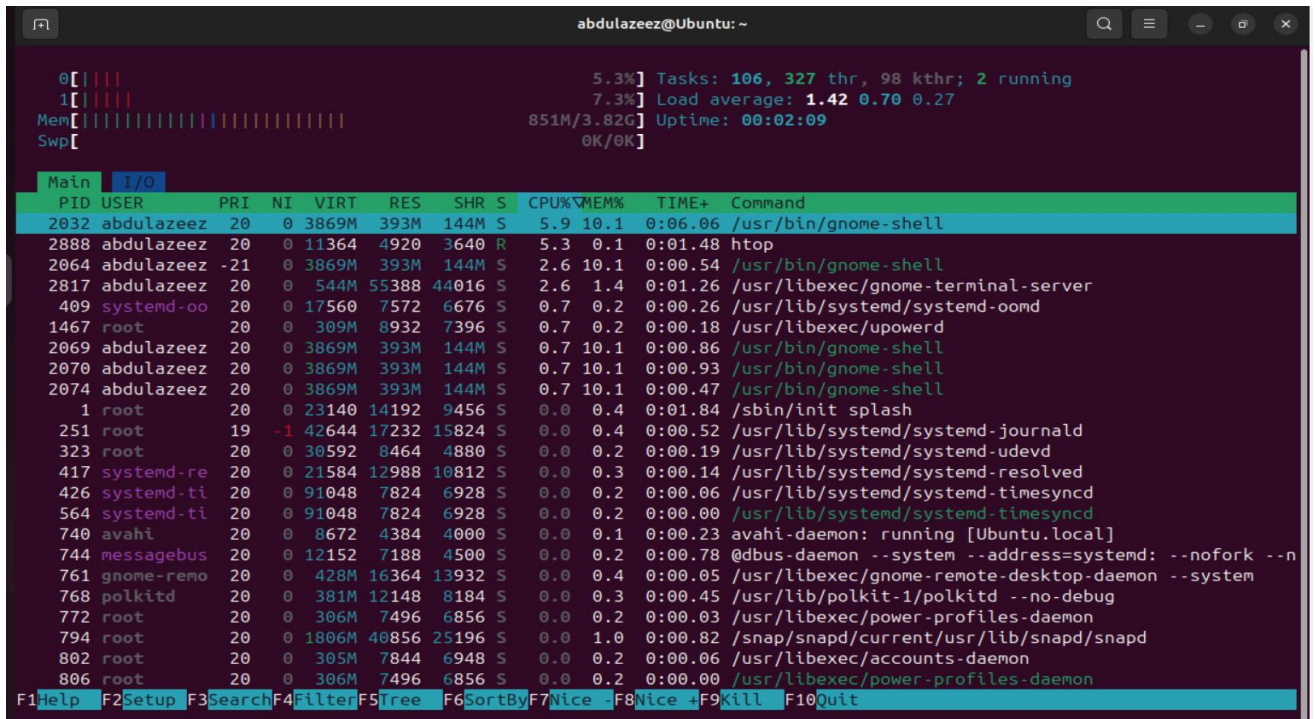


Week 6: Performance Evaluation & Analysis

1. Baseline Performance Test

Before doing any heavy testing, I opened htop to see how the system performs when it is not doing anything big. CPU usage was low, memory looked stable, and the load average was normal.



The screenshot shows the htop utility running on an Ubuntu system. The top status bar displays the following information:

- CPU: 5.3% (Tasks: 106, 327 thr, 98 kthr; 2 running)
- Load average: 1.42 0.70 0.27
- Memory: 851M/3.82G
- Uptime: 00:02:09
- Swap: 0K/0K

The main table lists running processes with the following columns: PID, USER, PRI, NI, VIRT, RES, SHR, S, CPU%, MEM%, TIME+, and Command. The processes are sorted by CPU usage, with the highest usage being 10.1% for several processes.

