

Q3: running processes-kernel-module, outputs using dmesg

The screenshot shows a Linux terminal window with the following content:

```
http
https://www.youtube.com
Welcome to Ubuntu 22.04.1 LTS
Tasks: 110, 755 thr, 264 kthr, 2 running
Load average: 0.31 0.40 0.48
Uptime: 04:12:15
Main / 0
PID USER PRI NI VIRT RES SHR S CPU%MEM TIME+ Command
122565 _orfnoblit 20 0 33.36 219M 157M S 4.5 3.0 9:18.16 /opt/visual-studio-code/code --type=cpu-process
291614 _orfnoblit 20 0 10900 6912 3840 R 3.9 0.1 0:04.78 top
1602 root 20 0 25.46 211M 136M S 3.2 2.9 23:58:75 /usr/lib/Xorg -polkitstn top -background none -be
122599 _orfnoblit 20 0 33.36 219M 157M S 3.2 3.0 8:27:93 /opt/visual-studio-code/code --type=cpu-process
122614 _orfnoblit 20 0 11326 279M 97396 S 3.2 3.8 15:51.30 /opt/visual-studio-code/code --type=renderer -c
1171 _orfnoblit 20 0 1121M 2928M 21764 S 1.3 0.4 3:01:55 polybar -q main -c /home/_orfnoblitr/.config/p
1679 _orfnoblit 20 0 33.40 407M 208M S 1.3 5.6 11:01.40 /opt/brave-bin/brave
122617 _orfnoblit 20 0 11326 279M 97396 S 1.3 3.8 1:59.84 /opt/visual-studio-code/code --type=renderer -c
272931 _orfnoblit 20 0 33.15 268M 134M S 1.3 3.0 0:27:91 /opt/brave-bin/brave -i -type=renderer -c /home/_orfnoblitr/.config/p
11515 _orfnoblit 20 0 1121M 2928M 21764 S 0.6 0.4 0:24.82 polybar -q main -c /home/_orfnoblitr/.config/p
11317 _orfnoblit 20 0 1121M 2928M 21764 S 0.6 0.4 0:27.69 polybar -q gain -c /home/_orfnoblitr/.config/p
1319 _orfnoblit 20 0 1121M 2928M 21764 S 0.6 0.4 0:34.82 polybar -q main -c /home/_orfnoblitr/.config/p
1522 _orfnoblit 20 0 1121M 2928M 21764 S 0.6 0.4 0:15.16 polybar -q main -c /home/_orfnoblitr/.config/p
1735 _orfnoblit 20 0 33.15 407M 208M S 0.6 0.4 0:27.97 /opt/brave-bin/brave -i -type=renderer -c /home/_orfnoblitr/.config/p
122513 _orfnoblit 20 0 11226 193M 111M S 0.6 0.8 0:22:17 /opt/visual-studio-code/code --unity-launch
122598 _orfnoblit 20 0 33.36 219M 157M S 0.6 3.0 1:14.72 /opt/visual-studio-code/code --type=cpu-process
122655 _orfnoblit 20 0 11216 97892 40884 S 0.6 1.3 0:33.72 /opt/visual-studio-code/code --type=utility --ut
122689 _orfnoblit 20 0 22784 15672 10492 S 0.0 0.2 0:02.77 /sbin/init splash
1 root 20 0 25824 13944 13048 S 0.0 0.2 0:01.48 /usr/lib/systemd/systemd-journald
385 root 20 0 35740 18880 7936 S 0.0 0.1 0:01.00 /usr/lib/systemd/systemd-udev
38 systemd-t 20 0 22216 13440 11136 S 0.0 0.2 0:03.76 /usr/lib/systemd/systemd-resolved
754 systemd-t 20 0 91635 4576 7600 S 0.0 0.1 0:00.22 /usr/lib/systemd/systemd-timesyncd
777 systemd-t 20 0 91635 4576 7600 S 0.0 0.1 0:00.00 /usr/lib/systemd/systemd-timesyncd
794 avahi 20 0 9484 4480 4224 S 0.0 0.1 0:07.00 avahi-daemon: running [aaradhya@verano-asustufgami
795 systemd-b 20 0 12584 6144 5632 S 0.0 0.1 0:08.81 /usr/lib/bluetooth/bluetoothd
796 dbus 20 0 10600 5568 7432 S 0.0 0.1 0:04:14 /usr/bin/dbus-daemon --system --address=systemd:
797 polkitd 20 0 383M 9576 7376 S 0.0 0.1 0:00:29 /usr/lib/polkit-1/polkitd --no-debug
798 pigpio 20 0 18280 6972 7808 S 0.0 0.0 0:00.00 /usr/lib/systemd/systemd-logind
799 avahi 20 0 9172 1420 1024 S 0.0 0.0 0:00.00 avahi-daemon: chroot helper
800 systemd-b 20 0 333M 26572 19576 S 0.0 0.4 0:09:27 /usr/bin/NetworkManager --no-daemon
801 root 20 0 13720 45392 9984 S 0.0 0.2 0:02:41 /usr/bin/wpa_supplicant -u -s -O /run/wpa_supplic
834 systemd-b 20 0 383M 9576 7376 S 0.0 0.1 0:00.00 /usr/lib/polkit-1/polkitd --no-debug
836 polkitd 20 0 383M 9576 7376 S 0.0 0.1 0:00.00 /usr/lib/polkit-1/polkitd --no-debug
837 systemd-b 20 0 383M 9576 7376 S 0.0 0.1 0:00:14 /usr/lib/polkit-1/polkitd --no-debug
841 root 20 0 333M 26572 19576 S 0.0 0.4 0:00.30 /usr/bin/NetworkManager --no-daemon
843 systemd-b 20 0 333M 26572 19576 S 0.0 0.4 0:00.00 /usr/bin/NetworkManager --no-daemon
845 root 20 0 382M 14528 10480 S 0.0 0.2 0:02.18 /usr/bin/NetworkManager --no-daemon
854 root 20 0 382M 14528 10480 S 0.0 0.2 0:00.07 /usr/bin/ModemManager 4M views - 1 year ago
856 root 20 0 382M 14528 10480 S 0.0 0.2 0:00.00 /usr/bin/ModemManager
857 root 20 0 382M 14528 10480 S 0.0 0.2 0:00.00 /usr/bin/ModemManager
Files - Setup PS Search - Filter - True - SortBy - Name - Size - File - Edit - Run - Terminal - Help
```

