisarg@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 as of Thu 02 Feb 2023 10:56:30 PM UTC

 System load:          0.71
 Usage of /:           50.8% of 8.02GB
 Memory usage:         10%
 Swap usage:           0%
 Processes:            140
 Users logged in:     1
 IPv4 address for ens3: 10.0.2.15
 IPv6 address for ens3: fec0::5054:ff:fe12:3456

 * Introducing Expanded Security Maintenance for Applications.
 Receive updates to over 25,000 software packages with your
 Ubuntu Pro subscription. Free for personal use.

 https://ubuntu.com/pro

 0 updates can be applied immediately.

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

Last login: Thu Feb  2 22:55:46 2023
nisarg@ubuntuserver:~$
```

The arguments used with QEMU are:

1. accel: hardware acceleration
2. m: memory
3. smp: total cores allocated
4. hda: virtual hard drive
5. netdev: network device
6. device: I/O devices
7. nographic: run without GUI loader

## Installing Docker

Docker is a set of PaaS products that use OS-level virtualization to deliver software in packages called containers. It is a software framework for building, running, and managing containers on servers and the cloud.

### Install Docker Desktop

We need to install Docker desktop application from the below link and follow the steps mentioned:

#### [Docker Installation Guide for Ubuntu](#)

Once, the application is installed, from terminal we need to run:

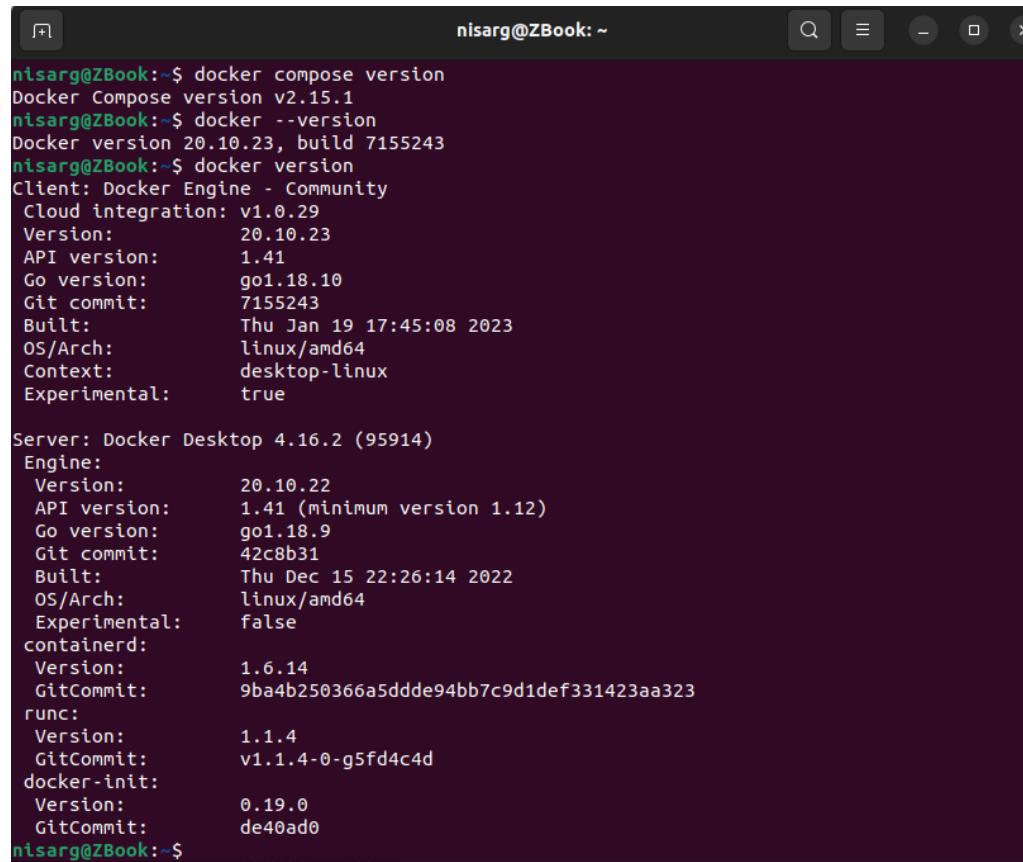
```
$ systemctl --user start docker-desktop
```

There is an **optional** step where we can manage Docker as non-root user which can be done using the below link.

#### [Manage Docker as a non-root user](#)

Then we are checking the version of Docker Engine, Docker Compose and Docker Desktop

```
$ docker compose version  
$ docker --version  
$ docker version
```



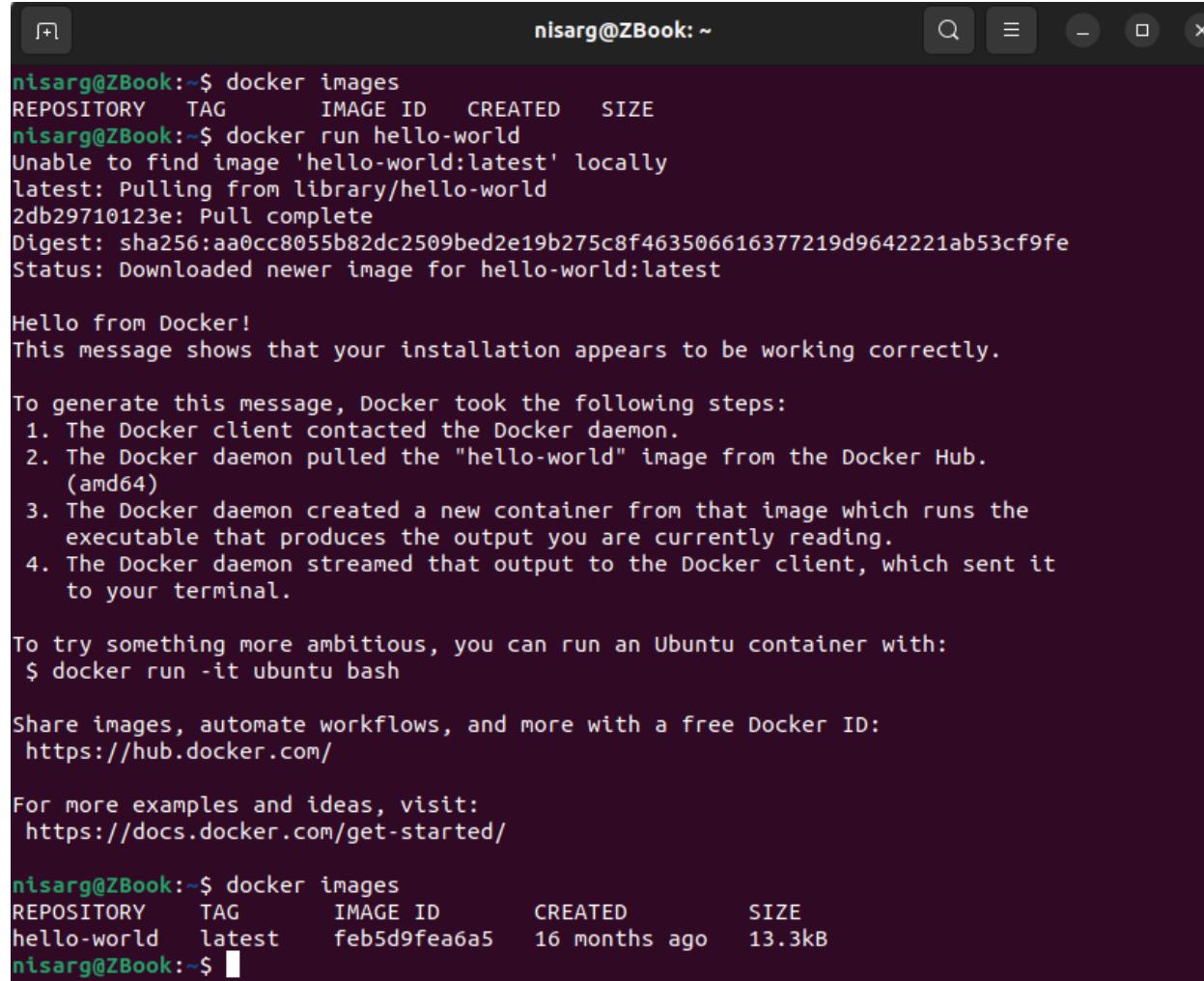
The screenshot shows a terminal window with a dark background and light-colored text. The title bar says "nisarg@ZBook: ~". The window contains the following command outputs:

```
nisarg@ZBook:~$ docker compose version
Docker Compose version v2.15.1
nisarg@ZBook:~$ docker --version
Docker version 20.10.23, build 7155243
nisarg@ZBook:~$ docker version
Client: Docker Engine - Community
  Cloud integration: v1.0.29
  Version:          20.10.23
  API version:     1.41
  Go version:      go1.18.10
  Git commit:      7155243
  Built:           Thu Jan 19 17:45:08 2023
  OS/Arch:         linux/amd64
  Context:         desktop-linux
  Experimental:   true

Server: Docker Desktop 4.16.2 (95914)
  Engine:
    Version:        20.10.22
    API version:   1.41 (minimum version 1.12)
    Go version:    go1.18.9
    Git commit:    42c8b31
    Built:         Thu Dec 15 22:26:14 2022
    OS/Arch:       linux/amd64
    Experimental: false
  containerd:
    Version:        1.6.14
    GitCommit:      9ba4b250366a5ddde94bb7c9d1def331423aa323
  runc:
    Version:        1.1.4
    GitCommit:      v1.1.4-0-g5fd4c4d
  docker-init:
    Version:        0.19.0
    GitCommit:      de40ad0
nisarg@ZBook:~$
```

Once we know that the docker is running, we check whether the docker containers are working as expected. Hereafter running the command, since the image “hello-world” was not available locally, it pulled the latest image from Docker Repository and ran it.

```
$ docker images  
$ docker run hello-world  
$ docker images
```



A screenshot of a terminal window titled "nisarg@ZBook: ~". The terminal displays the following text:

```
nisarg@ZBook:~$ docker images  
REPOSITORY      TAG      IMAGE ID      CREATED      SIZE  
nisarg@ZBook:~$ docker run hello-world  
Unable to find image 'hello-world:latest' locally  
latest: Pulling from library/hello-world  
2db29710123e: Pull complete  
Digest: sha256:aa0cc8055b82dc2509bed2e19b275c8f463506616377219d9642221ab53cf9fe  
Status: Downloaded newer image for hello-world:latest  
  
Hello from Docker!  
This message shows that your installation appears to be working correctly.  
  
To generate this message, Docker took the following steps:  
1. The Docker client contacted the Docker daemon.  
2. The Docker daemon pulled the "hello-world" image from the Docker Hub.  
(amd64)  
3. The Docker daemon created a new container from that image which runs the  
executable that produces the output you are currently reading.  
4. The Docker daemon streamed that output to the Docker client, which sent it  
to your terminal.  
  
To try something more ambitious, you can run an Ubuntu container with:  
$ docker run -it ubuntu bash  
  
Share images, automate workflows, and more with a free Docker ID:  
https://hub.docker.com/  
  
For more examples and ideas, visit:  
https://docs.docker.com/get-started/
```

The terminal prompt "nisarg@ZBook:~\$ " is visible at the bottom left.

## Create Container

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
```

```

nisarg@ZBook:~$ docker run -it ubuntu:20.04
Unable to find image 'ubuntu:20.04' locally
20.04: Pulling from library/ubuntu
b549f31133a9: Pull complete
Digest: sha256:4a45212e9518f35983a976eead0de5eecc555a2f047134e9dd2cfc589076a00d
Status: Downloaded newer image for ubuntu:20.04
root@c35e8d76ff29:/# apt-get update
Get:1 http://archive.ubuntu.com/ubuntu focal InRelease [265 kB]
Get:2 http://security.ubuntu.com/ubuntu focal-security InRelease [114 kB]
Get:3 http://archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Get:4 http://security.ubuntu.com/ubuntu focal-security/multiverse amd64 Packages [27.7 kB]
Get:5 http://archive.ubuntu.com/ubuntu focal-backports InRelease [108 kB]
Get:6 http://security.ubuntu.com/ubuntu focal-security/restricted amd64 Packages [1882 kB]
Get:7 http://archive.ubuntu.com/ubuntu focal/universe amd64 Packages [11.3 MB]
Get:8 http://security.ubuntu.com/ubuntu focal-security/main amd64 Packages [2448 kB]
Get:9 http://security.ubuntu.com/ubuntu focal-security/universe amd64 Packages [991 kB]
Get:10 http://archive.ubuntu.com/ubuntu focal/main amd64 Packages [1275 kB]
Get:11 http://archive.ubuntu.com/ubuntu focal/multiverse amd64 Packages [177 kB]
Get:12 http://archive.ubuntu.com/ubuntu focal/restricted amd64 Packages [33.4 kB]
Get:13 http://archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages [2921 kB]
Get:14 http://archive.ubuntu.com/ubuntu focal-updates/universe amd64 Packages [1291 kB]
Get:15 http://archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 Packages [31.2 kB]
Get:16 http://archive.ubuntu.com/ubuntu focal-updates/restricted amd64 Packages [2009 kB]
Get:17 http://archive.ubuntu.com/ubuntu focal-backports/universe amd64 Packages [28.6 kB]
Get:18 http://archive.ubuntu.com/ubuntu focal-backports/main amd64 Packages [55.2 kB]
Fetched 25.1 MB in 5s (5450 kB/s)
Reading package lists... Done
root@c35e8d76ff29:/# apt-get upgrade
Reading package lists... Done
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
root@c35e8d76ff29:/#

```

Docker Commands	Description
docker pull [image_name] : [tag]	To pull a docker image having a specific tag
docker images	To list out all locally available images
docker run [image_name]	To run a docker image
docker ps	To list out all the running containers
docker commit [container_id] [image_name]	To commit current container as a new image
docker history	To show history of an image

## Test Conditions

For the VM, we will consider these two test conditions to conduct the experiment. The same conditions will be repeated for QEMU and Docker for consistency between results. We will be using [Sysbench](#) for system benchmark testing.

**Note: Due to system restrictions on total number of cores and Sysbench only supports memory up to 3GB, only these test conditions were successfully completed.**

Cores	Memory Allocation (RAM)
2	2 GB
2	3 GB

# Experimentation and Reports

## Condition 1: 2GB RAM and 2 Cores on QEMU

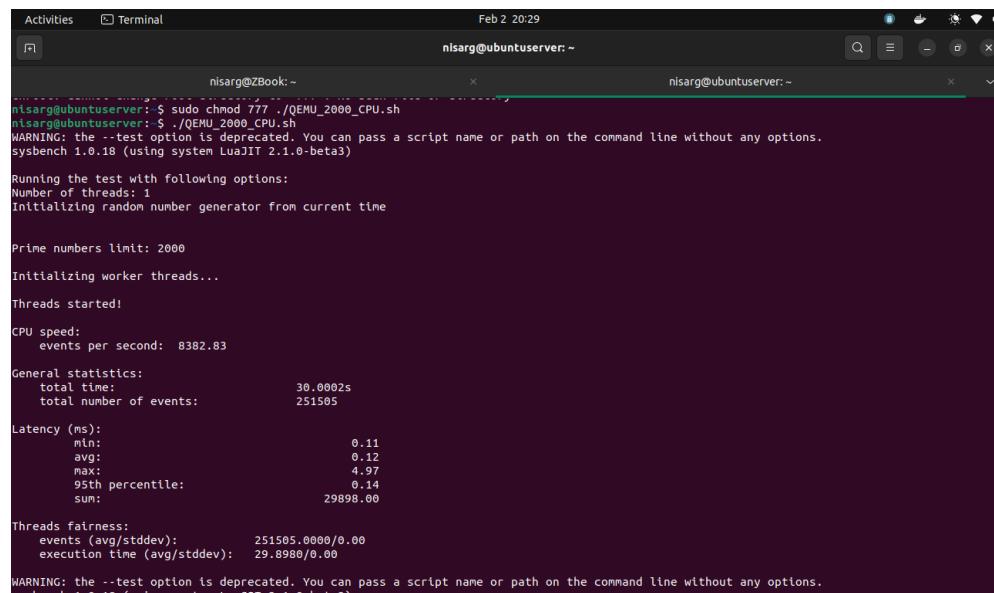
### CPU Testing

For CPU testing, we will be using 3 test cases to check the system performance with varying max-prime argument.

```
$ sysbench cpu --cpu-max-prime=<random_value> --num-threads=<random_value> --time=<random_value> run
```

