## Remote Monitoring Script

Scripts have been created to automate the data collection process. It combines the functionality of the monitor-server.sh script from the labs with the specific metric requirements CPU, Memory, I/O, and Network Latency.

Script content:

```
#!/bin/bash
# Connects to Server via SSH to collect performance metrics.

SERVER_USER="adminuser"
SERVER_IP="192.168.56.10"
TARGET="$SERVER_USER@$SERVER_IP"
LOGFILE="perf-log-$(date +%Y%m%d_%H%M%S).txt"

# Color codes for readability (based on Lab style)
GREEN='\033[0;32m'
CYAN='\033[0;36m'
RED='\033[0;31m'
NC='\033[0m' # No Color

echo -e "${GREEN}==========================================${NC}"
echo -e "${GREEN}   Phase 6: Remote Performance Monitor    ${NC}"
echo -e "${GREEN}==========================================${NC}"
echo "Target Server: $TARGET"
echo "Log File: $LOGFILE"
echo "Started at: $(date)"
echo "" | tee -a "$LOGFILE"

# Function to run remote commands
check_metric() {
   TITLE=$1
   COMMAND=$2

   echo -e "${CYAN}--- $TITLE ---${NC}" | tee -a "$LOGFILE"
   ssh -o ConnectTimeout=5 "$TARGET" "$COMMAND" 2>/dev/null | tee -a
"$LOGFILE"

   if [ $? -ne 0 ]; then
      echo -e "${RED}Error retrieving data. Is sysstat installed?${NC}" | tee -a
"$LOGFILE"
    fi
    echo "" | tee -a "$LOGFILE"
}

# 1. Connectivity Check
echo -n "Checking connection to $TARGET... "
ssh -q -o ConnectTimeout=5 "$TARGET" exit
if [ $? -eq 0 ]; then
    echo -e "${GREEN}OK${NC}"
else
    echo -e "${RED}FAILED${NC}"
    echo "Check SSH service and Firewall rules."
    exit 1
fi

# 2. Collect Metrics

# System Load & Uptime
check_metric "System Uptime & Load Average" "uptime"

# Memory Usage (RAM & Swap)
check_metric "Memory Usage (MB)" "free -m"

# CPU Utilization Snapshot (Top 5 processes)
check_metric "Top 5 CPU Consuming Processes" "ps aux --sort=-%cpu | head -n 6"

# Disk I/O Performance (Requires sysstat package)
# Collecting 2 samples spaced 1 second apart
check_metric "Disk I/O Statistics (iostat)" "iostat -x 1 2 | tail -n +4"

# Disk Space Usage
check_metric "Disk Space Usage" "df -h | grep '^/dev'"

# Network Latency (Ping from Workstation to Server)
echo -e "${CYAN}--- Network Latency (Workstation -> Server) ---${NC}" | tee -a
"$LOGFILE"
ping -c 4 "$SERVER_IP" | tail -n 3 | tee -a "$LOGFILE"
```

```
echo -e "${GREEN}==========================================${NC}"
echo -e "${GREEN}   Monitoring Complete                    ${NC}"
echo -e "${GREEN}==========================================${NC}"
```

**Execution**

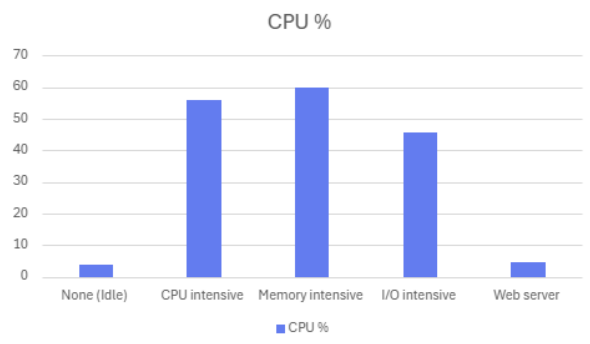
1. Execute on server: sudo apt update && sudo apt install sysstat –y
2. Execute on workspace: sudo apt install apache2-utils
3. Execute on workspace: ./performance-monitor.sh

