

COEN 241 Homework 1

Setup details

Operating System: Kubuntu 20.10

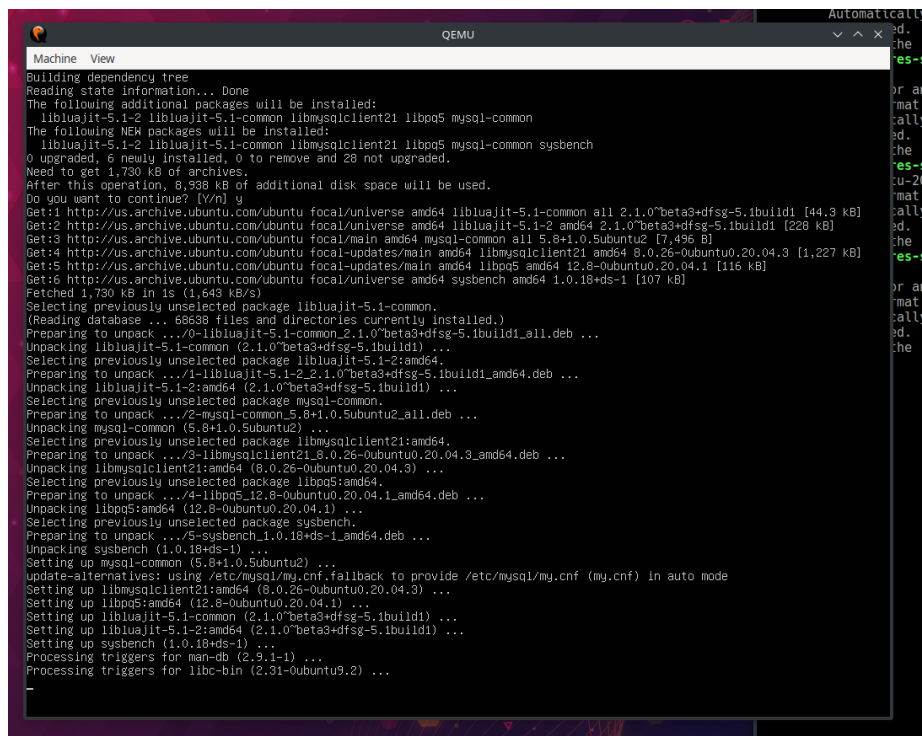
Kernel Version: 5.8.0-63-generic

OS Type: 64-bit

Processors: 8 × Intel® Core™ i7-1065G7 CPU @ 1.30GHz

Memory: 15.3 GiB of RAM

Graphics Processor: Mesa Intel® Iris® Plus Graphics



```
Machine View
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  liblua5.1-2 liblua5.1-common libmysqlclient21 libpq5 mysql-common
The following NEW packages will be installed:
  liblua5.1-2 liblua5.1-common libmysqlclient21 libpq5 mysql-common sysbench
0 upgraded, 6 newly installed, 0 to remove and 28 not upgraded.
Need to get 1,730 kB of archives.
After this operation, 8,938 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://us.archive.ubuntu.com/ubuntu focal/universe amd64 liblua5.1-common all 2.1.0~beta3+dfsg-5.1build1 [44.3 kB]
Get:2 http://us.archive.ubuntu.com/ubuntu focal/universe amd64 liblua5.1-2 amd64 2.1.0~beta3+dfsg-5.1build1 [228 kB]
Get:3 http://us.archive.ubuntu.com/ubuntu focal/main amd64 mysql-common all 5.8+1.0.5ubuntu2 [7,496 B]
Get:4 http://us.archive.ubuntu.com/ubuntu focal-updates/main amd64 libmysqlclient21 amd64 8.0.26-0ubuntu0.20.04.3 [1,227 kB]
Get:5 http://us.archive.ubuntu.com/ubuntu focal-updates/main amd64 libpq5 amd64 12.8-0ubuntu0.20.04.1 [116 kB]
Get:6 http://us.archive.ubuntu.com/ubuntu focal/universe amd64 sysbench amd64 1.0.18+ds-1 [107 kB]
Fetched 1,730 kB in 1s (1,693 kB/s)
Selecting previously unselected package liblua5.1-common.
(Reading database ... 68638 files and directories currently installed.)
Preparing to unpack .../0-liblua5.1-common_2.1.0~beta3+dfsg-5.1build1_all.deb ...
Unpacking liblua5.1-common (2.1.0~beta3+dfsg-5.1build1) ...
Selecting previously unselected package liblua5.1-2:amd64.
Preparing to unpack .../1-liblua5.1-2_2.1.0~beta3+dfsg-5.1build1_amd64.deb ...
Unpacking liblua5.1-2:amd64 (2.1.0~beta3+dfsg-5.1build1) ...
Selecting previously unselected package mysql-common.
Preparing to unpack .../2-mysql-common_5.8+1.0.5ubuntu2_all.deb ...
Unpacking mysql-common (5.8+1.0.5ubuntu2) ...
Selecting previously unselected package libmysqlclient21:amd64.
Preparing to unpack .../3-libmysqlclient21_8.0.26-0ubuntu0.20.04.3_amd64.deb ...
Unpacking libmysqlclient21:amd64 (8.0.26-0ubuntu0.20.04.3) ...
Selecting previously unselected package libpq5:amd64.
Preparing to unpack .../4-libpq5_12.8-0ubuntu0.20.04.1_amd64.deb ...
Unpacking libpq5:amd64 (12.8-0ubuntu0.20.04.1) ...
Selecting previously unselected package sysbench.
Preparing to unpack .../5-sysbench_1.0.18+ds-1_amd64.deb ...
Unpacking sysbench (1.0.18+ds-1) ...
Setting up mysql-common (5.8+1.0.5ubuntu2) ...
update-alternatives: using /etc/mysql/my.cnf.fallback to provide /etc/mysql/my.cnf (my.cnf) in auto mode
Setting up libmysqlclient21:amd64 (8.0.26-0ubuntu0.20.04.3) ...
Setting up libpq5:amd64 (12.8-0ubuntu0.20.04.1) ...
Setting up liblua5.1-common (2.1.0~beta3+dfsg-5.1build1) ...
Setting up liblua5.1-2:amd64 (2.1.0~beta3+dfsg-5.1build1) ...
Setting up sysbench (1.0.18+ds-1) ...
Processing triggers for man-db (2.3.1-1) ...
Processing triggers for libc-bin (2.31-0ubuntu9.2) ...
```

