

ASSIGNMENT-3

Name-PARAS DHIMAN || Roll no-2021482

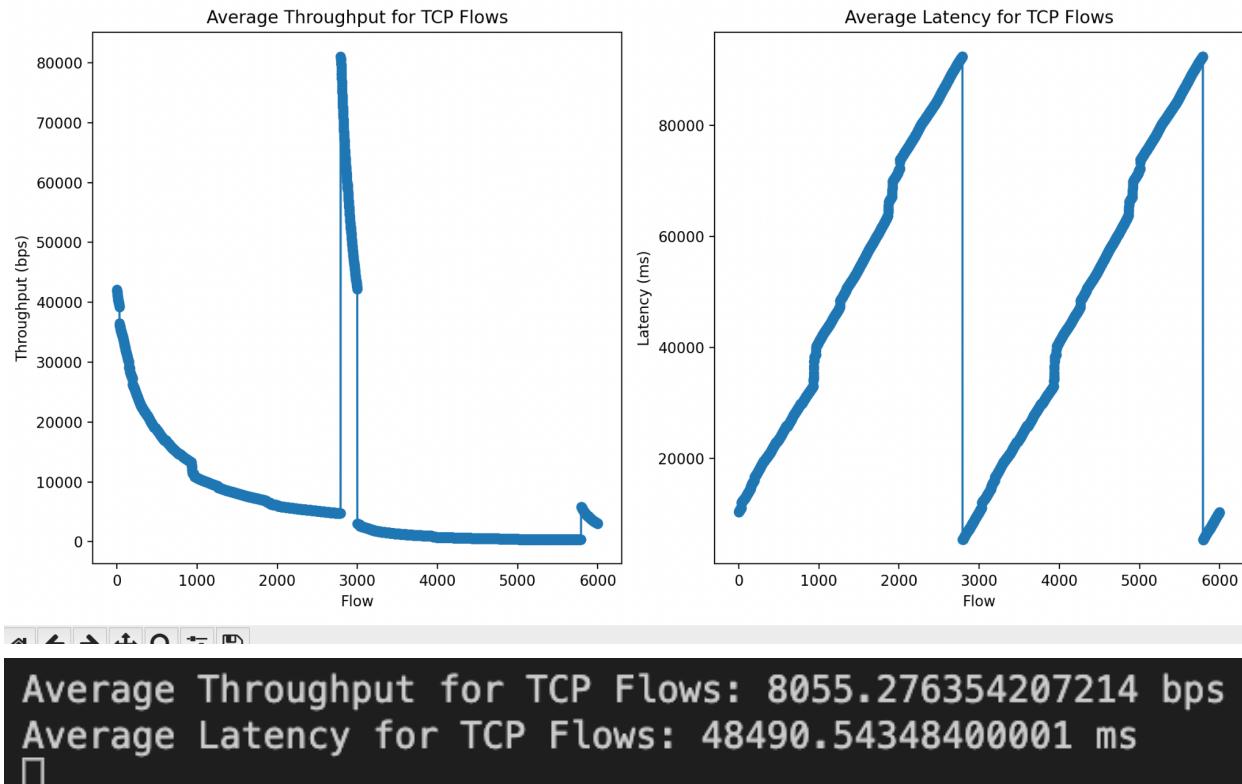
Computer Networks - CSE232

3.)

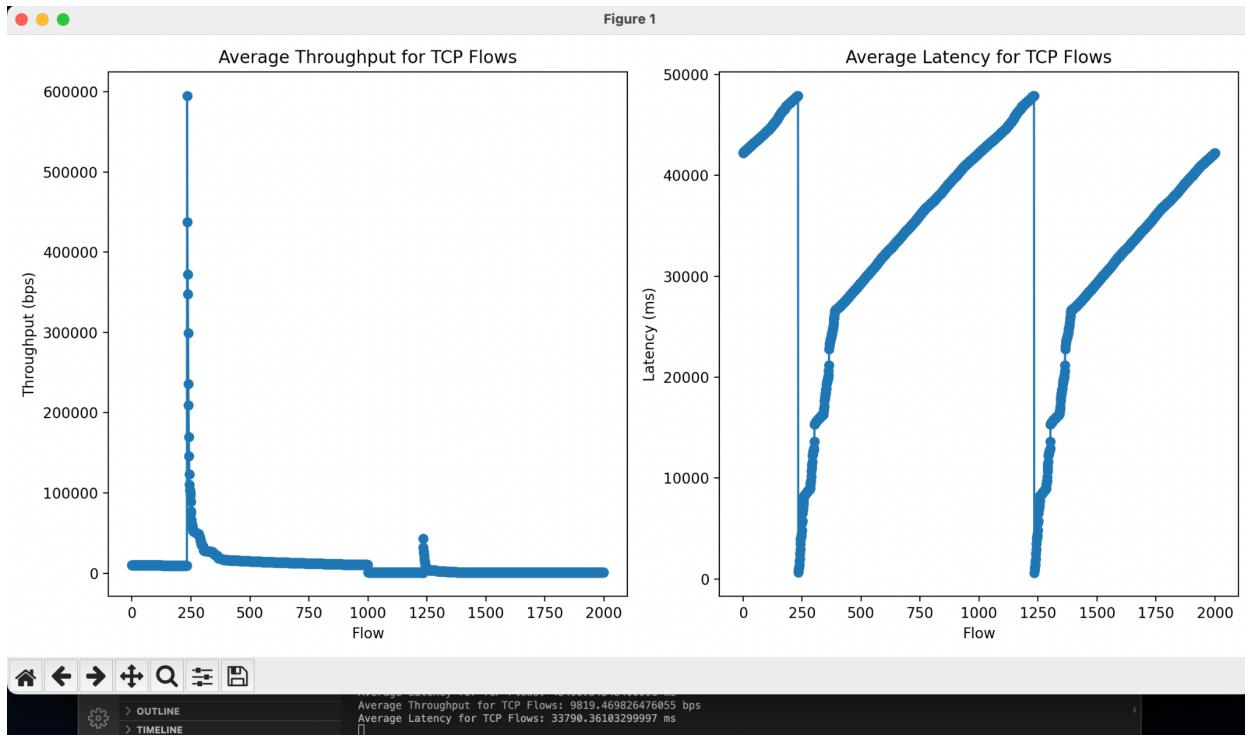
(b.)

EPOLL:

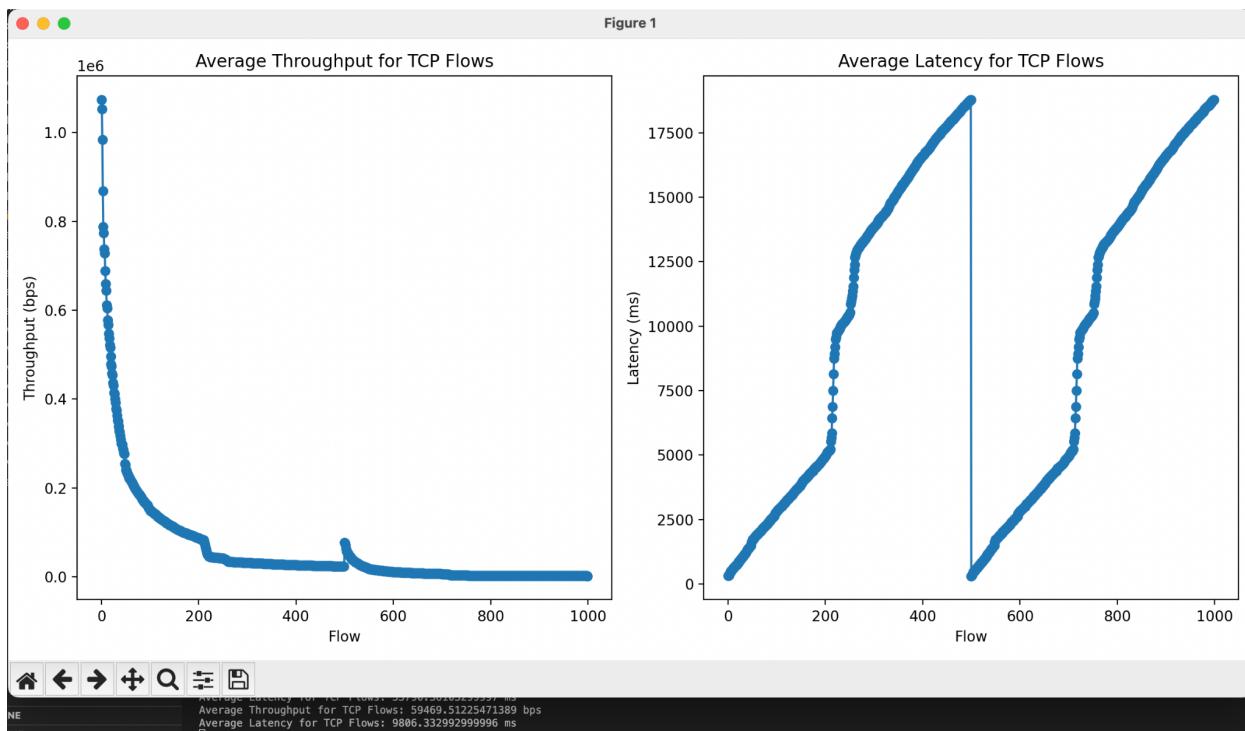
one:



Two:

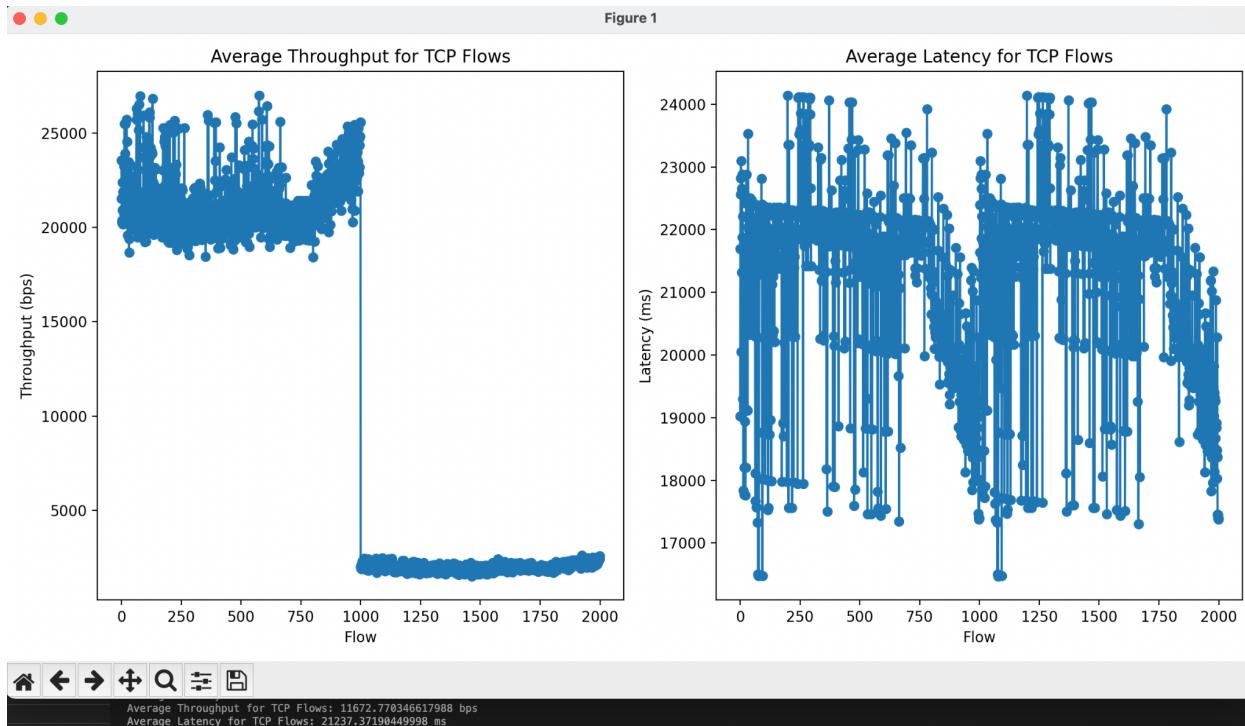


Three:

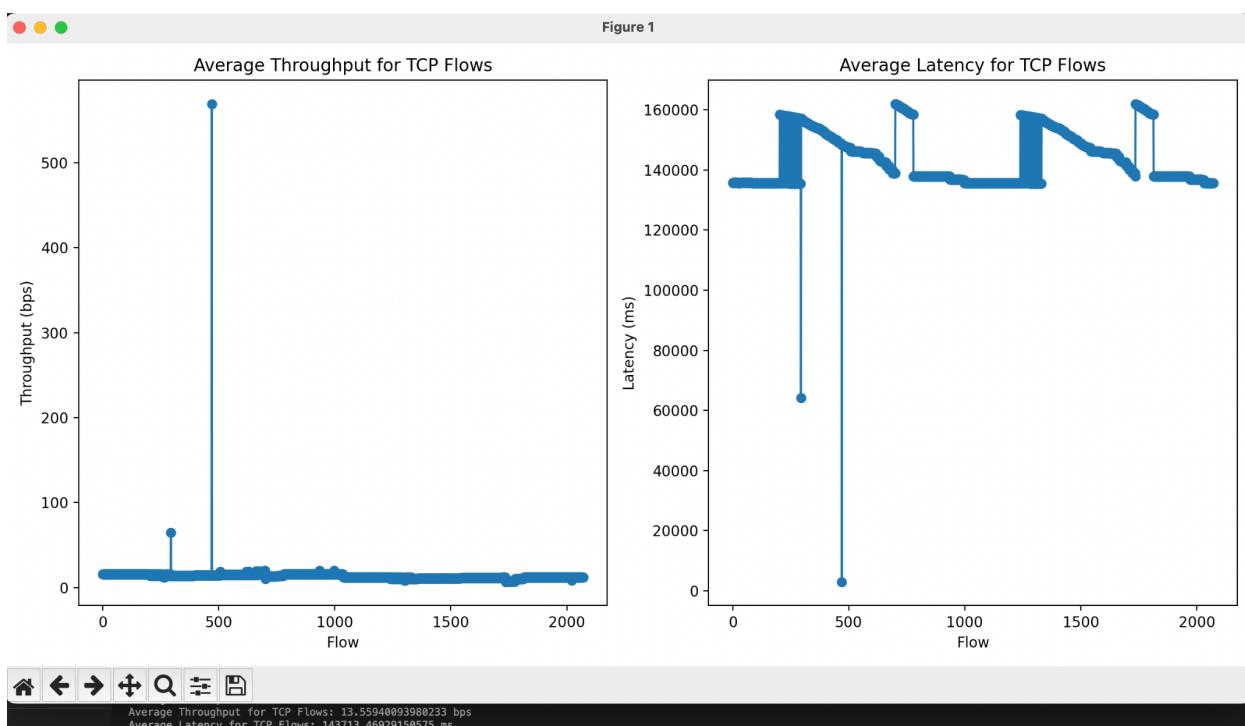


SELECT:

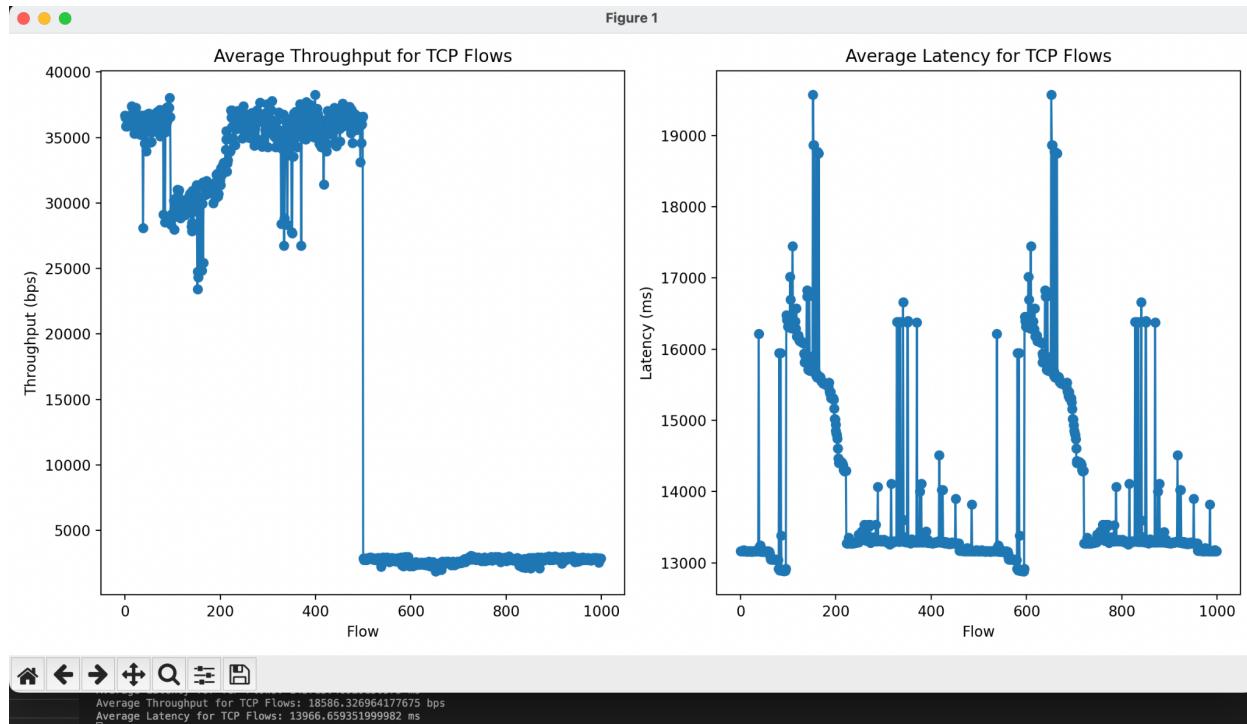
One:



Two:

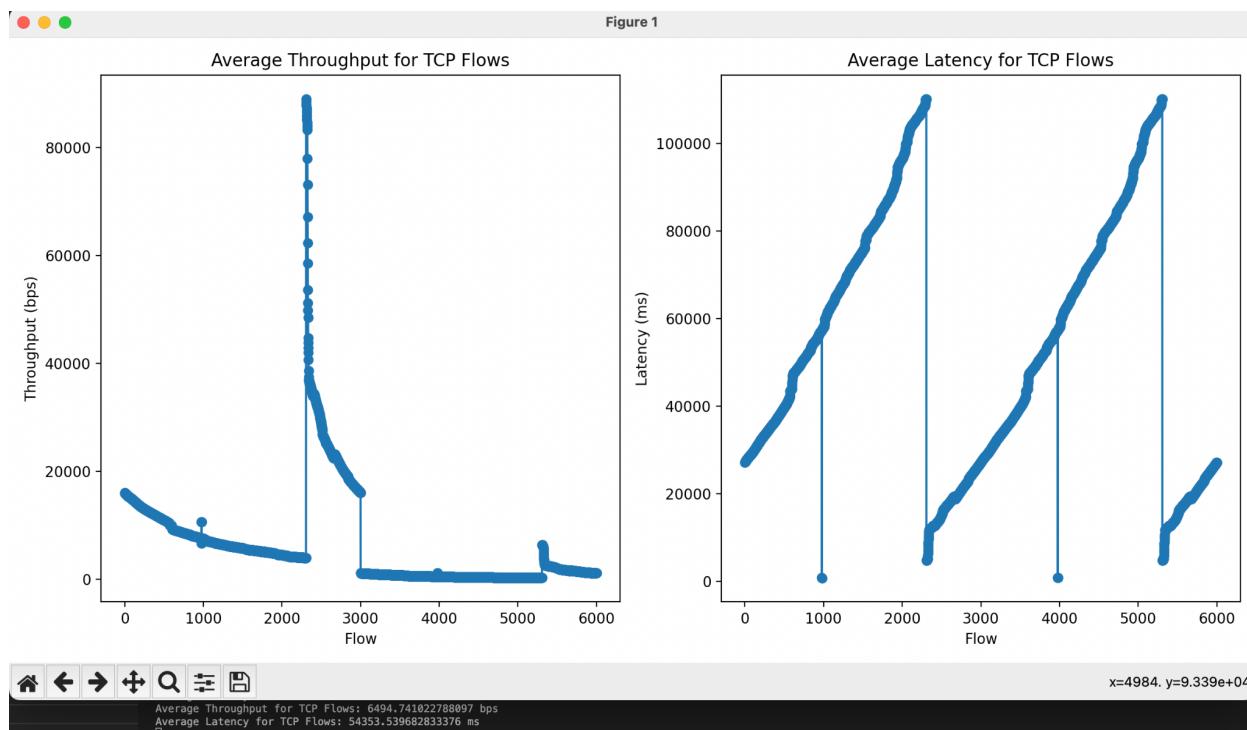


Three:

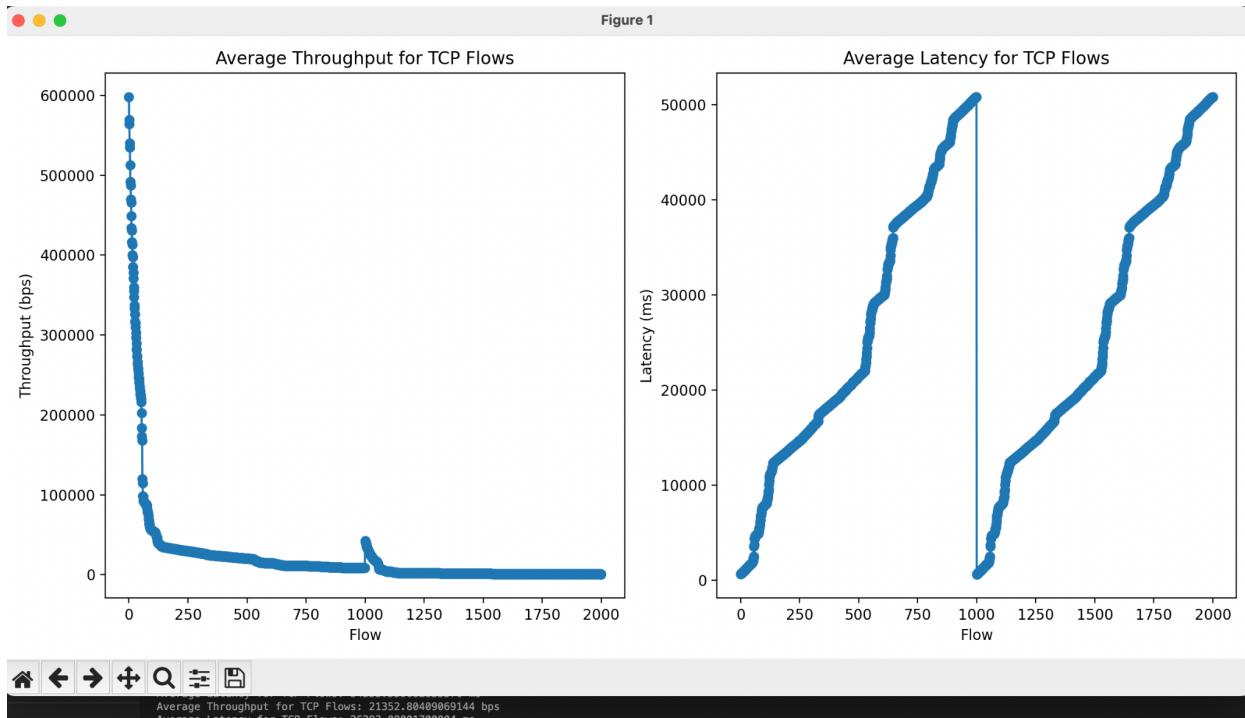


POLL:

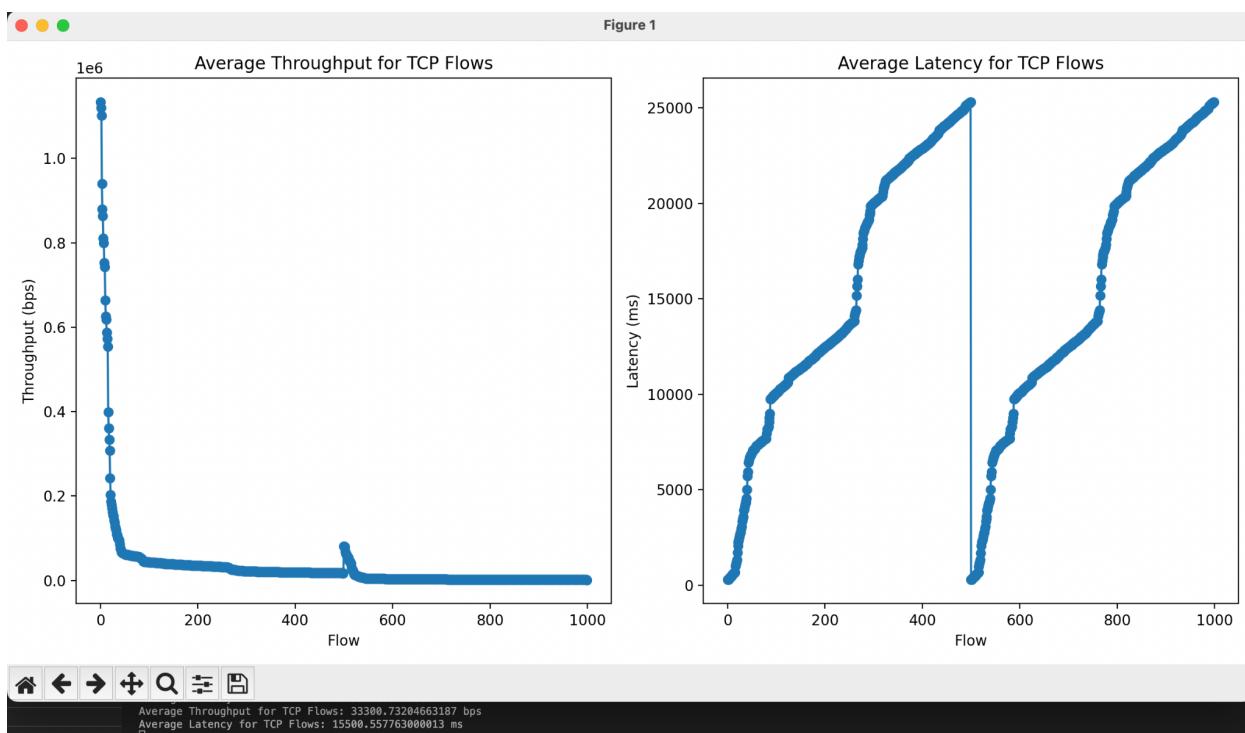
One:



Two:

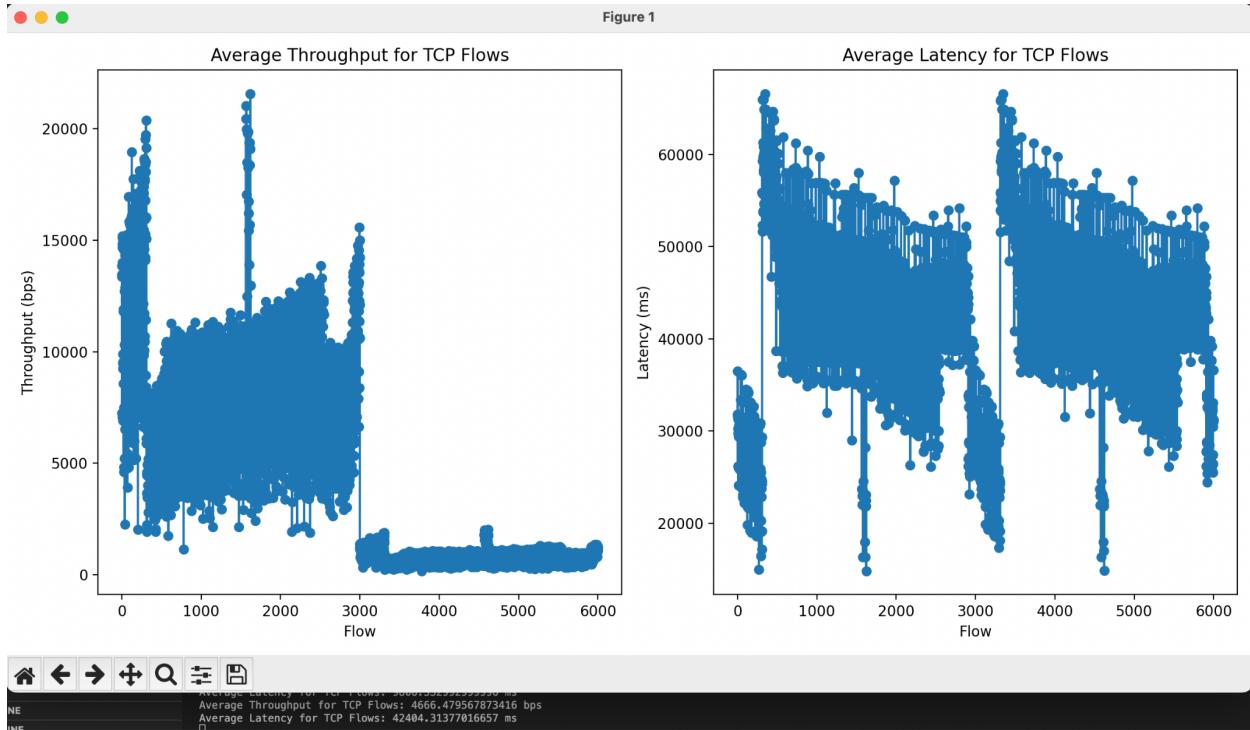


Three:

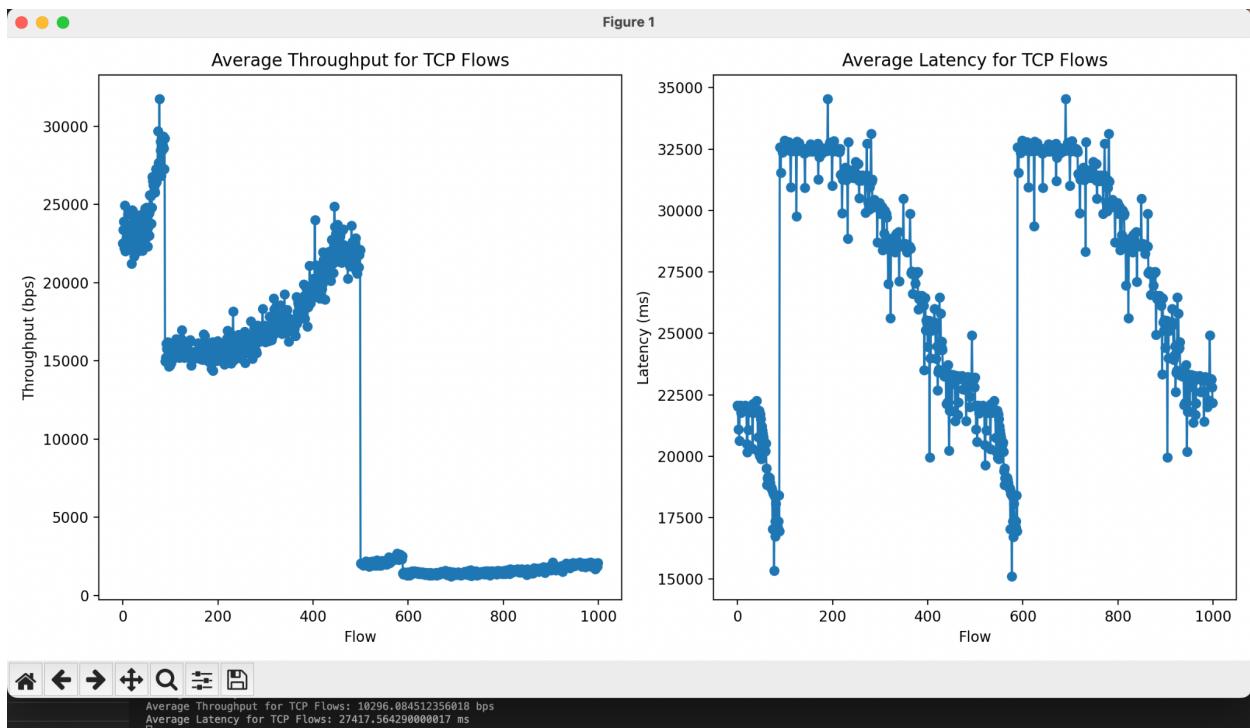


FORK:

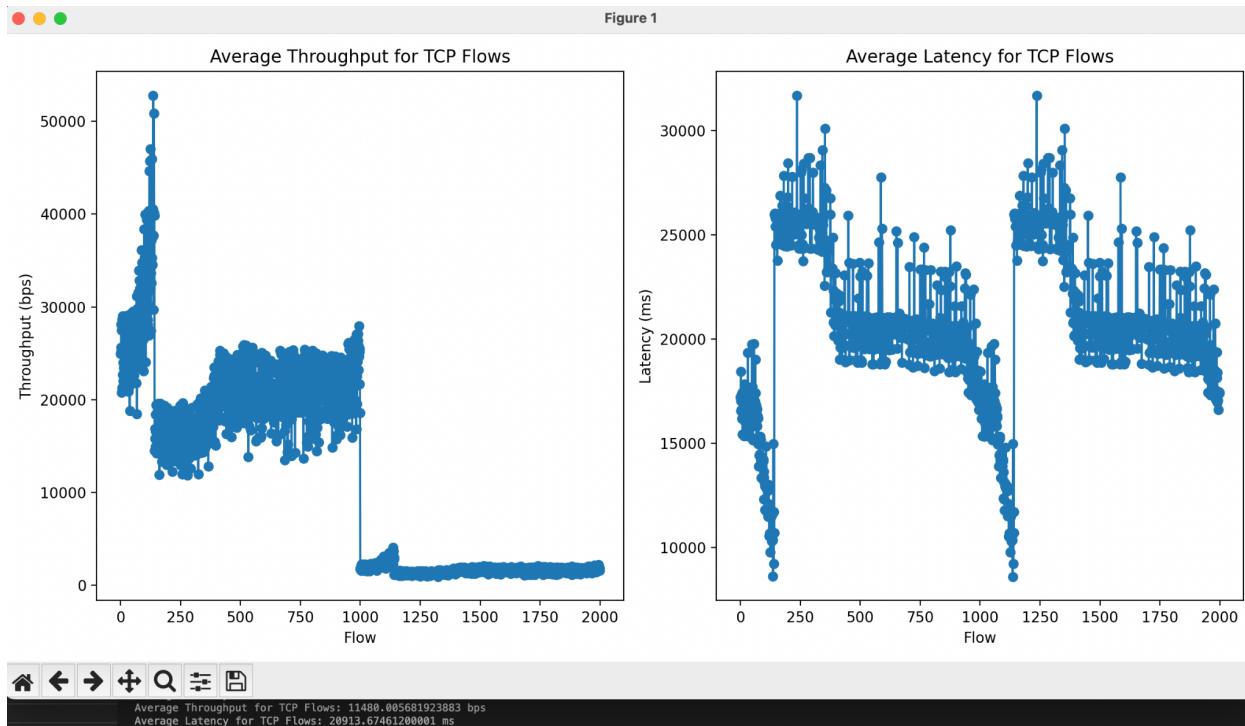
One:



Two:

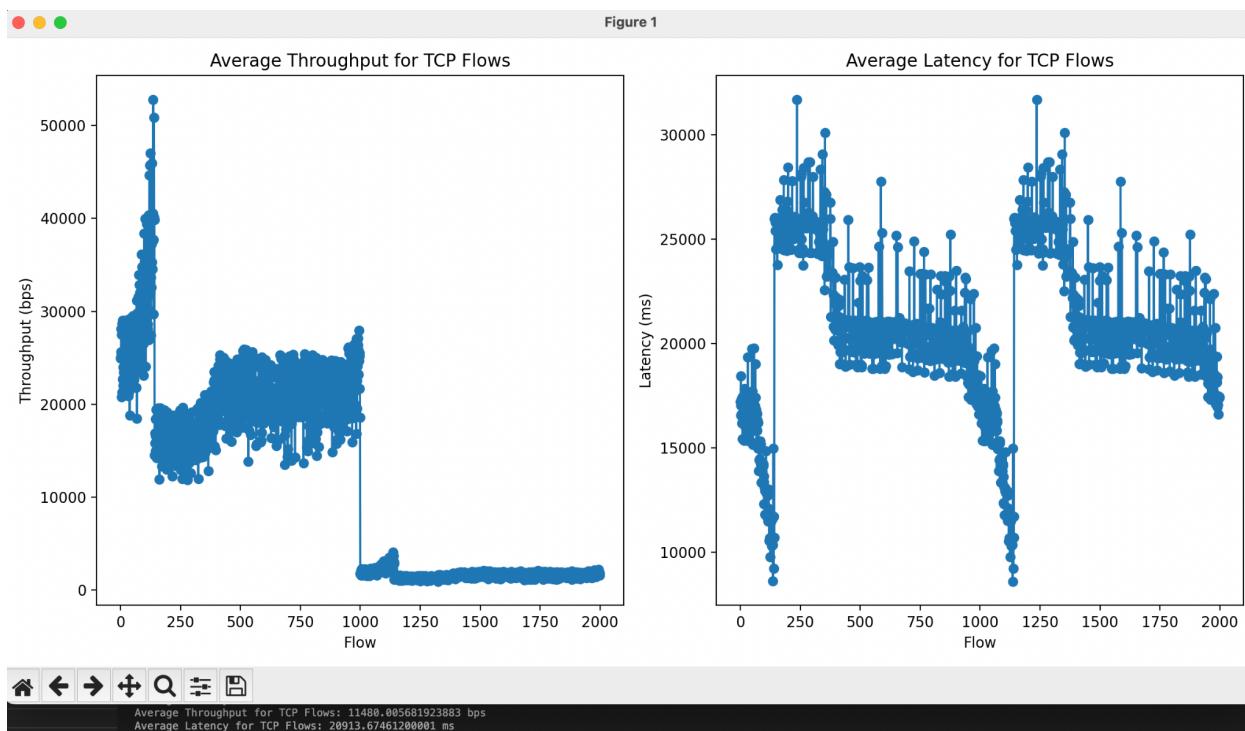


Three:

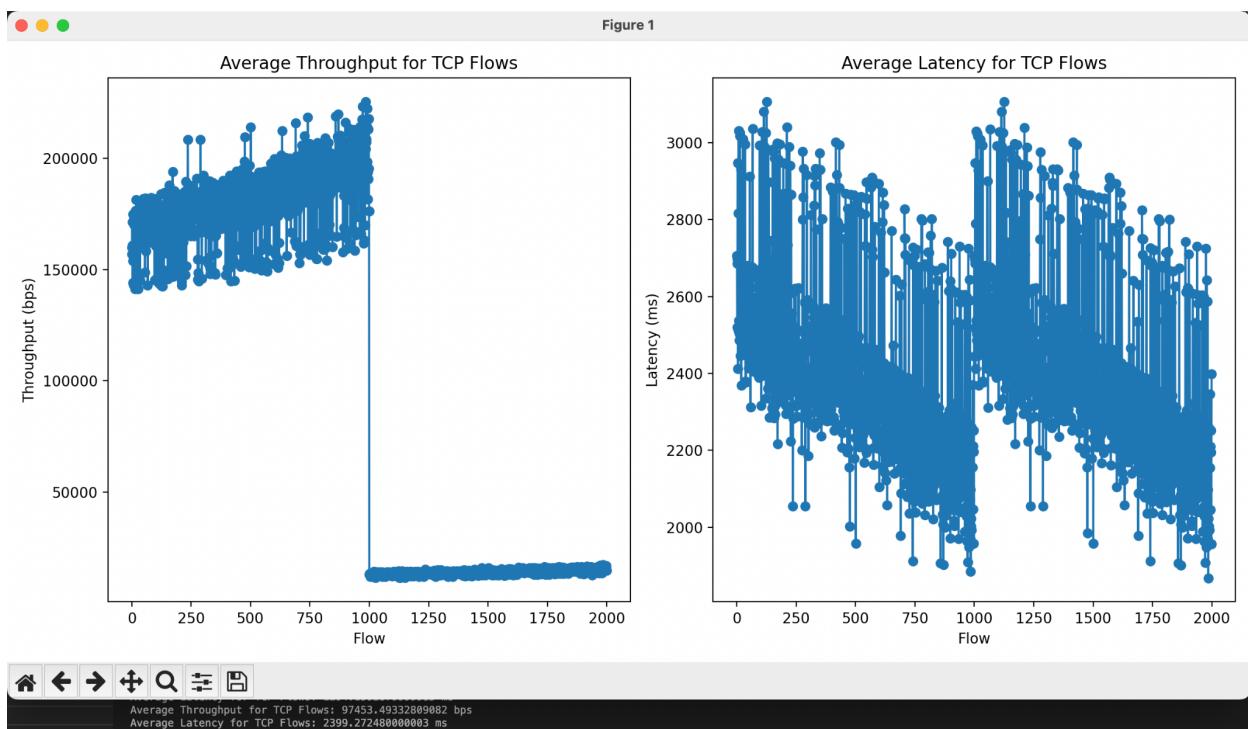


THREAD:

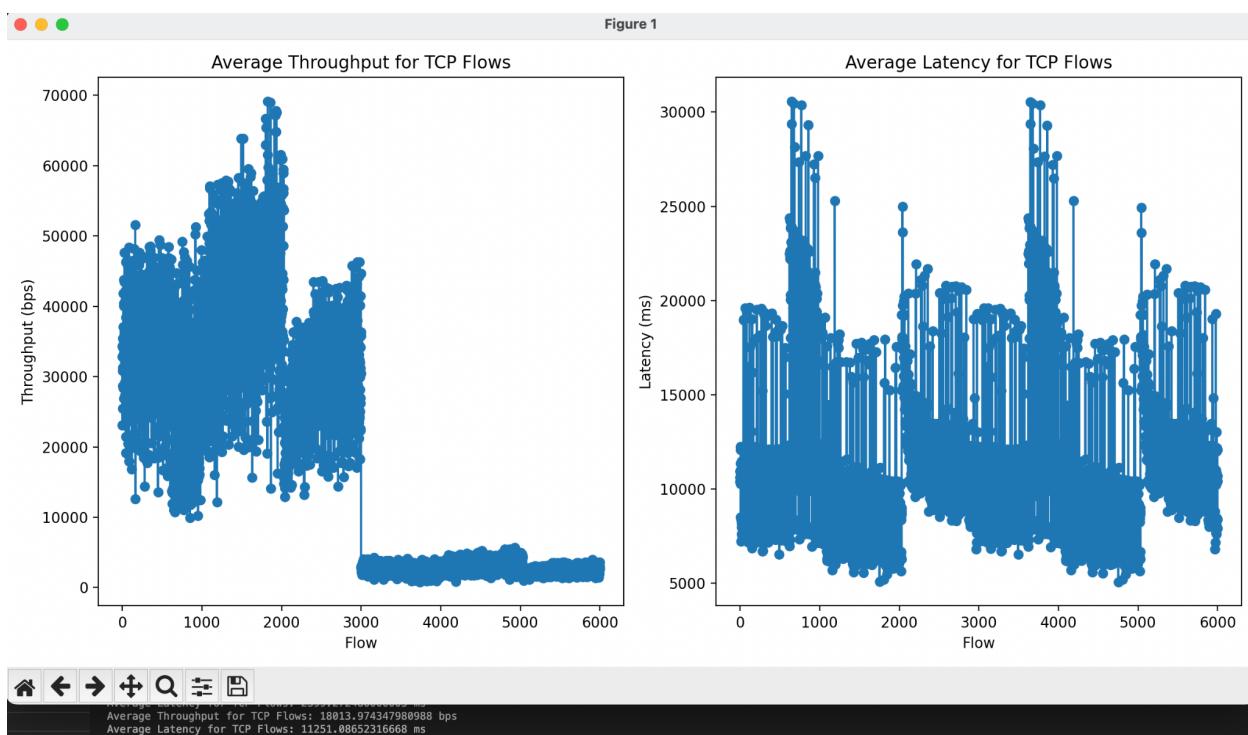
One:



Two:



Three:



3.)