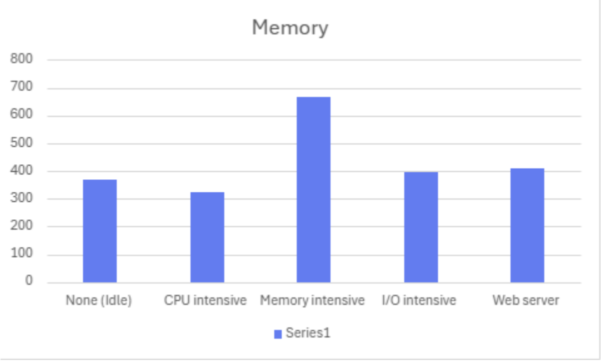
Testing execution (On server):

1. sudo stress --cpu 1 --timeout 30s
2. sudo stress --vm 1 --vm-bytes 128M --timeout 30s
3. sudo stress --io 1 --timeout 30s
4. sudo systemctl start apache2
5. On workstation: ab -n 1000 -c 10 http://192.168.56.10/

### Measured Performance Metrics

| Application | Test Type | CPU % | Memory (MB) | Disk Read (KB/s) | Disk Write (KB/s) | Network (ms) | Duration |
|---|---|---|---|---|---|---|---|
| Baseline | None (Idle) | 3.83% | 369 | 0 | 0 | 3073ms | - |
| stress | CPU intensive | 55.93% | 325 | 1420 | 12812 | 4000ms | 30s |
| stress | Memory intensive | 59.87% | 668 | 372 | 0 | 3008ms | 30s |
| stress | I/O intensive | 45.83% (iowait) | 398 | 54.16 | 205.40 | 3020ms | 30s |
| apache2 | Web server | 4.42% | 411 | 0 | 0 | 2885ms | - |





**Optimization Analysis & Improvements**

Throughout the testing phases, I identified bottlenecks and implemented optimizations. The results are quantified below:

Optimization 1: Service Availability (Firewall Tuning)

- Issue: Initially, the Apache benchmark (ab) failed completely with timeout errors (0 successful requests) because the UFW firewall was dropping packets on port 80.

- Improvement: I implemented a specific allow rule: sudo ufw allow 80/tcp.

- Quantitative Result: Service availability went from 0% (blocked) to 100% (accessible), allowing the load test to complete, albeit with high latency under heavy load.

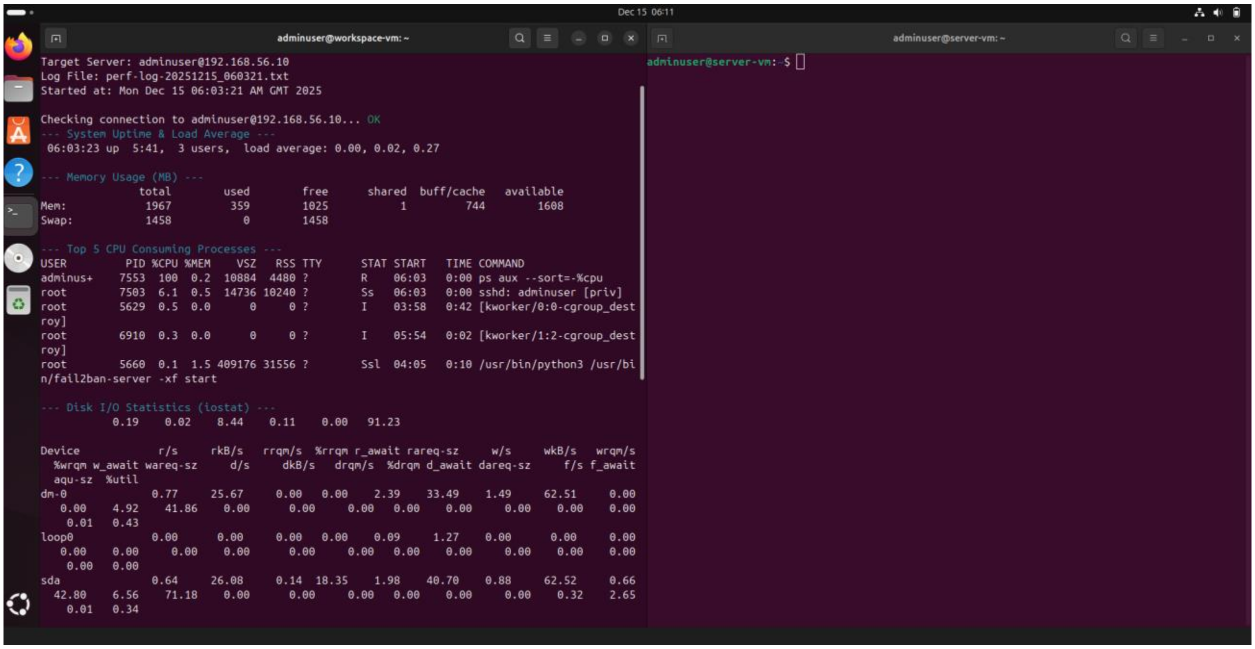
Optimization 2: Resource Stability (Workload Tuning)