Sysbench tests

sudo bash cpu.sh # see appendix

sudo bash file.sh

less cpu-test

less file-test

Results

sudo qemu-system-x86_64 -hda ubuntu.img -boot d -m 1536

Time results (5 trials): 30.874, 30.5345, 30.3964, 33.7535, 36.9213

Mean 32.49

Min 30.3964

Max 36.9213

StdDev 2.53

File I/O results (5 trials): 26.53, 27.07, 28.75, 24.03, 25.52

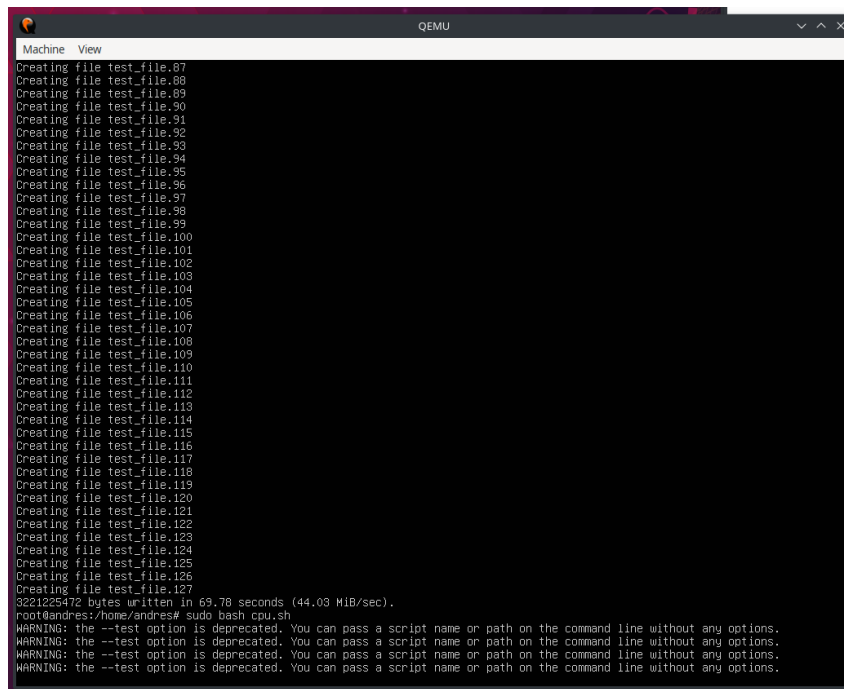
Mean 26.48

Min 24.03

Max 28.75

StdDev 1.57

`sudo qemu-system-x86_64 -hda ubuntu.img -boot d -smp 255`

A screenshot of a QEMU virtual machine window. The window title is "QEMU". The main display area shows a terminal output. The output consists of a list of file creation messages: "Creating file test_file.87" through "Creating file test_file.127". Below these, it says "322125472 bytes written in 69.78 seconds (44.03 MiB/sec)". There are also three warning messages: "WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options." repeated three times.

```
Machine View
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
322125472 bytes written in 69.78 seconds (44.03 MiB/sec).
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
WARNING: the --test option is deprecated. You can pass a script name or path on the command line without any options.
```

File I/O results (5 trials):

Time: 56.03, 73.85, 68.65, 66.56, 69.78 s

Mean 66.97

Min 56.03

Max 73.85

StdDev 5.96

Speed: 54.83, 41.6, 44.75, 46.15, 44.03 MiB/sec

Disk: 3072 Mb

CPU results (5 trials):

Time: 31.8, 34.3, 34.04, 35.145, 33.98 s

Mean 33.85

Min 31.8

Max 35.145
StdDev 1.11
Speed: .03, .03, .03, .03, .03 events/s

```
QEMU
Machine View
General statistics:
  total time:          13.9681s
  total number of events: 3
Latency (ms):
  min:                4653.17
  avg:                4655.98
  max:                4657.80
  95th percentile:    4683.57
  sum:                13967.94
Threads fairness:
  events (avg/stddev):  3.0000/0.00
  execution time (avg/stddev): 13.9679/0.00
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: 10000000
Initializing worker threads...
Threads started!

CPU speed:
  events per second:    0.21
General statistics:
  total time:          13.9990s
  total number of events: 3