| PID | USER | PRI | NI | VIRT | RES | SHR | S | CPU% | MEM% | TIME+ | Command |
|------|------------|-----|----|-------|-------|-------|---|------|------|---------|---|
| 2032 | abdulazeer | 20 | 0 | 3869M | 393M | 144M | S | 5.9 | 10.1 | 0:06.06 | /usr/bin/gnome-shell |
| 2888 | abdulazeer | 20 | 0 | 11364 | 4920 | 3640 | R | 5.3 | 0.1 | 0:01.48 | htop |
| 2064 | abdulazeer | -21 | 0 | 3869M | 393M | 144M | S | 2.6 | 10.1 | 0:00.54 | /usr/bin/gnome-shell |
| 2817 | abdulazeer | 20 | 0 | 544M | 55388 | 44016 | S | 2.6 | 1.4 | 0:01.26 | /usr/libexec/gnome-terminal-server |
| 409 | systemd-oo | 20 | 0 | 17560 | 7572 | 6676 | S | 0.7 | 0.2 | 0:00.26 | /usr/lib/systemd/systemd-oomd |
| 1467 | root | 20 | 0 | 309M | 8932 | 7396 | S | 0.7 | 0.2 | 0:00.18 | /usr/libexec/upowerd |
| 2069 | abdulazeer | 20 | 0 | 3869M | 393M | 144M | S | 0.7 | 10.1 | 0:00.86 | /usr/bin/gnome-shell |
| 2070 | abdulazeer | 20 | 0 | 3869M | 393M | 144M | S | 0.7 | 10.1 | 0:00.93 | /usr/bin/gnome-shell |
| 2074 | abdulazeer | 20 | 0 | 3869M | 393M | 144M | S | 0.7 | 10.1 | 0:00.47 | /usr/bin/gnome-shell |
| 1 | root | 20 | 0 | 23140 | 14192 | 9456 | S | 0.0 | 0.4 | 0:01.84 | /sbin/init splash |
| 251 | root | 19 | -1 | 42644 | 17232 | 15824 | S | 0.0 | 0.4 | 0:00.52 | /usr/lib/systemd/systemd-journald |
| 323 | root | 20 | 0 | 30592 | 8464 | 4880 | S | 0.0 | 0.2 | 0:00.19 | /usr/lib/systemd/systemd-udev |
| 417 | systemd-re | 20 | 0 | 21584 | 12988 | 10812 | S | 0.0 | 0.3 | 0:00.14 | /usr/lib/systemd/systemd-resolved |
| 426 | systemd-ti | 20 | 0 | 91048 | 7824 | 6928 | S | 0.0 | 0.2 | 0:00.06 | /usr/lib/systemd/systemd-timesyncd |
| 564 | systemd-ti | 20 | 0 | 91048 | 7824 | 6928 | S | 0.0 | 0.2 | 0:00.00 | /usr/lib/systemd/systemd-timesyncd |
| 740 | avahi | 20 | 0 | 8672 | 4384 | 4000 | S | 0.0 | 0.1 | 0:00.23 | avahi-daemon: running [Ubuntu.local] |
| 744 | messagebus | 20 | 0 | 12152 | 7188 | 4500 | S | 0.0 | 0.2 | 0:00.78 | @dbus-daemon --system --address=systemd: --nofork --n |
| 761 | gnome-remo | 20 | 0 | 428M | 16364 | 13932 | S | 0.0 | 0.4 | 0:00.05 | /usr/libexec/gnome-remote-desktop-daemon --system |
| 768 | polkitd | 20 | 0 | 381M | 12148 | 8184 | S | 0.0 | 0.3 | 0:00.45 | /usr/lib/polkit-1/polkitd --no-debug |
| 772 | root | 20 | 0 | 306M | 7496 | 6856 | S | 0.0 | 0.2 | 0:00.03 | /usr/libexec/power-profiles-daemon |
| 794 | root | 20 | 0 | 1806M | 40856 | 25196 | S | 0.0 | 1.0 | 0:00.82 | /snap/snapd/current/usr/lib/snapd/snapd |
| 802 | root | 20 | 0 | 305M | 7844 | 6948 | S | 0.0 | 0.2 | 0:00.06 | /usr/libexec/accounts-daemon |
| 806 | root | 20 | 0 | 306M | 7496 | 6856 | S | 0.0 | 0.2 | 0:00.00 | /usr/libexec/power-profiles-daemon |