The screenshot shows a C program for counting running processes and its output using dmesg.

```
Q3.2.c 4 x dmesgRunKOutput.txt | Katerle
1 #include <linux/processes.h>
2 #include <linux/module.h>
3 #include <linux/init.h>
4 #include <linux/sched/signal.h>
5 #include <linux/syscalls.h>
6
7 MODULE_LICENSE("GPL");
8 MODULE_AUTHOR("Aru");
9 MODULE_DESCRIPTION("A simple kernel module to count running processes");
10
11
12 // Function to count running processes
13 static int count_running_processes(void) {
14     struct task_struct *task;
15     int count = 0;
16
17     // Traverse the process list
18     for_each_process(task) {
19         if (task->state == TASK_RUNNING) {
20             count++;
21         }
22     }
23
24     return count;
25 }
26
27 // System call implementation
28 asmlinkage long sys_count_processes(void) {
29     int running_processes = count_running_processes();
30     printk(KERN_INFO "Number of running processes: %d\n", running_processes);
31     return running_processes;
32 }
33
34 // Module initialization
35 static int __init init_syscall_module(void) {
36     printk(KERN_INFO "Loaded: Aaradhya's process counter kernel module & number of running processes is: %d\n", count_running_processes());
37     return 0;
38 }
39
40 // Module cleanup
41 static void __exit exit_syscall_module(void) {
42     printk(KERN_INFO "Unloaded: Aaradhya's process counter kernel module\n");
43 }
44
45 module_init(init_syscall_module);
46 module_exit(exit_syscall_module);
47
```