Latency (ms):
  min:                4653.26
  avg:                4666.24
  max:                4680.60
  95th percentile:    4683.57
  sum:                13998.73
Threads fairness:
  events (avg/stddev):  3.0000/0.00
  execution time (avg/stddev): 13.9987/0.00
(END)
```

```
sudo qemu-system-x86_64 -hda ubuntu.img -boot d -smp 255 -accel kvm
```

File I/O results (5 trials):

Time: 7.32, 6.14, 11.94, 12.75, 12.16 s
Mean 10.062
Min 6.14
Max 12.75
StdDev 2.75
Speed: 419.45, 500.37, 257.32, 240.97, 252.63 MiB/sec
Disk: 3072 Mb

CPU results (5 trials):

Time: 13.969, 13.992, 13.978, 13.968, 13.999 s
Mean 13.9812
Min 13.968
Max 13.999
StdDev .012
Speed: .21, .21, .21, .21, .21 events/s

Docker

```
(base) andres@andres-spectre-kubuntu:~$ sudo docker images
REPOSITORY          TAG             IMAGE ID        CREATED         SIZE
ubuntu              latest         ba6accdd29     6 days ago     72.8MB
hello-world         latest         feb5d9fea6a5   4 weeks ago    13.3kB
csmnpp/ubuntu-sysbench latest         2787c5e16909   5 years ago    336MB
(base) andres@andres-spectre-kubuntu:~$ sudo docker ps
CONTAINER ID   IMAGE          COMMAND         CREATED        STATUS          PORTS          NAMES
e9035116f747   2787c5e16909  "/bin/bash"    7 minutes ago  Up 7 minutes           elastic_boyd
7a91187fd6ff   ubuntu        "bash"         20 minutes ago Up 20 minutes (Paused) ubuntu_bash
(base) andres@andres-spectre-kubuntu:~$
```

```
sysbench 0.4.12: multi-threaded system evaluation benchmark
```

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

```
Doing CPU performance benchmark
```

```
Threads started!
Done.
```

```
Maximum prime number checked in CPU test: 50000
```

```
Test execution summary:
```

```
total time:                29.9554s
total number of events:    10000
total time taken by event execution: 29.9535
per-request statistics:
  min:                2.70ms
  avg:                3.00ms
  max:                6.45ms
  approx. 95 percentile: 3.58ms
```

```
Threads fairness:
```

```
events (avg/stddev):    10000.0000/0.00
execution time (avg/stddev): 29.9535/0.00
```

```
sysbench 0.4.12: multi-threaded system evaluation benchmark
```