*Test Run 1: Prime Limit = 2000*

Now, we will be running the test script having cpu-max-prime=2000



The terminal window shows the command being run:

```
nisarg@ZBook:~$ sudo chmod 777 ./QEMU_2000_CPU.sh
nisarg@ubuntuserver:~$ ./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!

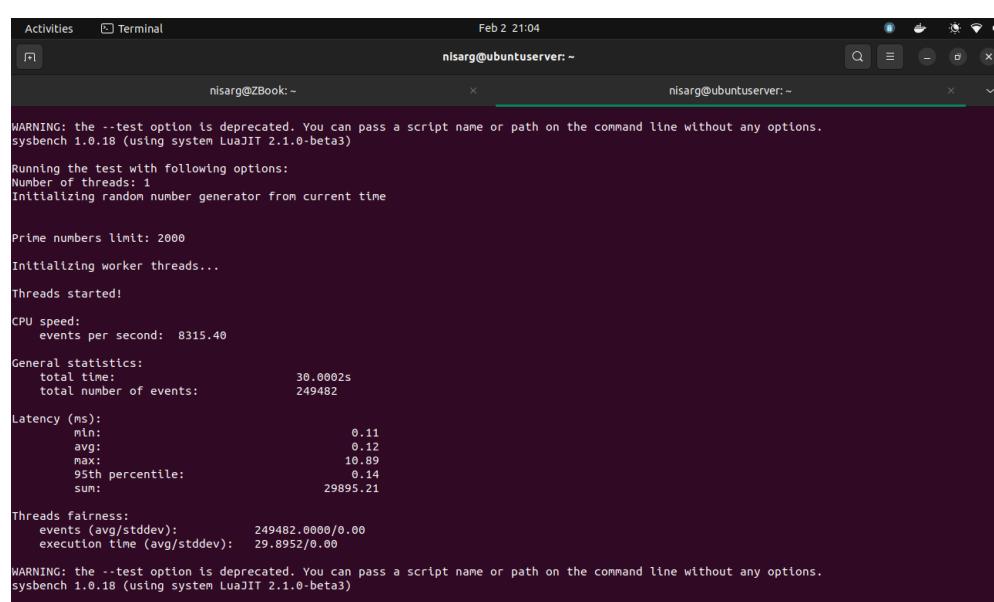
CPU speed:
events per second: 8382.83

General statistics:
total time: 30.0002s
total number of events: 251505

Latency (ms):
min: 0.11
avg: 0.12
max: 4.97
95th percentile: 0.14
sum: 29898.00

Threads fairness:
events (avg/stddev): 251505.0000/0.00
execution time (avg/stddev): 29.8980/0.00

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)
```

The terminal window shows the command being run:

```
nisarg@ZBook:~$ sudo chmod 777 ./QEMU_2000_CPU.sh
nisarg@ubuntuserver:~$ ./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: 8315.40

General statistics:
total time: 30.0002s
total number of events: 249482

Latency (ms):
min: 0.11
avg: 0.12
max: 10.89
95th percentile: 0.14
sum: 29895.21

Threads fairness:
events (avg/stddev): 249482.0000/0.00
execution time (avg/stddev): 29.8952/0.00

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)
```

```
Activities Terminal Feb 2 21:05
nisarg@ZBook:~ nisarg@ubuntuserver:~
```

```
nisarg@ZBook:~ 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: 8430.20
General statistics:
total time: 30.0002s
total number of events: 252925

Latency (ms):
min: 0.11
avg: 0.12
max: 4.49
95th percentile: 0.14
sum: 29898.10

Threads fairness:
events (avg/stddev): 252925.0000/0.00
execution time (avg/stddev): 29.8981/0.00

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
```

```
Activities Terminal Feb 2 21:06
nisarg@ZBook:~ nisarg@ubuntuserver:~
```

```
nisarg@ZBook:~ 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: 8387.41
General statistics:
total time: 30.0002s
total number of events: 251641

Latency (ms):
min: 0.11
avg: 0.12
max: 5.61
95th percentile: 0.14
sum: 29896.10

Threads fairness:
events (avg/stddev): 251641.0000/0.00
execution time (avg/stddev): 29.8961/0.00

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:
```

```
Activities Terminal Feb 2 21:06
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
nisarg@ZBook: ~ x nisarg@ubuntuserver: ~ x
events (avg/stddev): 251641.0000/0.00
execution time (avg/stddev): 29.8961/0.00
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

Prime numbers limit: 2000
Initializing worker threads...

Threads started!

CPU speed:
  events per second: 8310.76

General statistics:
  total time:          30.0002s
  total number of events: 249342

Latency (ms):
  min:                 0.11
  avg:                 0.12
  max:                17.50
  95th percentile:    0.14
  sum:                29895.51

Threads fairness:
  events (avg/stddev): 249342.0000/0.00
  execution time (avg/stddev): 29.8955/0.00
nisarg@ubuntuserver:~$
```

Iteration Number	Number of Events per Second
1	8382.83
2	8315.40
3	8430.20
4	8387.41
5	8310.76

#### Statistics for Test Run 1:

- Average number of events per second: 8365.82
- Maximum number of events per second: 8430.20
- Minimum number of events per second: 8310.76

### *Test Run 2: Prime Limit = 20000*

Now, we will be running the test script having cpu-max-prime=20000

```
Activities Terminal Feb 2 21:17
nisarg@ubuntuserver: ~
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
nisarg@ubuntuserver: $ ./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: 358.65

General statistics:
total time: 30.0023s
total number of events: 10761

Latency (ms):
min: 2.58
avg: 2.79
max: 6.34
95th percentile: 2.91
sum: 29985.70

Threads fairness:
events (avg/stddev): 10761.0000/0.00
execution time (avg/stddev): 29.9857/0.00

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)
```

```
Activities Terminal Feb 2 21:18
nisarg@ubuntuserver: ~
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
nisarg@ubuntuserver: $ ./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: 354.58

General statistics:
total time: 30.0025s
total number of events: 10639

Latency (ms):
min: 2.58
avg: 2.82
max: 19.71
95th percentile: 3.19
sum: 29983.73

Threads fairness:
events (avg/stddev): 10639.0000/0.00
execution time (avg/stddev): 29.9837/0.00

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:
```

```
Activities Terminal Feb 2 21:18
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
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: 358.21
General statistics:
total time: 30.0026s
total number of events: 10748

Latency (ms):
min: 2.58
avg: 2.79
max: 7.25
95th percentile: 2.91
sum: 29984.85

Threads fairness:
events (avg/stddev): 10748.0000/0.00
execution time (avg/stddev): 29.9849/0.00

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
```

```
Activities Terminal Feb 2 21:19
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
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: 357.99
General statistics:
total time: 30.0019s
total number of events: 10741

Latency (ms):
min: 2.01
avg: 2.79
max: 4.06
95th percentile: 2.91
sum: 29985.65

Threads fairness:
events (avg/stddev): 10741.0000/0.00
execution time (avg/stddev): 29.9857/0.00

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
```

```
Activities Terminal Feb 2 21:19
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
events (avg/stddev): 10741.0000/0.00
execution time (avg/stddev): 29.9857/0.00
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

Prime numbers limit: 20000
Initializing worker threads...

Threads started!

CPU speed:
  events per second: 359.10

General statistics:
  total time: 30.0004s
  total number of events: 10774

Latency (ms):
  min: 2.60
  avg: 2.78
  max: 5.10
  95th percentile: 2.91
  SUM: 29982.45

Threads fairness:
  events (avg/stddev): 10774.0000/0.00
  execution time (avg/stddev): 29.9825/0.00
nisarg@ubuntuserver: $
```

Iteration Number	Number of Events per Second
1	358.65
2	358.58
3	358.21
4	357.99
5	359.10

#### Statistics for Test Run 2:

- Average number of events per second: 358.51
- Maximum number of events per second: 359.10
- Minimum number of events per second: 357.99

### *Test Run 3: Prime Limit = 200000*

Now, we will be running the test script having cpu-max-prime=200000

```
Activities Terminal Feb 3 03:42
nisarg@ubuntuserver: ~
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
nisarg@ubuntuserver:~$ ./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: 16.19

General statistics:
total time: 30.0177s
total number of events: 486

Latency (ms):
min: 60.71
avg: 61.76
max: 74.29
95th percentile: 63.32
sum: 30014.73

Threads fairness:
events (avg/stddev): 486.0000/0.00
execution time (avg/stddev): 30.0147/0.00

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)
```

```
Activities Terminal Feb 3 03:43
nisarg@ubuntuserver: ~
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
nisarg@ubuntuserver:~$ 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: 16.23

General statistics:
total time: 30.0602s
total number of events: 488

Latency (ms):
min: 60.85
avg: 61.59
max: 69.23
95th percentile: 63.32
sum: 30057.31

Threads fairness:
events (avg/stddev): 488.0000/0.00
execution time (avg/stddev): 30.0573/0.00

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
```

```
Activities Terminal Feb 3 03:43
nisarg@ZBook:~ nisarg@ubuntuserver:~

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: 16.09

General statistics:
total time: 30.0078s
total number of events: 483

Latency (ms):
min: 60.81
avg: 62.12
max: 96.77
95th percentile: 64.47
sum: 30004.76

Threads fairness:
events (avg/stddev): 483.0000/0.00
execution time (avg/stddev): 30.0048/0.00

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
```

```
Activities Terminal Feb 3 03:44
nisarg@ZBook:~ nisarg@ubuntuserver:~

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: 15.86

General statistics:
total time: 30.0037s
total number of events: 476

Latency (ms):
min: 60.90
avg: 63.03
max: 144.31
95th percentile: 66.84
sum: 30000.29

Threads fairness:
events (avg/stddev): 476.0000/0.00
execution time (avg/stddev): 30.0003/0.00

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
```

```

Activities Terminal Feb 3 03:44
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
nisarg@ZBook: ~ x nisarg@ubuntuserver: ~ x v
events (avg/stddev): 476.0000/0.00
execution time (avg/stddev): 30.0003/0.00
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

Prime numbers limit: 200000
Initializing worker threads...
Threads started!

CPU speed:
  events per second: 16.03

General statistics:
  total time: 30.0002s
  total number of events: 481

Latency (ms):
  min: 60.91
  avg: 62.36
  max: 111.50
  95th percentile: 66.84
  sum: 29996.98

Threads fairness:
  events (avg/stddev): 481.0000/0.00
  execution time (avg/stddev): 29.9970/0.00
nisarg@ubuntuserver: $ 

```

Iteration Number	Number of Events per Second
1	16.19
2	16.23
3	16.09
4	15.86
5	16.03

### Statistics for Test Run 3:

- Average number of events per second: 16.08
- Maximum number of events per second: 16.23
- Minimum number of events per second: 15.86

## File I/O Testing

For file testing, we will be testing a system with sequential rewrite and combined random read-write.

```

$ sysbench --num-threads=16 --test=fileio --file-total-size=2G --time=30 --file-test-mode=<test_mode> prepare
$ sysbench --num-threads=16 --test=fileio --file-total-size=2G --time=30 --file-test-mode=<test_mode> run
$ sysbench --num-threads=16 --test=fileio --file-total-size=2G --time=30 --file-test-mode=<test_mode> cleanup

```

### *Test Run 1: Mode = Sequential*

Here, the sysbench is generating 128 files summing up to 2 GB

#### **Iteration 1**

```
Activities Terminal Feb 3 04:40
nisarg@ubuntuserver: ~
nisarg@ZBook: ~
nisarg@ubuntuserver: ~

nisarg@ubuntuserver: $ ./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
Creating file test_file.22
Creating file test_file.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27

Activities Terminal Feb 3 04:40
nisarg@ubuntuserver: ~
nisarg@ZBook: ~
nisarg@ubuntuserver: ~

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 21.84 seconds (93.75 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...
```

```
Activities Terminal Feb 3 04:40
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
Doing sequential rewrite test
Initializing worker threads...
Threads started!

File operations:
  reads/s:          0.00
  writes/s:        2966.96
  fsyncs/s:        3862.93

Throughput:
  read, MiB/s:      0.00
  written, MiB/s:   46.36

General statistics:
  total time:       30.2841s
  total number of events: 204801

Latency (ms):
  min:              0.01
  avg:             2.34
  max:            99.59
  95th percentile: 8.13
  sum:           479652.60

Threads fairness:
  events (avg/stddev): 12800.0625/395.40
  execution time (avg/stddev): 29.9783/0.00

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...
nisarg@ubuntuserver: $
```

## Iteration 2

```
Activities Google Chrome Feb 3 22:38
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
nisarg@ubuntuserver: $ ./NEWFILEIO_SFQ.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
Creating file test_file_22
Creating file test_file_23
Creating file test_file_24
Creating file test_file_25
Creating file test_file_26
Creating file test_file_27
Creating file test_file_28
Creating file test_file_29
Creating file test_file_30
Creating file test_file_31
Creating file test_file_32
Creating file test_file_33
Creating file test_file_34
Creating file test_file_35
Creating file test_file_36
Creating file test_file_37
Creating file test_file_38
Creating file test_file_39
Creating file test_file_40
Creating file test_file_41
Creating file test_file_42
Creating file test_file_43
Creating file test_file_44
```

```

Activities  Google Chrome
Feb 3 22:39
nlsarg@ZBook: ~
nlsarg@ubuntuserver: ~

Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 18.86 seconds (113.42 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

Activities  Google Chrome
Feb 3 22:39
nlsarg@ZBook: ~
nlsarg@ubuntuserver: ~

2147483648 bytes written in 10.06 seconds (111.42 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
Rewrite mode: rewrite 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:          2768.11
  fsyncs/s:          3088.49

Throughput:
  read, MiB/s:       0.00
  written, MiB/s:    45.13

General statistics:
  total time:        30.2867s
  total number of events: 190606

Latency (ms):
  mtn:                0.01
  avg:                2.51
  max:               150.67
  95th percentile:   8.58
  sum:              47910.56

Threads fairness:
  events (avg/stddev): 11912.8750/438.50
  execution time (avg/stddev): 29.9444/0.01

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...
nlsarg@ubuntuserver: $ 

```

### Iteration 3

```
Activities Google Chrome Feb 3 22:42
nisarg@ubuntuserver:~ nisarg@ubuntuserver:~
```

```
nisarg@ubuntuserver:~$ ./OFILELTILETO_SFQ.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, 1GB4KB each, 2848Mb total
Creating files for the test...
extra file open flags: (none)
Creating file test_file.0
Creating file test_file.1
Creating file test_file.2
Creating file test_file.3
Creating file test_file.4
Creating file test_file.5
Creating file test_file.6
Creating file test_file.7
Creating file test_file.8
Creating file test_file.9
Creating file test_file.10
Creating file test_file.11
Creating file test_file.12
Creating file test_file.13
Creating file test_file.14
Creating file test_file.15
Creating file test_file.16
Creating file test_file.17
Creating file test_file.18
Creating file test_file.19
Creating file test_file.20
Creating file test_file.21
Creating file test_file.22
Creating file test_file.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
```

```
Activities Google Chrome Feb 3 22:43
nisarg@ubuntuserver:~ nisarg@ubuntuserver:~
```

```
Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 12.23 seconds (167.45 MB/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, 10MB each
2GB total file size
```

```
Activities Google Chrome Feb 3 22:43
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
2147483648 bytes written in 12.23 seconds (167.45 MB/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)
file size: 16MB each
2GB total file size
Block size 16KB
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:         3683.18
 fsyncs/s:        4013.49

Throughput:
 read, MB/s:       0.00
 written, MB/s:   48.17

General statistics:
 total time:      30.2986s
 total number of events: 212934

Latency (ms):
 min:                  0.01
 avg:                 2.25
 max:                 88.04
 95th percentile:    7.98
 sum:           479183.15

Threads fairness:
 events (avg/stddev):     13308.3750/266.73
 execution time (avg/stddev): 29.9469/0.01

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...
nisarg@ubuntuserver: ~
```

Serial run iterations	Results	
1	reads/s	0.00
	writes/sec	2966.96
	fsyncs/s	3862.93
	events/s	6762.66
2	reads/s	0.00
	writes/sec	2760.11
	fsyncs/s	3600.49
	events/s	6293.39
3	reads/s	0.00
	writes/sec	3083.18
	fsyncs/s	4013.49
	events/s	7029.47

### *Test Run 2: Mode = Combined Random*

Here, the sysbench is generating 128 files summing up to 2 GB

## *Iteration 1*

```
Activities Google Chrome Feb 3 22:49
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
nisarg@ubuntuserver: ~

nisarg@ubuntuserver: $ ./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 1.0.16 (using system LuejIT 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.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
```

```
Activities Google Chrome Feb 3 22:49
nisarg@ubuntuserver: ~ nisarg@ubuntuserver: ~
Creating file test_file.82
Creating file test_file.83
Creating file test_file.84
Creating file test_file.85
Creating file test_file.86
Creating file test_file.87
Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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
[100.00 MB/s]
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
```

```

Activities  Google Chrome
Feb 3 22:49
nisarg@ZBook: ~
nisarg@ubuntuserver: ~

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, 16MB each
2GB total file size
Block size: 1MB
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:          867.93
  writes/s:         578.57
  fsyncs/s:        1916.75

Throughput:
  read, MB/s:       13.56
  written, MB/s:   9.04

General statistics:
  total time:      30.3163s
  total number of events: 99919

Latency (ms):
  min:                0.00
  avg:                4.88
  max:              105.21
  95th percentile:  16.41
  sum:            479577.52

Threads fairness:
  events (avg/stddev):    6244.9375/167.87
  execution time (avg/stddev): 29.9736/0.66

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...
nisarg@ubuntuserver: $ 