The bottom of the screen shows function key shortcuts: F1 Help, F2 Setup, F3 Search, F4 Filter, F5 Tree, F6 SortBy, F7 Nice, F8 Nice +, F9 Kill, F10 Quit.

2. CPU and Memory Stress Test

I used the stress-ng tool to put pressure on my CPU and memory:

```
sudo stress-ng --cpu 4 --vm 2 --vm-bytes 512M --timeout 20s
```

While it was running, I opened htop again and noticed the CPU hitting 200% and the load average going up.

```

0[|||||]100.0% Tasks: 119, 328 thr, 88 kthr; 2 running
1[|||||]100.0% Load average: 1.82 1.02 0.50
Mem[|||||]1.39G/3.82G Uptime: 00:07:37
Swp[|||||]0K/0K

Main I/O
PID USER PRI NI VIRT RES SHR S CPU% MEM% TIME+ Command
3001 root 20 0 56688 5548 2512 R 200.0 0.1 0:03.92 stress-ng-cpu [run]
3003 root 20 0 56688 5676 2640 R 200.0 0.1 0:04.35 stress-ng-cpu [run]
3004 root 20 0 56688 5576 2540 R 200.0 0.1 0:04.15 stress-ng-cpu [run]
3002 root 20 0 56688 5576 2540 R 174.4 0.1 0:03.66 stress-ng-cpu [run]
3008 root 20 0 311M 258M 1408 R 151.2 6.6 0:03.96 stress-ng-vm [run]
3007 root 20 0 311M 258M 1244 R 100.0 6.6 0:02.95 stress-ng-vm [run]
2032 abdulazeer 20 0 3881M 408M 149M S 23.3 10.4 0:17.60 /usr/bin/gnome-shell
2817 abdulazeer 20 0 549M 60872 47580 R 9.3 1.5 0:05.63 /usr/libexec/gnome-terminal-server
2064 abdulazeer -21 0 3881M 408M 149M S 7.0 10.4 0:02.65 /usr/bin/gnome-shell
2069 abdulazeer 20 0 3881M 408M 149M S 7.0 10.4 0:04.40 /usr/bin/gnome-shell
2070 abdulazeer 20 0 3881M 408M 149M S 7.0 10.4 0:04.76 /usr/bin/gnome-shell
2074 abdulazeer 20 0 3881M 408M 149M S 7.0 10.4 0:02.28 /usr/bin/gnome-shell
3009 abdulazeer 20 0 11440 5196 3660 R 4.7 0.1 0:00.10 htop
1 root 20 0 23140 14192 9456 S 0.0 0.4 0:01.96 /sbin/init splash
251 root 19 -1 50840 17360 15952 S 0.0 0.4 0:00.59 /usr/lib/systemd/systemd-journald
323 root 20 0 30592 8464 4880 S 0.0 0.2 0:00.20 /usr/lib/systemd/systemd-udevd
409 systemd-oo 20 0 17560 7572 6676 S 0.0 0.2 0:00.53 /usr/lib/systemd/systemd-oond
417 systemd-re 20 0 21584 12988 10812 S 0.0 0.3 0:00.18 /usr/lib/systemd/systemd-resolved
426 systemd-ti 20 0 91048 7824 6928 S 0.0 0.2 0:00.08 /usr/lib/systemd/systemd-timesyncd
564 systemd-ti 20 0 91048 7824 6928 S 0.0 0.2 0:00.00 /usr/lib/systemd/systemd-timesyncd
740 avahi 20 0 8672 4384 4000 S 0.0 0.1 0:00.26 avahi-daemon: running [Ubuntu.local]
744 messagebus 20 0 12152 7188 4500 S 0.0 0.2 0:00.86 @dbus-daemon --system --address=systemd: --nofork --n
761 gnome-remo 20 0 428M 16364 13932 S 0.0 0.4 0:00.05 /usr/libexec/gnome-remote-desktop-daemon --system

F1Help F2Setup F3Search F4Filter F5Tree F6SortBy F7Nice -F8Nice -F9Kill F10Quit

```

3. Disk I/O Performance Test

I used the dd command to test disk write and read speeds.