The output of the program is shown in the terminal window:

```
Ass2 make
make -C /lib/modules/6.5.3-arch1-1/build M=/home/_orfnoblitr/Documents/IIITD/OS/Ass2 modules
make[1]: Entering directory '/usr/lib/modules/6.5.3-arch1-1/build'
CC [M] /home/_orfnoblitr/Documents/IIITD/OS/Ass2/Q3_2.o
MODPOST /home/_orfnoblitr/Documents/IIITD/OS/Ass2/Module.symvers
LD [M] /home/_orfnoblitr/Documents/IIITD/OS/Ass2/Q3_2.ko
BTF [M] /home/_orfnoblitr/Documents/IIITD/OS/Ass2/Q3_2.ko
make[1]: Leaving directory '/usr/lib/modules/6.5.3-arch1-1/build'
Ass2
```


The screenshot displays a Linux terminal environment with two main panes. The left pane shows the source code for a kernel module named 'ass2'. The right pane shows the output of the compilation and execution commands.

Left Pane (Source Code):

```
C 03.2x 4 X | dmesgRunKernelOutput.txt | *kafelife|
C 03.2x > | count_running_processes(void)
1 #include <linux/module.h>
2 #include <linux/kernel.h>
3 #include <linux/init.h>
4 #include <linux/sched/signal.h>
5 #include <linux/syscalls.h>
6
7 MODULE_LICENSE("GPL");
8 MODULE_AUTHOR("Aru");
9 MODULE_DESCRIPTION("A simple kernel module to count running processes");
10
11 // Function to count running processes
12 static int count_running_processes(void) {
13     struct task_struct *task;
14     int count = 0;
15
16     // Traverse the process list
17     for_each_process(task) {
18         if (task->state == TASK_RUNNING){
19             count++;
20         }
21     }
22
23     return count;
24 }
25
26 // System call implementation
27 asmlinkage long sys_count_processes(void) {
28     int running_processes = count_running_processes();
29
30     printk(KERN_INFO "Number of running processes: %d\n", running_processes);
31     return running_processes;
32 }
33
34 // Module initialization
35 static int __init init_syscall_module(void) {
36     printk(KERN_INFO "Loaded: Aaradhy's process counter kernel module & number of running processes is: ");
37     return 0;
38 }
39
40 // Module cleanup
41 static void __exit exit_syscall_module(void) {
42     printk(KERN_INFO "Unloaded: Aaradhy's process counter kernel module\n");
43 }
44
45 module_init(init_syscall_module);
46 module_exit(exit_syscall_module);
47
```

Right Pane (Terminal Output):