```

## Iteration 2

```

Activities  Google Chrome
Feb 3 22:58
nisarg@ZBook: ~
nisarg@ubuntuserver: ~

nisarg@ubuntuserver: $ ./QEMUFILEIO_BENCH.ch
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, 16384Mb 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.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44

```

```
Activities Google Chrome Feb 3 22:58
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 13.10 seconds (156.37 MB/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 Lusitano 2.1.0-beta)

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

Extra file open flags: (none)
128 files, 10MB each
2GB total file size
```

```
Activities Google Chrome Feb 3 22:58
nisarg@ubuntuserver: ~ nisarg@ubuntuserver: ~

WARNING: -num-threads is deprecated, use --threads instead
sysbench 1.0.16 (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, 16MB each
file size
block size 1MIB
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: 826.54
 writes/s: 550.91
 syncs/s: 1829.64

Throughput:
 read, MB/s: 12.91
 written, MB/s: 8.61

General statistics:
 total time: 30.4168s
 total number of events: 95507

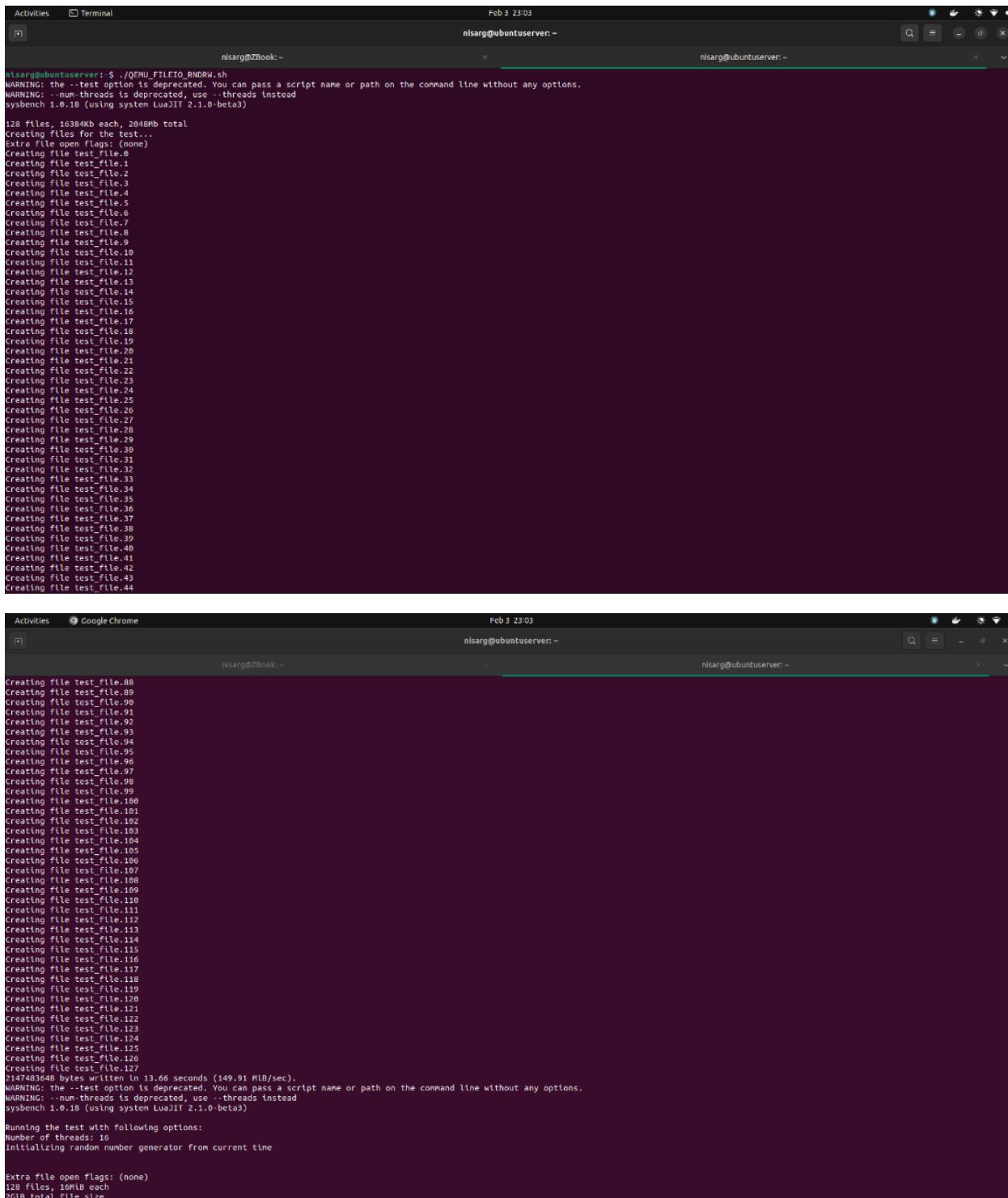
Latency (ms):
 min: 0.00
 avg: 5.92
 max: 113.91
 95th percentile: 17.01
 SUM: 479635.22

Threads fairness:
 events (avg/stddev): 5969.1875/240.48
 execution time (avg/stddev): 29.9772/0.00

WARNING: the -t 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 1.0.16 (using system LuaJIT 2.1.0-beta3)

Removing test files...
nisarg@ubuntuserver: ~
```

### Iteration 3



```
Activities Terminal Feb 3 23:03 nisarg@ubuntuserver:~ nisarg@ubuntuserver:~ nisarg@ubuntuserver:~ S ./OFMULFTLTO_BNRW.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, 16MB each, 2048Mb total Creating files for test... Extra file open flags: (none) Creating file test_file.0 Creating file test_file.1 Creating file test_file.2 Creating file test_file.3 Creating file test_file.4 Creating file test_file.5 Creating file test_file.6 Creating file test_file.7 Creating file test_file.8 Creating file test_file.9 Creating file test_file.10 Creating file test_file.11 Creating file test_file.12 Creating file test_file.13 Creating file test_file.14 Creating file test_file.15 Creating file test_file.16 Creating file test_file.17 Creating file test_file.18 Creating file test_file.19 Creating file test_file.20 Creating file test_file.21 Creating file test_file.22 Creating file test_file.23 Creating file test_file.24 Creating file test_file.25 Creating file test_file.26 Creating file test_file.27 Creating file test_file.28 Creating file test_file.29 Creating file test_file.30 Creating file test_file.31 Creating file test_file.32 Creating file test_file.33 Creating file test_file.34 Creating file test_file.35 Creating file test_file.36 Creating file test_file.37 Creating file test_file.38 Creating file test_file.39 Creating file test_file.40 Creating file test_file.41 Creating file test_file.42 Creating file test_file.43 Creating file test_file.44
```

```
Activities Google Chrome Feb 3 23:03 nisarg@ubuntuserver:~ nisarg@ubuntuserver:~ nisarg@ubuntuserver:~ Creating file test_file.88 Creating file test_file.89 Creating file test_file.90 Creating file test_file.91 Creating file test_file.92 Creating file test_file.93 Creating file test_file.94 Creating file test_file.95 Creating file test_file.96 Creating file test_file.97 Creating file test_file.98 Creating file test_file.99 Creating file test_file.100 Creating file test_file.101 Creating file test_file.102 Creating file test_file.103 Creating file test_file.104 Creating file test_file.105 Creating file test_file.106 Creating file test_file.107 Creating file test_file.108 Creating file test_file.109 Creating file test_file.110 Creating file test_file.111 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 1147403648 bytes written in 13.66 seconds (149.91 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
```

```

Activities  Google Chrome
Feb 3 23:03
nisarg@ZBook:~ nisarg@ubuntuserver:~  Search  Minimize  Maximize  Close

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: 1000
Initializing random number generator from current time

Extra file open flags: (none)
128 files, 16MB each
2GB total file size
Block size 10KiB
Number of random 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:          927.59
  writes/s:         618.34
  fsyncs/s:        2043.36

Throughput:
  read, MB/s:       14.49
  written, MB/s:    9.66

General statistics:
  total time:      30.3362s
  total number of events: 1066843

Latency (ms):
  min:                 0.00
  avg:                 4.49
  max:                123.82
  95th percentile:    15.00
  sum:               479651.02

Threads fairness:
  events (avg/stddev):   6677.6875/222.46
  execution time (avg/stddev): 29.9782/0.01

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...
nisarg@ubuntuserver:~ $ 

```

Combined run iterations	Results	
1	reads/s	867.93
	writes/sec	578.57
	fsyncs/s	1916.75
	events/s	3295.88
2	reads/s	826.54
	writes/sec	550.91
	fsyncs/s	1829.64
	events/s	3139.94
3	reads/s	927.59
	writes/sec	618.34
	fsyncs/s	2043.36
	events/s	3521.96

## Condition 2: 3GB RAM and 2 Cores on QEMU

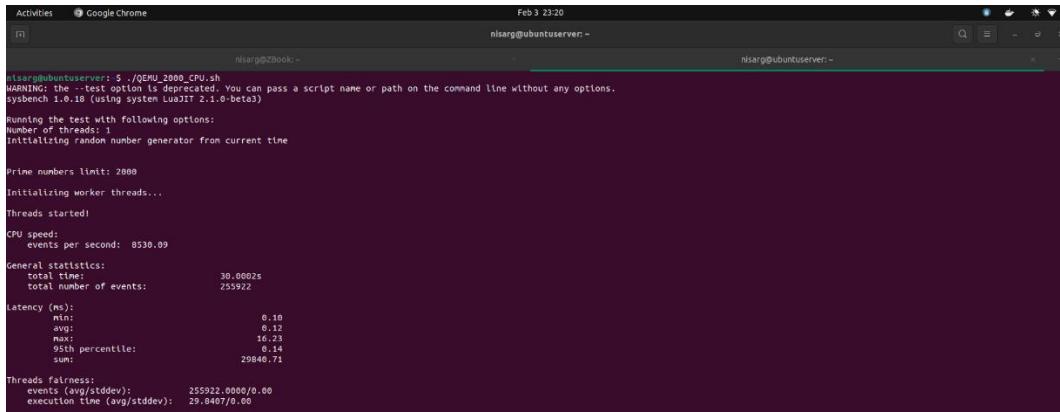
### CPU Testing

For CPU testing, we will be using 3 test cases to check the system performance with varying max-prime argument.

```
$ sysbench cpu --cpu-max-prime=<random_value> --num-threads=<random_value> --time=<random_value> run
```

#### *Test Run 1: Prime Limit = 2000*

Now, we will be running the test script having cpu-max-prime=2000



```
nisarg@ubuntuserver:~$ ./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 1.0.10 (using system LuaJIT 2.1.0-beta3)

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

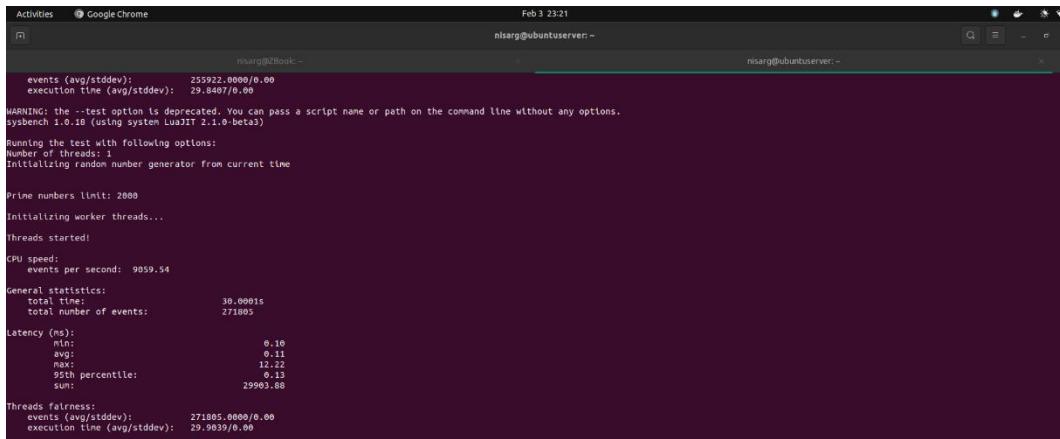
Prime numbers limit: 2000
Initializing worker threads...
Threads started!

CPU speed:
events per second: 8538.09

General statistics:
total time: 30.00025
total number of events: 255922

Latency (ns):
min: 0.10
avg: 0.12
max: 16.23
95th percentile: 1.44
sum: 298467.74

Threads fairness:
events (avg/stddev): 255922.0000/0.00
execution time (avg/stddev): 29.8407/0.00
```



```
nisarg@ubuntuserver:~$ ./QEMU_2000_CPU.sh
events (avg/stddev): 255922.0000/0.00
execution time (avg/stddev): 29.8407/0.00
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.10 (using system LuaJIT 2.1.0-beta3)

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

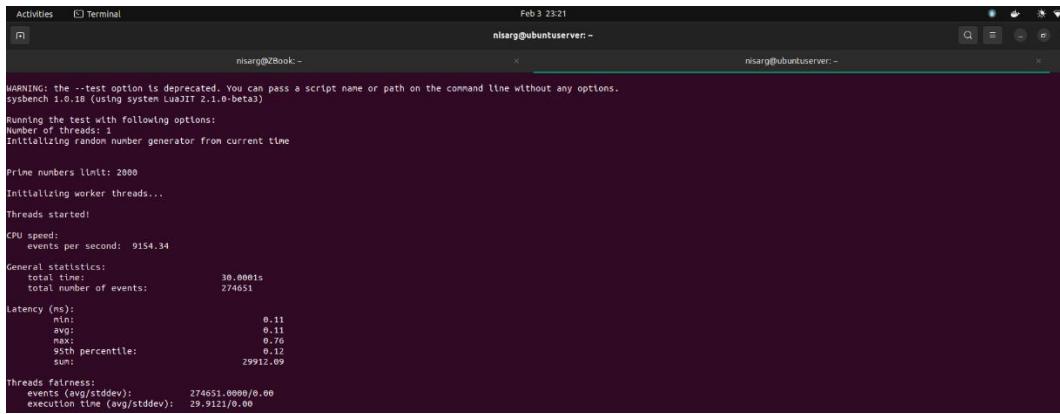
Prime numbers limit: 2000
Initializing worker threads...
Threads started!

CPU speed:
events per second: 9059.54

General statistics:
total time: 38.00015
total number of events: 271805

Latency (ns):
min: 0.10
avg: 0.11
max: 12.22
95th percentile: 0.13
sum: 29963.88

Threads fairness:
events (avg/stddev): 271805.0000/0.00
execution time (avg/stddev): 29.9089/0.00
```



```
nisarg@ubuntuserver:~$ ./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 1.0.10 (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: 9154.34

General statistics:
total time: 38.00015
total number of events: 274651

Latency (ns):
min: 0.11
avg: 0.11
max: 0.76
95th percentile: 0.12
sum: 29911.09

Threads fairness:
events (avg/stddev): 274651.0000/0.00
execution time (avg/stddev): 29.9121/0.00
```

```

Activities Google Chrome Feb 3 23:22
[nisarg@ZBook: ~] nisarg@ubuntu: ~
events (avg/stddev): 274651.0000/0.00
execution time (avg/stddev): 29.9121/0.00
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

Prime numbers limit: 2000
Initializing worker threads...
Threads started!
CPU speed:
events per second: 9170.84
General statistics:
total time: 38.8862s
total number of events: 275146
Latency (ms):
min: 0.10
avg: 0.11
max: 1.72
95th percentile: 0.12
sum: 29901.86
Threads fairness:
events (avg/stddev): 275146.0000/0.00
execution time (avg/stddev): 29.9089/0.00
nisarg@ubuntu: ~
```

```

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.18 (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: 9666.55
General statistics:
total time: 38.0001s
total number of events: 272816
Latency (ms):
min: 0.10
avg: 0.11
max: 0.43
95th percentile: 0.13
sum: 29901.34
Threads fairness:
events (avg/stddev): 272816.0000/0.00
execution time (avg/stddev): 29.9013/0.00
nisarg@ubuntu: ~
```

Iteration Number	Number of Events per Second
1	8530.09
2	9059.54
3	9154.34
4	9170.84
5	9066.55

### Statistics for Test Run 1:

- Average number of events per second: 8996.27
- Maximum number of events per second: 9170.84
- Minimum number of events per second: 8530.09

### *Test Run 2: Prime Limit = 20000*

Now, we will be running the test script having `cpu-max-prime=20000`

```
Activities Terminal Feb 3 23:28
nisarg@ZBook:~ nisarg@ubuntuserver:~
```