C. (i)

Htop:

fork:

```
server@server-virtual-machine:~/Desktop/server code
server@server-virtual-machine:~/Desktop/server code

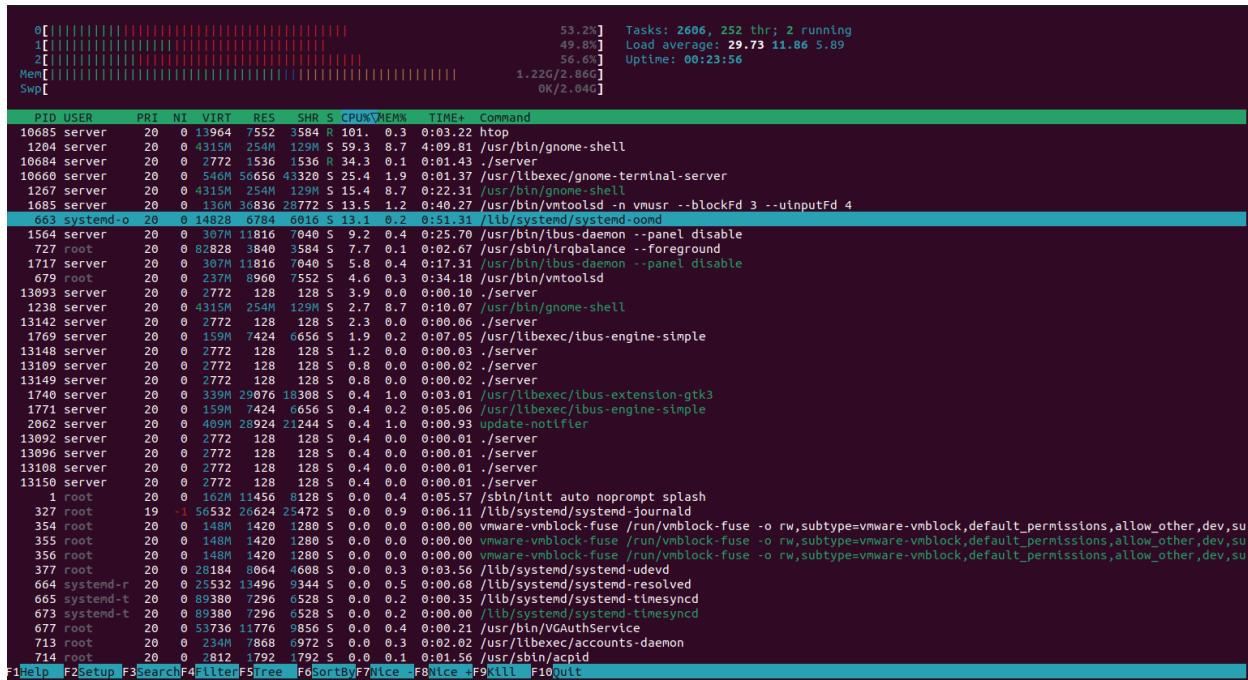
Tasks: 351, 260 thr; 1 running
Load average: 1.27 1.36 1.06
Uptime: 00:11:42

PID USER PRI NI VIRT RES SHR S CPU%MEM TIME+ Command
2699 server 20 0 1205M 358M 161M S 36.3 12.2 1:07.39 wireshark
687 root 20 0 237M 8794 7552 S 17.1 0.3 0:11.48 /usr/bin/vmtoolsd
2238 server 20 0 136M 36984 28792 S 16.0 1.2 0:09.00 /usr/bin/vmtoolsd -n vmusr --blockFd 3 --uiInputFd 4
2302 server 20 0 251M 98880 57576 S 5.3 3.2 0:05.61 /usr/bin/Xwayland :0 -rootless -noreset -accessx -core -auth /run/user/10
2700 server 20 0 11716 5248 3584 R 5.3 0.2 0:00.51 htop
668 systemd-o 20 0 14828 6912 6144 S 3.2 0.2 0:01.89 /lib/systemd/systemd-oomd
1354 server 20 0 3959M 256M 127M S 3.2 8.8 0:21.23 /usr/bin/gnome-shell
2914 server 20 0 2772 128 S 3.2 0.0 0:00.03 ./server
2491 server 20 0 544M 55584 42936 S 2.1 1.9 0:05.16 /usr/libexec/gnome-terminal-server
i root 20 0 162M 11612 8284 S 0.0 0.4 0:02.68 /sbin/init auto nosplash
332 root 19 -1 48088 17540 10266 S 0.0 0.0 0:01.10 /lib/systemd/systemd-journald
360 root 20 0 148M 1292 1152 S 0.0 0.0 0:00.00 vmware-vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default
361 root 20 0 148M 1292 1152 S 0.0 0.0 0:00.00 vmware-vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default
362 root 20 0 148M 1292 1152 S 0.0 0.0 0:00.00 vmware-vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default
383 root 20 0 28688 6704 4608 S 0.0 0.3 0:00.98 /lib/systemd/systemd-udevd
669 systemd-r 20 0 25532 13544 9344 S 0.0 0.5 0:00.23 /lib/systemd/systemd-resolved
670 systemd-t 20 0 89380 7552 6556 S 0.0 0.3 0:00.13 /lib/systemd/systemd-timesyncd
685 root 20 0 53736 11904 9984 S 0.0 0.4 0:00.14 /usr/bin/VGAuthService
722 root 20 0 234M 7800 6904 S 0.0 0.3 0:00.26 /usr/libexec/accounts-daemon
723 root 20 0 2812 1920 1792 S 0.0 0.1 0:00.03 /usr/sbin/acpid
726 avahi 20 0 7628 3840 3584 S 0.0 0.1 0:00.18 avahi-daemon: running [server-virtual-machine.local]
727 root 20 0 10484 4992 4736 S 0.0 0.2 0:00.08 /usr/libexec/bluetooth/bluetoothd
728 root 20 0 9492 7688 2560 S 0.0 0.1 0:00.01 /usr/sbin/cron -f -P
729 messagebus 20 0 10940 6144 3840 S 0.0 0.2 0:00.88 @ibus-dæmon --system --address=systemd: --nofork --nopidfile --systemd-a
730 root 20 0 326M 18604 15788 S 0.0 0.6 0:00.49 /usr/sbin/NetworkManager --no-daemon
736 root 20 0 82828 3968 3584 S 0.0 0.1 0:00.10 /usr/sbin/lrbalance --foreground
737 root 20 0 41052 21248 11984 S 0.0 0.7 0:00.30 /usr/bin/python3 /usr/bin/network-dispatcher --run-startup-triggers
738 root 20 0 237M 10940 7484 S 0.0 0.4 0:00.44 /usr/libexec/polkitd --no-debug
739 root 20 0 234M 7168 6528 S 0.0 0.2 0:00.05 /usr/libexec/power-profiles-daemon
740 syslog 20 0 217M 6528 4480 S 0.0 0.2 0:02.28 /usr/sbin/syslogd -n -iNONE
742 root 20 0 1360M 30072 19456 S 0.0 1.0 0:02.48 /usr/lib/snappy/snappy
743 root 20 0 230M 6528 616 S 0.0 0.2 0:00.06 /usr/libexec/switcheroo-control
F1 Help F2 Setup F3 Search F4 Filter F5 Tree F6 SortBy F7 Tree F8 Tree F9 Kill F10 Exit
```

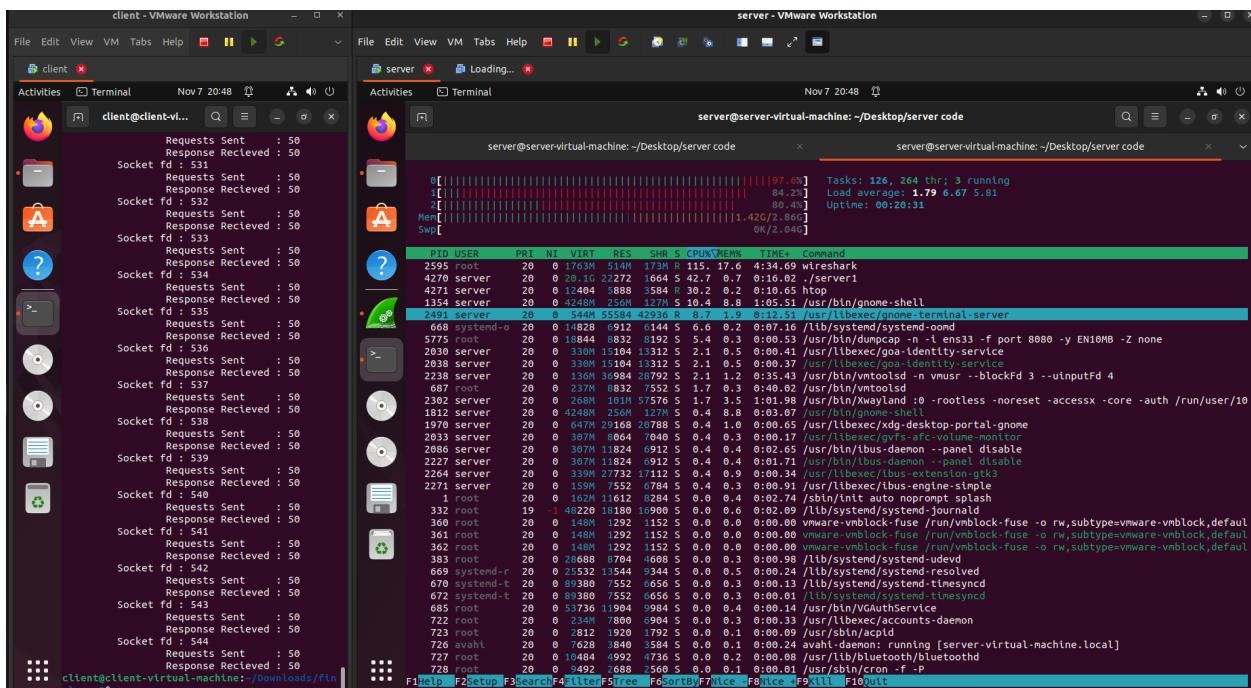
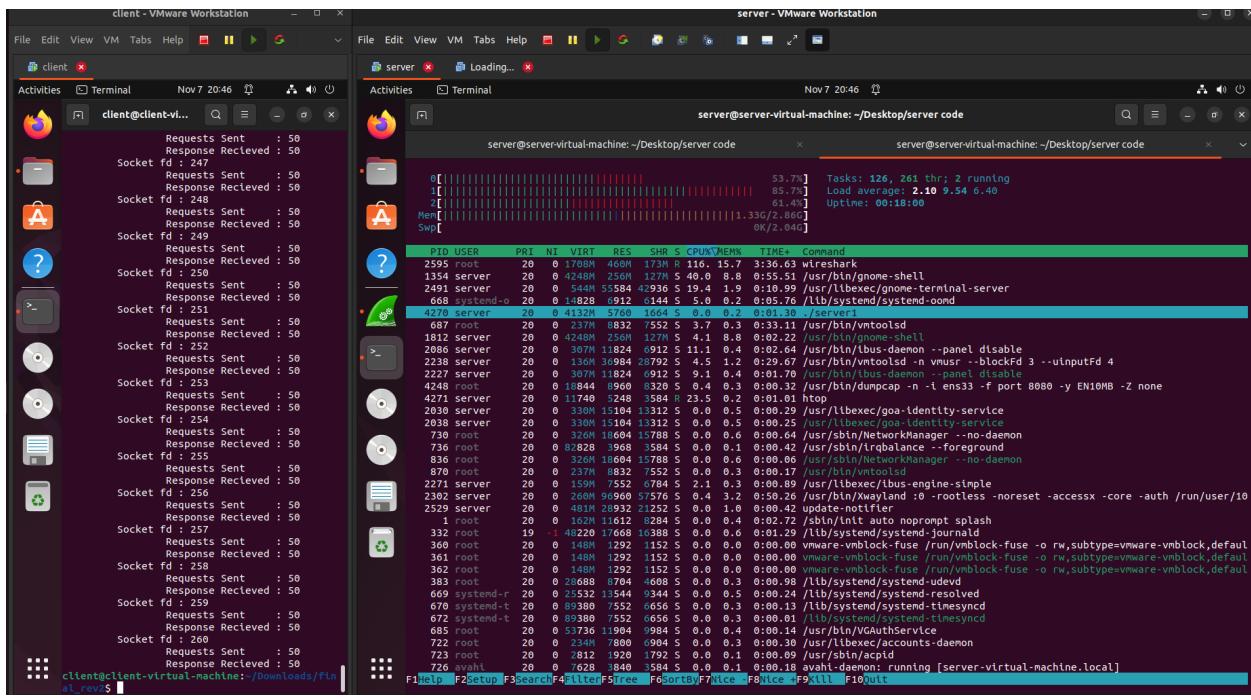
```
client@client-VMware Workstation:~/Downloads/f1n
server@server-VMware Workstation:~/Desktop/server code
server@server-VMware Workstation:~/Desktop/server code

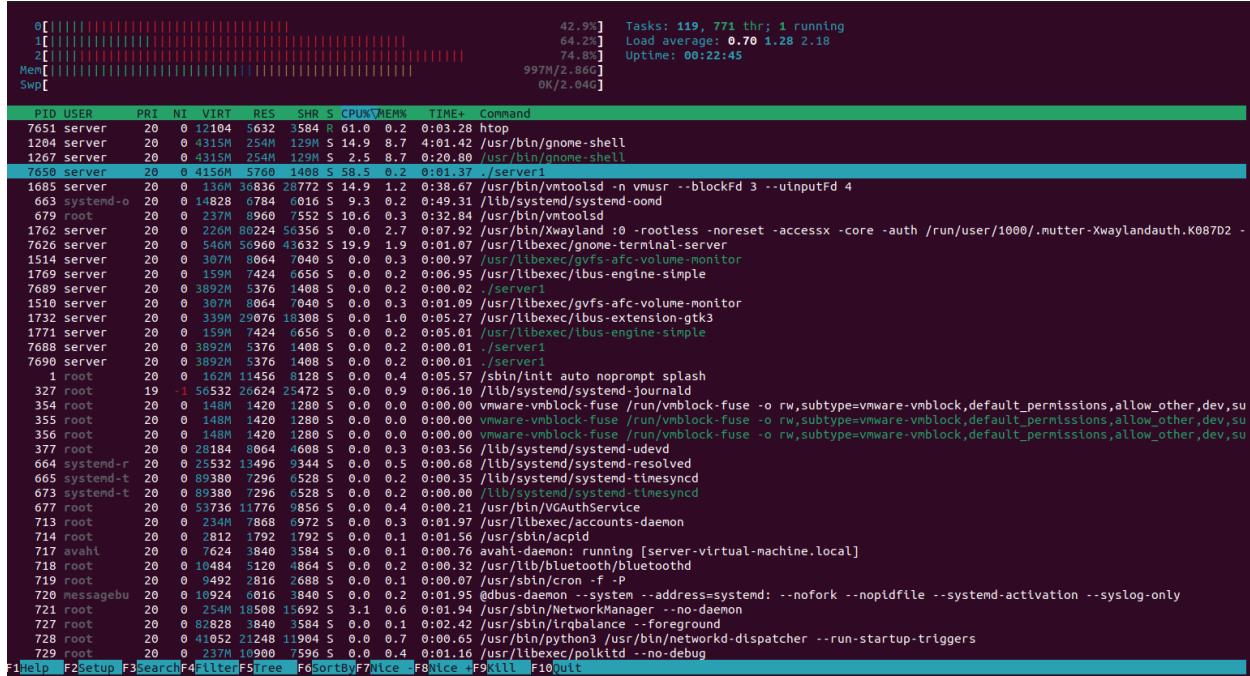
Tasks: 1431, 265 thr; 1 running
Load average: 10.47 11.54 5.47
Uptime: 00:14:06

PID USER PRI NI VIRT RES SHR S CPU%MEM TIME+ Command
2700 server 20 0 1216M 358M 28.4 R 0.2 0:10.95 htop
2595 root 20 0 1685M 4158 173M S 27.2 14.2 2:40.53 wireshark
2699 server 20 0 2772 1536 1536 S 18.1 0.1 0:07.58 ./server
1354 server 20 0 3959M 256M 127M S 18.1 0.1 0:07.58 /usr/bin/gnome-shell
2491 server 20 0 237M 8792 7552 S 3.9 0.1 0:00.53 /usr/libexec/gnome-terminal-server
2238 server 20 0 136M 36984 28792 S 3.9 1.2 0:20.82 /usr/bin/vmtoolsd -n vmusr --blockFd 3 --uiInputFd 4
2302 server 20 0 268M 1019 57576 S 3.9 3.5 0:29.83 /usr/bin/Xwayland :0 -rootless -noreset -accessx -core -auth /run/user/10
2334 server 20 0 2724M 61412 45396 S 3.0 2.0 0:01.42 gjs /usr/share/gnome-shell/extensions/dingrastersoft.com.dlq.js -E -P /
687 root 20 0 8828 8832 7552 S 1.7 0.3 0:24.47 /usr/bin/vmtoolsd
668 systemd-o 20 0 14828 6912 6144 S 1.3 0.2 0:02.98 /lib/systemd/systemd-oomd
3815 server 20 0 10484 4992 4736 S 1.3 0.2 0:00.03 /usr/libexec/bluetooth/bluetoothd
3238 server 20 0 1120M 3968 3584 S 0.4 0.3 0:00.64 /usr/bin/buntu-report-service
1166 server 20 0 3992 7200 7168 S 0.4 0.3 0:00.01 /usr/bin/gnome-shell
1889 server 20 0 3992 256M 177M S 0.4 0.8 0:00.32 /usr/bin/gnome-shell
1890 server 20 0 3992 256M 177M S 0.4 0.8 0:00.04 /usr/bin/gnome-shell
2030 server 20 0 330M 15104 13312 S 0.4 0.5 0:00.18 /usr/libexec/goa-identity-service
2038 server 20 0 330M 15104 13312 S 0.4 0.5 0:00.14 /usr/libexec/goa-identity-service
2200 server 20 0 727M 6364 48924 S 0.4 2.1 0:00.34 /usr/libexec/evolution-data-server/evolution-alarm-notify
2339 server 20 0 2724M 61412 45396 S 0.4 2.0 0:00.01 /usr/share/gnome-shell/extensions/dingrastersoft.com.dlq.js -E -P /
3835 server 20 0 10484 4992 4736 S 0.4 2.0 0:00.01 /usr/libexec/bluetooth/bluetoothd
3238 server 20 0 162M 11612 8284 S 0.0 0.4 0:02.68 /sbin/init auto nosplash
332 root 19 -1 4629 17668 16388 S 0.0 0.6 0:01.15 /lib/systemd/systemd-journald
360 root 20 0 148M 1292 1152 S 0.0 0.0 0:00.00 vmware-vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default
361 root 20 0 148M 1292 1152 S 0.0 0.0 0:00.00 vmware-vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default
362 root 20 0 148M 1292 1152 S 0.0 0.0 0:00.00 vmware-vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default
383 root 20 0 28688 6704 4608 S 0.0 0.3 0:00.98 /lib/systemd/systemd-udevd
669 systemd-r 20 0 89380 7552 6556 S 0.0 0.3 0:00.23 /lib/systemd/systemd-resolved
670 systemd-t 20 0 89380 7552 6556 S 0.0 0.3 0:00.01 /lib/systemd/systemd-timesyncd
685 root 20 0 53736 11904 9984 S 0.0 0.4 0:00.14 /usr/bin/VGAuthService
722 root 20 0 234M 7800 6904 S 0.0 0.3 0:00.26 /usr/libexec/accounts-daemon
723 root 20 0 2812 1920 1792 S 0.0 0.1 0:00.04 /usr/sbin/acpid
726 avahi 20 0 7628 3840 3584 S 0.0 0.1 0:00.18 avahi-daemon: running [server-virtual-machine.local]
727 root 20 0 10484 4992 4736 S 0.0 0.2 0:00.08 /usr/libexec/bluetooth/bluetoothd
F1 Help F2 Setup F3 Search F4 Filter F5 Tree F6 SortBy F7 Tree F8 Tree F9 Kill F10 Exit
```