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
[+] [sh]
[+] [sh]
Ass2 make
make -C /lib/modules/6.5.3-arch1-1/build M=/home/_0frnblttr8/Documents/IITD/O5/Ass2 modules
make[1]: Entering directory '/usr/lib/modules/6.5.3-arch1-1/build'
CC [M] /home/_0frnblttr8/Documents/IITD/O5/Ass2/Q3_2.o
MODPOST /home/_0frnblttr8/Documents/IITD/O5/Ass2/module.symvers
LD [M] /home/_0frnblttr8/Documents/IITD/O5/Ass2/Q3_2.ko
BTF [M] /home/_0frnblttr8/Documents/IITD/O5/Ass2/Q3_2.ko
make[1]: Leaving directory '/usr/lib/modules/6.5.3-arch1-1/build'
[+] [sh] Ass2 sudo insmod Q3_2.ko
[sudo] password for _0frnblttr8:
[+] [sh] Ass2 sudo dmesg | head
[ ] [ ] [ ] Linux version 6.5.3-arch1-1 (linum@rchlink) (gcc (GCC) 13.2.1 20230801, GNU ld (GNU Binutils) 2.41.0)
#1 SMP PREEMPT_DYNAMIC Wed, 13 Sep 2023 08:37:40 +0000
[ ] [ ] [ ] Command line: BOOT_IMAGE=/boot/vmlinuz-linux root=UUID=5b8127e6-7888-4eed-bbed-c35432d44dc1 rw quiet ip
lsm nvmls_drm module=1 loglevel=3 udev log_level=3 vt.global_cursor_default=0
[ ] [ ] [ ] BIOS-provided physical RAM map:
[ ] [ ] [ ] BIOS-e820: [mem 0x0000000000000000-0x0000000000000fff] usable
[ ] [ ] [ ] BIOS-e820: [mem 0x0000000000000000-0x0000000000000fff] reserved
[ ] [ ] [ ] BIOS-e820: [mem 0x0000000000000000-0x0000000000000fff] reserved
[ ] [ ] [ ] BIOS-e820: [mem 0x0000000000000000-0x0000000000000fff] reserved
[ ] [ ] [ ] BIOS-e820: [mem 0x0000000000000000-0x0000000000000fff] ACPI NVS
[ ] [ ] [ ] BIOS-e820: [mem 0x0000000000000000-0x0000000000000fff] usable
[ ] [ ] [ ] Ass2 sudo dmesg | tail
5930.340139] wlan0: associated
5933.546065] wlan0: disassociated from lcid:de:ab:ff:20 (Reason: 15=4WAY_HANDSHAKE_TIMEOUT)
6243.140863] wlan0: authenticate with b8:11:4b:cfcf:40:6b
6243.332186] wlan0: send auth to b8:11:4b:cfcf:40:6b (try 1/3)
6243.334663] wlan0: authenticated
6243.336872] wlan0: associate with b8:11:4b:cfcf:40:6b (try 1/3)
6243.348259] wlan0: RX AssocResp from b8:11:4b:cfcf:40:6b (capab=<v41 status=0 aid=4)
6243.377725] wlan0: associated
6243.626695] wlan0: Limiting TX power to 20 dBm as advertised by b8:11:4b:cfcf:40:6b
6815.633405] loaded: Aaradhy's process counter kernel module & number of running processes is: 1
[+] [sh] Ass2 sudo rmmod Q3_2.ko
[+] [sh] Ass2 sudo dmesg | head
[ ] [ ] [ ] Linux version 6.5.3-arch1-1 (linum@rchlink) (gcc (GCC) 13.2.1 20230801, GNU ld (GNU Binutils) 2.41.0)
#1 SMP PREEMPT_DYNAMIC Wed, 13 Sep 2023 08:37:40 +0000
[ ] [ ] [ ] Command line: BOOT_IMAGE=/boot/vmlinuz-linux root=UUID=5b8127e6-7888-4eed-bbed-c35432d44dc1 rw quiet ip
lsm nvmls_drm module=1 loglevel=3 udev log_level=3 vt.global_cursor_default=0
[ ] [ ] [ ] BIOS-provided physical RAM map:
[ ] [ ] [ ] BIOS-e820: [mem 0x0000000000000000-0x0000000000000fff] usable
[ ] [ ] [ ] BIOS-e820: [mem 0x0000000000000000-0x0000000000000fff] reserved
[ ] [ ] [ ] BIOS-e820: [mem 0x0000000000000000-0x0000000000000fff] usable
[ ] [ ] [ ] BIOS-e820: [mem 0x0000000000000000-0x0000000000000fff] reserved
[ ] [ ] [ ] BIOS-e820: [mem 0x0000000000000000-0x0000000000000fff] reserved
[ ] [ ] [ ] BIOS-e820: [mem 0x0000000000000000-0x0000000000000fff] ACPI NVS
[ ] [ ] [ ] BIOS-e820: [mem 0x0000000000000000-0x0000000000000fff] usable
[+] [sh] Ass2
```

Q1 Artix: login prompt, disk partitions, htop and neofetch

```

:: Starting hostname [done]
:: Adjusting huclock [done]
:: Starting kmod-static-nodes [done]
:: Starting tmpfiles-dev [done]
:: Starting udev daemon [busy]
Starting udevd version 254.3-1-artix

:: Triggering udev uevents [done]
:: Loading user-specified modules [done]
:: Waiting for udev uevents to be processed [done]
:: Starting console-setup [done]
:: Starting net-lo [done]
:: Checking filesystems [busy]
fsck.fat 4.2 (2021-01-31)
There are differences between boot sector and its backup.
This is mostly harmless. Differences: (offset:original/backup)
 65:01/00
  Not automatically fixing this.
Dirty bit is set. Fs was not properly unmounted and some data may be corrupt.
Automatically removing dirty bit.