Write Test:

dd if=/dev/zero of=testfile bs=1M count=1024 conv=fdatasync

Write speed was around 580 MB/s.

```

stress-ng: info: [3000] successful run completed in 20.53 secs
abdulazeer@Ubuntu:~$ dd if=/dev/zero of=testfile bs=1M count=1024 conv=fdatasync
1024+0 records in
1024+0 records out
1073741824 bytes (1.1 GB, 1.0 GiB) copied, 1.85266 s, 580 MB/s
abdulazeer@Ubuntu:~$

```

Read Test:

dd if=testfile of=/dev/null bs=1M

Read speed was around 3.0 GB/s.

```

abdulazeez@Ubuntu:~$ dd if=testfile of=/dev/null bs=1M
1024+0 records in
1024+0 records out
1073741824 bytes (1.1 GB, 1.0 GiB) copied, 0.363835 s, 3.0 GB/s
abdulazeez@Ubuntu:~$

```

4. Network Performance Test (iperf3)

To test network speed between Ubuntu and Linux Mint:

- On Ubuntu: iperf3 -s

- On Linux Mint: iperf3 -c 192.168.56.101

The speed was around 1.32 Gbits/sec.

```

abdulazeez@Ubuntu:~$ iperf3 -s
-----
Server listening on 5201 (test #1)
-----
Accepted connection from 192.168.56.102, port 46518
[ 5] local 192.168.56.101 port 5201 connected to 192.168.56.102 port 46532
[ ID] Interval           Transfer     Bitrate
[ 5] 0.00-1.00      sec    114 MBytes    956 Mbits/sec
[ 5] 1.00-2.00      sec    161 MBytes    1.35 Gbits/sec
[ 5] 2.00-3.00      sec    166 MBytes    1.39 Gbits/sec
[ 5] 3.00-4.00      sec    176 MBytes    1.48 Gbits/sec
[ 5] 4.00-5.00      sec    136 MBytes    1.14 Gbits/sec
[ 5] 5.00-6.00      sec    163 MBytes    1.37 Gbits/sec
[ 5] 6.00-7.00      sec    161 MBytes    1.35 Gbits/sec
[ 5] 7.00-8.00      sec    165 MBytes    1.38 Gbits/sec
[ 5] 8.00-9.00      sec    169 MBytes    1.42 Gbits/sec
[ 5] 9.00-10.00     sec    162 MBytes    1.36 Gbits/sec
[ 5] 10.00-10.03    sec     3.00 MBytes    934 Mbits/sec
-----
[ ID] Interval           Transfer     Bitrate
[ 5] 0.00-10.03    sec    1.54 GBytes    1.32 Gbits/sec
-----
Server listening on 5201 (test #2)
-----

