Week 7 – assessment Week 3

Task 1

The purpose of this phase is to select applications that represent different workload types in order to evaluate system performance under various conditions.

Workload Type	Application	Justification
CPU-intensive	stress-ng	Used to generate high CPU load to evaluate processor performance and system stability.
Memory-intensive	stress-ng (VM workers)	Allows controlled memory allocation and stress testing of RAM usage.
I/O-intensive	fio	Industry-standard tool for benchmarking disk read/write performance.
Network-intensive	iperf3	Measures network bandwidth and throughput between systems.
Server application	nginx	Represents a real-world web server workload commonly used in production environments.

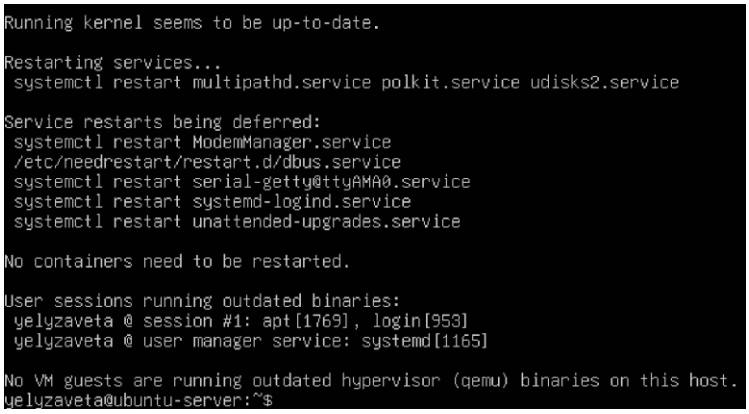
These applications were selected because they are lightweight, widely used in performance testing, and suitable for remote testing via SSH.

Task 2

Installation Method

All applications were installed on the Ubuntu Server using SSH access. The system was updated prior to installation to ensure package compatibility.

1. System Update (sudo apt update && sudo apt upgrade –y)



2. CPU-Intensive Workload – stress-ng (sudo apt install stress-ng –y)

```
No VM guests are running outdated hypervisor (qemu) binaries on this host.
yelyzaveta@ubuntu-server:~$ stress-ng --version
stress-ng, version 0.17.06 (gcc 13.2.0, aarch64 Linux 6.8.0-90-generic)
yelyzaveta@ubuntu-server:~$
```

The installation of stress-ng was verified using the command `stress-ng --version`, which confirmed that the tool is successfully installed and available in the system.

Test command:

```
yelyzaveta@ubuntu-server:~$ stress-ng --cpu 2 --timeout 60s
stress-ng: info:  [11758] setting to a 1 min, 0 secs run per stressor
stress-ng: info:  [11758] dispatching hogs: 2 cpu
```