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: 389.55  
General statistics:  
total time: 38.0014s  
total number of events: 11688  
Latency (ms):  
min: 2.48  
avg: 2.57  
max: 5.60  
95th percentile: 2.71  
sum: 29986.38  
Threads fairness:  
events (avg/stddev): 11688.0000/0.00  
execution time (avg/stddev): 29.9864/0.00

```
Activities Google Chrome Feb 3 23:28
nirarg@Book: ~ nirarg@ubuntuuser: ~
events (avg/stddev): 11688.0000/0.00
execution time (avg/stddev): 29.9864/0.00
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

Prime numbers llimit: 20000
Initializing worker threads...

Threads started!

CPU speed:
  events per second: 307.00

General statistics:
  total time: 30.00025
  total number of events: 11011

Latency (ms):
  min: 2.50
  avg: 2.58
  max: 4.64
  95th percentile: 2.76
  sum: 29985.72

Threads fairness:
  events (avg/stddev): 11611.0000/0.00
  execution time (avg/stddev): 29.9857/0.00
```

```
Activities Google Chrome Feb 23:29
nisarg@Book: ~ nisarg@ubuntuserver: ~ nisarg@ubuntuserver: ~

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: 388.82

General statistics:
    total time:          38.0018s
    total number of events: 11666

Latency (ms):
    min:                  2.50
    avg:                  2.57
    max:                  7.44
    95th percentile:      2.71
    sum:                 29987.20

Threads fairness:
    events (avg/stddev): 11666.0000/0.00
    execution time (avg/stddev): 29.9872/0.00

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

Prime numbers limit: 20000
Initializing worker threads...
Threads started!

CPU speed:
    events per second: 384.83

General statistics:
    total time:          30.0005s
    total number of events: 11546

Latency (ms):
    min:                  2.49
    avg:                  2.66
    max:                  7.52
    95th percentile:      2.81
    sum:                 29984.12

Threads fairness:
    events (avg/stddev): 11546.0000/0.00
    execution time (avg/stddev): 29.9841/0.00

nisarg@ubuntuserver: ~
```

Iteration Number	Number of Events per Second
1	371.21
2	389.55
3	387.00
4	388.82
5	384.83

## Statistics for Test Run 2:

- Average number of events per second: 384.28
  - Maximum number of events per second: 389.55
  - Minimum number of events per second: 371.21

### *Test Run 3: Prime Limit = 200000*

Now, we will be running the test script having `cpu-max-prime=200000`

```
Activities Google Chrome Feb 3 23:39
[1] nisarg@ZBook: ~
nisarg@ubuntuserver: ~
nisarg@ubuntuserver: ~

nisarg@ubuntuserver: $ ./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 2.1.1-0-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: 16.15

General statistics:
    total time:           30.02975
    total number of events: 485

Latency (ns):
    min:                 61.09
    q1:                  63.51
    max:                 69.62
    95th percentile:     63.32
    sum:                 30024.35

Threads fairness:
    events (avg/stddev): 485.0000/0.00
    execution time (avg/stddev): 30.0243/0.00
```

```
Activities Terminal Feb 3 23:39
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.10 (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: 16.14

General statistics:
  total timer:           38.04905
  total number of events: 485

Latency (ms):
  min:                  61.14
  avg:                  61.95
  max:                  67.96
  95th percentile:      63.32
  sum:                 30843.89

Threads fairness:
  events (avg/stddev): 485.0000/0.00
  execution time (avg/stddev): 38.0439/0.00
```

```
Activities Terminal Feb 3 23:38
nisarg@ZBook: ~ nisarg@ubuntuserver: ~
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: 16.15

General statistics:
total time: 30.0353s
total number of events: 485

Latency (ms):
min: 61.28
avg: 61.92
max: 68.22
95th percentile: 63.32
sum: 30831.74

Threads fairness:
events (avg/stddev): 485.0000/0.00
execution time (avg/stddev): 30.0317/0.00
```

```
Activities Terminal Feb 3 23:39
nisarg@Book: ~ nisarg@ubuntuserver: ~

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: 16.08

General statistics:
total time: 30.0348s
total number of events: 463

Latency (ms):
min: 61.30
avg: 62.18
max: 81.63
95th percentile: 63.32
sum: 30031.44

Threads fairness:
events (avg/stddev): 483.0000/0.00
execution time (avg/stddev): 30.0314/0.00

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

Prime numbers limit: 200000
Initializing worker threads...
Threads started!

CPU speed:
events per second: 16.14

General statistics:
total time: 30.0557s
total number of events: 485

Latency (ms):
min: 61.27
avg: 61.96
max: 65.13
95th percentile: 63.32
sum: 30052.58

Threads fairness:
events (avg/stddev): 485.0000/0.00
execution time (avg/stddev): 30.0526/0.00

nisarg@ubuntuserver: ~
```

Iteration Number	Number of Events per Second
1	16.15
2	16.14
3	16.15
4	16.08
5	16.14

## Statistics for Test Run 3:

- Average number of events per second: 16.13
  - Maximum number of events per second: 16.08
  - Minimum number of events per second: 16.15

## File I/O Testing

For file testing, we will be testing a system with sequential read-write and combined random read-write.

```
$ sysbench --num-threads=16 --test=fileio --file-total-size=2G --time=30 --file-test-mode=<test mode> prepare
```

```
$ sysbench --num-threads=16 --test=fileio --file-total-size=2G --time=30 --file-test-mode=<test mode> run
```

```
$ sysbench --num-threads=16 --test=fileio --file-total-size=2G --time=30 --file-test-mode=<test mode> cleanup
```

### *Test Run 1: Mode = Sequential*

Here, the sysbench is generating 128 files summing up to 2 GB

#### **Iteration 1**

```
Activities ② Google Chrome Feb 3 23:44
nisarg@ZBook: ~ nisarg@ubuntuserver: ~

nisarg@ubuntuserver:~$ ./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, 10384kb 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.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
Creating file test_file.45
```

```
Activities ② Google Chrome Feb 3 23:46
nisarg@ZBook: ~ nisarg@ubuntuserver: ~

nisarg@ubuntuserver:~$ ./QEMU_FILEIO_SEQ.sh
Creating file test_file.86
Creating file test_file.87
Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 17.80 seconds (114.65 MB/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)
```

```
Activities Google Chrome Feb 3 23:45
nisiarg@Book: ~ nisiarg@ubuntuserver: ~
2147483648 bytes written in 17.86 seconds (114.65 MB/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)
2G file size, 100% cache
2GB total file size
Block size 16KB
Periodic fsync enabled, calling fsync() each 100 requests.
Calling fdatasync() at the end of test, Enabled.
Testing CPU and memory I/O performance
doing sequential rewrite test
Initialzing worker threads...

Threads started!

File operations:
    reads/s:          0.00
    writes/s:        3150.82
    fsyncs/s:        4100.52

Throughput:
    read, MB/s:      0.00
    written, MB/s:   49.23

General statistics:
    total time:           30.30785
    total number of events: 217737

Latency (ms):
    min:                 0.00
    avg:                  2.20
    max:                  78.17
    95th percentile:     6.13
    sum:      479775.70

Threads fairness:
    events/second/stddev: 13688.5625/682.53
    execution time (avg/stddev): 20.9862/0.00

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...
nisiarg@ubuntuserver: ~
```

## *Iteration 2*

```
Activities Terminal Feb 4 00:18
nisarg@ZBook:~ nisarg@ubuntuserver:~ nisarg@ubuntuserver:~
```

```
nisarg@ubuntuserver:~ ./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 1.0.19 (using system LuaJIT 2.1.0-beta3)

128 files, 10384kb each, 2048Mb total
Creating files for the test...
Extra file open flags: (none)
 0
 1
 2
 3
 4
 5
 6
 7
 8
 9
 10
 11
 12
 13
 14
 15
 16
 17
 18
 19
 20
 21
 22
 23
 24
 25
 26
 27
 28
 29
 30
 31
 32
 33
 34
 35
 36
 37
 38
 39
 40
 41
 42
 43
 44
 45
 46
 47
 48
 49
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 69
 70
 71
 72
 73
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 75
 76
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 81
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 85
 86
 87
 88
 89
 90
 91
 92
 93
 94
 95
 96
 97
 98
 99
 100
 101
 102
 103
 104
 105
 106
 107
 108
 109
 110
 111
 112
 113
 114
 115
 116
 117
 118
 119
 120
 121
 122
 123
 124
 125
 126
 127
 128
```

```
Activities Terminal Feb 4 00:18
nisarg@ZBook:~ nisarg@ubuntuserver:~
```

```
Creating file test_file.82
Creating file test_file.83
Creating file test_file.84
Creating file test_file.85
Creating file test_file.86
Creating file test_file.87
Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 13.72 seconds (149.28 MB/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
Initialising random number generator from current time

Activities Terminal Feb 4 00:18
nisarg@ZBook:~ nisarg@ubuntuserver:~
```

```
nisarg@ZBook:~ nisarg@ubuntuserver:~
```

```
2147483648 bytes written in 13.72 seconds (149.28 MB/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
Initialising random number generator from current time

Extra file open flags: (none)
IOX: 1000 events each
zGUB total file size
Block size 16kB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling sync() after each event of test, Enabled.
Using direct I/O mode
Doing sequential rewrite test
Initialising worker threads...
Threads started!

File operations:
  reads/s:          0.00
  writes/s:        3109.95
  fsync/s:         4046.58

Throughput:
  read, MB/s:       0.00
  written, MB/s:   48.59

General statistics:
  total time:      30.4566s
  total number of events: 215643

Latency (ms):
  min:                 0.00
  avg:                2.22
  max:               97.10
  95th percentile:    7.98
  sum:            479695.92

Threads fairness:
  events (avg/stddev): 13477.6875/404.50
  execution time (avg/stddev): 29.9816/0.00

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...
nisarg@ubuntuserver:~
```

### Iteration 3

The image shows two side-by-side terminal windows on a Linux desktop environment. Both terminals are running the command `./QEMU_FILEIO_SQ.sh`. The left terminal window has a timestamp of Feb 4 00:23 and displays the progress of file creation from test\_file.0 to test\_file.44. The right terminal window also has a timestamp of Feb 4 00:23 and shows the continuation of the process from test\_file.02 to test\_file.121. Both windows include system status messages at the bottom about deprecated options and the use of LuaJIT.

```
nisarg@ubuntuserver:~/QEMU_FILEIO_SQ.sh
WARNING: the -v-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, 16384K each, 2048MB total
Creating file for the test...
Extra file open flags: (none)
Creating file test_file.0
Creating file test_file.1
Creating file test_file.2
Creating file test_file.3
Creating file test_file.4
Creating file test_file.5
Creating file test_file.6
Creating file test_file.7
Creating file test_file.8
Creating file test_file.9
Creating file test_file.10
Creating file test_file.11
Creating file test_file.12
Creating file test_file.13
Creating file test_file.14
Creating file test_file.15
Creating file test_file.16
Creating file test_file.17
Creating file test_file.18
Creating file test_file.19
Creating file test_file.20
Creating file test_file.21
Creating file test_file.22
Creating file test_file.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44

nisarg@ZBook:~
```

```
nisarg@ubuntuserver:~/QEMU_FILEIO_SQ.sh
Feb 4 00:23
nisarg@ZBook:~
```

```
Creating file test_file.02
Creating file test_file.03
Creating file test_file.04
Creating file test_file.05
Creating file test_file.06
Creating file test_file.07
Creating file test_file.08
Creating file test_file.09
Creating file test_file.10
Creating file test_file.11
Creating file test_file.12
Creating file test_file.13
Creating file test_file.14
Creating file test_file.15
Creating file test_file.16
Creating file test_file.17
Creating file test_file.18
Creating file test_file.19
Creating file test_file.20
Creating file test_file.21
Creating file test_file.22
Creating file test_file.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44

nisarg@ubuntuserver:~
```

```
Activities Terminal Feb 4 00:23
nisarg@ZBook:~ nisarg@ubuntuserver:~ nisarg@ubuntuserver:~
```

2147483648 bytes written in 11.75 seconds (174.36 Mbytes/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)

2G files, 1MB each

2GB total file size

Block size 1kB

Periodic FSync enabled, calling fsync() each 100 requests.

Using syncronous I/O mode

Doing sequential rewrite test

Initializing worker threads...

Threads started!

File operations:

	reads/s	writes/s	fsyncs/s
	0.00	3198.54	4158.23

Throughput:

	read, MB/s	written, MB/s
	0.00	49.98

General statistics:

	total time:	total number of events:
	30.2933s	220826

Latency (ms):

	min:	avg:	max:	95th percentile:	sum:
	0.00	2.17	85.86	7.98	479176.87

Threads fairness:

	events (avg/stddev)	execution time (avg/stddev)
	13801.0250/470.85	29.9857/0.00

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...

```
nisarg@ubuntuserver:~$
```

Serial run iterations	Results	
1	reads/s	0.00
	writes/sec	3150.82
	fsyncs/s	4100.52
	events/s	7184.19
2	reads/s	0.00
	writes/sec	3109.95
	fsyncs/s	4046.58
	events/s	7089.65
3	reads/s	0.00
	writes/sec	3198.54
	fsyncs/s	4158.23
	events/s	7289.60

### *Test Run 2: Mode = Combined Random*

Here, the sysbench is generating 128 files summing up to 2 GB

## *Iteration 1*

```
Activities Terminal Feb 4 00:26
nisarg@ubuntuserver: ~
nisarg@ubuntuserver: ~
nisarg@ubuntuserver: S ./QEMU_FILEIO_RDRN.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 Lubutu 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.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
Creating file test_file.45
Creating file test_file.46
Creating file test_file.47
```

```
Activities Terminal Feb 4 00:26
nisarg@Book:~ nisarg@ubuntuserver:~ nisarg@ubuntuserver:~

Creating file test_file.82
Creating file test_file.83
Creating file test_file.84
Creating file test_file.85
Creating file test_file.86
Creating file test_file.87
Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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
214783648 bytes written in 14.16 seconds (144.68 MB/sec).
WARNING: --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 2.1.6-beta3)

Running the test with following options:
Number of threads: 16
```

```
Activities Terminal Feb 4 00:26
nisarg@ZBook:~ nisarg@ubuntuserver:~ nisarg@ubuntuserver:~
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, 10MB each
ZGM total file size
Block size 1kB
Number of IO requests: 0
Read/write ratio for combined random IO test: 1.50
Periodic fsync enabled, calling fsync() each 100 requests.
Calling sync() 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:          958.81
    writes/s:         639.21
    fsyncs/s:        2112.68

Throughput:
    read, MiB/s:      14.98
    written, MiB/s:   9.09

General statistics:
    total time:           30.34025
    total number of events: 110572

Latency (ns):
    min:                  0.00
    avg:                 4.24
    max:                 94.99
    95th percentile:     14.46
    sun:                479887.48

Threads fairness:
    events (avg/stddev):   6910.7500/373.00
    execution time (avg/stddev): 29.9930/0.00

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...
nisarg@ubuntuserver:~
```

## *Iteration 2*

```
Activities Terminal Feb 4 00:29
nisarg@ZBook:~ nisarg@ubuntuserver:~
```

```
Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 12.64 seconds (162.03 MB/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, 10MB each
1GB total file size
```

```
Activities Terminal Feb 4 00:29
nisarg@ZBook:~ nisarg@ubuntuserver:~
```

```
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, 10MB each
1GB total file size
block size: 1MB
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.
Testing in synchronous I/O mode
using random r/w test
Initializing worker threads...

Threads started!

File operations:
 reads/s:          1008.53
 writes/s:         672.38
 fsyncs/s:        2217.93

Throughput:
 read, MB/s:      15.76
 written, MB/s:   10.51

General statistics:
 total time:           38.2967s
 total number of events: 116081

Latency (μs):
 min:                  0.00
 avg:                 4.13
 max:                102.44
 95th percentile:    13.70
 sum:               479826.54

Threads Fairness:
 events (avg/stddev): 7255.0625/545.29
 execution time (avg/stddev): 29.9892/0.60

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...
nisarg@ubuntuserver: $
```

## ***Iteration 3***

```
Activities Terminal Feb 4 00:31
nisarg@ubuntuserver:~ nisarg@ubuntuserver:~

Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 11.61 seconds (176.33 MB/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 1.0.10 (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, 16MB each
2GB total file size
Block size: 16KB
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
```

Combined run iterations	Results	
1	reads/s	958.81
	writes/sec	639.21
	fsyncs/s	2112.68
	events/s	3643.45
2	reads/s	1008.53
	writes/sec	672.38
	fsyncs/s	2217.93
	events/s	3831.47
3	reads/s	1031.85
	writes/sec	687.90
	fsyncs/s	2267.97
	events/s	3920.48