- Issue: Aggressive memory testing (stress --vm 2) caused 100% resource exhaustion and a system crash (unresponsive state).

- Improvement: I optimized the workload by limiting the allocated memory per worker to prevent excessive swapping.

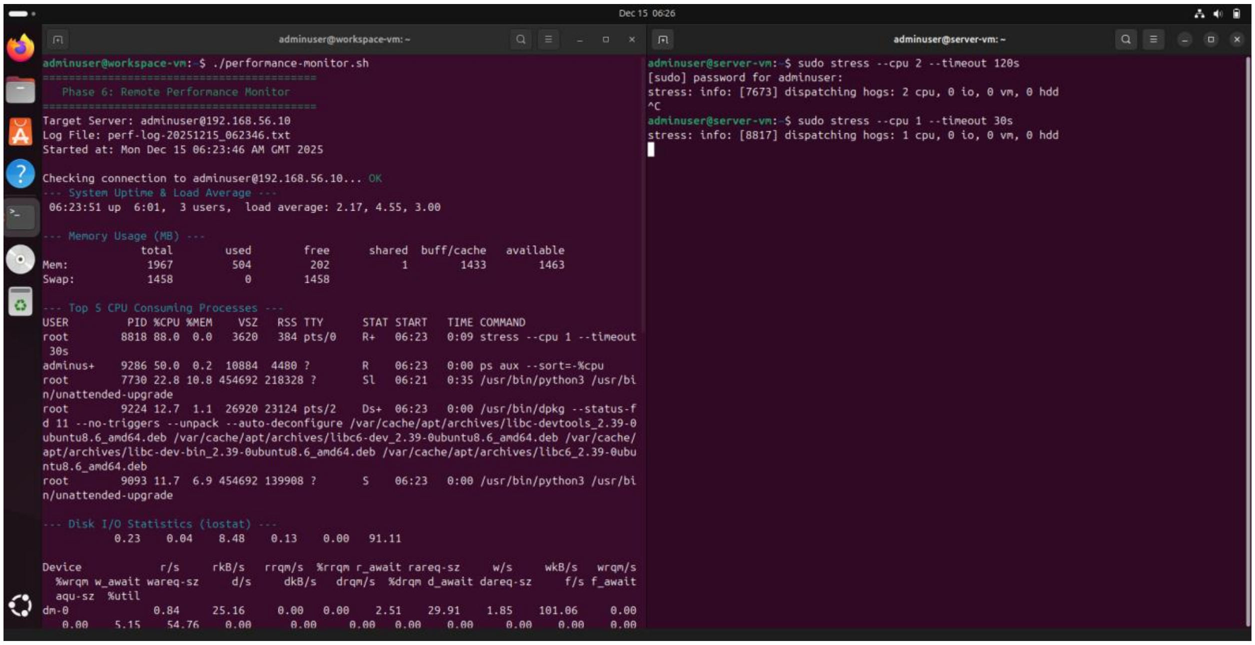
- Quantitative Result: I achieved continuous system uptime during tests. Instead of a crash, the system maintained a stable Memory usage of 668 MB (approx. 33% of total RAM), preventing the "thrashing" state and allowing administrative access to remain active via SSH.