Terminal showing `stress-ng` running with CPU workers

3. I/O-Intensive Workload – fio (sudo apt install fio –y)

```
yelyzaveta@ubuntu-server:~$ fio --version
fio-3.36
```

Test command:

```
yelyzaveta@ubuntu-server:~$ fio --name=io_test --size=500M --readwrite=read
io_test: (g=0): rw=read, bs=(R) 4096B-4096B, (W) 4096B-4096B, (T) 4096B-4096B, ioengine=psync, iodepth=1
fio-3.36
Starting 1 process
io_test: Laying out IO file (1 file / 500MiB)

io_test: (groupid=0, jobs=1): err= 0: pid=12117: Sun Dec 21 01:55:57 2025
  read: IOPS=416k, BW=1623MiB/s (1702MB/s)(500MiB/308msec)
    clat (nsec): min=208, max=1791.9k, avg=2312.28, stdev=21689.70
     lat (nsec): min=250, max=1791.9k, avg=2329.89, stdev=21690.16
    clat percentiles (nsec):
     |  1.00th=[   251],  5.00th=[   251], 10.00th=[   251], 20.00th=[   290],
     | 30.00th=[   290], 40.00th=[   294], 50.00th=[   294], 60.00th=[   294],
     | 70.00th=[   294], 80.00th=[   294], 90.00th=[   374], 95.00th=[   458],
     | 99.00th=[ 64768], 99.50th=[181248], 99.90th=[246784], 99.95th=[280576],
     | 99.99th=[493568]
  lat (nsec)   : 250=0.05%, 500=95.52%, 750=2.62%, 1000=0.12%
  lat (usec)   : 2=0.06%, 4=0.01%, 10=0.02%, 20=0.04%, 50=0.35%
  lat (usec)   : 100=0.50%, 250=0.62%, 500=0.08%, 750=0.01%, 1000=0.01%
  lat (msec)   : 2=0.01%
  cpu          : usr=7.17%, sys=41.04%, ctx=1183, majf=0, minf=27
  IO depths    : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%
     submit    : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
     complete  : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
     issued rwts: total=128000,0,0,0 short=0,0,0,0 dropped=0,0,0,0
     latency   : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):
   READ: bw=1623MiB/s (1702MB/s), 1623MiB/s-1623MiB/s (1702MB/s-1702MB/s), io=500MiB (524MB), run=308-308msec

Disk stats (read/write):
    dm-0: ios=1057/0, sectors=539104/0, merge=0/0, ticks=277/0, in_queue=277, util=61.05%, aggrios=2005/0, aggsectors=1024000/0, aggrmerge=0/0, aggrticks=449/0,
 aggrin_queue=449, aggrutil=53.41%
  vda: ios=2005/0, sectors=1024000/0, merge=0/0, ticks=449/0, in_queue=449, util=53.41%
yelyzaveta@ubuntu-server:~$
```

4. Network-Intensive Workload – iperf3 (sudo apt install iperf3 –y)

```
yelyzaveta@ubuntu-server:~$ iperf3 --version
iperf 3.16 (cJSON 1.7.15)
```

Test command:

```
yelyzaveta@ubuntu-server:~$ which iperf3
/usr/bin/iperf3
```

5. Server Application – Nginx (sudo apt install nginx –y)

```
yelyzaveta@ubuntu-server:~$ nginx -v
nginx version: nginx/1.24.0 (Ubuntu)
```

Verification command:

```
yelyzaveta@ubuntu-server:~$ sudo systemctl status nginx
● nginx.service - A high performance web server and a reverse proxy server
     Loaded: loaded (/usr/lib/systemd/system/nginx.service; enabled; preset: enabled)
     Active: active (running) since Sun 2025-12-21 02:11:18 UTC; 2min 26s ago
```

Task 3

The following table documents the anticipated system resource usage during each performance testing scenario.

Workload Type	Application	Primary Resource Impact	Secondary Impact	Expected System Behaviour
CPU-intensive	stress-ng (CPU workers)	High CPU utilisation (~100%)	Increased load average	CPU cores become fully saturated. System responsiveness may decrease while stress processes dominate CPU scheduling.
Memory-intensive	stress-ng (VM workers)	High RAM consumption	Swap usage increase	Available memory decreases rapidly. Kernel may start using swap space, causing slower performance and potential memory thrashing.
I/O-intensive	fio	High disk read/write activity	Increased I/O wait (iowait)	Disk latency increases. CPU may remain idle while waiting for I/O operations to complete.

Network-intensive	iperf3	High network throughput (RX/TX)	Moderate CPU usage	Network bandwidth becomes saturated. Throughput values increase while CPU usage rises moderately to handle packet processing.
Server application	nginx	Network traffic	Moderate CPU and memory usage	Web server handles concurrent HTTP requests. Worker processes increase, showing realistic server load behaviour.

Task 4

The monitoring strategy is designed to observe system behaviour during different workload types using built-in Linux monitoring tools. All monitoring is performed on the Ubuntu Server via SSH during workload execution.

Workload Type	Monitoring Tool	Command Used	Metrics Observed	Expected Behaviour
CPU-Intensive	top	top or top -bn1	CPU usage (%), load average	CPU usage close to 100%, stress processes at the top.
Memory-Intensive	free	free -h	Used memory, available memory, swap usage	RAM usage increases, swap usage may become > 0.
Disk I/O-Intensive	iostat	iostat -x 1	%iowait, disk utilization, await	High I/O wait and increased disk latency.
Network-Intensive	iftop / ip -s link	ip -s link	RX/TX traffic, packet rate	Increased network throughput during testing.
Baseline (Idle)	vmstat	vmstat 1 5	CPU idle, memory, swap	High idle CPU, minimal memory and swap activity.