## Condition 3: 2GB RAM and 2 Cores on Docker

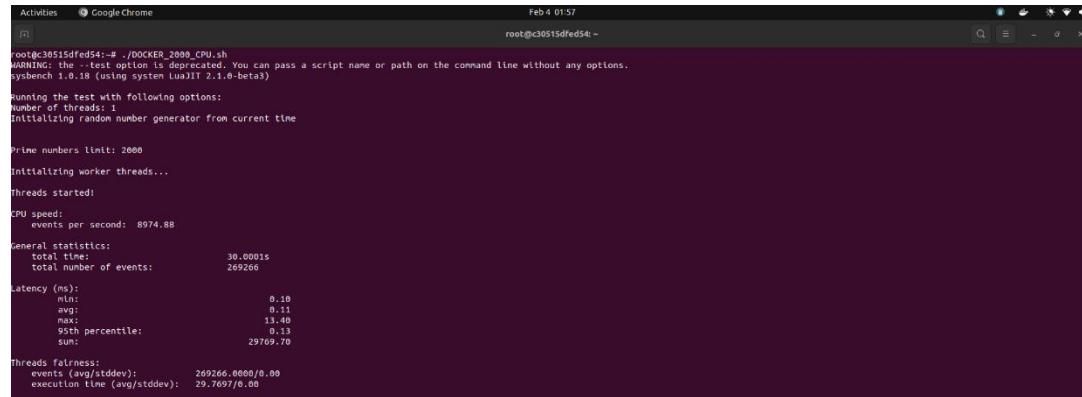
### CPU Testing

For CPU testing, we will be using 3 test cases to check the system performance with varying max-prime argument.

```
$ sysbench cpu --cpu-max-prime=<random_value> --num-threads=<random_value> --time=<random_value> run
```

#### *Test Run 1: Prime Limit = 2000*

Now, we will be running the test script having cpu-max-prime=2000



```
Activities  Google Chrome Feb 4 01:57
root@c30515dfed54: ~

root@c30515dfed54: ~ ./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 1.0.10 (using system LuajIT 2.1.0-beta3)

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

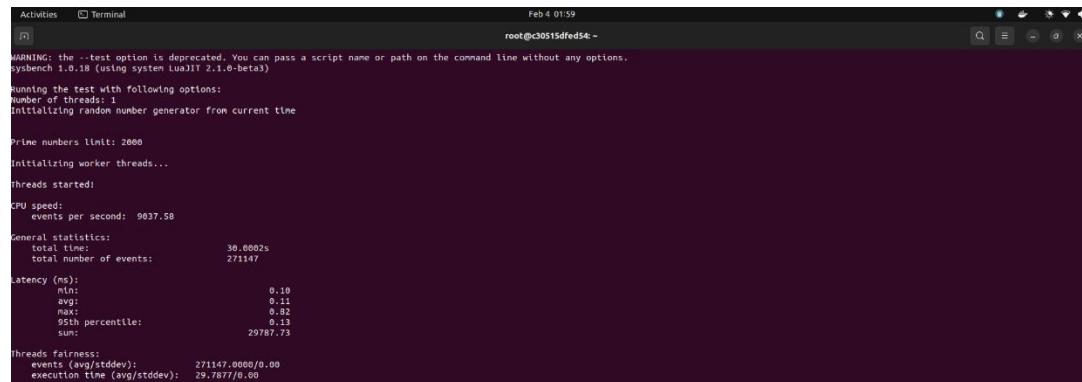
Prime numbers limit: 2000
Initializing worker threads...
Threads started!

CPU speed:
events per second: 8974.88

General statistics:
total time: 30.0001s
total number of events: 269266

Latency (ns):
min: 0.10
avg: 0.11
max: 1.40
95th percentile: 0.13
sum: 29769.70

Threads fairness:
events (avg/stddev): 269266.0000/0.00
execution time (avg/stddev): 29.7697/0.00
```



```
Activities  Terminal Feb 4 01:59
root@c30515dfed54: ~

root@c30515dfed54: ~ ./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 1.0.10 (using system LuajIT 2.1.0-beta3)

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

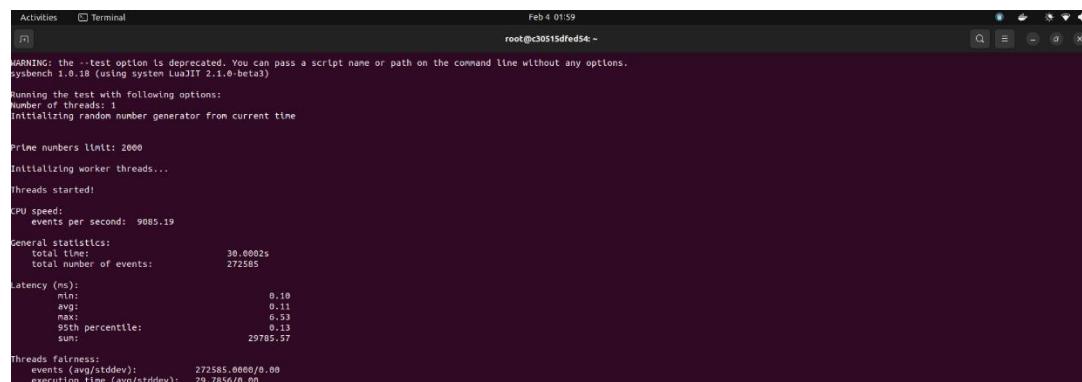
Prime numbers limit: 2000
Initializing worker threads...
Threads started!

CPU speed:
events per second: 9037.58

General statistics:
total time: 30.0002s
total number of events: 271147

Latency (ns):
min: 0.10
avg: 0.11
max: 0.42
95th percentile: 0.13
sum: 29787.73

Threads fairness:
events (avg/stddev): 271147.0000/0.00
execution time (avg/stddev): 29.7877/0.00
```



```
Activities  Terminal Feb 4 01:59
root@c30515dfed54: ~

root@c30515dfed54: ~ ./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 1.0.10 (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: 9085.19

General statistics:
total time: 30.0002s
total number of events: 272585

Latency (ns):
min: 0.10
avg: 0.11
max: 0.53
95th percentile: 0.13
sum: 29785.57

Threads fairness:
events (avg/stddev): 272585.0000/0.00
execution time (avg/stddev): 29.7856/0.00
```

```

Activities Terminal Feb 4 02:00
root@c30515dfed54: ~

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.10 (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: 9010.61
General statistics:
  total time:          30.0002s
  total number of events: 270339
Latency (ms):
  min:                 0.10
  avg:                 0.11
  max:                 2.64
  95th percentile:    0.13
  sum:                29786.39
Threads fairness:
  events (avg/stddev): 270339.0000/0.00
  execution time (avg/stddev): 29.7864/0.00
root@c30515dfed54:~ []

```

```

WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.10 (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: 9048.32
General statistics:
  total time:          30.0002s
  total number of events: 271479
Latency (ms):
  min:                 0.10
  avg:                 0.11
  max:                 8.36
  95th percentile:    0.18
  sum:                29786.64
Threads fairness:
  events (avg/stddev): 271476.0000/0.00
  execution time (avg/stddev): 29.7886/0.00
root@c30515dfed54:~ []

```

Iteration Number	Number of Events per Second
1	8974.88
2	9037.58
3	9085.19
4	9010.61
5	9048.32

### Statistics for Test Run 1:

- Average number of events per second: 9031.32
- Maximum number of events per second: 9085.19
- Minimum number of events per second: 8974.88

## Test Run 2: Prime Limit = 20000

Now, we will be running the test script having cpu-max-prime=20000

```
Activities Terminal Feb 4 02:07
root@c30515dfed54: ~

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-beta)

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: 366.52

General statistics:
total time: 30.0019s
total number of events: 10997

Latency (ms):
min: 2.50
avg: 7.72
max: 14.07
95th percentile: 3.19
sum: 29961.07

Threads fairness:
events (avg/stddev): 10997.0000/0.00
execution time (avg/stddev): 29.9611/0.00

Activities Terminal Feb 4 02:09
root@c30515dfed54: ~

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-beta)

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: 363.98

General statistics:
total time: 30.0025s
total number of events: 10921

Latency (ms):
min: 2.30
avg: 7.74
max: 16.93
95th percentile: 3.25
sum: 29960.11

Threads fairness:
events (avg/stddev): 10921.0000/0.00
execution time (avg/stddev): 29.9601/0.00

Activities Terminal Feb 4 02:09
root@c30515dfed54: ~

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-beta)

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: 380.31

General statistics:
total time: 30.0024s
total number of events: 11411

Latency (ms):
min: 2.50
avg: 2.63
max: 5.31
95th percentile: 3.02
sum: 29974.50

Threads fairness:
events (avg/stddev): 11411.0000/0.00
execution time (avg/stddev): 29.9745/0.00

Activities Terminal Feb 4 02:10
root@c30515dfed54: ~

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-beta)

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: 383.43

General statistics:
total time: 30.0005s
total number of events: 11504

Latency (ms):
min: 2.50
avg: 2.61
max: 28.08
95th percentile: 2.76
sum: 29974.95

Threads fairness:
events (avg/stddev): 11504.0000/0.00
execution time (avg/stddev): 29.9750/0.00
```

```

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

Prime numbers limit: 20000
Initializing worker threads...
Threads started!

CPU speed:
  events per second: 388.42

General statistics:
  total time:          30.0020s
  total number of events: 11654

Latency (ms):
  min:                2.50
  avg:                7.77
  max:               10.29
  95th percentile:    2.66
  sum:              29981.39

Threads fairness:
  events (avg/stddev): 11654.0000/0.00
  execution time (avg/stddev): 29.9814/0.00
root@c30515dfed54:~#

```

Iteration Number	Number of Events per Second
1	366.52
2	363.98
3	380.31
4	383.43
5	388.42

#### Statistics for Test Run 2:

- Average number of events per second: 376.53
- Maximum number of events per second: 388.42
- Minimum number of events per second: 363.98

#### Test Run 3: Prime Limit = 200000

Now, we will be running the test script having cpu-max-prime=200000

```

Activities Terminal Feb 4 02:21
root@c30515dfed54:~# ./DOCKER_200000_CPU.sh
root@c30515dfed54:~#
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: 16.06

General statistics:
  total time:          38.0149s
  total number of events: 482

Latency (ms):
  min:                60.91
  avg:                65.26
  max:               104.00
  95th percentile:   64.47
  sum:              30011.47

Threads fairness:

```

```
Activities Terminal Feb 4 02:22
root@e30515dfed54: ~
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.10 (using system LuajIT 2.1.0-beta)

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: 16.13

General statistics:
total time: 30.0682s
total number of events: 484

Latency (ms):
min: 60.90
avg: 61.99
max: 75.07
95th percentile: 63.32
sum: 30068.79

Threads fairness:
events (avg/stddev): 484.0000/0.00
execution time (avg/stddev): 30.0689/0.00
```

```
Activities Terminal Feb 4 02:22
root@e30515dfed54: ~
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.10 (using system LuajIT 2.1.0-beta)

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: 15.99

General statistics:
total time: 30.0690s
total number of events: 480

Latency (ms):
min: 60.90
avg: 61.91
max: 115.03
95th percentile: 65.65
sum: 30065.40

Threads fairness:
events (avg/stddev): 480.0000/0.00
execution time (avg/stddev): 30.0654/0.00
```

```
Activities Terminal Feb 4 02:22
root@e30515dfed54: ~
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.10 (using system LuajIT 2.1.0-beta)

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: 16.14

General statistics:
total time: 30.0482s
total number of events: 485

Latency (ms):
min: 60.86
avg: 61.95
max: 77.60
95th percentile: 63.32
sum: 30044.83

Threads fairness:
events (avg/stddev): 485.0000/0.00
execution time (avg/stddev): 30.0448/0.00
```

```
Activities Terminal Feb 4 02:22
root@e30515dfed54: ~
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.10 (using system LuajIT 2.1.0-beta)

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: 16.13

General statistics:
total time: 30.0043s
total number of events: 494

Latency (ms):
min: 60.88
avg: 61.99
max: 89.44
95th percentile: 63.32
sum: 30006.86

Threads fairness:
events (avg/stddev): 484.0000/0.00
execution time (avg/stddev): 30.0069/0.00
root@c30515dfed54: ~
```

Iteration Number	Number of Events per Second
1	16.06
2	16.13
3	15.99
4	16.14
5	16.13

### Statistics for Test Run 3:

- Average number of events per second: 16.09
- Maximum number of events per second: 16.14
- Minimum number of events per second: 15.99

## File I/O Testing

For file testing, we will be testing a system with sequential read-write and combined random read-write.

```
$ sysbench --num-threads=16 --test=fileio --file-total-size=2G --time=30 --file-test-mode=<test_mode> prepare
$ sysbench --num-threads=16 --test=fileio --file-total-size=2G --time=30 --file-test-mode=<test_mode> run
$ sysbench --num-threads=16 --test=fileio --file-total-size=2G --time=30 --file-test-mode=<test_mode> cleanup
```

### *Test Run 1: Mode = Sequential*

Here, the sysbench is generating 128 files summing up to 2 GB

#### **Iteration 1**

```
root@e30515fed54:~# ./DOCKER_FILEIO_SEQ.sh
WARNING: The --num-threads option is deprecated. You can pass a script name or path on the command line without any options.
WARNING: --num-threads is deprecated, use -t threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

128 files, 1536Mb each, 2048Mb total
Creating file for the test...
Extra file open flags: (none)
Creating file test_file.1
Creating file test_file.2
Creating file test_file.3
Creating file test_file.4
Creating file test_file.5
Creating file test_file.6
Creating file test_file.7
Creating file test_file.8
Creating file test_file.9
Creating file test_file.10
Creating file test_file.11
Creating file test_file.12
Creating file test_file.13
Creating file test_file.14
Creating file test_file.15
Creating file test_file.16
Creating file test_file.17
Creating file test_file.18
Creating file test_file.19
Creating file test_file.20
Creating file test_file.21
Creating file test_file.22
Creating file test_file.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
Creating file test_file.45
Creating file test_file.46
Creating file test_file.47
```

```
Activities Google Chrome Feb 4 02:35 root@ct0515dfed5d:~  
  
Creating file test_file.00  
Creating file test_file.01  
Creating file test_file.02  
Creating file test_file.03  
Creating file test_file.04  
Creating file test_file.05  
Creating file test_file.06  
Creating file test_file.07  
Creating file test_file.08  
Creating file test_file.09  
Creating file test_file.10  
Creating file test_file.11  
Creating file test_file.12  
Creating file test_file.13  
Creating file test_file.14  
Creating file test_file.15  
Creating file test_file.16  
Creating file test_file.17  
Creating file test_file.18  
Creating file test_file.19  
Creating file test_file.20  
Creating file test_file.21  
Creating file test_file.22  
Creating file test_file.23  
Creating file test_file.24  
Creating file test_file.25  
Creating file test_file.26  
Creating file test_file.27  
2147483648 bytes written in 13.93 seconds (147.06 MB/sec).  
Usage: ./sysbench [options] pass <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
```

```
Activities Terminal Feb 4 02:35
root@c30515dfed54: ~

Creating File test_file.i26
Creating File test_file.i37
2147483648 bytes written in 13.93 seconds (147.06 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)
2GB files, 100% read
2GiB total file size
Block size 10KiB
Periodic FSYNC enabled, calling fsync() each 100 requests.
File sync (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:        9304.55
    fsyncs/s:       11975.32

Throughput:
    read, MiB/s:      0.00
    written, MiB/s:   145.38

General statistics:
    total time:           30.0158s
    total number of events: 636722

Latency (ms):
    stdev:                0.01
    avg:                  0.74
    max:                 82.46
    95th percentile:      5.88
    sum:                 473847.84

Threads fairness:
    events (avg/stddev): 39795.3250/1166.71
    execution time (avg/stddev): 29.0355/0.02

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...
rpost@c30515dfed54: ~
```

## Iteration 2

```
Activities  Google Chrome  Feb 4 02:41
root@c30515dfed54:~# ./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.19
Creating file test_file.20
Creating file test_file.21
Creating file test_file.22
Creating file test_file.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
Creating file test_file.45
Creating file test_file.46
Creating file test_file.47

Activities  Terminal  Feb 4 02:43
root@c30515dfed54:~#
Creating file test_file.82
Creating file test_file.83
Creating file test_file.84
Creating file test_file.85
Creating file test_file.86
Creating file test_file.87
Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 10.58 seconds (193.61 MB/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
```

```
Activities Terminal Feb 4 02:43
root@c30515dfed54:~-
Creating file test_file.126
Creating file test_file.127
1147403648 bytes written in 10.58 seconds (193.61 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 1.0.10 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 10
Initializing random number generator from current time

Extra file open flags: (none)
128 files, 16MiB each
2GiB total file size
Block size 10KiB
Per-operation syncs 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:         8651.60
  fsyncs/s:        11141.92

Throughput:
  read, MiB/s:      0.00
  written, MiB/s:   135.18

General statistics:
  total time:       30.03995
  total number of events: 5925795

Latency (ms):
  min:                 0.01
  avg:                 0.00
  max:                151.48
  95th percentile:    5.99
  sum:               474846.44

Threads fairness:
  events (avg/stddev): 37036.1875/778.75
  execution time (avg/stddev): 29.6779/0.63

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 1.0.10 (using system LuaJIT 2.1.0-beta3)

Removing test files...
root@c30515dfed54:~-
```