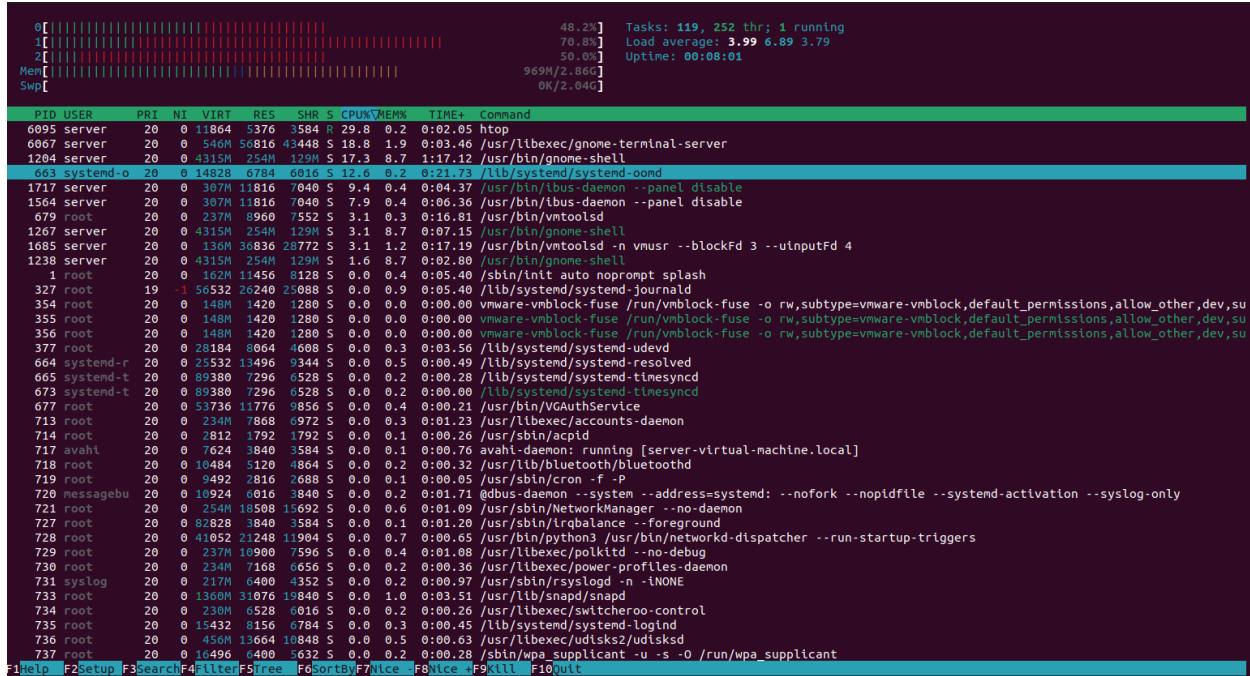


Thread:





Select:



```

Administrator (user "root"
:details.

chine:-/Downloads/f1n
172.16.123.129:8080

Too many open files
chine:-/Downloads/f1n
172.16.123.129:8080

chine:-/Downloads/f1n
172.16.123.129:8080

Tasks: 126, 257 thr; 1 running
Load average: 0.30 1.29 0.98
Uptime: 00:08:51

PID USER PRI NI VIRT RES SHR S CPU%MEM TIME+ Command
2595 root 20 0 1126M 284M 161M S 4.6 9.7 0:13.51 wireshark
2679 server 20 0 2772 1498 1498 S 3.3 0.6 0:00.25 ./select
2681 server 20 0 11456 4992 3584 R 1.3 0.2 0:00.23 htop
687 root 20 0 237M 8794 7552 S 0.7 0.3 0:03.40 /usr/bin/vmtoolsd
2302 server 20 0 250M 96852 57448 S 0.7 3.2 0:02.47 /usr/bin/Xwayland :0 -rootless -noreset -accessx -core -auth /run/user/10
2491 server 20 0 544M 5584 42936 S 0.7 1.9 0:02.79 /usr/libexec/gnome-terminal-server
1 root 20 0 162M 1612 8284 S 0.0 0.4 0:02.68 /sbin/init auto noplrompt splash
332 root 19 -1 48088 17412 16132 S 0.0 0.6 0:00.98 /lib/systemd/systemd-journal
360 root 20 0 148M 1292 1152 S 0.0 0.0 0:00.00 vmware-vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default
361 root 20 0 148M 1292 1152 S 0.0 0.0 0:00.00 vmware-vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default
362 root 20 0 148M 1292 1152 S 0.0 0.0 0:00.00 vmware-vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default
383 root 20 0 28688 8794 4688 S 0.0 0.3 0:00.98 /lib/systemd/systemd-udevd
668 systemd-o 20 0 14828 6912 6144 S 0.0 0.2 0:01.46 /lib/systemd/systemd-oomd
669 systemd-r 20 0 25532 13544 9344 S 0.0 0.5 0:00.23 /lib/systemd/systemd-resolved
670 systemd-t 20 0 89380 7552 656 S 0.0 0.3 0:00.12 /lib/systemd/systemd-timesyncd
672 systemd-t 20 0 89380 7552 656 S 0.0 0.3 0:00.01 /lib/systemd/systemd-timesyncd
685 root 20 0 53736 11994 9984 S 0.0 0.4 0:00.14 /usr/bin/VGAuthService
722 root 20 0 234M 7898 5984 S 0.0 0.3 0:00.24 /usr/libexec/accounts-daemon
723 root 20 0 2812 1928 1792 S 0.8 0.1 0:00.02 /usr/sbin/acpid
726 avahil 20 0 7628 3848 3584 S 0.0 0.1 0:00.18 avahi-daemon: running [server-virtual-machine.local]
727 root 20 0 16484 4992 4736 S 0.0 0.2 0:00.08 /usr/lib/bluetooth/bluetoothd
728 root 20 0 9492 2688 2560 S 0.0 0.1 0:00.01 /usr/sbin/cron -f -P
729 messagebus 20 0 10940 6144 3840 S 0.0 0.2 0:00.08 @ibus-daemon -system --address=systemd: --nofork --nopidfile --systemd-a
730 root 20 0 326M 16604 15788 S 0.0 0.6 0:00.47 /usr/sbin/NetworkManager --no-daemon
736 root 20 0 82828 3968 3584 S 0.0 0.1 0:00.08 /usr/lib/irqbalance --foreground
737 root 20 0 41052 21248 11994 S 0.0 0.7 0:00.30 /usr/bin/python3 /usr/bin/networkd-dispatcher --run-startup-triggers
738 root 20 0 237M 10940 7484 S 0.0 0.4 0:00.44 /usr/libexec/polkitd --no-debug
739 root 20 0 234M 7168 6528 S 0.0 0.2 0:00.05 /usr/libexec/power-profiles-daemon
740 syslog 20 0 217M 6528 4480 S 0.0 0.2 0:02.26 /usr/sbin/syslogd -n -tNONE
742 root 20 0 1366M 30336 19456 S 0.0 1.0 0:02.43 /usr/lib/snapd/snapd
743 root 20 0 230M 6528 6016 S 0.0 0.2 0:00.06 /usr/libexec/switcheroo-control
744 root 20 0 15440 7848 656 S 0.0 0.3 0:00.22 /lib/systemd/systemd-logind
745 root 20 0 456M 13644 10828 S 0.0 0.5 0:00.26 /usr/libexec/udisks2/udisksd
746 root 20 0 16496 6528 5760 S 0.0 0.2 0:00.06 /sbin/wpa_supplicant -u -s -0 /run/wpa_supplicant
F1:help F2:Setup F3:Search F4:Filter F5:Tree F6:SortByF7:rice F8:rice +F9:Kill F10:quit

```

```

Administrator (user "root"
:details.

chine:-/Downloads/f1n
172.16.123.129:8080

Too many open files
chine:-/Downloads/f1n
172.16.123.129:8080

chine:-/Downloads/f1n
172.16.123.129:8080

Tasks: 126, 257 thr; 3 running
Load average: 0.27 1.08 0.92
Uptime: 00:10:00

PID USER PRI NI VIRT RES SHR S CPU%MEM TIME+ Command
2679 server 20 0 2772 1498 1498 R 296. 0.6 0:08.72 ./select
2659 root 20 0 18844 8832 8192 R 234. 0.3 0:07.01 /usr/bin/dumpcap -n -i ens33 -f port 8080 -y EN10MB -z none
2595 root 20 0 1136M 290M 161M R 232. 9.9 0:15.67 wireshark
722 root 20 0 1360M 30072 19456 S 7.3 1.0 0:02.47 /usr/lib/snapd/snapd
Wireshark 20 0 1360M 30072 19456 S 7.3 1.0 0:00.11 /usr/lib/snapd/snapd
687 root 20 0 237M 8794 7552 R 1.8 0.3 0:03.63 /usr/bin/vmtoolsd
2030 server 20 0 330M 55184 13312 S 1.8 0.5 0:00.06 /usr/libexec/goa-identity-service
2491 server 20 0 544M 5584 42936 S 1.8 1.9 0:03.33 /usr/libexec/gnome-terminal-server
2681 server 20 0 11456 4992 3584 R 1.8 0.2 0:01.44 htop
1 root 20 0 162M 1612 8284 S 0.0 0.4 0:02.68 /sbin/init auto noplrompt splash
332 root 19 -1 48088 17412 16132 S 0.0 0.6 0:00.98 /lib/systemd/systemd-journal
360 root 20 0 148M 1292 1152 S 0.0 0.0 0:00.00 vmware-vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default
361 root 20 0 148M 1292 1152 S 0.0 0.0 0:00.00 vmware-vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default
362 root 20 0 148M 1292 1152 S 0.0 0.0 0:00.00 vmware-vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default
383 root 20 0 28688 8794 4688 S 0.0 0.3 0:00.98 /lib/systemd/systemd-udevd
668 systemd-o 20 0 14828 6912 6144 S 0.0 0.2 0:01.59 /lib/systemd/systemd-oomd
669 systemd-r 20 0 25532 13544 9344 S 0.0 0.5 0:00.23 /lib/systemd/systemd-resolved
670 systemd-t 20 0 89380 7552 656 S 0.0 0.3 0:00.13 /lib/systemd/systemd-timesyncd
672 systemd-t 20 0 89380 7552 656 S 0.0 0.3 0:00.01 /lib/systemd/systemd-timesyncd
685 root 20 0 53736 11994 9984 S 0.0 0.4 0:00.14 /usr/bin/VGAuthService
722 root 20 0 2812 1928 1792 S 0.0 0.1 0:00.02 /usr/sbin/acpid
726 avahil 20 0 7628 3848 3584 S 0.0 0.1 0:00.18 avahi-daemon: running [server-virtual-machine.local]
728 root 20 0 9492 2688 2560 S 0.0 0.1 0:00.01 /usr/sbin/cron -f -P
729 messagebus 20 0 10940 6144 3840 S 0.0 0.2 0:00.08 @ibus-daemon -system --address=systemd: --nofork --nopidfile --systemd-a
730 root 20 0 326M 16604 15788 S 0.0 0.6 0:00.48 /usr/sbin/NetworkManager --no-daemon
736 root 20 0 82828 3968 3584 S 0.0 0.1 0:00.08 /usr/lib/irqbalance --foreground
737 root 20 0 41052 21248 11994 S 0.0 0.7 0:00.30 /usr/bin/python3 /usr/bin/networkd-dispatcher --run-startup-triggers
738 root 20 0 237M 10940 7484 S 0.0 0.4 0:00.44 /usr/libexec/polkitd --no-debug
739 root 20 0 234M 7168 6528 S 0.0 0.2 0:00.05 /usr/libexec/power-profiles-daemon
740 syslog 20 0 217M 6528 4480 S 0.0 0.2 0:02.26 /usr/sbin/syslogd -n -tNONE
742 root 20 0 1366M 30336 19456 S 0.0 1.0 0:02.43 /usr/lib/snapd/snapd
743 root 20 0 230M 6528 6016 S 0.0 0.2 0:00.06 /usr/libexec/switcheroo-control
744 root 20 0 15440 7848 656 S 0.0 0.3 0:00.22 /lib/systemd/systemd-logind
F1:help F2:Setup F3:Search F4:Filter F5:Tree F6:SortByF7:rice F8:rice +F9:Kill F10:quit