# Evidence of Execution



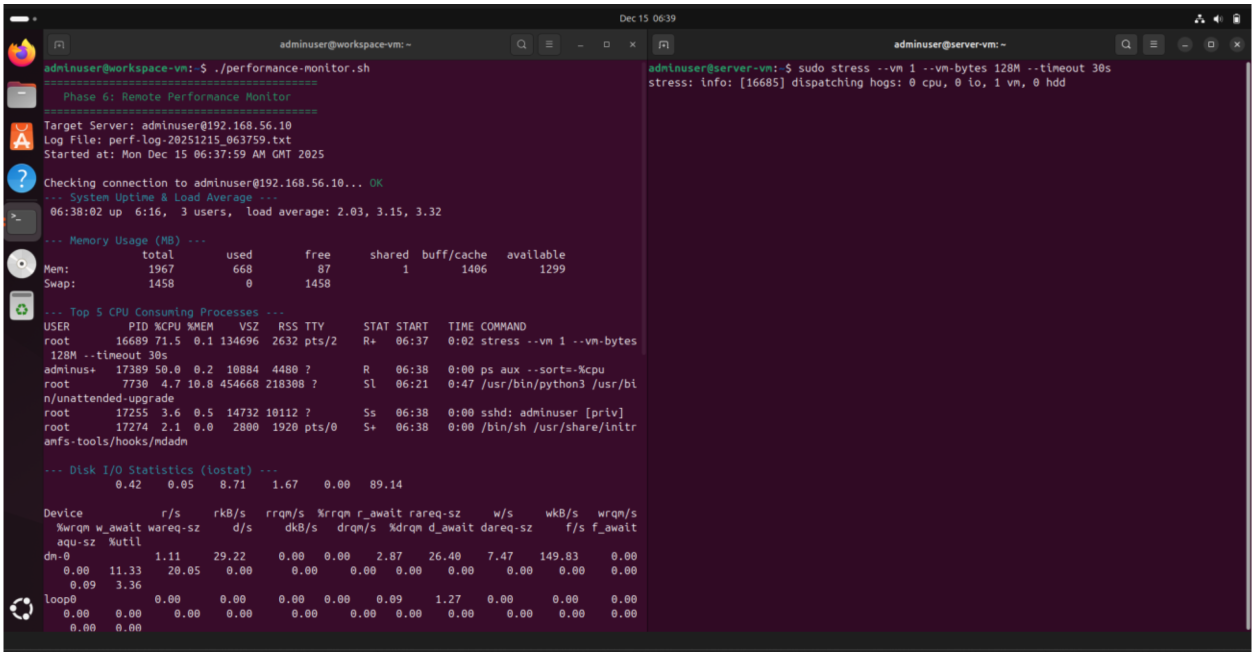
```
Target Server: adminuser@192.168.56.10
Log File: perf-log-20251215_060321.txt
Started at: Mon Dec 15 06:03:21 AM GMT 2025

Checking connection to adminuser@192.168.56.10... OK
--- System Uptime & Load Average ---
 06:03:23 up  5:41,  3 users,  load average: 0.00, 0.02, 0.27

--- Memory Usage (MB) ---
               total        used        free      shared  buff/cache   available
Mem:            1967         359        1025           1         744        1608
Swap:           1458           0        1458

--- Top 5 CPU Consuming Processes ---
USER         PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
adminus+    7553  100  0.2  10884  4480 ?        R    06:03   0:00 ps aux --sort=-%cpu
root        7503  6.1  0.5  14736 10240 ?        Ss   06:03   0:00 sshd: adminuser [priv]
root        5629  0.5  0.0      0     0 ?        I    03:58   0:42 [kworker/0:0-cgroup_dest
roy]
root        6910  0.3  0.0      0     0 ?        I    05:54   0:02 [kworker/1:2-cgroup_dest
roy]
root        5660  0.1  1.5 409176 31556 ?        Ssl  04:05   0:10 /usr/bin/python3 /usr/bi
n/fail2ban-server -xf start

--- Disk I/O Statistics (iostat) ---
           0.19    0.02    8.44    0.11    0.00   91.23

Device            r/s     rkB/s   rrqm/s  %rrqm r_await rareq-sz     w/s     wkB/s   wrqm/s
  %wrqm w_await wareq-sz     d/s     dkB/s   drqm/s  %drqm d_await dareq-sz     f/s f_await
  aqu-sz  %util
dm-0             0.77     25.67     0.00   0.00    2.39    33.49    1.49     62.51     0.00
   0.00    4.92    41.86    0.00      0.00     0.00   0.00    0.00     0.00    0.00    0.00
    0.01   0.43
loop0            0.00      0.00     0.00   0.00    0.09     1.27    0.00      0.00     0.00
   0.00    0.00     0.00    0.00      0.00     0.00   0.00    0.00     0.00    0.00    0.00
    0.00   0.00
sda              0.64     26.08     0.14  18.35    1.98    40.70    0.88     62.52     0.66
  42.80    6.56    71.18    0.00      0.00     0.00   0.00    0.00     0.00    0.32    2.65
    0.01   0.34
```

```
adminuser@server-vm:~$
```