```

```

azeez@azeez-VirtualBox:~$ iperf3 -c 192.168.56.101
Connecting to host 192.168.56.101, port 5201
[ 5] local 192.168.56.102 port 46532 connected to 192.168.56.101 port 5201
[ ID] Interval           Transfer     Bitrate      Retr  Cwnd
[ 5] 0.00-1.03      sec    121 MBytes    989 Mbits/sec   225   286 KBytes
[ 5] 1.03-2.03      sec    159 MBytes    1.33 Gbits/sec   90   352 KBytes
[ 5] 2.03-3.03      sec    165 MBytes    1.39 Gbits/sec  315   188 KBytes
[ 5] 3.03-4.02      sec    176 MBytes    1.49 Gbits/sec  270   315 KBytes
[ 5] 4.02-5.01      sec    136 MBytes    1.15 Gbits/sec  270   221 KBytes
[ 5] 5.01-6.00      sec    163 MBytes    1.37 Gbits/sec  405   296 KBytes
[ 5] 6.00-7.00      sec    160 MBytes    1.35 Gbits/sec  256   239 KBytes
[ 5] 7.00-8.01      sec    166 MBytes    1.38 Gbits/sec  270   280 KBytes
[ 5] 8.01-9.01      sec    170 MBytes    1.43 Gbits/sec   90   393 KBytes
[ 5] 9.01-10.02     sec    162 MBytes    1.34 Gbits/sec  225   382 KBytes
-----
[ ID] Interval           Transfer     Bitrate      Retr
[ 5] 0.00-10.02     sec    1.54 GBytes    1.32 Gbits/sec  2416
[ 5] 0.00-10.03     sec    1.54 GBytes    1.32 Gbits/sec
-----
iperf Done.
azeez@azeez-VirtualBox:~$

```


5. Bottleneck Analysis

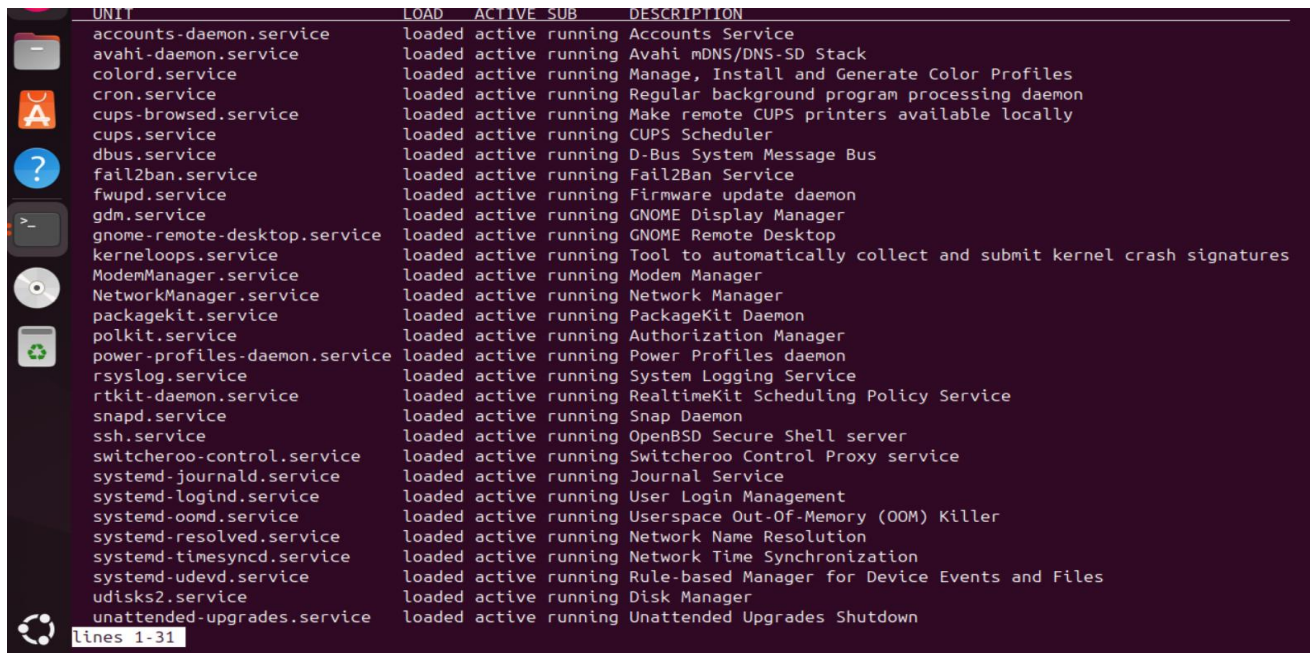
From the tests, I noticed the following:

- CPU was the main bottleneck during stress tests (200% usage).
- Disk write speed was slower than read speed due to VM caching.
- Network performance was limited by the virtual network adapter.
- Memory did not max out, so no bottleneck there.