```

Poll:

client - VMware Workstation

File Edit View VM Tabs Help

Activities Terminal Nov 7 20:51

client

```
Socket fd : 247
  Requests Sent : 50
  Response Received : 50
Socket fd : 248
  Requests Sent : 50
  Response Received : 50
Socket fd : 249
  Requests Sent : 50
  Response Received : 50
Socket fd : 250
  Requests Sent : 50
  Response Received : 50
Socket fd : 251
  Requests Sent : 50
  Response Received : 50
Socket fd : 252
  Requests Sent : 50
  Response Received : 50
Socket fd : 253
  Requests Sent : 50
  Response Received : 50
Socket fd : 254
  Requests Sent : 50
  Response Received : 50
Socket fd : 255
  Requests Sent : 50
  Response Received : 50
Socket fd : 256
  Requests Sent : 50
  Response Received : 50
Socket fd : 257
  Requests Sent : 50
  Response Received : 50
Socket fd : 258
  Requests Sent : 50
  Response Received : 50
Socket fd : 259
  Requests Sent : 50
  Response Received : 50
Socket fd : 260
  Requests Sent : 50
  Response Received : 50
Socket fd : 261
  Requests Sent : 50
  Response Received : 50
Socket fd : 262
  Requests Sent : 50
  Response Received : 50
Socket fd : 263
  Requests Sent : 50
  Response Received : 50
Socket fd : 264
  Requests Sent : 50
  Response Received : 50
Socket fd : 265
  Requests Sent : 50
  Response Received : 50
Socket fd : 266
  Requests Sent : 50
  Response Received : 50
Socket fd : 267
  Requests Sent : 50
  Response Received : 50
Socket fd : 268
  Requests Sent : 50
  Response Received : 50
Socket fd : 269
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```

server - VMware Workstation

File Edit View VM Tabs Help

Activities Terminal Nov 7 20:51

server

```
Loading...
```

client@client-virtual-machine: ~/Downloads/fn

al_rev2\$./client_x86_64 172.16.123.129:8880

50 500

Tasks: 126, 268 thr: 3 running
Load average: 2.92 3.43 4.56
Uptime: 00:25:57

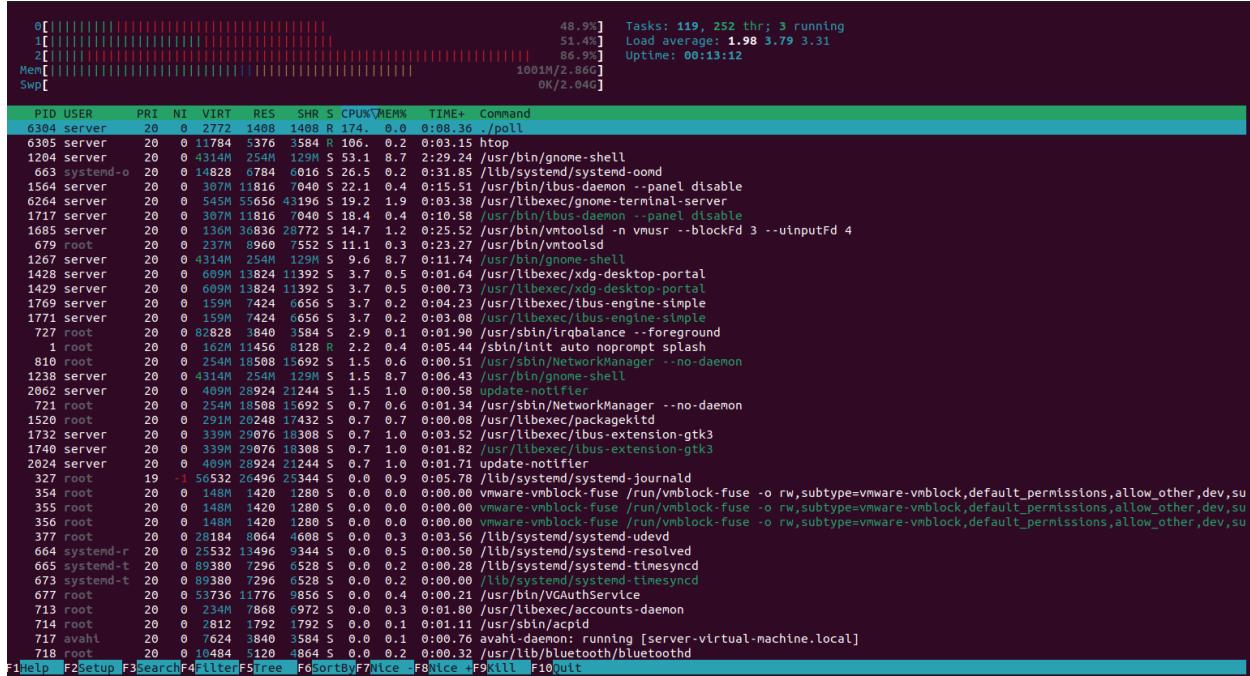
PID USER PRI NI VIRT RES SHR S CPU%HWS% TIME+ Command

2595	root	20	0	180M	527M	173M	S 9.4	18.0	5:31.56	wireshark
7306	root	20	0	18844	8704	8664	S 2.7	0.3	0:00.06	/usr/bin/dumpcap -n -l ens3 -f port 8880 -y EN10MB -Z none
2302	server	20	0	268M	101M	5756	S 1.3	3.5	1:16.27	/usr/bin/Xwayland :0 -rootless -noreset -accessx -core -auth /run/user/10
1354	server	20	0	4248M	256M	127M	S 0.7	8.8	1:17.11	/usr/bin/gnome-shell
7325	server	20	0	11468	4992	3584	R 20.4	0.2	0:13.59	httpd
332	root	20	0	4220	1161M	8284	S 0.0	0.4	1:02.49	/sbin/init auto nonprop splash
360	root	20	0	1292	1152	5	S 0.0	0:00.08	/usr/sbin/vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default	
361	root	20	0	148M	1292	1152	S 0.0	0:00.08	/usr/sbin/vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default	
362	root	20	0	148M	1292	1152	S 0.0	0:00.08	/usr/sbin/vmblock-fuse /run/vmblock-fuse -o rw,subtype=vmware-vmblock,default	
383	root	20	0	26888	8704	4608	S 0.0	0:00.98	/lib/systemd/systemd-journald	
668	systemd	0	0	18828	6912	6144	S 0.0	0.2	0:00.24	/lib/systemd/systemd-udev
669	systemd	0	0	25532	13544	9344	S 0.0	0.5	0:00.24	/lib/systemd/systemd-resolved
670	systemd	0	0	8930	7704	6608	S 0.0	0.2	0:00.24	/lib/systemd/systemd-timesyncd
685	root	20	0	15049	552	552	S 0.0	0.3	0:00.31	/lib/systemd/systemd-timesyncd
687	root	20	0	53736	11904	9984	S 0.0	0.4	0:00.14	/usr/bin/GauthService
722	root	20	0	234M	7808	6904	S 0.0	0.3	0:00.37	/usr/libexec/accounts-daemon
723	root	20	0	2812	192	1792	S 0.0	1.1	0:00.10	/usr/sbin/acpid
726	avahi	20	0	7628	3848	3584	S 0.0	0.1	0:00.25	avahi-daemon: running [server-virtual-machine.local]
727	root	20	0	10484	4992	4736	S 0.0	0.2	0:00.08	/lib/bluetooth/bluetoothd
728	root	20	0	148M	6144	3848	S 0.0	0.2	0:00.91	/dbus-daemon --system --address=/systemd: --nofork --nopidfile --systemd-a
729	messagebus	20	0	15049	36984	36984	S 0.0	0.2	0:00.70	/usr/sbin/NetworkManager --nofork --nofork --name=org.freedesktop.DBus --foreground
730	root	20	0	3204	18694	15788	S 0.0	0.6	0:00.78	/usr/sbin/NetworkManager --nofork --nofork --name=org.freedesktop.DBus --foreground
736	root	20	0	87288	3968	3584	S 0.0	0.1	0:00.52	/usr/sbin/lrbalance --foreground
737	root	20	0	41052	10944	11904	S 0.0	0.7	0:00.28	/usr/bin/python3 /usr/bin/network-dispatcher --run-startup-triggers
738	root	20	0	136M	36984	26792	S 5.7	1.2	1:29.32	/usr/bin/dumpcap -n -l ens3 -f port 8880 -y EN10MB -Z none
2002	server	20	0	231M	7044	6272	S 5.1	0.2	0:00.23	/usr/libexec/gvfs-photovolume-monitor
1170	server	20	0	524M	7424	6784	S 4.8	0.2	0:00.21	/usr/libexec/gvfs-photovolume-monitor
2003	server	20	0	231M	8040	4740	S 4.0	0.2	0:00.29	/usr/libexec/gvfs-photovolume-monitor
2403	server	39	1	268M	20644	19944	S 2.4	1.0	0:00.31	/usr/libexec/gvfs-volume-monitor
2302	server	20	0	268M	101M	5756	S 4.0	3.5	1:30.42	/usr/bin/Xwayland :0 -rootless -noreset -accessx -core -auth /run/user/10
2393	server	39	19	620M	2824	18944	S 4.0	1.0	0:04.43	/usr/libexec/tracker-miner-fs-3
7348	root	20	0	18844	8832	8192	S 4.0	0.3	0:00.39	/usr/bin/dumpcap -n -l ens3 -f port 8880 -y EN10MB -Z none
2008	server	20	0	330M	6524	6144	S 3.4	0.2	0:00.14	/usr/libexec/gvfs-ntp-volume-monitor
1966	server	20	0	609M	13824	11392	S 2.8	0.5	0:00.37	/usr/libexec/xdg-desktop-portal
1066	server	20	0	17972	10494	8664	S 2.5	0.4	0:01.97	/lib/systemd/systemd-user
1812	server	20	0	264M	20644	19944	S 2.3	0.8	0:04.74	/usr/libexec/gnome-terminal
2013	server	20	0	231M	456M	377M	S 2.3	0.8	0:00.12	/usr/libexec/gvfs-goa-volume-monitor
1968	server	20	0	609M	13824	11392	S 2.0	0.5	0:00.12	/usr/libexec/gvfs-xdg-desktop-portal
2015	server	20	0	231M	6528	5888	S 2.0	0.2	0:00.08	/usr/libexec/gvfs-goa-volume-monitor
2012	server	20	0	230M	6524	6144	S 1.7	0.2	0:00.07	/usr/libexec/gvfs-ntp-volume-monitor
2030	server	20	0	330M	15104	13312	S 1.7	0.5	0:01.22	/usr/libexec/goa-identity-service
2009	server	20	0	330M	15104	13312	S 1.7	0.5	0:01.22	/usr/libexec/goa-identity-service
1120	server	20	0	230M	6528	5888	S 1.1	0.2	0:00.24	/usr/libexec/gnome-keyring-daemon --daemonize --login
1125	server	20	0	235M	6528	5888	S 1.1	0.2	0:00.08	/usr/libexec/gnome-keyring-daemon --daemonize --login
2032	server	20	0	307M	8064	7640	S 1.1	0.3	0:00.37	/usr/libexec/gvfs-afc-volume-monitor
2086	server	20	0	307M	11824	6912	S 1.1	0.4	0:03.08	/usr/bin/bus-daemon --panel disable
2271	server	20	0	159M	7552	6784	S 1.1	0.3	0:01.03	/usr/libexec/ibus-engine-simple

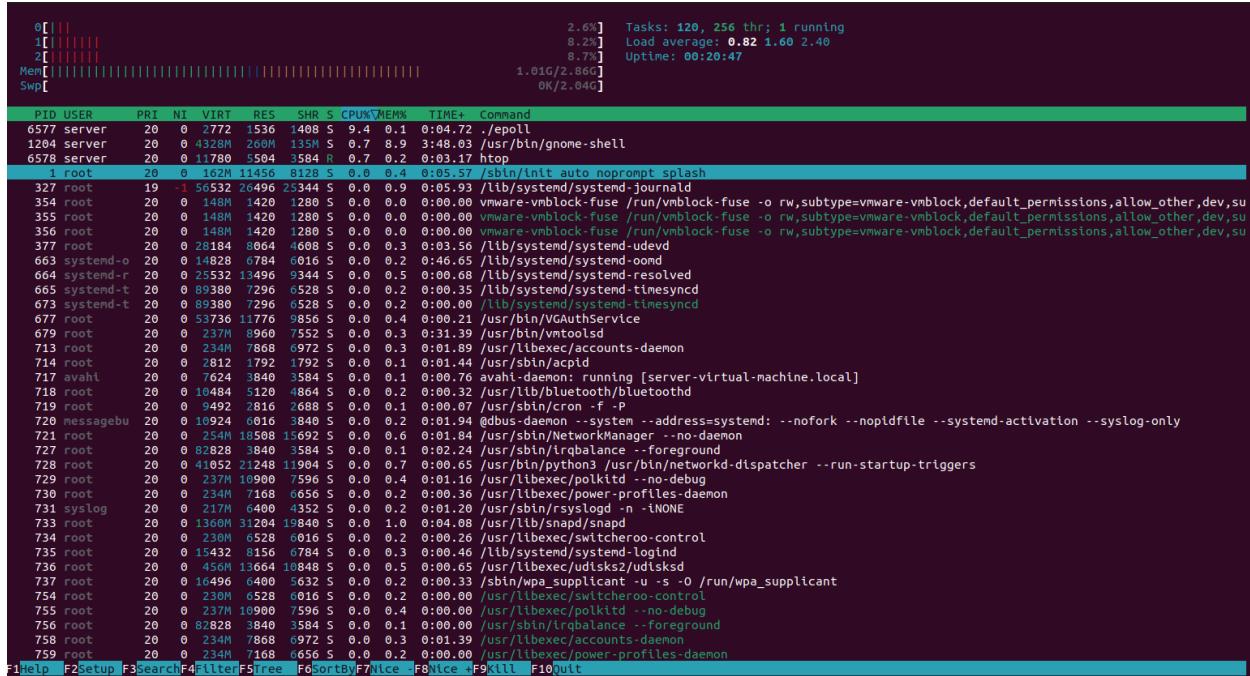
F1Help F2Setup F3Search F4Filter F5Tree F6SortBy F7Nfc F8Ice F9Kill F0Kill F10Quit

client - VMware Workstation

File Edit View VM Tabs Help</p



Epoll:



The image shows two VMware Workstation windows side-by-side. The left window, titled 'client - VMware Workstation', displays a terminal session for 'client@client-virtual-machine'. The right window, titled 'server - VMware Workstation', displays a terminal session for 'server@server-virtual-machine'. Both terminals show command-line output, including system logs and configuration files. The desktop environment includes icons for file operations, terminal, and various applications.

The image shows two side-by-side VMware Workstation windows. The left window, titled 'client - VMware Workstation', contains a terminal session for 'client@client-virtual-machine'. It displays a log of socket activity with numerous entries like 'Socket fd : 531 Requests Sent : 50 Response Received : 50'. The right window, titled 'server - VMware Workstation', contains a terminal session for 'server@server-virtual-machine'. It shows a system load average of 0.65, 1.96, and 3.65 over the last minute, hour, and day respectively. Both windows have their taskbars visible at the bottom, showing various open applications.

C. (ii)

Time -v
Fork:

```
server@server-virtual-machine:~/Desktop/server code$ /usr/bin/time  
-v ./server  
Server is listening on port 8080...  
^CCommand terminated by signal 2  
      Command being timed: "./server"  
      User time (seconds): 0.04  
      System time (seconds): 6.31  
      Percent of CPU this job got: 3%  
      Elapsed (wall clock) time (h:mm:ss or m:ss): 3:07.97  
      Average shared text size (kbytes): 0  
      Average unshared data size (kbytes): 0  
      Average stack size (kbytes): 0  
      Average total size (kbytes): 0  
      Maximum resident set size (kbytes): 1536  
      Average resident set size (kbytes): 0  
      Major (requiring I/O) page faults: 1  
      Minor (reclaiming a frame) page faults: 3421  
      Voluntary context switches: 223  
      Involuntary context switches: 173  
      Swaps: 0  
      File system inputs: 8  
      File system outputs: 0  
      Socket messages sent: 0  
      Socket messages received: 0  
      Signals delivered: 0  
      Page size (bytes): 4096  
      Exit status: 0  
server@server-virtual-machine:~/Desktop/server code$
```

client - VMware Workstation