*** Filesystem was changed ***
Writing changes.
/dev/sda1: 3 files, 37/130811 clusters

:: Remounting root filesystem rw [done]
:: Starting mount-all [done]
:: Activating swap [done]
:: Starting random-seed [done]
:: Starting tmpfiles-setup [done]
:: Starting sysusers [done]
:: Saving dnsmg log [done]
:: Loading sysctl settings [busy]
* Applying /usr/lib/sysctl.d/10-artix.conf ...
* Applying /usr/lib/sysctl.d/55-iputils.conf ...
fs.inotify.max_user_instances = 1024
fs.inotify.max_user_watches = 524288
net.ipv4.ping_group_range = 0 2147483647

:: Running binfmt [done]
:: Starting cleanup [done]
:: Initialization complete [done]
- runit: leave stage: /etc/runit/1
- runit: enter stage: /etc/runit/2
runsvchdir: default: current.

Artix Linux 6.5.2-artix1-1 (tty1)
artix login: aru
Password:
laru@artix ~1$

```

```

:: Triggering udev uevents [done]
:: Loading user-specified modules [done]
:: Waiting for udev uevents to be processed [done]
:: Starting console-setup [done]
:: Starting net-lo [done]
:: Checking filesystems [busy]
fsck.fat 4.2 (2021-01-31)
There are differences between boot sector and its backup.
This is mostly harmless. Differences: (offset:original/backup)
 65:01/00
  Not automatically fixing this.
Dirty bit is set. Fs was not properly unmounted and some data may be corrupt.
Automatically removing dirty bit.

*** Filesystem was changed ***
Writing changes.
/dev/sda1: 3 files, 37/130811 clusters

:: Remounting root filesystem rw [done]
:: Starting mount-all [done]
:: Activating swap [done]
:: Starting random-seed [done]
:: Starting tmpfiles-setup [done]
:: Starting sysusers [done]
:: Saving dnsmg log [done]
:: Loading sysctl settings [busy]
* Applying /usr/lib/sysctl.d/10-artix.conf ...
* Applying /usr/lib/sysctl.d/55-iputils.conf ...
fs.inotify.max_user_instances = 1024
fs.inotify.max_user_watches = 524288
net.ipv4.ping_group_range = 0 2147483647

:: Running binfmt [done]
:: Starting cleanup [done]
:: Initialization complete [done]
- runit: leave stage: /etc/runit/1
- runit: enter stage: /etc/runit/2
runsvchdir: default: current.

Artix Linux 6.5.2-artix1-1 (tty1)
artix login: aru
Password:
laru@artix ~1$ lsblk
NAME MAJ:MIN RM SIZE RO TYPE MOUNTPOINTS
sda 8:0 0 20G 0 disk
├─sda1 8:1 0 512M 0 part /boot/efi
└─sda2 8:2 0 19.5G 0 part /
sr0 11:0 1 793M 0 rom
laru@artix ~1$

```

```
0.9% Tasks: 29, 4 thr, 85 kthr; 1 running
0.0% Load average: 0.15 0.16 0.09
0.0% Uptime: 00:09:00
0.0%
Mem 86.4M/3.81G
Swap 0K/2.00G