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

```
Doing CPU performance benchmark
```

```
Threads started!
Done.
```

```
Maximum prime number checked in CPU test: 50000
```

```
Test execution summary:
```

```
total time:                30.8763s
total number of events:    10000
total time taken by event execution: 30.8736
per-request statistics:
  min:                2.70ms
  avg:                3.09ms
  max:                9.81ms
  approx. 95 percentile: 3.44ms
```

```
Threads fairness:
```

```
events (avg/stddev):    10000.0000/0.00
execution time (avg/stddev): 30.8736/0.00
```

```
root@e9035116f747:/# cat cpu-test
```

sysbench --test=cpu --cpu-max-prime=50000 run >> cpu-test

CPU results (5 trials):

Time: 28.527, 29.094, 30.361, 29.955, 30.876 s

Mean 29.76

Min 28.527

Max 30.876

StdDev .85

Analysis

This homework involved running tests using sysbench in an Ubuntu virtual machine using the QEMU hypervisor as well as a Docker container. For QEMU, I used three different sets of options in the command line: -m 1536, -smp 255, and -accel kvm. I kept the test values the same in order to see the performance differences between these options. -m 1536 was my baseline that I targeted 30 seconds for, and then -smp (symmetric multiprocessing) was slightly slower. The fastest was -accel kvm which uses acceleration using kvm hardware assisted virtualization, which expectedly increased performance.

This homework also involved creating a docker container. I pulled an image from the web which had sysbench pre-installed and ran a similar test for the CPU benchmark, although after some testing, I had to set the max prime to only 50000 for my Docker container.

I ran all of these tests using the Ubuntu operating system with a dual-boot.

Appendix

Docker installation

installing docker

sudo apt update

sudo apt install \

apt-transport-https \

ca-certificates \

curl \

gnupg

curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo gpg --dearmor -o /usr/share/keyrings/docker-archive-keyring.gpg

echo "deb [arch=\$(dpkg --print-architecture)

signed-by=/usr/share/keyrings/docker-archive-keyring.gpg]

https://download.docker.com/linux/ubuntu \

\$(lsb_release -cs) stable" | sudo tee /etc/apt/sources.list.d/docker.list > /dev/null

sudo apt update

sudo apt install docker-ce docker-ce-cli containerd.io

sudo docker run hello-world

sudo docker pull csminpp/ubuntu-sysbench

sudo docker images

sudo docker ps

sudo docker run -it 2787c5e16909

this is the image id of the pulled image

QEMU installation

using ubuntu

sudo apt update

sudo apt install qemu

sudo qemu-system-x86_64 -hda ubuntu.img -boot d -cdrom

./ubuntu-20.04.3-live-server-amd64.iso -m 1536

run installation setup

sudo qemu-system-x86_64 -hda ubuntu.img -boot d -m 1536

enter ubuntu server

sudo apt update

sudo apt install sysbench

file.sh

```
#!/bin/sh
```

```
sysbench --num-threads=16 --test=fileio --file-total-size=3G --file-test-mode=rndrw run > file-test  
rm test_file.*
```

```
echo 3 > /proc/sys/vm/drop_caches
```

```
sysbench --num-threads=16 --test=fileio --file-total-size=3G --file-test-mode=rndrw run >> file-test  
echo 3 > /proc/sys/vm/drop_caches
```

```
sysbench --num-threads=16 --test=fileio --file-total-size=3G --file-test-mode=rndrw run >> file-test  
rm test_file.*
```

```
echo 3 > /proc/sys/vm/drop_caches
```

```
sysbench --num-threads=16 --test=fileio --file-total-size=3G --file-test-mode=rndrw run >> file-test  
rm test_file.*
```

```
echo 3 > /proc/sys/vm/drop_caches
```

```
sysbench --num-threads=16 --test=fileio --file-total-size=3G --file-test-mode=rndrw run >> file-test  
rm test_file.*
```

```
echo 3 > /proc/sys/vm/drop_caches
```

cpu.sh

```
#!/bin/sh
```

```
sysbench --test=cpu --cpu-max-prime=10000000 run > cpu-test
```

```
sysbench --test=cpu --cpu-max-prime=10000000 run >> cpu-test
```

```
sysbench --test=cpu --cpu-max-prime=10000000 run >> cpu-test
```

```
sysbench --test=cpu --cpu-max-prime=10000000 run >> cpu-test
```

```
sysbench --test=cpu --cpu-max-prime=10000000 run >> cpu-test
```