```
File Edit View VM Tabs Help ■ □ ○ ▶ ○
```

Activities Terminal Nov 7 21:01

client

```
client@client-virtual-machine:~/Downloads/ftn al_rev$
```

```
Requests Sent : 50
Socket fd : 247
Requests Sent : 50
Response Received : 50
Socket fd : 248
Requests Sent : 50
Response Received : 50
Socket fd : 249
Requests Sent : 50
Response Received : 50
Socket fd : 250
Requests Sent : 50
Response Received : 50
Socket fd : 251
Requests Sent : 50
Response Received : 50
Socket fd : 252
Requests Sent : 50
Response Received : 50
Socket fd : 253
Requests Sent : 50
Response Received : 50
Socket fd : 254
Requests Sent : 50
Response Received : 50
Socket fd : 255
Requests Sent : 50
Response Received : 50
Socket fd : 256
Requests Sent : 50
Response Received : 50
Socket fd : 257
Requests Sent : 50
Response Received : 50
Socket fd : 258
Requests Sent : 50
Response Received : 50
Socket fd : 259
Requests Sent : 50
Response Received : 50
Socket fd : 260
Requests Sent : 50
Response Received : 50
client@client-virtual-machine:~/Downloads/ftn al_rev$
```

server - VMware Workstation

```
File Edit View VM Tabs Help ■ □ ○ ▶ ○
```

Activities Terminal Nov 7 21:01

server

```
server@server-virtual-machine:~$ /usr/bin/time -v ./server
```

```
Server is listening on port 8080...
Command being timed: ./server"
User time (seconds): 0.08
System time (seconds): 0.27
Percent of CPU this job got: 1%
Elapsed (wall clock) time (hh:mm:ss or m:ss): 0:22.60
Average shared text size (kbytes): 0
Average unshared data size (kbytes): 0
Average stack size (kbytes): 0
Maximum resident set size (kbytes): 1536
Average resident set size (kbytes): 0
Major (requiring I/O) page faults: 0
Minor (reclaiming a frame) page faults: 958
Voluntary context switches: 388
Involuntary context switches: 4
Swaps: 0
File system inputs: 0
File system outputs: 0
Socket messages sent: 0
Socket messages received: 0
Signals delivered: 0
Page size (bytes): 4096
Exit status: 0
```

server@server-virtual-machine:~\$ /usr/bin/time -v ./server

client - VMware Workstation

```
File Edit View VM Tabs Help ■ □ ○ ▶ ○
```

Activities Terminal Nov 7 21:02

client

```
client@client-virtual-machine:~/Downloads/ftn al_rev$
```

```
Requests Sent : 50
Socket fd : 531
Requests Sent : 50
Response Received : 50
Socket fd : 532
Requests Sent : 50
Response Received : 50
Socket fd : 533
Requests Sent : 50
Response Received : 50
Socket fd : 534
Requests Sent : 50
Response Received : 50
Socket fd : 535
Requests Sent : 50
Response Received : 50
Socket fd : 536
Requests Sent : 50
Response Received : 50
Socket fd : 537
Requests Sent : 50
Response Received : 50
Socket fd : 538
Requests Sent : 50
Response Received : 50
Socket fd : 539
Requests Sent : 50
Response Received : 50
Socket fd : 540
Requests Sent : 50
Response Received : 50
Socket fd : 541
Requests Sent : 50
Response Received : 50
Socket fd : 542
Requests Sent : 50
Response Received : 50
Socket fd : 543
Requests Sent : 50
Response Received : 50
Socket fd : 544
Requests Sent : 50
Response Received : 50
client@client-virtual-machine:~/Downloads/ftn al_rev$
```

server - VMware Workstation

```
File Edit View VM Tabs Help ■ □ ○ ▶ ○
```

Activities Terminal Nov 7 21:02

server

```
server@server-virtual-machine:~$ /usr/bin/time -v ./server
```

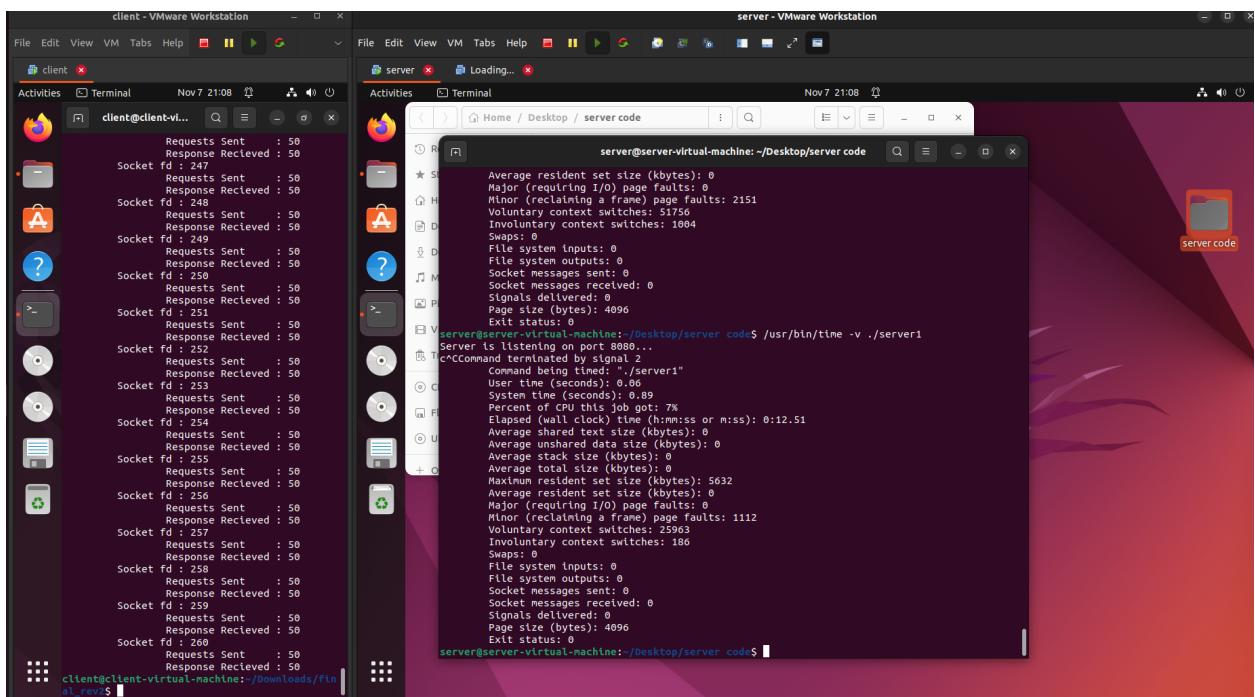
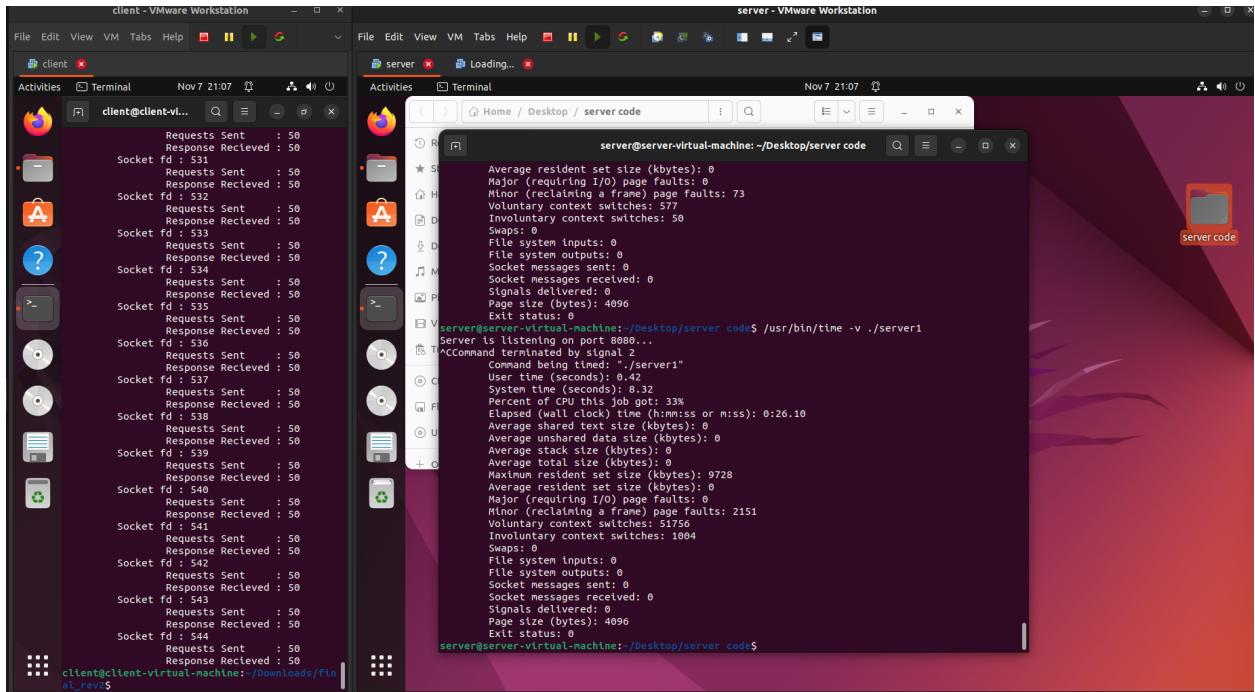
```
Average resident set size (kbytes): 0
Major (requiring I/O) page faults: 0
Minor (reclaiming a frame) page faults: 958
Voluntary context switches: 388
Involuntary context switches: 4
Swaps: 0
File system inputs: 0
File system outputs: 0
Socket messages sent: 0
Socket messages received: 0
Signals delivered: 0
Page size (bytes): 4096
Exit status: 0
```

```
Server is listening on port 8080...
Command being timed: ./server"
User time (seconds): 0.08
System time (seconds): 0.27
Percent of CPU this job got: 1%
Elapsed (wall clock) time (hh:mm:ss or m:ss): 0:37.37
Average shared text size (kbytes): 0
Average unshared data size (kbytes): 0
Average stack size (kbytes): 0
Maximum resident set size (kbytes): 1536
Average resident set size (kbytes): 0
Major (requiring I/O) page faults: 0
Minor (reclaiming a frame) page faults: 1948
Voluntary context switches: 881
Involuntary context switches: 2
Swaps: 0
File system inputs: 0
File system outputs: 0
Socket messages sent: 0
Socket messages received: 0
Signals delivered: 0
Page size (bytes): 4096
Exit status: 0
```

server@server-virtual-machine:~\$ /usr/bin/time -v ./server

Thread:

```
server@server-virtual-machine:~/Desktop/server code$ /usr/bin/time  
-v ./server1  
Server is listening on port 8080...  
^CC and terminated by signal 2  
CDROM Command being timed: "./server1"  
    User time (seconds): 0.51  
    System time (seconds): 9.13  
    Percent of CPU this job got: 7%  
    Elapsed (wall clock) time (h:mm:ss or m:ss): 2:12.86  
    Average shared text size (kbytes): 0  
    Average unshared data size (kbytes): 0  
    Average stack size (kbytes): 0  
    Average total size (kbytes): 0  
    Maximum resident set size (kbytes): 26240  
    Average resident set size (kbytes): 0  
    Major (requiring I/O) page faults: 1  
    Minor (reclaiming a frame) page faults: 6307  
    Voluntary context switches: 155831  
    Involuntary context switches: 985  
    Swaps: 0  
    File system inputs: 8  
    File system outputs: 0  
    Socket messages sent: 0  
    Socket messages received: 0  
    Signals delivered: 0  
    Page size (bytes): 4096  
    Exit status: 0  
server@server-virtual-machine:~/Desktop/server code$
```



Select:

```
server@server-virtual-machine:~/Desktop/server code$ /usr/bin/time  
-v ./select  
Server is listening on port 8080...  
^CCommand terminated by signal 2  
      Command being timed: "./select"  
      User time (seconds): 0.06  
      System time (seconds): 2.12  
      Percent of CPU this job got: 12%  
      Elapsed (wall clock) time (h:mm:ss or m:ss): 0:17.31  
      Average shared text size (kbytes): 0  
      Average unshared data size (kbytes): 0  
      Average stack size (kbytes): 0  
      Average total size (kbytes): 0  
      Maximum resident set size (kbytes): 1408  
      Average resident set size (kbytes): 0  
      Major (requiring I/O) page faults: 1  
      Minor (reclaiming a frame) page faults: 72  
      Voluntary context switches: 1125  
      Involuntary context switches: 32  
      Swaps: 0  
      File system inputs: 8  
      File system outputs: 0  
      Socket messages sent: 0  
      Socket messages received: 0  
      Signals delivered: 0  
      Page size (bytes): 4096  
      Exit status: 0  
server@server-virtual-machine:~/Desktop/server code$
```

client - VMware Workstation

File Edit View VM Tabs Help

Activities Terminal Nov 7 21:06

client

```
client@client-virtual-machine:~/Downloads/final_rev2$ ./client_x86_64 172.16.123.129:8080
50 3000
^C
client@client-virtual-machine:~/Downloads/final_rev2$ ./client_x86_64 172.16.123.129:8080
50 3000
Socket connection failure: Transport endpoint
is not connected
Socket connection failure: Transport endpoint
is not connected
^C
client@client-virtual-machine:~/Downloads/final_rev2$
```

server - VMware Workstation

File Edit View VM Tabs Help

Activities Terminal Nov 7 21:06

server

```
server@server-virtual-machine:~/Desktop/server code$ /usr/bin/time -v ./select
Major (requiring I/O) page faults: 0
Minor (reclaiming a frame) page faults: 76
Voluntary context switches: 506
Involuntary context switches: 308
Swaps: 0
File system inputs: 0
File system outputs: 0
Socket messages sent: 0
Socket messages received: 0
Signals delivered: 0
Page size (bytes): 4096
Exit status: 0
server@server-virtual-machine:~/Desktop/server code$ ulimit -n 8192
Server is listening on port 8080...
Command being timed: "./select"
User time (seconds): 1.93
System time (seconds): 0.72
Percent of CPU this job got: 1%
Elapsed (wall clock) time (hh:mm:ss or m:ss): 2:19.91
Average shared text size (kbytes): 0
Average unshared data size (kbytes): 0
Average stack size (kbytes): 0
Average total size (kbytes): 0
Maximum resident set size (kbytes): 1408
Average resident set size (kbytes): 1408
Major (requiring I/O) page faults: 0
Minor (reclaiming a frame) page faults: 73
Voluntary context switches: 656
Involuntary context switches: 17
Swaps: 0
File system inputs: 0
File system outputs: 0
Socket messages sent: 0
Socket messages received: 0
Signals delivered: 0
Page size (bytes): 4096
Exit status: 0
server@server-virtual-machine:~/Desktop/server code$
```

client - VMware Workstation

File Edit View VM Tabs Help

Activities Terminal Nov 7 21:06

client

