

CSC3150

Operating system

Assignment #5

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## •Introduction

In assignment 4, I needed to make a prime device in Linux and implement file operations in kernel module to control device.

## •How did you design your program?

For `drv_read` function, I used `myini()` function and `print`.

For write function, `a` is belongs to operator, `b` and `c` are operand and `print`.

For `ioctl` fuction, it is for print the answer.

For `drv_arithmetic_routine`, as well, `a` is belongs to operator, `b` and `c` are operand and `print`.

For initialize which is `init_module` function, I wanted to initialize device and make alive. So used `kmalloc(DMA_BUFSIZE, GFP_KERNEL)` and allocate work routine from `kmalloc(sizeof(*work_routine), GFP_KERNEL)`

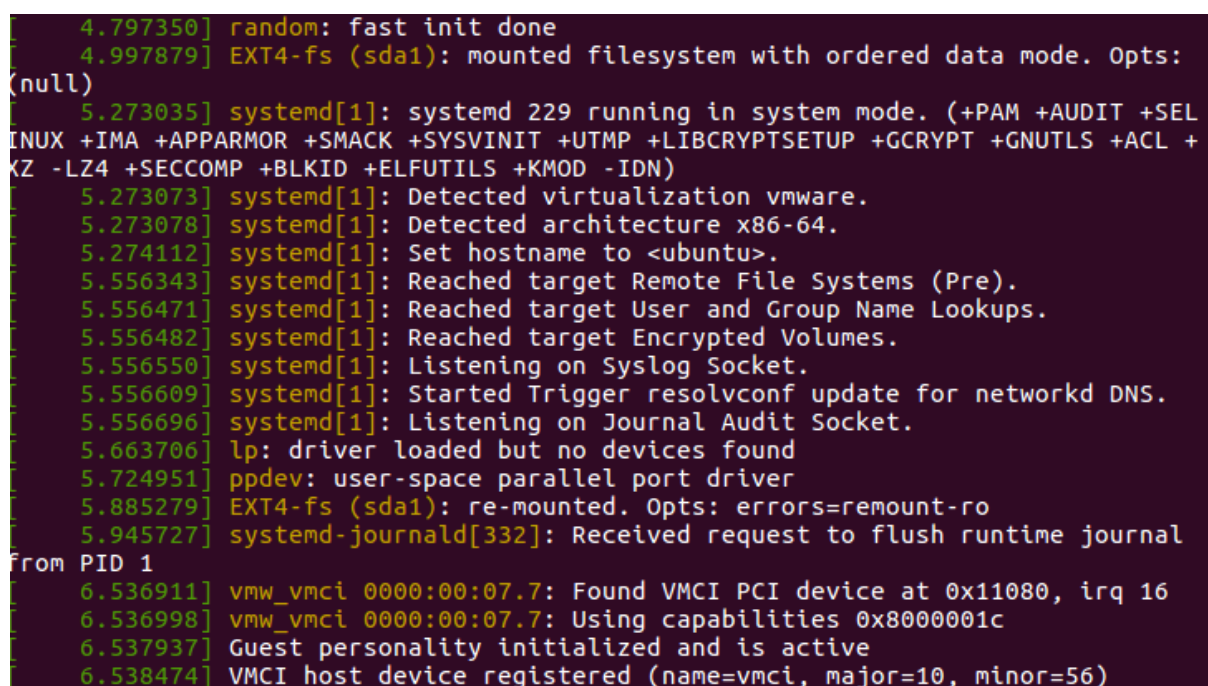
For exit modules, I used `kfree(dma_buf)`, and `kfree(work_routine)` for free DMA buffer and work routine.

For bonus, I followed tutorial `request_irq` function in `init_modules` function and for handle, I just added 1 to `interrupt`.

- The steps to execute your program.

1. make
2. dmesg
3. sudo ./mkdev.sh 243 0
4. ./test
5. make clean
6. sudo ./rmdev.sh
7. (bonus) watch -n 1 cat /proc/interrupts