### Iteration 3

```
Activities Terminal Feb 4 02:46
root@c30515dfed54:~-
root@c30515dfed54:~# ./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 1.0.10 (using system LuaJIT 2.1.0-beta3)

128 files, 16384KiB each, 2GiB total
Creating files for the test.
Extra file open flags: (none)
Creating file test_file.0
Creating file test_file.1
Creating file test_file.2
Creating file test_file.3
Creating file test_file.4
Creating file test_file.5
Creating file test_file.6
Creating file test_file.7
Creating file test_file.8
Creating file test_file.9
Creating file test_file.10
Creating file test_file.11
Creating file test_file.12
Creating file test_file.13
Creating file test_file.14
Creating file test_file.15
Creating file test_file.16
Creating file test_file.17
Creating file test_file.18
Creating file test_file.19
Creating file test_file.20
Creating file test_file.21
Creating file test_file.22
Creating file test_file.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
Creating file test_file.45
Creating file test_file.46
Creating file test_file.47
```

```
Activities  Google Chrome Feb 4 02:46
root@c30515dfed54: ~

Creating file test_file.82
Creating file test_file.83
Creating file test_file.84
Creating file test_file.85
Creating file test_file.86
Creating file test_file.87
Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 10.79 seconds (189.80 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
```

```
Activities  Terminal Feb 4 02:47
root@c30515dfed54: ~

Creating file test_file.126
Creating file test_file.127
2147483648 bytes written in 10.79 seconds (189.80 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, 10kB each
2GiB total file size
Block size 10kB
Per-thread sync mode enabled, calling fsync() each 100 requests.
(Calling fsync() at the end of test, disabled.
Using synchronous I/O mode
Doing sequential rewrite test
Initializing worker threads...

Threads started!

File operations:
  reads/s:          0.00
  writes/s:         9188.70
  fsyncs/s:        11627.77

Throughput:
  read, MiB/s:      0.00
  written, MiB/s:   143.57

General statistics:
  total time:           30.8569s
  total number of events: 429679

Latency (ms):
  min:                 0.01
  avg:                 0.75
  max:                145.73
  95th percentile:     5.88
  sum:            474499.71

Threads fairness:
  events (avg/stddev): 39354.9375/747.23
  execution time (avg/stddev): 29.0562/0.02

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@c30515dfed54: #
```

Serial run iterations	Results	
1	reads/s	0.00
	writes/sec	9304.55
	fsyncs/s	11975.32
	events/s	21212.89
2	reads/s	0.00
	writes/sec	8651.60
	fsyncs/s	11141.92
	events/s	19726.59
3	reads/s	0.00
	writes/sec	9188.70
	fsyncs/s	11827.77
	events/s	20949.57

### Test Run 2: Mode = Combined Random

Here, the sysbench is generating 128 files summing up to 2 GB

#### Iteration 1

```
Activities Terminal Feb 4 02:50
root@30515dfed54: ~
root@30515dfed54: # ./POOKER FILEIO_BENCHMARK
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, 16384Mb each, 2848Mb total
Creating files for the test...
Extra file open flags: (none)
Creating file test_file.0
Creating file test_file.1
Creating file test_file.2
Creating file test_file.3
Creating file test_file.4
Creating file test_file.5
Creating file test_file.6
Creating file test_file.7
Creating file test_file.8
Creating file test_file.9
Creating file test_file.10
Creating file test_file.11
Creating file test_file.12
Creating file test_file.13
Creating file test_file.14
Creating file test_file.15
Creating file test_file.16
Creating file test_file.17
Creating file test_file.18
Creating file test_file.19
Creating file test_file.20
Creating file test_file.21
Creating file test_file.22
Creating file test_file.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
Creating file test_file.45
Creating file test_file.46
Creating file test_file.47
```

```
Activities Terminal Feb 4 02:50
root@c30515dfed54: ~
Creating file test_file.82
Creating file test_file.83
Creating file test_file.84
Creating file test_file.85
Creating file test_file.86
Creating file test_file.87
Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 10-40 seconds (199.98 MB/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
```

```
Activities Terminal Feb 4 02:50
root@c30515dfed54: ~
Creating file test_file.111
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 10-40 seconds (199.98 MB/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, 16MB each
3GB total file size
Block size 16kB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Per thread IO requests (calling fsync() at the end of test, Enabled).
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: 3127.10
 writes/s: 2804.51
 syncs/s: 6735.04

Throughput:
 read, MB/s: 48.86
 written, MB/s: 32.57

General statistics:
 total time: 30.1041s
 total number of events: 357616

Latency (ms):
 min: 0.00
 avg: 1.34
 max: 94.40
 95th percentile: 4.25
 sum: 478917.05

Threads fairness:
 events (avg/stddev): 22351.0000/206.11
 execution time (avg/stddev): 29.9324/0.00

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@c30515dfed54: ~
```

## Iteration 2

```
Activities Terminal Feb 4 02:53
root@c30515dfed54:~# ./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, 2948Mb total
Creating files for the test...
Extra file open flags: (none)
Creating file test_file.0
Creating file test_file.1
Creating file test_file.2
Creating file test_file.3
Creating file test_file.4
Creating file test_file.5
Creating file test_file.6
Creating file test_file.7
Creating file test_file.8
Creating file test_file.9
Creating file test_file.10
Creating file test_file.11
Creating file test_file.12
Creating file test_file.13
Creating file test_file.14
Creating file test_file.15
Creating file test_file.16
Creating file test_file.17
Creating file test_file.18
Creating file test_file.19
Creating file test_file.20
Creating file test_file.21
Creating file test_file.22
Creating file test_file.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
Creating file test_file.45
Creating file test_file.46
Creating file test_file.47
```

```
Activities Terminal Feb 4 02:53
root@c30515dfed54:~# ./DOCKER_FILEIO_RNDRW.sh
Creating file test_file.82
Creating file test_file.83
Creating file test_file.84
Creating file test_file.85
Creating file test_file.86
Creating file test_file.87
Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 10.46 seconds (195.83 Mb/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
```

```

Activities Terminal Feb 4 02:33
root@c30515dfed54: ~

2147483648 bytes written in 10.40 seconds (195.83 MB/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, 10MB each
Total file size: 1280MB
block size 10Kb
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() every 100 requests and of test, Enabled.
Using direct I/O mode
Doing random r/w test
Initializing worker threads...

Threads started!

File operations:
  reads/s:          3173.52
  writes/s:         2115.40
  fsync/s:          6850.12

Throughput:
  read, MB/s:      49.59
  written, MB/s:   33.05

General statistics:
  total time:       30.0421s
  total number of events: 362236

Latency (ms):
  min:              0.00
  avg:              1.32
  max:              72.33
  95th percentile: 4.25
  sum:             478823.75

Threads fairness:
  events (avg/stddev): 22639.7500/168.33
  execution time (avg/stddev): 29.9205/0.00

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@c30515dfed54: ~

```

### Iteration 3

```

Activities Terminal Feb 4 02:30
root@c30515dfed54: ~

root@c30515dfed54:~/DOCKER_FU/FIO_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, 10384kB 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.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
Creating file test_file.45
Creating file test_file.46
creating file test_file.47

```

```
Activities Terminal Feb 4 02:56
root@c30515dfed54: ~
Creating file test_file.82
Creating file test_file.83
Creating file test_file.84
Creating file test_file.85
Creating file test_file.86
Creating file test_file.87
Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 10.22 seconds (200.33 MB/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 -t 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
```

```
Activities Terminal Feb 4 02:56
root@c30515dfed54: ~
2147483648 bytes written in 10.22 seconds (200.33 MB/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 -t 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)
1TB total file size
2GiB total file size
Block size 10KB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Per thread number of IO requests: 100 (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:           5953.04
 writes/s:          2155.19
 syncs/s:           6961.30

Throughput:
 read, MB/s:        50.52
 written, MB/s:     33.67

General statistics:
 total time:        30.04525
 total number of events: 369018

Latency (ms):
 min:                 0.00
 avg:                 1.30
 max:                96.22
 95th percentile:    4.10
 sum:               478853.81

Threads fairness:
 events (avg/stddev): 23063.6250/267.70
 execution time (avg/stddev): 29.9284/0.00

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 -t threads instead
sysbench 1.0.18 (using system LuajIT 2.1.0-beta3)

Removing test files...
root@c30515dfed54: ~
```

Combined run iterations	Results	
1	reads/s	3127.10
	writes/sec	2084.51
	fsyncs/s	6735.04
	events/s	11879.31
2	reads/s	3173.52
	writes/sec	2115.40
	fsyncs/s	6836.12
	events/s	12057.61
3	reads/s	3233.04
	writes/sec	2155.19
	fsyncs/s	6961.30
	events/s	1282.09

## Condition 4: 3GB RAM and 2 Cores on Docker

### CPU Testing

For CPU testing, we will be using 3 test cases to check the system performance with varying max-prime argument.

```
$ sysbench cpu --cpu-max-prime=<random_value> --num-threads=<random_value> --time=<random_value> run
```

#### *Test Run 1: Prime Limit = 2000*

Now, we will be running the test script having cpu-max-prime=2000

```
Activities Terminal Feb 4 04:27
root@034420e445d3:~-
./00CKER_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!
Threads started!
CPU speed:
  events per second: 7685.16

General statistics:
  total time:          30.00010s
  total number of events: 228182

Latency (ms):
  min:                 0.11
  avg:                 0.13
  max:                17.79
  95th percentile:    0.15
  sum:                29613.53

Threads fairness:
  events (avg/stddev): 228182.0000/0.00
  execution time (avg/stddev): 29.6135/0.00
```

```
Activities Terminal Feb 4 04:27
root@034420e445d3:~-
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: 8033.07
General statistics:
total time: 30.00001s
total number of events: 241016
Latency (ms):
min: 0.11
avg: 0.12
max: 10.32
95th percentile: 0.15
sum: 29691.12
Threads fairness:
events (avg/stddev): 241016.0000/0.00
execution time (avg/stddev): 29.6911/0.00
```

```
Activities Terminal Feb 4 04:28
root@034420e445d3:~-
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: 7569.51
General statistics:
total time: 30.00002s
total number of events: 227106
Latency (ms):
min: 0.11
avg: 0.13
max: 47.53
95th percentile: 0.15
sum: 29037.48
Threads fairness:
events (avg/stddev): 227106.0000/0.00
execution time (avg/stddev): 29.6375/0.00
```

```
Activities Terminal Feb 4 04:28
root@034420e445d3:~-
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: 7765.59
General statistics:
total time: 30.00010s
total number of events: 232994
Latency (ms):
min: 0.11
avg: 0.13
max: 19.72
95th percentile: 0.15
sum: 29671.96
Threads fairness:
events (avg/stddev): 232994.0000/0.00
execution time (avg/stddev): 29.6720/0.00
```

```
Activities Terminal Feb 4 04:28
root@034420e445d3:~-
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: 7676.49
General statistics:
total time: 30.00001s
total number of events: 230311
Latency (ms):
min: 0.11
avg: 0.13
max: 20.30
95th percentile: 0.15
sum: 29038.51
Threads fairness:
events (avg/stddev): 230311.0000/0.00
execution time (avg/stddev): 29.6385/0.00
root@034420e445d3:~#
```

Iteration Number	Number of Events per Second
1	7605.16
2	8033.07
3	7569.51
4	7765.59
5	7676.49

### Statistics for Test Run 1:

- Average number of events per second: 7729.96
- Maximum number of events per second: 8033.07
- Minimum number of events per second: 7605.16

### Test Run 2: Prime Limit = 20000

Now, we will be running the test script having cpu-max-prime=20000

```
Activities Terminal Feb 4 04:32
root@034420e445d3:~# ./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: 357.13

General statistics:
total time: 30.00008s
total number of events: 10715

Latency (ms):
min: 2.59
avg: 2.80
max: 13.75
99th percentile: 3.62
sum: 29974.54

Threads fairness:
events (avg/stddev): 10715.0000/0.00
execution time (avg/stddev): 29.9745/0.00
```

```
Activities Terminal Feb 4 04:33
root@034420e445d3:~#
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: 355.90

General statistics:
total time: 30.00115s
total number of events: 10678

Latency (ms):
min: 2.53
avg: 2.81
max: 19.53
99th percentile: 3.62
sum: 29974.68

Threads fairness:
events (avg/stddev): 10678.0000/0.00
execution time (avg/stddev): 29.9741/0.00
```

```

Activities Terminal Feb 4 04:33
root@034420e445d:~-
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.10 (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: 356.54
General statistics:
total time: 30.0003s
total number of events: 10697
Latency (ms):
min: 2.59
avg: 2.88
max: 15.54
95th percentile: 2.97
sum: 29974.58
Threads fairness:
events (avg/stddev): 10697.0000/0.00
execution time (avg/stddev): 29.9746/0.00

Activities Terminal Feb 4 04:34
root@034420e445d:~-
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.10 (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: 357.91
General statistics:
total time: 30.0024s
total number of events: 10739
Latency (ms):
min: 2.59
avg: 2.79
max: 15.34
95th percentile: 2.91
sum: 29977.03
Threads fairness:
events (avg/stddev): 10739.0000/0.00
execution time (avg/stddev): 29.9776/0.00

Activities Terminal Feb 4 04:35
root@034420e445d:~-
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
sysbench 1.0.10 (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: 354.86
General statistics:
total time: 30.0011s
total number of events: 10647
Latency (ms):
min: 2.59
avg: 2.82
max: 19.53
95th percentile: 3.13
sum: 29974.28
Threads fairness:
events (avg/stddev): 10647.0000/0.00
execution time (avg/stddev): 29.9743/0.00
root@034420e445d:~#

```

Iteration Number	Number of Events per Second
1	357.13
2	355.90
3	356.54
4	357.91
5	354.86

### Statistics for Test Run 2:

- Average number of events per second: 356.47
- Maximum number of events per second: 357.91
- Minimum number of events per second: 354.86

### Test Run 3: Prime Limit = 200000

Now, we will be running the test script having cpu-max-prime=200000

```
Activities   Google Chrome Feb 4 04:36
root@034420e445d3: ~ /dockers_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: 14.00
General statistics:
total time: 30.0023s
total number of events: 428
Latency (ms):
min: 65.53
avg: 71.42
max: 144.56
95th percentile: 86.00
sum: 29997.32
Threads fairness:
events (avg/stddev): 428.0000/0.00
execution time (avg/stddev): 29.9973/0.00

Activities   Terminal Feb 4 04:37
root@034420e445d3: ~
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: 14.25
General statistics:
total time: 30.6376s
total number of events: 428
Latency (ms):
min: 65.59
avg: 70.17
max: 146.26
95th percentile: 86.03
sum: 36052.72
Threads fairness:
events (avg/stddev): 428.0000/0.00
execution time (avg/stddev): 30.6327/0.00

Activities   Terminal Feb 4 04:37
root@034420e445d3: ~
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: 14.27
General statistics:
total time: 30.6586s
total number of events: 429
Latency (ms):
min: 65.48
avg: 70.06
max: 149.73
95th percentile: 86.03
sum: 36053.83
Threads fairness:
events (avg/stddev): 429.0000/0.00
execution time (avg/stddev): 30.6538/0.00

Activities   Terminal Feb 4 04:38
root@034420e445d3: ~
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: 14.42
General statistics:
total time: 30.8340s
total number of events: 439
Latency (ms):
min: 65.39
avg: 68.40
max: 133.91
95th percentile: 73.13
sum: 36029.39
Threads fairness:
events (avg/stddev): 439.0000/0.00
execution time (avg/stddev): 30.8294/0.00
```

```

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)

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: 14.36

General statistics:
  total time:          30.0198s
  total number of events: 431

Latency (ms):
  mtn:                63.59
  avg:                69.64
  std:                180.84
  95th percentile:    78.60
  sum:               30014.15

Threads fairness:
  events (avg/stddev): 431.0000/0.00
  execution time (avg/stddev): 30.0142/0.00

root@3442be445d1:#

```

Iteration Number	Number of Events per Second
1	14.00
2	14.25
3	14.27
4	14.62
5	14.36

#### Statistics for Test Run 3:

- Average number of events per second: 14.30
- Maximum number of events per second: 14.62
- Minimum number of events per second: 14.00

#### File I/O Testing

For file testing, we will be testing a system with sequential read-write and combined random read-write.

```

$ sysbench --num-threads=16 --test=fileio --file-total-size=2G --time=30 --file-test-mode=<test_mode> prepare

$ sysbench --num-threads=16 --test=fileio --file-total-size=2G --time=30 --file-test-mode=<test_mode> run

$ sysbench --num-threads=16 --test=fileio --file-total-size=2G --time=30 --file-test-mode=<test_mode> cleanup