Main 1/0
PID USER PRI NI UIRT RES SHR S CPU% MEM% TIME+ Command
1844 aru 20 0 9204 5120 3712 R 0.9 0.1 0:00.05 htop
1 root 20 0 1012 512 512 S 0.0 0.0 0:00.38 runit
758 root 20 0 2928 1280 1280 S 0.0 0.0 0:00.01 runsudir -P /run/runit/service log: oothd[790]: src/plugin.c:plugin_init() System does not supp
763 root 20 0 2776 1280 1280 S 0.0 0.0 0:00.00 runsv udevd
764 root 20 0 2776 1280 1280 S 0.0 0.0 0:00.00 runsvagetty-tty6
765 root 20 0 2776 1280 1280 S 0.0 0.0 0:00.00 runsvagetty-tty2
766 root 20 0 2776 1280 1280 S 0.0 0.0 0:00.00 runsv logind
767 root 20 0 2776 1280 1280 S 0.0 0.0 0:00.00 runsv cupsd
768 root 20 0 2776 1280 1280 S 0.0 0.0 0:00.00 runsvagetty-tty3
769 root 20 0 2776 1280 1280 S 0.0 0.0 0:00.00 runsvagetty-tty1
770 root 20 0 2776 1280 1280 S 0.0 0.0 0:00.00 runsv bluetoothd
771 root 20 0 2776 1152 1152 S 0.0 0.0 0:00.00 runsvagetty-tty5
772 root 20 0 2776 1280 1280 S 0.0 0.0 0:00.00 runsv NetworkManager
773 root 20 0 2776 1280 1280 S 0.0 0.0 0:00.00 runsvagetty-tty4
774 root 20 0 2776 1152 1152 S 0.0 0.0 0:00.00 runsv dbus
775 root 20 0 6408 2304 2048 S 0.0 0.1 0:00.00agetty tty5 38400 linux
776 root 20 0 6408 2304 2048 S 0.0 0.1 0:00.00agetty tty6 38400 linux
777 root 20 0 6408 2048 1920 S 0.0 0.1 0:00.00agetty tty2 38400 linux
778 root 20 0 7288 4352 3840 S 0.0 0.1 0:00.02 login -- aru
779 root 20 0 399M 23456 18432 S 0.0 0.6 0:00.11 NetworkManager -n
780 root 20 0 6408 2304 2048 S 0.0 0.1 0:00.00agetty tty4 38400 linux
781 root 20 0 6408 2304 2048 S 0.0 0.1 0:00.00agetty tty3 38400 linux
782 root 20 0 14916 4352 4096 S 0.0 0.1 0:00.01 /usr/lib/elogind/elogind
783 root 20 0 26598 5760 4864 S 0.0 0.1 0:00.00 udevd
784 root 20 0 15752 6784 5760 S 0.0 0.2 0:00.01 cupsd -f
785 root 20 0 2924 1280 1280 S 0.0 0.0 0:00.00 sologd -tt /var/log/dbus
788 dbus 20 0 4800 3200 2816 S 0.0 0.1 0:00.02 dbus-daemon --system --nofork --nopidfile
790 root 20 0 9516 5120 4736 S 0.0 0.1 0:00.00 /usr/lib/bluetooth/bluetoothd -n
806 root 20 0 399M 23456 18432 S 0.0 0.6 0:00.00 NetworkManager -n
807 root 20 0 399M 23456 18432 S 0.0 0.6 0:00.00 NetworkManager -n
808 root 20 0 399M 23456 18432 S 0.0 0.6 0:00.00 NetworkManager -n
818 aru 20 0 8156 4608 3840 S 0.0 0.1 0:00.06 -bash
1843 root 20 0 399M 23456 18432 S 0.0 0.6 0:00.00 NetworkManager -n

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

```
aru@artix ~]$ neofetch

      'o'
    'ooo'
  'ooxxx'
'ooxxxxx'
'ooxkxxxx'
'oiioxkxxxx'
':::iiiiioxxx'
':::ioxxx'
':::jiooo'
'oooio--' 'i:io'
'ooooxxxio:--'
'ooooooooxxxooii:--'
'ooooooooxxxkkxoiiiiij'
'ooooooooxxxoiiii:~'
'ooooooooxi:~'
'ooooxi:~'
'i:~'
'~'

OS: Artix Linux x86_64
Host: VirtualBox 1.2
Kernel: 6.5.2-artix1-1
Uptime: 8 mins
Packages: 296 (pacman)
Shell: bash 5.1.16
Resolution: 1280x800
Terminal: /dev/tty1
CPU: AMD Ryzen 7 4800H with Radeon Graphics (4) @ 2.894GHz
GPU: 00:02.0 VMware SUGA II Adapter
Memory: 89MiB / 3903MiB
```