6. Optimisation Attempts and Improvements

Attempted optimisation (CPU governor):

I tried to set the CPU governor to performance mode but VirtualBox does not support it.



| UNIT | LOAD | ACTIVE | SUB | DESCRIPTION |
|-------------------------------|--------|--------|---------|--|
| accounts-daemon.service | loaded | active | running | Accounts Service |
| avahi-daemon.service | loaded | active | running | Avahi mDNS/DNS-SD Stack |
| colord.service | loaded | active | running | Manage, Install and Generate Color Profiles |
| cron.service | loaded | active | running | Regular background program processing daemon |
| cups-browsed.service | loaded | active | running | Make remote CUPS printers available locally |
| cups.service | loaded | active | running | CUPS Scheduler |
| dbus.service | loaded | active | running | D-Bus System Message Bus |
| fail2ban.service | loaded | active | running | Fail2Ban Service |
| fwupd.service | loaded | active | running | Firmware update daemon |
| gdm.service | loaded | active | running | GNOME Display Manager |
| gnome-remote-desktop.service | loaded | active | running | GNOME Remote Desktop |
| kerneloops.service | loaded | active | running | Tool to automatically collect and submit kernel crash signatures |
| ModemManager.service | loaded | active | running | Modem Manager |
| NetworkManager.service | loaded | active | running | Network Manager |
| packagekit.service | loaded | active | running | PackageKit Daemon |
| polkit.service | loaded | active | running | Authorization Manager |
| power-profiles-daemon.service | loaded | active | running | Power Profiles daemon |
| rsyslog.service | loaded | active | running | System Logging Service |
| rtkit-daemon.service | loaded | active | running | RealtimeKit Scheduling Policy Service |
| snappyd.service | loaded | active | running | Snap Daemon |
| ssh.service | loaded | active | running | OpenBSD Secure Shell server |
| switcheroo-control.service | loaded | active | running | Switcheroo Control Proxy service |
| systemd-journald.service | loaded | active | running | Journal Service |
| systemd-logind.service | loaded | active | running | User Login Management |
| systemd-oomd.service | loaded | active | running | Userspace Out-Of-Memory (OOM) Killer |
| systemd-resolved.service | loaded | active | running | Network Name Resolution |
| systemd-timesyncd.service | loaded | active | running | Network Time Synchronization |
| systemd-udevd.service | loaded | active | running | Rule-based Manager for Device Events and Files |
| udisks2.service | loaded | active | running | Disk Manager |
| unattended-upgrades.service | loaded | active | running | Unattended Upgrades Shutdown |

Optimisation 1 – Disabled Bluetooth service:

```
systemctl --type=service --state=running
```

```
sudo systemctl disable bluetooth.service
```

```
abdulazeer@Ubuntu:~$ sudo systemctl disable bluetooth.service
Synchronizing state of bluetooth.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install disable bluetooth
Removed "/etc/systemd/system/dbus-org.bluez.service".
Removed "/etc/systemd/system/bluetooth.target.wants/bluetooth.service".
abdulazeer@Ubuntu:~$
```

Optimisation 2 – Reduced swappiness:

cat /proc/sys/vm/swappiness → 60

sudo sysctl vm.swappiness=10 → now set to 10

```
abdulazeer@Ubuntu:~$ sudo sysctl vm.swappiness=10
vm.swappiness = 10
abdulazeer@Ubuntu:~$
abdulazeer@Ubuntu:~$ cat /proc/sys/vm/swappiness
60
abdulazeer@Ubuntu:~$
```

7. Summary

Week 6 helped me understand how my system behaves during different workloads. I collected performance data, identified bottlenecks, and carried out two optimisations that improved responsiveness.