```

### *Test Run 1: Mode = Sequential*

Here, the sysbench is generating 128 files summing up to 2 GB

#### **Iteration 1**

```
Activities Terminal Feb 4 04:39
root@034420e445d3:~/WORKS/FILED_SEQ.sh
WARNING: --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, 16MB 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.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
Creating file test_file.45
Creating file test_file.46
creating file test_file.47
```

```
Activities Google Chrome Feb 4 04:40
root@034420e445d3:~/
Creating file test_file.82
Creating file test_file.83
Creating file test_file.84
Creating file test_file.85
Creating file test_file.86
Creating file test_file.87
Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 11.70 seconds (175.00 MB/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
```

```

Activities Terminal Feb 4 04:40
root@034420e445d3:~-

Creating file test_file.0
Creating file test_file.1
2147483648 bytes written in 11.70 seconds (175.00 MB/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 LuCI 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, 10MB each
2GiB total file size
Block size: 1024
periodic fsync enabled, calling fsync() each 100 requests.
Calling fsync() at the end of test, Enabled.
Using synchronous I/O mode
Using sequential rewrites
Initializing worker threads...

Threads started!

File operations:
  reads/s:          0.00
  writes/s:        7717.83
  fsyncs/s:       9945.58

Throughput:
  read, MiB/s:      0.00
  written, MiB/s: 126.58

General statistics:
  total time:           30.0227s
  total number of events: 528263

Latency (ms):
  min:                 0.91
  max:                103.44
  avg:                  0.90
  95th percentile:     0.32
  sum:                475879.31

Threads Fairness:
  events (avg/stddev): 33016.4375/911.45
  execution time (avg/stddev): 29.7425/0.62

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 LuCI 2.1.0-beta3)

Removing test files...
root@034420e445d3:#

```

## Iteration 2

```

Activities Terminal Feb 4 04:42
root@034420e445d3:~-

root@034420e445d3:~# ./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 LuCI 2.1.0-beta3)

128 files, 10MB each, 256MiB total
Creating files for the test.
Extra file open flags: (none)
Creating file test_file.0
Creating file test_file.1
Creating file test_file.2
Creating file test_file.3
Creating file test_file.4
Creating file test_file.5
Creating file test_file.6
Creating file test_file.7
Creating file test_file.8
Creating file test_file.9
Creating file test_file.10
Creating file test_file.11
Creating file test_file.12
Creating file test_file.13
Creating file test_file.14
Creating file test_file.15
Creating file test_file.16
Creating file test_file.17
Creating file test_file.18
Creating file test_file.19
Creating file test_file.20
Creating file test_file.21
Creating file test_file.22
Creating file test_file.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
Creating file test_file.45
Creating file test_file.46
Creating file test_file.47

```

```
Activities Terminal Feb 4 04:42
root@034420e445d3:~ [1]
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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
1547483648 bytes written in 11.23 seconds (182.40 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 1.0.10 (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 memory size
Block size 16kib
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling sync() at the end of test, Enabled.
Using synchronous I/O mode
Doing sequential rewrite test
```

```
Activities Terminal Feb 4 04:42
root@034420e445d3:~ [1]
Creating file test_file.126
Creating file test_file.127
1547483648 bytes written in 11.23 seconds (182.40 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 1.0.10 (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 memory size
Block size 16kib
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling sync() 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:        8666.61
  fsyncs/s:       11882.32

Throughput:
  read, MiB/s:     0.00
  written, MiB/s: 134.48

General statistics:
  total time:      30.0280s
  total number of events: 589207

Latency (ms):
  min:              0.01
  avg:             84.81
  max:            89.78
  95th percentile: 5.88
  sum:           475095.21

Threads fairness:
  events /avg/stddev: 36825.4375/902.06
  execution time /avg/stddev: 29.0935/0.01

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 1.0.10 (using system LuaJIT 2.1.0-beta3)

Removing test files...
root@034420e445d3:~ [1]
```

### Iteration 3

```
Activities Terminal Feb 4 04:44
root@034420e445d3: ~

root@034420e445d3:~/DOCKERFILETEST-3GB.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 1.0.10 (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.1
Creating file test_file.2
Creating file test_file.3
Creating file test_file.4
Creating file test_file.5
Creating file test_file.6
Creating file test_file.7
Creating file test_file.8
Creating file test_file.9
Creating file test_file.10
Creating file test_file.11
Creating file test_file.12
Creating file test_file.13
Creating file test_file.14
Creating file test_file.15
Creating file test_file.16
Creating file test_file.17
Creating file test_file.18
Creating file test_file.19
Creating file test_file.20
Creating file test_file.21
Creating file test_file.22
Creating file test_file.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
Creating file test_file.45
Creating file test_file.46
Creating file test_file.47

Activities Terminal Feb 4 04:44
root@034420e445d3: ~

Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 10.91 seconds (187.78 MB/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 1.0.10 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1024
Initializing random number generator from current time

Extra file open flags: (none)
128 files, 16MB each
2GiB total file size
Block size: 1024K
Perfetto sync 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!
```

```

Activities Terminal Fe0 4 04:44
root@034420e445d3: ~

Creating file test_file.128
Creating file test_file.127
2147483648 bytes written in 10.91 seconds (187.78 MB/sec).
WARNING: the -test option is deprecated, you can pass a script name or path on the command line without any options.
WARNING: the -runThreads 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, 16MB each
File size: 16MB
Block size 16kB
Periodic FSYNC enabled, calling fsync() each 100 requests.
Calling sync() at the end of test, Enabled.
Using /dev/zero as a data source
Doing sequential rewrite test
Initializing worker threads...

Threads started!

File operations:
  reads/s:          0.00
  writes/s:        9145.46
  fsyncs/s:       11772.06
Throughput:
  read, MB/s:      0.00
  written, MB/s: 142.98
General statistics:
  total time:      30.6249s
  total number of events: 626619
Latency (ms):
  min:             0.01
  avg:             0.76
  max:            138.51
  95th percentile: 5.67
  sum:           475162.61
Threads fairness:
  events (avg/stddev): 39126.17/8.86,46
  execution time (avg/stddev): 29.6977/8.62
WARNING: the -test option is deprecated, You can pass a script name or path on the command line without any options.
WARNING: the -runThreads is deprecated, use --threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
root@034420e445d3: ~#

```

Serial run iterations	Results	
1	reads/s	0.00
	writes/sec	7717.03
	fsyncs/s	9945.58
	events/s	17595.45
2	reads/s	0.00
	writes/sec	8606.61
	fsyncs/s	11082.32
	events/s	19621.92
3	reads/s	0.00
	writes/sec	9145.46
	fsyncs/s	11772.06
	events/s	20850.59

## *Test Run 2: Mode = Combined Random*

Here, the sysbench is generating 128 files summing up to 2 GB

### **Iteration 1**

```
Activities Terminal Feb 4 04:48
root@034420e445d3:~# ./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
Creating file test_file.17
Creating file test_file.18
Creating file test_file.19
Creating file test_file.20
Creating file test_file.21
Creating file test_file.22
Creating file test_file.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
Creating file test_file.45
Creating file test_file.46
Creating file test_file.47
```

```
Activities Terminal Feb 4 04:48
root@034420e445d3:~# ./DOCKER_FILEIO_RNDRW.sh
Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 11.23 seconds (182.32 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
```

```

Activities Terminal Feb 4 04:49
root@034420e445d3: ~

2147483648 bytes written in 11.23 seconds (182.32 MB/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: 10
Initializing random number generator from current time

Extra file open Flags: (none)
128 files, 10KB each
20GB total size
Block size 10KB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Performs 100 requests (including fsync) each 100 requests.
Calling sync() 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:           3161.79
  writes/s:          2107.59
  fsyncs/s:          6809.38

Throughput:
  read, MB/s:        49.40
  written, MB/s:     32.93

General statistics:
  total time:        30.03975
  total number of events: 360816

Latency (ms):
  min:               0.00
  avg:                1.33
  max:              125.87
  95th percentile:   4.18
  sum:            478692.91

Threads fairness:
  events (avg/stddev): 22551.0000/174.74
  execution time (avg/stddev): 29.9183/0.01

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@034420e445d3: ~

```

## Iteration 2

```

Activities Terminal Feb 4 04:51
root@034420e445d3: ~

root@034420e445d3:~/# ./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, 10384KB 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.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
Creating file test_file.45
Creating file test_file.46
Creating file test_file.47

```

```
Activities Terminal Feb 4 04:51
root@034420e445d3: ~

Creating file test_file.82
Creating file test_file.83
Creating file test_file.84
Creating file test_file.85
Creating file test_file.86
Creating file test_file.87
Creating file test_file.88
Creating file test_file.89
Creating file test_file.90
Creating file test_file.91
Creating file test_file.92
Creating file test_file.93
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 12.04 seconds (170.10 MB/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 -t 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
```

```
Activities Terminal Feb 4 04:51
root@034420e445d3: ~

2147483648 bytes written in 12.04 seconds (170.10 MB/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 -t 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)
1048576 bytes each
256MB total file size
block size 16KB
Number of IO requests: 0
Read/Write ratio for combined random IO test: 1.50
Per thread IO requests (calling sync() each 100 requests.
Calling sync() at the end of test, Enabled.
Using synchronous I/O mode
Doing random r/w test
Initializing worker threads...
1threads started!

File operations:
 reads/s:           3110.87
 writes/s:          2873.63
 fsyncs/s:          6702.26

Throughput:
 read, MB/s:        48.61
 written, MB/s:     32.46

General statistics:
 total time:        30.0300s
 total number of events: 354933

Latency (ms):
 min:                0.00
 avg:                1.35
 max:                76.79
 95th percentile:   4.33
 sum:               478653.47

Threads fairness:
 events (avg/stddev): 22183.3125/282.66
 execution time (avg/stddev): 29.9158/0.00

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 -t threads instead
sysbench 1.0.18 (using system LuaJIT 2.1.0-beta3)

Removing test files...
root@034420e445d3: ~
```

### Iteration 3

```
Activities Terminal Feb 4 04:57
root@034420e445d3:~/[0]# ./FILEIO_RND00W.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, 10MB each, 2640MB total
Creating files for the test...
Extra file open flags: (none)
Creating file test_file.0
Creating file test_file.1
Creating file test_file.2
Creating file test_file.3
Creating file test_file.4
Creating file test_file.5
Creating file test_file.6
Creating file test_file.7
Creating file test_file.8
Creating file test_file.9
Creating file test_file.10
Creating file test_file.11
Creating file test_file.12
Creating file test_file.13
Creating file test_file.14
Creating file test_file.15
Creating file test_file.16
Creating file test_file.17
Creating file test_file.18
Creating file test_file.19
Creating file test_file.20
Creating file test_file.21
Creating file test_file.22
Creating file test_file.23
Creating file test_file.24
Creating file test_file.25
Creating file test_file.26
Creating file test_file.27
Creating file test_file.28
Creating file test_file.29
Creating file test_file.30
Creating file test_file.31
Creating file test_file.32
Creating file test_file.33
Creating file test_file.34
Creating file test_file.35
Creating file test_file.36
Creating file test_file.37
Creating file test_file.38
Creating file test_file.39
Creating file test_file.40
Creating file test_file.41
Creating file test_file.42
Creating file test_file.43
Creating file test_file.44
Creating file test_file.45
Creating file test_file.46
Creating file test_file.47
```

```
Activities Terminal Feb 4 04:57
root@034420e445d3:~/[0]# ./FILEIO_RND00W.sh
Creating file test_file.94
Creating file test_file.95
Creating file test_file.96
Creating file test_file.97
Creating file test_file.98
Creating file test_file.99
Creating file test_file.100
Creating file test_file.101
Creating file test_file.102
Creating file test_file.103
Creating file test_file.104
Creating file test_file.105
Creating file test_file.106
Creating file test_file.107
Creating file test_file.108
Creating file test_file.109
Creating file test_file.110
Creating file test_file.111
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 10.90 seconds (187.88 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, 10MB each
2GB total file size
1000 requests
Number of IO requests: 6
Read/Write ratio for combined random IO test: 1.50
Periodic FSYNC is disabled, calling fsync() each 100 requests.
Call sync_file_range() at the end of test, Enabled.
Using synchronous I/O mode.
Doing random r/w test
Initializing worker threads...
```

```

Activities Terminal Fe6 4 04:57
root@034420e445d3:~-
2147483648 bytes written in 10.96 seconds (187.88 kB/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, 10MB each
2000 requests per file
Block size 16KB
Number of IO requests: 6
Read/Write ratio for combined random IO test: 1:50
Performing random I/O test, calling sync() each 100 requests.
Calling sync() 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:           3123.89
  writes/s:          2082.31
  fsyncs/s:          6731.65

Throughput:
  read, MB/s:        48.81
  written, MB/s:     32.54

General statistics:
  total time:        38.0201s
  total number of events: 356349

Latency (ms):
  min:               0.00
  q50:              1.34
  avg:               1.34
  max:              87.70
  95th percentile:  4.25
  sum:              478685.48

Threads fairness:
  events (avg/stddev): 22271.8125/333.42
  execution time (avg/stddev): 29.9176/0.60

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@034420e445d3:#

```

Combined run iterations	Results	
1	reads/s	3161.79
	writes/sec	2107.58
	fsyncs/s	6809.38
	events/s	12011.31
2	reads/s	3110.87
	writes/sec	2073.63
	fsyncs/s	6702.26
	events/s	11819.28
3	reads/s	3123.89
	writes/sec	2082.31
	fsyncs/s	6731.65
	events/s	11870.35

## Conclusion

As we increase the maximum prime number limit from 2000 to 200000, i.e., cpu-max-prime argument value, the number of events per second is decreasing. The same holds true for QEMU and Docker test environments. As we compare the QEMU with Docker, they have very close results and shows that QEMU is slightly faster. If we increase the system resources, there is no significant difference in the performances.

As we could gather, sequential rewrites are faster than combined random read and writes based on the number of events per second, writes per second and file syncs per second. We can additionally say that Docker was faster than QEMU. And even if we increase the system resources, there is no significant difference in the performances.

## Docker Container History

Image 1: 2 Cores with 2GB RAM (docker\_x2\_2g)

```
root@c30515dfed54:/ nisarg@ZBook: ~
nisarg@ZBook: $ docker ps
CONTAINER ID IMAGE COMMAND CREATED STATUS PORTS NAMES
034420e445d3 ubuntu:20.04 "/bin/bash" 14 hours ago Up 25 minutes
c30515dfed54 ubuntu:20.04 "/bin/bash" 17 hours ago Up 3 minutes
nisarg@ZBook: $ docker commit c30515dfed54 docker_x2_2g
invalid reference format: repository name must be lowercase
nisarg@ZBook: $ docker commit c30515dfed54 docker_x2_2g
sha256:32ee743ca1035176364f3227e679d13f945b7a6490fcfaf1f166e2289e453756
nisarg@ZBook: $ docker history docker_x2_2g
IMAGE CREATED CREATED BY SIZE COMMENT
32ee743ca103 14 seconds ago /bin/bash 61.9MB
e40cf56b4be3 3 days ago /bin/sh -c #(nop) CMD ["/bin/bash"] 0B
<missing> 3 days ago /bin/sh -c #(nop) ADD file:8b180a9b4497de0c6... 72.8MB
<missing> 3 days ago /bin/sh -c #(nop) LABEL org.opencontainers.... 0B
<missing> 3 days ago /bin/sh -c #(nop) LABEL org.opencontainers.... 0B
<missing> 3 days ago /bin/sh -c #(nop) ARG LAUNCHPAD_BUILD_ARCH 0B
<missing> 3 days ago /bin/sh -c #(nop) ARG RELEASE 0B
nisarg@ZBook: $
```

Image 2: 2 Cores with 3GB RAM (docker\_x2\_3g)

```
root@c30515dfed54:/ nisarg@ZBook: ~
nisarg@ZBook: $ docker commit 034420e445d3 docker_x2_3g
sha256:a2c1673489a4c82b0ea3e423b495a0e59123eb2f9e556c2fea987d168874540e
nisarg@ZBook: $ docker history docker_x2_3g
IMAGE CREATED CREATED BY SIZE COMMENT
a2c1673489a4 13 seconds ago /bin/bash 61.9MB
e40cf56b4be3 3 days ago /bin/sh -c #(nop) CMD ["/bin/bash"] 0B
<missing> 3 days ago /bin/sh -c #(nop) ADD file:8b180a9b4497de0c6... 72.8MB
<missing> 3 days ago /bin/sh -c #(nop) LABEL org.opencontainers.... 0B
<missing> 3 days ago /bin/sh -c #(nop) LABEL org.opencontainers.... 0B
<missing> 3 days ago /bin/sh -c #(nop) ARG LAUNCHPAD_BUILD_ARCH 0B
<missing> 3 days ago /bin/sh -c #(nop) ARG RELEASE 0B
nisarg@ZBook: $
```

## Performance Analysis

In this section we are listing the disk and CPU utilization for QEMU and docker during the experimentations.