- Screenshot of your program output.



```
4.797350] random: fast init done
4.997879] EXT4-fs (sda1): mounted filesystem with ordered data mode. Opts:
(null)
5.273035] systemd[1]: systemd 229 running in system mode. (+PAM +AUDIT +SEL
INUX +IMA +APPARMOR +SMACK +SYSVINIT +UTMP +LIBCRYPTSETUP +GCRYPT +GNUTLS +ACL +
XZ -LZ4 +SECCOMP +BLKID +ELFUTILS +KMOD -IDN)
5.273073] systemd[1]: Detected virtualization vmware.
5.273078] systemd[1]: Detected architecture x86-64.
5.274112] systemd[1]: Set hostname to <ubuntu>.
5.556343] systemd[1]: Reached target Remote File Systems (Pre).
5.556471] systemd[1]: Reached target User and Group Name Lookups.
5.556482] systemd[1]: Reached target Encrypted Volumes.
5.556550] systemd[1]: Listening on Syslog Socket.
5.556609] systemd[1]: Started Trigger resolvconf update for networkd DNS.
5.556696] systemd[1]: Listening on Journal Audit Socket.
5.663706] lp: driver loaded but no devices found
5.724951] ppdev: user-space parallel port driver
5.885279] EXT4-fs (sda1): re-mounted. Opts: errors=remount-ro
5.945727] systemd-journal[332]: Received request to flush runtime journal
from PID 1
6.536911] vmw_vmci 0000:00:07.7: Found VMCI PCI device at 0x11080, irq 16
6.536998] vmw_vmci 0000:00:07.7: Using capabilities 0x8000001c
6.537937] Guest personality initialized and is active
6.538474] VMCI host device registered (name=vmci, major=10, minor=56)
```

```

[ 9978.371233] exit_modules+0x8c/0x9b9 [mydev]
[ 9978.371236] Sys_delete_module+0x1e7/0x2d0
[ 9978.371238] ? exit_to_usermode_loop+0x9b/0xd0
[ 9978.371239] do_syscall_64+0x73/0x130
[ 9978.371242] entry_SYSCALL_64_after_hwframe+0x41/0xa6
[ 9978.371243] RIP: 0033:0x7f298f9d7a27
[ 9978.371243] RSP: 002b:00007ffd102b6418 EFLAGS: 00000206 ORIG_RAX: 0000000000000000
000b0
[ 9978.371244] RAX: ffffffffda RBX: 0000000000000000 RCX: 00007f298f9d7a27
[ 9978.371245] RDX: 000000000000000a RSI: 0000000000000080 RDI: 000055b5cf456258
[ 9978.371245] RBP: 000055b5cf4561f0 R08: 0000000000000000 R09: 1999999999999999
[ 9978.371246] R10: 0000000000000083 R11: 0000000000000206 R12: 00007ffd102b6630
[ 9978.371246] R13: 00007ffd102b7902 R14: 0000000000000000 R15: 000055b5cf4561f0
[ 9978.371247] Code: 39 7a 08 75 0e e9 12 02 00 00 4c 39 7b 08 74 57 48 89 da 48
8b 5a 18 48 85 db 75 ee 44 89 e6 48 c7 c7 08 82 ec 99 e8 95 a4 f9 ff <0f> 0b 48
8b 75 c8 4c 89 ef e8 b7 68 8d 00 49 8b 46 40 48 8b 80
[ 9978.371258] ---[ end trace 84df55f7e425e5b6 ]---
[ 9978.371259] OS_AS5:exit_modules(): unregister chrdev
[ 9978.371259] OS_AS5:exit_modules():.....End.....
[ 9982.126009] OS_AS5:init_modules():.....Start.....
[ 9982.126011] OS_AS5:init_modules(): irq request 1
[ 9982.126013] OS_AS5:init_modules(): register chrdev(243, 0)
[ 9982.126014] OS_AS5:init_modules(): allocate dma buffer
wklee610@ubuntu:~/Desktop/source$

```

```

wklee610@ubuntu:~/Desktop/source$ sudo ./mkdev.sh 243 0
mknod: /dev/mydev: File exists
crw-rw-rw- 1 root root 243, 0 Dec  8 03:28 /dev/mydev
wklee610@ubuntu:~/Desktop/source$ ./test
.....Start.....
100 p 10000 = 105019

Blocking IO
ans=105019 ret=105019

Non-Blocking IO
Queueing work
Waiting
Can read now.
ans=105019 ret=105019

.....End.....
wklee610@ubuntu:~/Desktop/source$

```

## Bonus

```
Every 1.0s: cat /proc/interrupts          Wed Dec  8 05:27:30 2021

    CPU0       CPU1
  0:         18          0  IO-APIC  2-edge  timer
  1:          0       2790  IO-APIC  1-edge  i8042
  8:          1          0  IO-APIC  8-edge  rtc0
  9:          0          0  IO-APIC  9-fasteoi  acpi
 12:         16     49376  IO-APIC 12-edge  i8042
 14:          0          0  IO-APIC 14-edge  ata_piix
 15:          0          0  IO-APIC 15-edge  ata_piix
 16:        363        411  IO-APIC 16-fasteoi  vmwgfx, snd_ens1371
 17:       8217     28416  IO-APIC 17-fasteoi  ehci_hcd:usb1, ioc0
 18:          0          67  IO-APIC 18-fasteoi  uhci_hcd:usb2
 19:          0     11106  IO-APIC 19-fasteoi  ens33
 24:          0          0  PCI-MSI 344064-edge  PCIe PME, pciehp
 25:          0          0  PCI-MSI 346112-edge  PCIe PME, pciehp
 26:          0          0  PCI-MSI 348160-edge  PCIe PME, pciehp
 27:          0          0  PCI-MSI 350208-edge  PCIe PME, pciehp
 28:          0          0  PCI-MSI 352256-edge  PCIe PME, pciehp
 29:          0          0  PCI-MSI 354304-edge  PCIe PME, pciehp
 30:          0          0  PCI-MSI 356352-edge  PCIe PME, pciehp
 31:          0          0  PCI-MSI 358400-edge  PCIe PME, pciehp
 32:          0          0  PCI-MSI 360448-edge  PCIe PME, pciehp
 33:          0          0  PCI-MSI 362496-edge  PCIe PME, pciehp
```

### • What did you learn from this assignment?

Since, this assignment I tried to follow tutorials but it was pretty hard to understand, even though it was last assignment but still really need to improve my coding skill.