

Device Driver

The main purpose of this assignment is to build a device driver that does something, meaning a device driver that performs or solves a specific task. For this assignment, I built a device driver that takes a simple string or series of characters and encrypts the string into something that humans cannot understand and also decrypts an encrypted message into the original string and displays it on the terminal. Most importantly, even though I have been able to make the device driver that can be loaded and unloaded successfully, but when it comes to testing it, I am still getting an error.

- Instructions to load and unload as well as to run the test
 - Head to the project folder
 - Navigate yourself to the module folder → `cd Module`
 - You are in the Module folder. Execute the following commands
 - `make`
 - At this point you compiled the program successfully if there are no errors
 - Load the device using the following commands
 - `sudo insmod Ayelew_Robel_HW6_device_driver.ko`
 - Create a node in /dev using the following command
 - `sudo mknod /dev/Ayelew_Robel_HW6_device_driver c 415 0`
 - At this point, you loaded the device successfully.
 - Now, head to the Test folder to test the device driver program. Execute the following commands to test the program
 - `cd ../Test`
 - At this point, you are in the Test folder
 - `make`
 - `make run`
 - To unload the device, execute the following commands
 - `sudo rmmod Ayelew_Robel_HW6_device_driver`
 - And remove from /dev
 - `sudo rm /dev/Ayelew_Robel_HW6_device_driver`

```
student@student-virtual-machine: ~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-dri...
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module$ make
make -C /lib/modules/`uname -r`/build M=/home/student/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module modules
make[1]: Entering directory '/usr/src/linux-headers-6.5.0-44-generic'
warning: the compiler differs from the one used to build the kernel
The kernel was built by: x86_64-linux-gnu-gcc-12 (Ubuntu 12.3.0-1ubuntu1~22.04) 12.3.0
You are using:          gcc-12 (Ubuntu 12.3.0-1ubuntu1~22.04) 12.3.0
CC [M] /home/student/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module/Ayelew_Robel_HW6_device_driver.o
MODPOST /home/student/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module/Module.symvers
CC [M] /home/student/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module/Ayelew_Robel_HW6_device_driver.mod.o
LD [M] /home/student/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module/Ayelew_Robel_HW6_device_driver.ko
BTF [M] /home/student/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module/Ayelew_Robel_HW6_device_driver.ko
make[1]: Leaving directory '/usr/src/linux-headers-6.5.0-44-generic'
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module$

student@student-virtual-machine: ~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module$ ls
Ayelew_Robel_HW6_device_driver.c  Ayelew_Robel_HW6_device_driver.mod  Ayelew_Robel_HW6_device_driver.mod.o  Makefile      Module.symvers
Ayelew_Robel_HW6_device_driver.ko  Ayelew_Robel_HW6_device_driver.mod.c  Ayelew_Robel_HW6_device_driver.o      modules.order
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module$ |
```

```
student@student-virtual-machine: ~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module$ sudo insmod Ayelew_Robel_HW6_device_driver.ko
[sudo] password for student:
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module$ lsmod
Module              Size  Used by
Ayelew_Robel_HW6_device_driver 12288  0
bnep                 32768  2
intel_rapl_msr       20480  0
vmw_balloon          28672  0
ip6t_REJECT          12288  1
nf_reject_ipv6       24576  1 ip6t_REJECT
xt_hl                 12288  22
intel_rapl_common    40960  1 intel_rapl_msr
ip6t_rt              16384  3
crct10dif_pclmul     12288  1
polyval_clmulni      12288  0
polyval_generic      12288  1 polyval_clmulni
ghash_clmulni_intel  16384  0
sha256_ssse3         32768  0
sha1_ssse3           32768  0
aesni_intel          356352  0
crypto_simd           16384  1 aesni_intel
cryptd                24576  2 crypto_simd,ghash_clmulni_intel
rapl                  20480  0
```

```
student@student-virtual-machine: ~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module$ sudo mknod /dev/Ayelew_Robel_HW6_device_driver c 415 0
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module$
```

```
student@student-virtual-machine: ~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module$ sudo mknod /dev/Ayelew_Robel_HW6_device_driver c 415 0
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module$ ls /dev
autofs          dmidelect      loop0          loop7          nvme0n1p2     snd            tty17          tty30          tty44          tty58          ttys12         ttys26         uinput         vcsa4          vmci
Ayelew_Robel_HW6_device_driver  dri            loop1          loop8          nvme0n1p3     sr0            tty18          tty31          tty45          tty59          ttys13         ttys27         urandom         vcsa5          vsock
block           ecryptfs       loop10         loop9          nvram          stderr         tty19          tty32          tty46          tty6            ttys14         ttys28         userfaultfd     vcsa6          zero
bsg             fb0            loop11         loop-control   port           stdin          tty2           tty33          tty47          tty60           ttys15         ttys29         userio          vcsu           zfs
btrfs-control   fd             loop12         mapper         ppp            stdout         tty20          tty34          tty48          tty61           ttys16         ttys3          vcs             vcsu1
bus             full           loop13         mcelog         psaux          tty            tty21          tty35          tty49          tty62           ttys17         ttys30         vcs1            vcsu2
cdrom           fuse           loop14         mem            ptmx           tty0           tty22          tty36          tty5            tty63           ttys18         ttys31         vcs2            vcsu3
char            hidraw0        loop15         midi           pts            tty1           tty23          tty37          tty50          tty7            ttys19         ttys54         vcs3            vcsu4
console         hpet           loop16         queue          random         tty10          tty24          tty38          tty51          tty8            ttys2           ttys5          vcs4            vcsu5
core            hugepages      loop17         net            rfcill         tty11          tty25          tty39          tty52          tty9            ttys20         ttys6          vcs5            vcsu6
cpu             hwrng          loop2          ng0n1          rtc            tty12          tty26          tty4            tty53          ttyprintk      ttys21         ttys7          vcs6            vfio
cpu_dma_latency initctl        loop3          null           rtc0           tty13          tty27          tty40          tty54          ttyS0           ttys22         ttys8          vcsa            vga_arbiter
cuse            input          loop4          nvme0           sg0            tty14          tty28          tty41          tty55          ttyS1           ttys23         ttys9          vcsa1           vhci
disk            kmsg           loop5          nvme0n1         shw            tty15          tty29          tty42          tty56          ttyS10          ttys24         udmabuf         vcsa2           vhost-net
dma_heap        log            loop6          nvme0n1p1       snapshot       tty16          tty3           tty43          tty57          ttyS11          ttys25         uhid           vcsa3           vhost-vsock
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module$
```