## QEMU Environment

### Disk Utilization

Configuration	Test Case	Results
2GB RAM 2 Cores	Sequential Re-write	Read = 0 MiB/s Write = 2936.75 MiB/s
	Combined Random Read-Write	Read = 874.02 MiB/s Write = 582.60 MiB/s
3GB RAM 2 Cores	Sequential Re-write	Read = 0 MiB/s Write = 3153.10 MiB/s
	Combined Random Read-Write	Read = 999.73 MiB/s Write = 666.50 MiB/s

### CPU Utilization

CPU Usage		79.1%
Kernel Usage	User Level	13.7%
	System Level	9.7%
	Idle	63.3%

```

Activities Terminal Feb 4 18:50
nisarg@ZBook: ~
nisarg@ZBook: ~
nisarg@ZBook: ~
nisarg@ZBook: ~

nisarg@ZBook: $ top
top - 18:50:25 up 43 min, 2 users, load average: 1.35, 2.06, 2.14
Tasks: 114 total, 1 running, 1 sleeping, 0 stopped, 0 zombie
Mem:  7824.0 total, 134.2 free, 4839.5 used, 2850.3 buff/cache
Hib Mem:  7824.0 total, 134.2 free, 4839.5 used, 2850.3 buff/cache
Hib Swap: 2048.0 total, 345.7 free, 1702.2 used, 325.3 avail Mem

      PID USER      PR  NI    VIRT    RES   %CPU  %MEM    TIME+ COMMAND
21234 root      20   0  4122900  2.5g 14828 79.1 32.4  1:14.60 qemu-system-x86
14855 ntsarg   20   0  608980  2.5g 14828 5 21.6  0:00.00 ksmarg_g
3947 ntsarg   20   0  4380792  1.8g 14828 5 21.0  0:00.00 qemu-system-x86
7459 ntsarg   20   0  1138.9g 65188 27516 5 1.7  0.8  0:27.92 chrome
7157 ntsarg   20   0  33.0g 65840 41284 5 1.3  0.8  1:03.04 chrome
3256 ntsarg   20   0  1174360 79632 4 5 0.7  1.0  0:08.62 snap-store
7161 ntsarg   20   0  32.4g 35536 24264 5 0.7  0.4  0:20.25 chrome
14855 ntsarg   20   0  570064 33260 22960 5 0.7  0.4  0:13.05 gnome-terminal-
1 root      20   0  0  0  0  0  0  0.0  0.0  0:00.00 init
187 root     0 -20  0  0  0  0  0  0.0  0.0  0:00.30 worker@/dev:kblockd
199 root     0 -20  0  0  0  0  0  0.0  0.0  0:00.05 worker@/3:dev:kblockd
263 root    19 -1  244400 21492 19788 5 0.3  0.3  0:09.32 systemd-journal
2833 ntsarg   20   0  5456200 145836 46696 5 0.3  1.8  1:45.13 gnome-shell
3498 ntsarg   20   0  755948 21540 5744 5 0.3  0.3  0:31.49 com.docker.back
3555 ntsarg   20   0  608980 29960 8548 5 0.3  0.4  0:23.83 Xwayland
3680 ntsarg   20   0  608980 29960 8548 5 0.3  0.4  0:23.83 Xwayland
3802 ntsarg   20   0  728860 9936 2324 5 0.3  0.1  0:03.61 com.docker.back
7110 ntsarg   20   0  32.6g 114880 33088 5 0.3  1.4  1:15.88 chrome
16261 ntsarg  20   0  1129.9g 82676 28160 5 0.3  1.0  0:06.97 chrome
22538 ntsarg  20   0  21984 3848 2884 R 0.3  0.0  0:00.06 top
1 root      20   0  171504 11984 3664 5 0.0  0.1  0:14.97 systemd
2 root      20   0  0  0  0  0  0.0  0.0  0:00.00 kthread
3 root     0 -20  0  0  0  0  0  0.0  0.0  0:00.00 rcu_bh
4 root     0 -20  0  0  0  0  0  0.0  0.0  0:00.00 rCU_par_g
5 root     0 -20  0  0  0  0  0  0.0  0.0  0:00.00 slab_flushq
6 root     0 -20  0  0  0  0  0  0.0  0.0  0:00.00 netns
8 root     0 -20  0  0  0  0  0  0.0  0.0  0:00.00 kworker@0:0-h-events_highpri
10 root    0 -20  0  0  0  0  0  0.0  0.0  0:00.00 mm_percpu_wq
12 root    20   0  0  0  0  0  0.0  0.0  0:00.00 rcu_tasks_rude_
13 root    20   0  0  0  0  0  0.0  0.0  0:00.00 user-space-trace
13 root    20   0  0  0  0  0  0.0  0.0  0:00.20 ksoftirqd/0
14 root    20   0  0  0  0  0  0.0  0.0  0:02.01 rcu_sched
15 root    rt  0  0  0  0  0  0.5  0.0  0.0  0:00.01 migration/0
16 root    -51  0  0  0  0  0  0.5  0.0  0.0  0:00.00 idle_inject/0
18 root    20   0  0  0  0  0  0.5  0.0  0.0  0:00.00 cpuhp/0
19 root    20   0  0  0  0  0  0.5  0.0  0.0  0:00.00 cpuhp/1
20 root    -51  0  0  0  0  0  0.5  0.0  0.0  0:00.00 migration/1
21 root    rt  0  0  0  0  0  0.5  0.0  0.0  0:00.13 migration/1
22 root    20   0  0  0  0  0  0.5  0.0  0.0  0:00.23 ksoftirqd/1
24 root    0 -20  0  0  0  0  0.1  0.0  0.0  0:00.00 cpuhp/2
25 root    20   0  0  0  0  0  0.5  0.0  0.0  0:00.00 tidle_inject/2
26 root    -51  0  0  0  0  0  0.5  0.0  0.0  0:00.13 migration/2
27 root    rt  0  0  0  0  0  0.5  0.0  0.0  0:00.13 migration/2
28 root    20   0  0  0  0  0  0.5  0.0  0.0  0:00.96 ksoftirqd/2

```

## Docker Environment

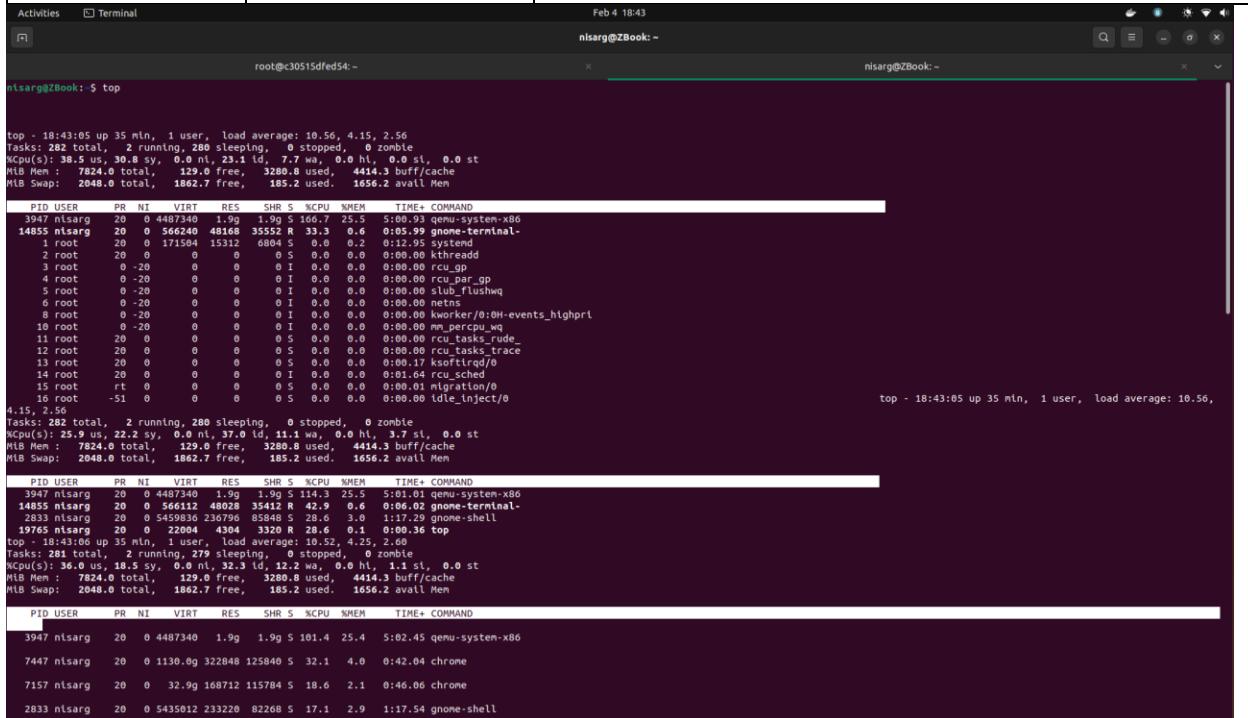
### Disk Utilization

Configuration	Test Case	Results
2GB RAM 2 Cores	Sequential Re-write	Read = 0 MiB/s Write = 9048.29 MiB/s
	Combined Random Read-Write	Read = 3177.89 MiB/s Write = 2118.37 MiB/s

3GB RAM 2 Cores	Sequential Re-write	Read = 0 MiB/s Write = 8489.7 MiB/s
	Combined Random Read-Write	Read = 3132.18 MiB/s Write = 2087.84 MiB/s

## CPU Utilization

CPU Usage		33.3%
Kernel Usage	User Level	38.5%
	System Level	30.8%
	Idle	23.1%



The screenshot shows two terminal windows. The left window displays the output of the 'top' command, which provides real-time information about system processes. It shows the following details:

- System load average: 10.56, 4.15, 2.65 over the last 1, 5, and 15 minutes respectively.
- Tasks: 282 total, 2 running, 280 sleeping, 0 stopped, 0 zombie.
- Processor usage: 25.9 us, 22.2 sy, 0.0 nt, 37.0 ld, 11.1 wa, 0.0 hi, 3.7 st, 0.0 st.
- Memory: 7824.0 total, 129.0 free, 3280.8 used, 4414.3 buff/cache.
- Swap: 2048.0 total, 1862.7 free, 185.2 used, 1656.2 avail Mem.

The right window shows the command 'nisarg@ZBook:~\$ top' being run.

## Extra Credit

### Dockerfile

The dockerfile has config steps for building a docker image from Ubuntu 20.04 version with necessary test scripts. The test scripts and setup scripts need to be placed in the same folder.

```
$ docker build -f Dockerfile -t new_image .
$ docker run -it new_image
```

The above commands will build the docker image and spin it up with needed test scripts. We can run the test scripts using below command:

```
$ bash SETUP.sh
```

```

Activities Terminal
Feb 5 00:59
root@a99729aa137f:/

ntsarg@ZBook:~/Documents/Cloud_Files/Cloud-Computing/HW1$ docker build -f Dockerfile -t new_image .
[+] Building 1.3s (15/15) FINISHED
--> [internal] load build definition from Dockerfile
--> >> transferring dockerfile: 38B
--> [internal] load .dockerignore
--> >> transferring context: 2B
--> resolve image config for docker.io/docker/dockerfile:1
--> [auth] docker/dockerfile:pull token for registry-1.docker.io
--> CACHED docker IMAGE://docker.io/docker/dockerfile:1@sha256:d2d74ff22a0e47b21f4bbde337e2ac4cd0a02a2226ef79264878db3dc7e87df8
--> [internal] load .dockerignore
--> [internal] load build definition from Dockerfile
--> [internal] load metadata for docker.io/library/ubuntu:20.04
--> [1/5] FROM docker.io/library/ubuntu:20.04
--> [internal] load build context
--> >> transferring context: 63B
--> CACHED [2/5] RUN apt-get update && apt-get install -y sysbench
--> CACHED [3/5] ADD DOCKER.tar.gz .
--> CACHED [4/5] COPY SETUP.sh .
--> CACHED [5/5] RUN chmod +R 777 /DOCKER && cd /DOCKER && mv *.sh ../
--> exporting layers
-->> writing image sha256:62108948d3739f027a09ec4d7fe6f93303bfbc8800a95a0954adb427ea74f
-->> naming to docker.io/library/new_image

Use 'docker scan' to run Snyk tests against images to find vulnerabilities and learn how to fix them
ntsarg@ZBook:~/Documents/Cloud_Files/Cloud-Computing/HW1$ docker run -it new_image bash
root@a99729aa137f:#
DOCKER_20000_CPU.sh DOCKER_FILEIO_RNDRW.sh SETUP.sh boot etc lib lib64 media opt root sbin sys usr
DOCKER_20000_CPU.sh DOCKER_2000_CPU.sh DOCKER_FILEIO_SEQ.sh bin dev home lib32 libx32 mnt proc run srv tmp var
root@a99729aa137f:#

```

## VagrantFile

The vagrant is a cloud infrastructure resource manager by HashiCorp. It can be provisioned on top of various providers like VirtualBox, VMWare, Docker, etc. Here, we have done using VirtualBox has the primary provider using **Ubuntu/Trusty64** as base image.

```
$ vagrant -v
```

```

MINGW64:/c/Users/nisar/OneDrive - scu.edu/COEN 241 - CC/Cloud-Computing/HW1

Nisarg@DESKTOP-TSHS2SF MINGW64 ~/OneDrive - scu.edu/COEN 241 - CC/Cloud-Computing/HW1 (main)
$ vagrant -v
Vagrant 2.3.4

Nisarg@DESKTOP-TSHS2SF MINGW64 ~/OneDrive - scu.edu/COEN 241 - CC/Cloud-Computing/HW1 (main)
$
```

```
$ vagrant box add ubuntu/trusty64
```

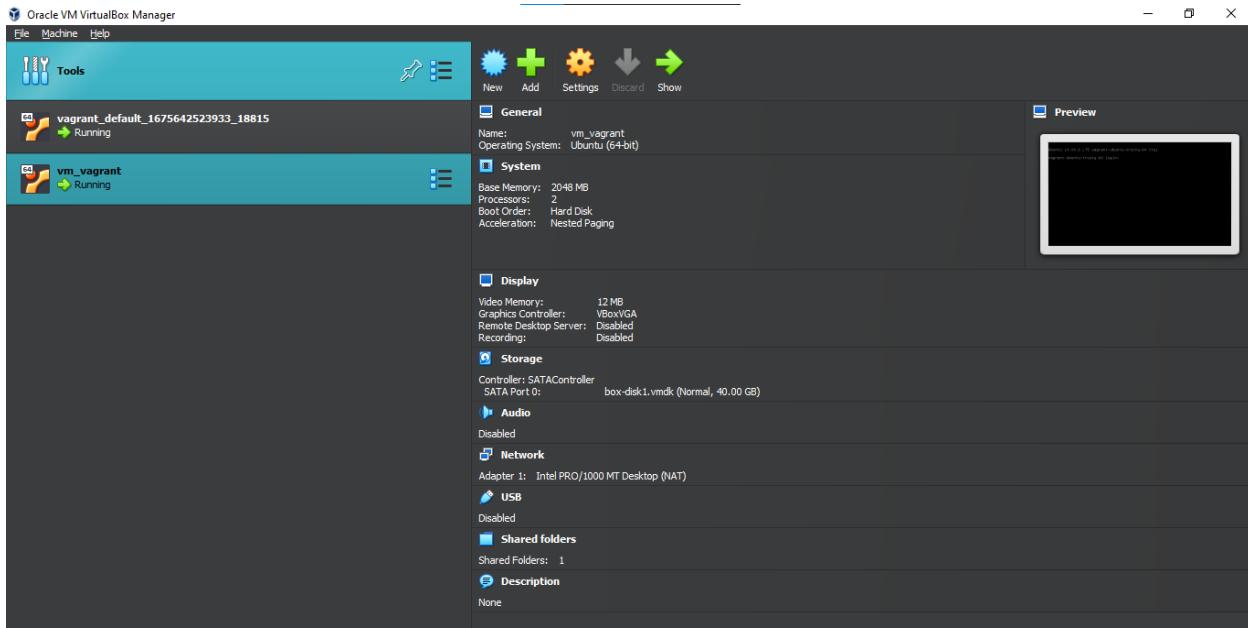
Now, we need to create a VagrantFile using Ruby's syntax and then use following command to spin up new VM.

```
$ vagrant up --provider=virtualbox
```

```

MINGW64:/c/Users/nisar/OneDrive - scu.edu/COEN 241 - CC/Cloud-Computing/HW1

Nisarg@DESKTOP-TSHS2SF MINGW64 ~/OneDrive - scu.edu/COEN 241 - CC/Cloud-Computing/HW1 (main)
$ vagrant up --provider=virtualbox
Bringing machine 'default' up with 'virtualbox' provider...
==> default: Importing base box 'ubuntu/trusty64'...
==> default: Matching MAC address for NAT networking...
==> default: Checking if box 'ubuntu/trusty64' version '20190514.0.0' is up to date...
==> default: Setting the name of the VM: vm_vagrant
==> default: Clearing any previously set forwarded ports...
==> default: Fixed port collision for 22 => 2222. Now on port 2200.
==> default: Clearing any previously set network interfaces...
==> default: Preparing network interfaces based on configuration...
    default: Adapter 1: nat
==> default: Forwarding ports...
    default: 22 (guest) => 2200 (host) (adapter 1)
```



## Git Repository

Account Name	bhalavat-nisarg
Repository Name	Cloud-Computing
Folder Containing HW	HW1
Link to Repo	<a href="https://github.com/bhalavat-nisarg/Cloud-Computing">https://github.com/bhalavat-nisarg/Cloud-Computing</a>