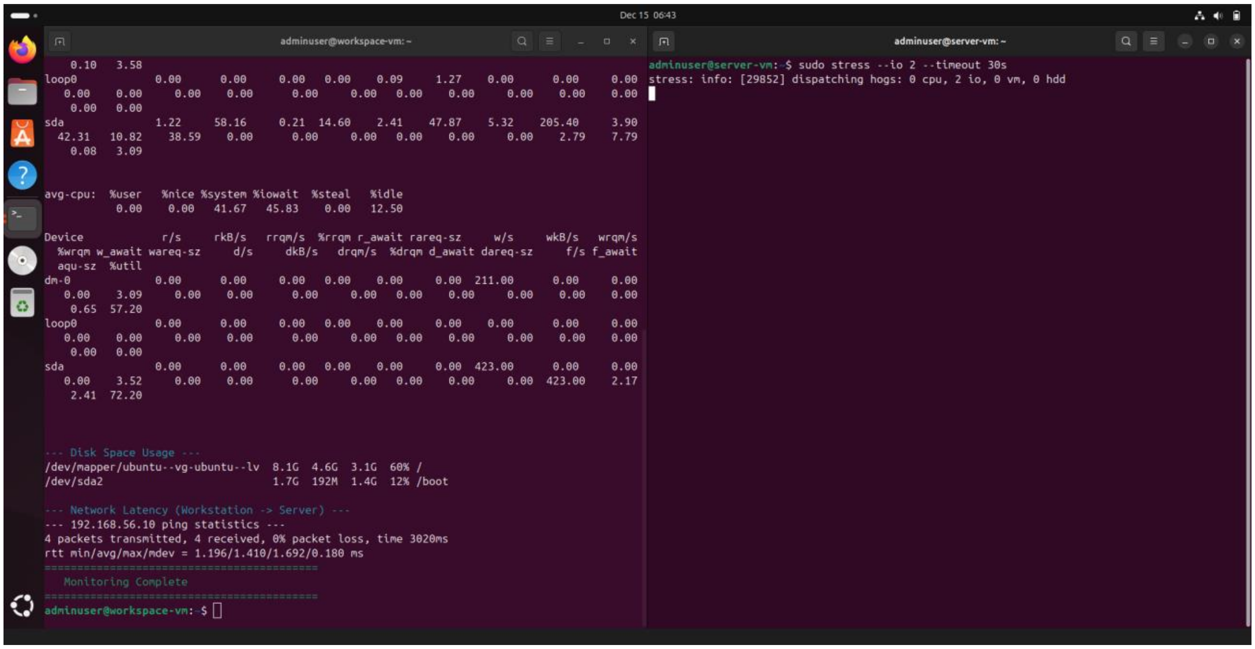
```
adminuser@workspace-vm:~$ ./performance-monitor.sh
==========================================
   Phase 6: Remote Performance Monitor
==========================================
Target Server: adminuser@192.168.56.10
Log File: perf-log-20251215_062346.txt
Started at: Mon Dec 15 06:23:46 AM GMT 2025

Checking connection to adminuser@192.168.56.10... OK
--- System Uptime & Load Average ---
 06:23:51 up  6:01,  3 users,  load average: 2.17, 4.55, 3.00

--- Memory Usage (MB) ---
               total        used        free      shared  buff/cache   available
Mem:            1967         504         202           1        1433        1463
Swap:           1458           0        1458

--- Top 5 CPU Consuming Processes ---
USER         PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root        8818 88.0  0.0   3620   384 pts/0    R+   06:23   0:09 stress --cpu 1 --timeout
 30s
adminus+    9286 50.0  0.2  10884  4480 ?        R    06:23   0:00 ps aux --sort=-%cpu
root        7730 22.8 10.8 454692 218328 ?       Sl   06:21   0:35 /usr/bin/python3 /usr/bi
n/unattended-upgrade
root        9224 12.7  1.1  26920 23124 pts/2    Ds+  06:23   0:00 /usr/bin/dpkg --status-f