Robel Ayelew
Github: RobelKasahun
Compiling and executing the Test

ID:922419937
CSC415 Operating Systems

```
student@student-virtual-machine: ~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Test
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Module$ cd ../Test
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Test$ |

student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Test$ make
gcc -c -o Ayelew_Robel_HW6_main.o Ayelew_Robel_HW6_main.c -g -I.
gcc -o Ayelew_Robel_HW6_main Ayelew_Robel_HW6_main.o -g -I. -l pthread
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Test$ |

student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Test$ make run
./Ayelew_Robel_HW6_main
Could not open the device file.
: Permission denied
make: *** [Makefile:59: run] Error 1
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Test$ |
```

```
student@student-virtual-machine: ~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun/Test$ cd ../
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun$ ls
Module  README.md  Test
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun$ lsmod
Module              Size  Used by
Ayelew_Robel_HW6_device_driver 12288  0
bnep                 32768  2
intel_rapl_msr       20480  0
vmw_balloon          28672  0
ip6t_REJECT          12288  1
nf_reject_ipv6       24576  1 ip6t_REJECT
xt_hl                 12288  22
intel_rapl_common    40960  1 intel_rapl_msr
ip6t_rt              16384  3
crc10dif_pclmul      12288  1
polyval_clmulni      12288  0
polyval_generic      12288  1 polyval_clmulni
ghash_clmulni_intel  16384  0
sha256_ssse3         32768  0
sha1_ssse3           32768  0
aesni_intel          356352  0
crypto_simd           16384  1 aesni_intel
cryptd               24576  2 crypto_simd,ghash_clmulni_intel
rapl                  20480  0
```

```
student@student-virtual-machine: ~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun$ sudo rmmod Ayelew_Robel_HW6_device_driver
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun$ lsmod
Module              Size  Used by
bnep                 32768  2
intel_rapl_msr       20480  0
vmw_balloon          28672  0
ip6t_REJECT          12288  1
nf_reject_ipv6       24576  1 ip6t_REJECT
xt_hl                 12288  22
intel_rapl_common    40960  1 intel_rapl_msr
ip6t_rt              16384  3
crc10dif_pclmul      12288  1
polyval_clmulni      12288  0
polyval_generic      12288  1 polyval_clmulni
ghash_clmulni_intel  16384  0
sha256_ssse3         32768  0
sha1_ssse3           32768  0
aesni_intel          356352  0
crypto_simd           16384  1 aesni_intel
cryptd               24576  2 crypto_simd,ghash_clmulni_intel
rapl                  20480  0
ipt_REJECT           12288  1
nf_reject_ipv4       16384  1 ipt_REJECT
xt_LOG               16384  10
```

```
student@student-virtual-machine: ~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun$ ls /dev
autofs          dmideid         loop0           loop7           nvme0n1p2      snd             tty17           tty30           tty44           tty58           ttyS12          ttyS26          uinput          vcsa4           vmci
Ayelew_Robel_HW6_device_driver  dri             loop1           loop8           nvme0n1p3      sr0             tty18           tty31           tty45           tty59           ttyS13          ttyS27          urandom          vcsa5           vsock
block           ecryptfs        loop10          loop9           nvram          stderr          tty19           tty32           tty46           tty6            ttyS14          ttyS28          userfaultfd     vcsa6           zero
bsg             fb0             loop11          loop-control    port           stdin           tty2            tty33           tty47           tty60           ttyS15          ttyS29          userio          vcsu            zfs
btrfs-control   fd             loop12          mapper          ppp            stdout          tty20           tty34           tty48           tty61           ttyS16          ttyS3           vcs             vcsu1
bus             full            loop13          mcelog          psaux          tty             tty21           tty35           tty49           tty62           ttyS17          ttyS30          vcs1            vcsu2
cdrom           fuse            loop14          mem             ptmx           tty0            tty22           tty36           tty5            tty63           ttyS18          ttyS31          vcs2            vcsu3
char            hidraw0         loop15          midi            pts            tty1            tty23           tty37           tty50           tty7            ttyS19          ttyS4           vcs3            vcsu4
console         hpet            loop16          mqueue          random          tty10           tty24           tty38           tty51           tty8            ttyS2           ttyS5           vcs4            vcsu5