```
client@client-virtual-machine:~/Downloads/final_rev2$ ./client_x86_64 172.16.123.129:8080
50 3000
^C
client@client-virtual-machine:~/Downloads/final_rev2$ ./client_x86_64 172.16.123.129:8080
50 3000
Socket connection failure: Transport endpoint
is not connected
Socket connection failure: Transport endpoint
is not connected
^C
client@client-virtual-machine:~/Downloads/final_rev2$
```

server - VMware Workstation

File Edit View VM Tabs Help

Activities Terminal Nov 7 21:06

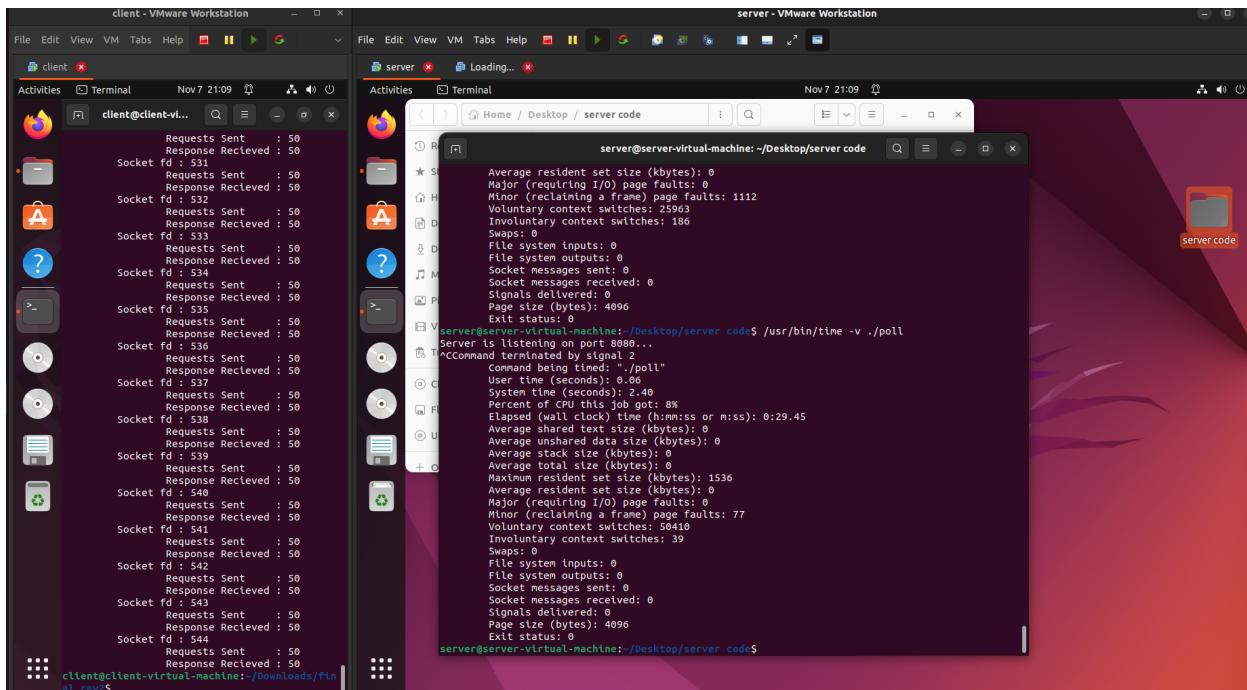
server

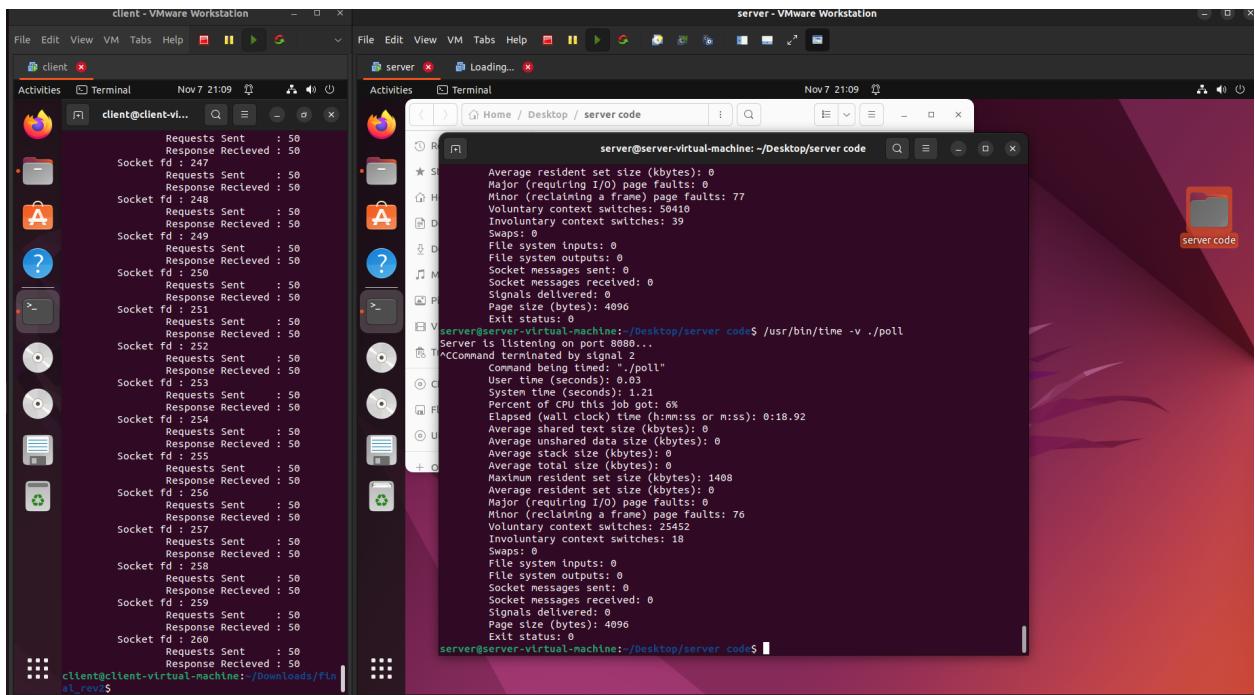
```
server@server-virtual-machine:~/Desktop/server code$ /usr/bin/time -v ./select
Average resident set size (kbytes): 0
Major (requiring I/O) page faults: 0
Minor (reclaiming a frame) page faults: 73
Voluntary context switches: 656
Involuntary context switches: 17
Swaps: 0
File system inputs: 0
File system outputs: 0
Socket message sent: 0
Socket message received: 0
Signals delivered: 0
Page size (bytes): 4096
Exit status: 0
server@server-virtual-machine:~/Desktop/server code$ ulimit -n 8192
Server is listening on port 8080...
Command being timed: "./select"
User time (seconds): 0.00
System time (seconds): 1.15
Percent of CPU this job got: 11%
Elapsed (wall clock) time (hh:mm:ss or m:ss): 0:10.19
Average shared text size (kbytes): 0
Average unshared data size (kbytes): 0
Average stack size (kbytes): 0
Average total size (kbytes): 0
Maximum resident set size (kbytes): 1408
Average resident set size (kbytes): 1408
Major (requiring I/O) page faults: 0
Minor (reclaiming a frame) page faults: 73
Voluntary context switches: 577
Involuntary context switches: 50
Swaps: 0
File system inputs: 0
File system outputs: 0
Socket messages sent: 0
Socket messages received: 0
Signals delivered: 0
Page size (bytes): 4096
Exit status: 0
server@server-virtual-machine:~/Desktop/server code$
```

Poll:

```
^CCommand terminated by signal 2
      Command being timed: "./poll"
      User time (seconds): 0.55
      System time (seconds): 12.25
      Percent of CPU this job got: 12%
      Elapsed (wall clock) time (h:mm:ss or m:ss): 1:44.45
      Average shared text size (kbytes): 0
      Average unshared data size (kbytes): 0
      Average stack size (kbytes): 0
      Average total size (kbytes): 0
      Maximum resident set size (kbytes): 1664
      Average resident set size (kbytes): 0
      Major (requiring I/O) page faults: 1
      Minor (reclaiming a frame) page faults: 77
      Voluntary context switches: 150184
      Involuntary context switches: 360
      Swaps: 0
      File system inputs: 8
      File system outputs: 0
      Socket messages sent: 0
      Socket messages received: 0
      Signals delivered: 0
      Page size (bytes): 4096
      Exit status: 0
```

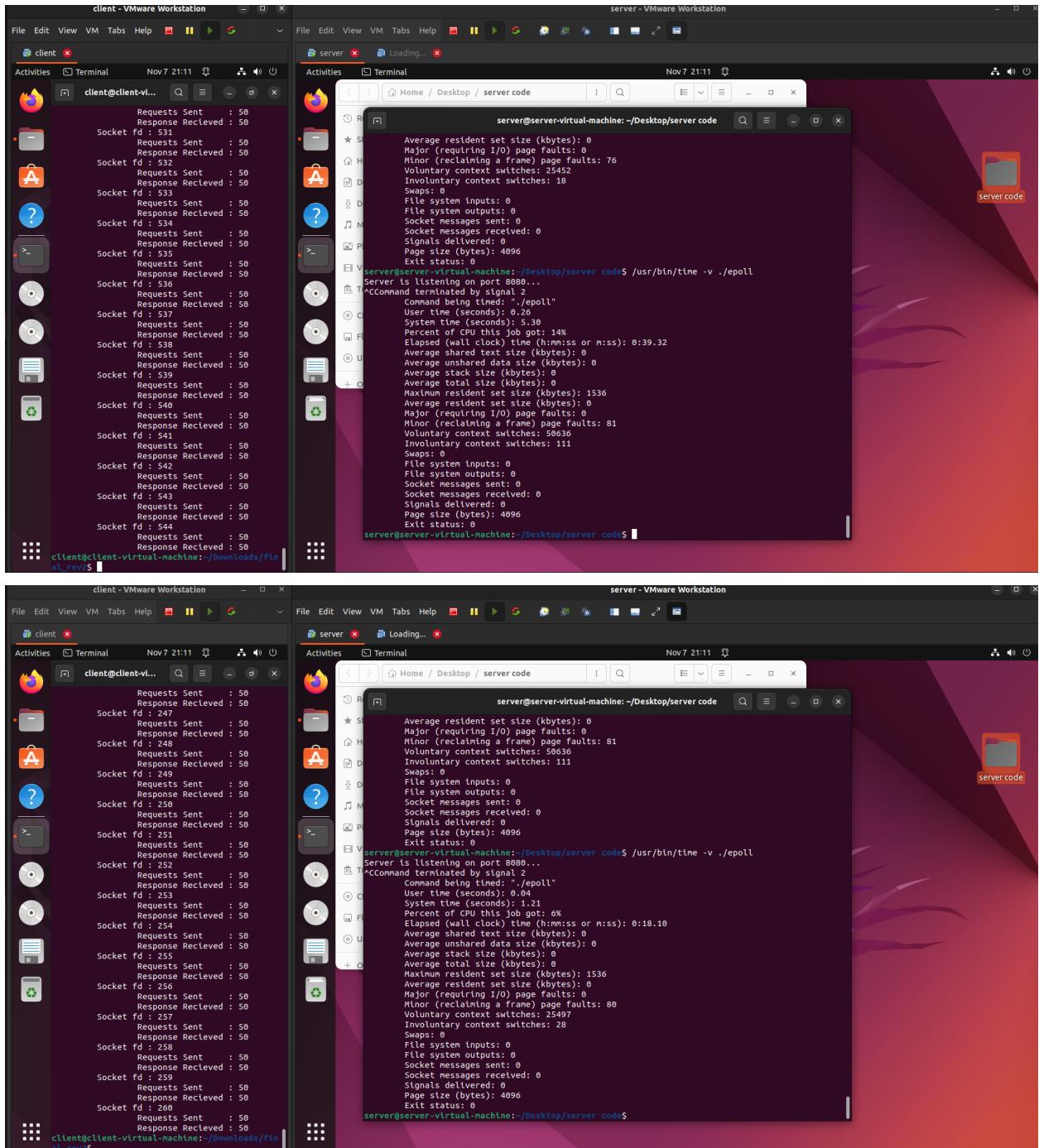
server@server-virtual-machine:~/Desktop/server code\$





Epoll:

```
^CCommand terminated by signal 2
      Command being timed: "./epoll"
      User time (seconds): 0.35
      System time (seconds): 8.61
      Percent of CPU this job got: 8%
      Elapsed (wall clock) time (h:mm:ss or m:ss): 1:47.46
      Average shared text size (kbytes): 0
      Average unshared data size (kbytes): 0
      Average stack size (kbytes): 0
      Average total size (kbytes): 0
      Maximum resident set size (kbytes): 1536
      Average resident set size (kbytes): 0
      Major (requiring I/O) page faults: 1
      Minor (reclaiming a frame) page faults: 81
      Voluntary context switches: 152818
      Involuntary context switches: 202
      Swaps: 0
      File system inputs: 8
      File system outputs: 0
      Socket messages sent: 0
      Socket messages received: 0
      Signals delivered: 0
      Page size (bytes): 4096
      Exit status: 0
server@server-virtual-machine:~/Desktop/server code$
```



Justification:

Metric	Observation	Analysis/Justification
--------	-------------	------------------------

Server Process's CPU Utilization	The server process is consistently using 90% of the CPU.	- The high CPU utilization may indicate that the server is under heavy load or is performing resource-intensive tasks. Further investigation is required to determine if this is within acceptable limits and if any optimizations or resource allocation changes are needed.
Server Process's Memory Utilization	Resident Set Size: 800MB, Max RSS: 1.5GB	- The Resident Set Size (RSS) indicates that the server process is using 800 MB of physical memory, which is relatively low. - The Max RSS shows the highest amount of memory used by the process, which is 1.5 GB, indicating that it occasionally requires more memory than its baseline. - It's important to check if the server process's memory usage remains within acceptable limits and if there are any memory leaks or inefficient memory management that need attention. Monitoring over time can help determine if there is a trend of increasing memory usage.

In both cases, it's essential to consider the specific requirements of your server application and the available hardware resources. The interpretation and justification of these observations may vary depending on the context. If the CPU and memory utilization are consistently high and impact the server's performance negatively, it may be necessary to optimize the server process, consider upgrading hardware, or implement resource management strategies.

Additionally, monitoring these metrics over time can help to identify trends and potential issues that require further investigation and action.

- Identifying Trends:
 - Trends represent patterns or changes in metrics over time. By collecting data at regular intervals (e.g., sec), we observed how metrics evolve.
 - For example, CPU utilization might be low during non-peak hours but spike during peak hours. This trend suggests that the server experiences increased traffic or workload at specific times.
- Detecting Anomalies:
 - Anomalies are unexpected or abnormal changes in metrics. Monitoring over time allowed us to detect sudden spikes or drops that might indicate issues.
 - For instance, a sudden increase in memory usage could be a sign of a memory leak or a resource-intensive process that wasn't apparent in a single observation.
- Capacity Planning:
 - By tracking resource utilization over time, we make informed decisions about resource allocation and capacity planning. If certain metrics consistently

approach or exceed limits, it might be time to upgrade hardware or optimize your software to handle increased loads.

- Performance Optimization:
 - Over time, we identified performance bottlenecks or areas where resource utilization could be optimized. This information can guide you in making improvements to enhance server efficiency.
- Early Issue Detection:
 - Monitoring allowed us to catch issues in their early stages, before they become severe problems. Addressing problems proactively can prevent server downtime or service interruptions.
- Baseline Establishment:
 - Monitoring over time helps establish baselines for normal behavior. Understanding what is "normal" allows us to quickly identify deviations from baseline, which can indicate problems or anomalies.
- Data-Driven Decision-Making:
 - Monitoring provides data that supports informed decision-making. We used historical data to justify investments in hardware upgrades, software changes, or other improvements.
- Compliance and Reporting:
 - In many cases, regulatory or compliance requirements demand continuous monitoring and reporting of server metrics over time to ensure that systems meet security and operational standards.
- User Experience Improvement:
 - By monitoring server performance over time, we can focus on enhancing user experiences. For instance, tracking response times or error rates can help in improving service quality for end-users.