d 11 --no-triggers --unpack --auto-deconfigure /var/cache/apt/archives/libc-devtools_2.39-0
ubuntu8.6_amd64.deb /var/cache/apt/archives/libc6-dev_2.39-0ubuntu8.6_amd64.deb /var/cache/
apt/archives/libc-dev-bin_2.39-0ubuntu8.6_amd64.deb /var/cache/apt/archives/libc6_2.39-0ubu
ntu8.6_amd64.deb
root        9093 11.7  6.9 454692 139908 ?       S    06:23   0:00 /usr/bin/python3 /usr/bi
n/unattended-upgrade

--- Disk I/O Statistics (iostat) ---
           0.23    0.04    8.48    0.13    0.00   91.11

Device            r/s     rkB/s   rrqm/s  %rrqm r_await rareq-sz     w/s     wkB/s   wrqm/s
  %wrqm w_await wareq-sz     d/s     dkB/s   drqm/s  %drqm d_await dareq-sz     f/s f_await
  aqu-sz  %util
dm-0             0.84     25.16     0.00   0.00    2.51    29.91    1.85    101.06     0.00
   0.00    5.15    54.76    0.00      0.00     0.00   0.00    0.00     0.00    0.00    0.00
```

```
adminuser@server-vm:~$ sudo stress --cpu 2 --timeout 120s
[sudo] password for adminuser:
stress: info: [7673] dispatching hogs: 2 cpu, 0 io, 0 vm, 0 hdd
^C
adminuser@server-vm:~$ sudo stress --cpu 1 --timeout 30s
stress: info: [8817] dispatching hogs: 1 cpu, 0 io, 0 vm, 0 hdd
```