core            hugepages       loop17          net             rtc            tty11           tty25           tty39           tty52           tty9            ttyS20          ttyS6           vcs5            vcsu6
cpu             hwrng           loop2           ng0n1           rtc0           tty12           tty26           tty4            tty53           ttyprintk       ttyS21          ttyS7           vcs6            vfio
cpu_dma_latency  initctl         loop3           null            sg0            tty13           tty27           tty40           tty54           ttyS0           ttyS22          ttyS8           vcsa            vga_arbiter
cuse            input           loop4           nvme0           sh0            tty14           tty28           tty41           tty55           ttyS1           ttyS23          ttyS9           vcsa1           vhci
disk            kmsg           loop5           nvme0n1         shw            tty15           tty29           tty42           tty56           ttyS10          ttyS24          udmabuf         vcsa2           vhost-net
dma_heap        log            loop6           nvme0n1p1       snapshot        tty16           tty3            tty57           tty62           ttyS11          ttyS25          uhid            vcsa3           vhost-vsock
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun$
```

```
student@student-virtual-machine: ~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun$ sudo rm /dev/Ayelew_Robel_HW6_device_driver
student@student-virtual-machine:~/Desktop/Summer-2024-CSC-415-assignments/csc415-assignment-6-device-driver-RobelKasahun$ ls /dev
autofs          dmideid         log            loop5           nvme0           rtc0            tty12           tty25           tty38           tty50           tty63           ttyS17          ttyS3           userio          vcsa6           vsock
block           dri             loop0           loop6           nvme0n1         sg0            tty13           tty26           tty39           tty51           tty7            ttyS18          ttyS30          vcs             vcsu1           zero
bsg             ecryptfs        loop1           loop7           nvme0n1p1       sh0            tty14           tty27           tty4            tty52           tty8            ttyS19          ttyS31          vcs1            vcsu2           zfs
btrfs-control   fb0             loop10          loop8           nvme0n1p2       snapshot        tty15           tty28           tty40           tty53           tty9            ttyS2           ttyS4           vcs2            vcsu3
bus             fd             loop11          loop9           nvme0n1p3       snd            tty16           tty29           tty41           tty54           ttyprintk       ttyS20          ttyS5           vcs3            vcsu4
cdrom           full            loop12          loop-control    nvram           sr0            tty17           tty3            tty42           tty55           ttyS0           ttyS21          ttyS6           vcs4            vcsu5
char            fuse            loop13          mapper          port            stderr          tty18           tty30           tty43           tty56           ttyS1           ttyS22          ttyS7           vcs5            vcsu6
console         hidraw0         loop14          mcelog          ppp             stdin           tty19           tty31           tty44           tty57           ttyS10          ttyS23          ttyS8           vcs6            vhost-net
core            hpet            loop15          mem             psaux           stdout          tty2            tty32           tty45           tty58           ttyS11          ttyS24          ttyS9           vcsa            vga_arbiter
cpu             hugepages       loop16          midi            ptmx            tty             tty20           tty33           tty46           tty59           ttyS12          ttyS25          udmabuf         vcsa1           vhci
cpu_dma_latency  hwrng           loop17          mqueue          pts             tty0            tty21           tty34           tty47           tty6            ttyS13          ttyS26          uhid            vcsa2           vhost-vsock
cuse            initctl         loop2           net             random          tty1            tty22           tty35           tty48           tty60           ttyS14          ttyS27          uinput          vcsa3           vmci
disk            input           loop3           ng0n1           rfkill          tty10           tty23           tty36           tty49           tty61           ttyS15          ttyS28          urandom         vcsa4
dma_heap        kmsg           loop4           null            rtc             tty11           tty24           tty37           tty5            tty62           ttyS16          ttyS29          userfaultfd     vcsa5
```