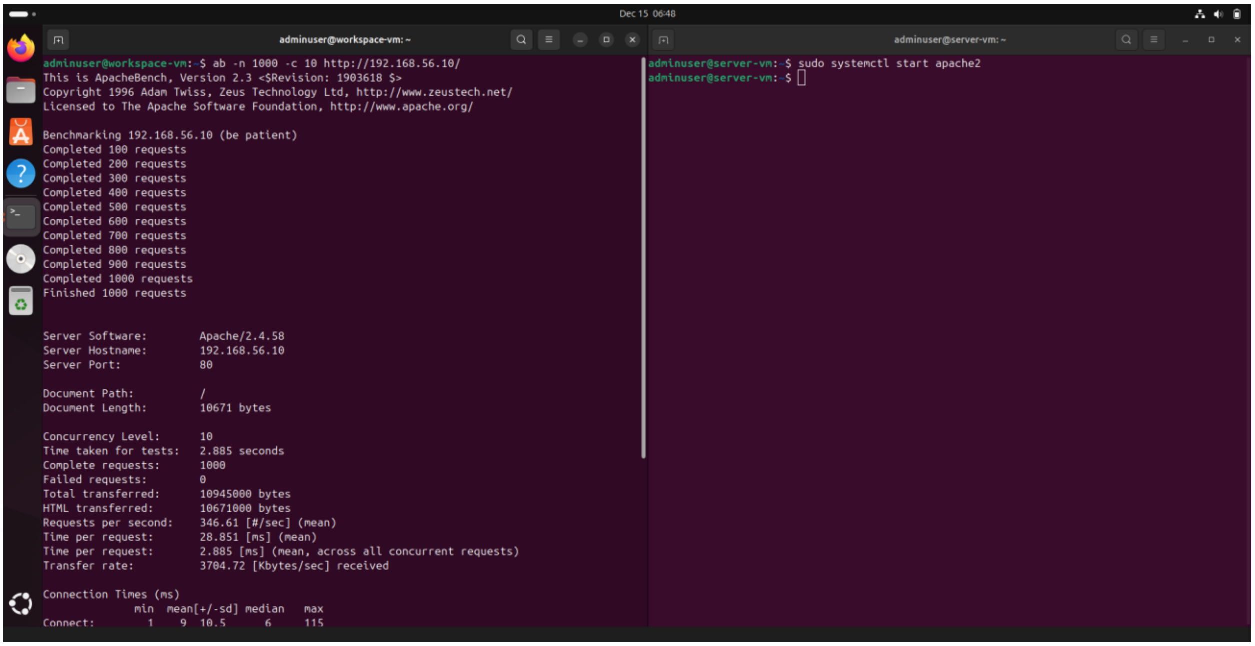
```
adminuser@workspace-vm:~$ ./performance-monitor.sh
==========================================
   Phase 6: Remote Performance Monitor
==========================================
Target Server: adminuser@192.168.56.10
Log File: perf-log-20251215_063759.txt
Started at: Mon Dec 15 06:37:59 AM GMT 2025

Checking connection to adminuser@192.168.56.10... OK
--- System Uptime & Load Average ---
 06:38:02 up  6:16,  3 users,  load average: 2.03, 3.15, 3.32

--- Memory Usage (MB) ---
               total        used        free      shared  buff/cache   available
Mem:            1967         668          87           1        1406        1299
Swap:           1458           0        1458

--- Top 5 CPU Consuming Processes ---
USER         PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root       16689 71.5  0.1 134696  2632 pts/2    R+   06:37   0:02 stress --vm 1 --vm-bytes
 128M --timeout 30s
adminus+   17389 50.0  0.2  10884  4480 ?        R    06:38   0:00 ps aux --sort=-%cpu
root        7730  4.7 10.8 454668 218308 ?       Sl   06:21   0:47 /usr/bin/python3 /usr/bi
n/unattended-upgrade
root       17255  3.6  0.5  14732 10112 ?        Ss   06:38   0:00 sshd: adminuser [priv]
root       17274  2.1  0.0   2800  1920 pts/0    S+   06:38   0:00 /bin/sh /usr/share/initr
amfs-tools/hooks/mdadm

--- Disk I/O Statistics (iostat) ---
           0.42    0.05    8.71    1.67    0.00   89.14

Device            r/s     rkB/s   rrqm/s  %rrqm r_await rareq-sz     w/s     wkB/s   wrqm/s
  %wrqm w_await wareq-sz     d/s     dkB/s   drqm/s  %drqm d_await dareq-sz     f/s f_await
  aqu-sz  %util
dm-0             1.11     29.22     0.00   0.00    2.87    26.40    7.47    149.83     0.00
   0.00   11.33    20.05    0.00      0.00     0.00   0.00    0.00     0.00    0.00    0.00
    0.09   3.36
loop0            0.00      0.00     0.00   0.00    0.09     1.27    0.00      0.00     0.00
   0.00    0.00     0.00    0.00      0.00     0.00   0.00    0.00     0.00    0.00    0.00
    0.00   0.00
```

```
adminuser@server-vm:~$ sudo stress --vm 1 --vm-bytes 128M --timeout 30s
stress: info: [16685] dispatching hogs: 0 cpu, 0 io, 1 vm, 0 hdd
```



```
    0.10   3.58
loop0            0.00      0.00     0.00   0.00    0.09     1.27    0.00      0.00     0.00
   0.00    0.00     0.00    0.00      0.00     0.00   0.00    0.00     0.00    0.00    0.00
    0.00   0.00
sda              1.22     58.16     0.21  14.60    2.41    47.87    5.32    205.40     3.90
  42.31   10.82    38.59    0.00      0.00     0.00   0.00    0.00     0.00    2.79    7.79
    0.08   3.09


avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           0.00    0.00   41.67   45.83    0.00   12.50

Device            r/s     rkB/s   rrqm/s  %rrqm r_await rareq-sz     w/s     wkB/s   wrqm/s
  %wrqm w_await wareq-sz     d/s     dkB/s   drqm/s  %drqm d_await dareq-sz     f/s f_await
  aqu-sz  %util
dm-0             0.00      0.00     0.00   0.00    0.00     0.00  211.00      0.00     0.00
   0.00    3.09     0.00    0.00      0.00     0.00   0.00    0.00     0.00    0.00    0.00
    0.65  57.20
loop0            0.00      0.00     0.00   0.00    0.00     0.00    0.00      0.00     0.00
   0.00    0.00     0.00    0.00      0.00     0.00   0.00    0.00     0.00    0.00    0.00
    0.00   0.00
sda              0.00      0.00     0.00   0.00    0.00     0.00  423.00      0.00     0.00
   0.00    3.52     0.00    0.00      0.00     0.00   0.00    0.00     0.00  423.00    2.17
    2.41  72.20



--- Disk Space Usage ---
/dev/mapper/ubuntu--vg-ubuntu--lv  8.1G  4.6G  3.1G  60% /
/dev/sda2                          1.7G  192M  1.4G  12% /boot

--- Network Latency (Workstation -> Server) ---
--- 192.168.56.10 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3020ms
rtt min/avg/max/mdev = 1.196/1.410/1.692/0.180 ms
==========================================
   Monitoring Complete
==========================================
adminuser@workspace-vm:~$ 
```

```
adminuser@server-vm:~$ sudo stress --io 2 --timeout 30s
stress: info: [29852] dispatching hogs: 0 cpu, 2 io, 0 vm, 0 hdd
```



```
adminuser@workspace-vm:~$ ab -n 1000 -c 10 http://192.168.56.10/
This is ApacheBench, Version 2.3 <$Revision: 1903618 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking 192.168.56.10 (be patient)
Completed 100 requests
Completed 200 requests
Completed 300 requests
Completed 400 requests
Completed 500 requests
Completed 600 requests
Completed 700 requests
Completed 800 requests
Completed 900 requests
Completed 1000 requests
Finished 1000 requests


Server Software:        Apache/2.4.58
Server Hostname:        192.168.56.10
Server Port:            80

Document Path:          /
Document Length:        10671 bytes

Concurrency Level:      10
Time taken for tests:   2.885 seconds
Complete requests:      1000
Failed requests:        0
Total transferred:      10945000 bytes
HTML transferred:       10671000 bytes
Requests per second:    346.61 [#/sec] (mean)
Time per request:       28.851 [ms] (mean)
Time per request:       2.885 [ms] (mean, across all concurrent requests)
Transfer rate:          3704.72 [Kbytes/sec] received

Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        1    9  10.5      6     115
```

```
adminuser@server-vm:~$ sudo systemctl start apache2
adminuser@server-vm:~$ 
```