

DEVICE DRIVERS – LAB EXERCISE 5

Submitted By:

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CED18I028

OBJECTIVE:

Write a C program. Compile. Insert the compiled program as a Kernel Module in Kernel. Remove the module from Kernel. Verify whether the insertion and deletion happened properly.

Linux Distribution Used:

MX Linux 19.1 (Running on Virtual machine)

```
kiran@LastNightmare00:~/Desktop
$ cat /etc/*-release
NAME="MX"
VERSION="19.1 (patito feo)"
ID="mx"
VERSION_ID="19.1"
PRETTY_NAME="MX 19.1 (patito feo)"
ANSI_COLOR="0;34"
HOME_URL="https://mxlinux.org"
BUG_REPORT_URL="https://mxlinux.org"
PRETTY_NAME="MX 19.1 patito feo"
DISTRIB_ID=MX
DISTRIB_RELEASE=19.1
DISTRIB_CODENAME="patito feo"
DISTRIB_DESCRIPTION="MX 19.1 patito feo"
PRETTY_NAME="Debian GNU/Linux 10 (buster)"
NAME="Debian GNU/Linux"
VERSION_ID="10"
VERSION="10 (buster)"
VERSION_CODENAME=buster
ID=debian
HOME_URL="https://www.debian.org/"
SUPPORT_URL="https://www.debian.org/support"
BUG_REPORT_URL="https://bugs.debian.org/"
```

Code:

```
#include <linux/module.h>  /* Needed by all modules */
#include <linux/kernel.h>  /* Needed for KERN_INFO */
#include <linux/init.h>    /* Needed for the macros */

///< The license type -- this affects runtime behavior
MODULE_LICENSE("GPL");

///< The author -- visible when you use modinfo
MODULE_AUTHOR("Kiran Thomas Cherian");

///< The description -- see modinfo
MODULE_DESCRIPTION("Hello World Kernal Modul Program");

///< The version of the module
MODULE_VERSION("0.1");

static int __init hello_start(void)
{
    printk(KERN_INFO "Loading my module\n");
    printk(KERN_INFO "Hello world by Kiran\n");
    return 0;
}
```

```
static void __exit hello_end(void)
{
    printk(KERN_INFO "Removing my module.bye..\n");
}

module_init(hello_start);
module_exit(hello_end);
```

Makefile Contents:

```
obj-m = CED18I028Lab5.o

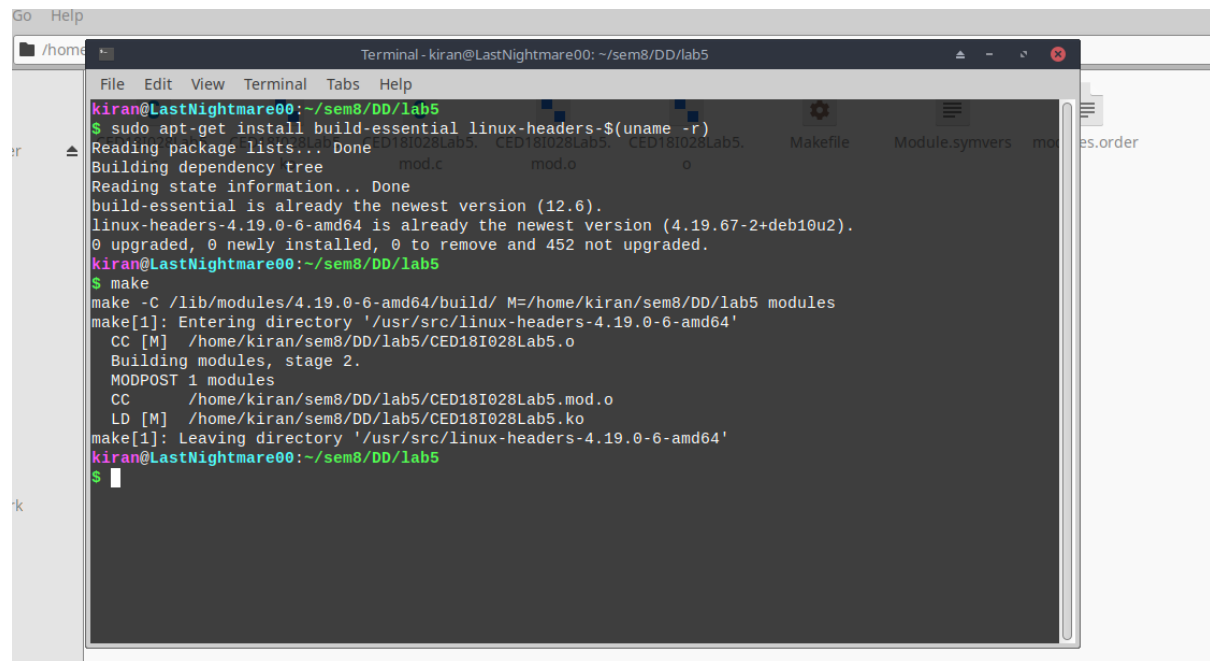
all:
    make -C /lib/modules/$(shell uname -r)/build/ M=$(PWD) modules

clean:
    make -C /lib/modules/$(shell uname -r)/build M=$(PWD) clean
```

The system must be prepared to build kernel code, and to do this you must have the Linux headers installed on your device. Under 64-bit Debian you can use:

\$ sudo apt-get install build-essential linux-headers-\$(uname -r)

Run the make command to compile the source code.



```
Go Help
/home
Terminal - kiran@LastNightmare00: ~/sem8/DD/lab5
File Edit View Terminal Tabs Help
kiran@LastNightmare00:~/sem8/DD/lab5
$ sudo apt-get install build-essential linux-headers-$(uname -r)
Reading package lists... Done
Building dependency tree
Reading state information... Done
build-essential is already the newest version (12.6).
linux-headers-4.19.0-6-amd64 is already the newest version (4.19.67-2+deb10u2).
0 upgraded, 0 newly installed, 0 to remove and 452 not upgraded.
kiran@LastNightmare00:~/sem8/DD/lab5
$ make
make -C /lib/modules/4.19.0-6-amd64/build/ M=/home/kiran/sem8/DD/lab5 modules
make[1]: Entering directory '/usr/src/linux-headers-4.19.0-6-amd64'
CC [M] /home/kiran/sem8/DD/lab5/CED18I028Lab5.o
Building modules, stage 2.
MODPOST 1 modules
CC /home/kiran/sem8/DD/lab5/CED18I028Lab5.mod.o
LD [M] /home/kiran/sem8/DD/lab5/CED18I028Lab5.ko
make[1]: Leaving directory '/usr/src/linux-headers-4.19.0-6-amd64'
kiran@LastNightmare00:~/sem8/DD/lab5
$
```

Then use insmod to load the module.

You can get information about the module using the modinfo command, which will identify the description, author and any module parameters that are defined. And to see the message, we need to read the kern.log in /var/log directory

```
Terminal - kiran@LastNightmare00: ~/sem8/DD/lab5
File Edit View Terminal Tabs Help
kiran@LastNightmare00:~/sem8/DD/lab5
$ ls
CED18I028Lab5.c CED18I028Lab5.mod.c CED18I028Lab5.o modules.order Makefile Module.symvers modules.order
CED18I028Lab5.ko CED18I028Lab5.mod.o Makefile Module.symvers
kiran@LastNightmare00:~/sem8/DD/lab5
$ sudo insmod CED18I028Lab5.ko
kiran@LastNightmare00:~/sem8/DD/lab5
$ modinfo CED18I028Lab5.ko
filename: /home/kiran/sem8/DD/lab5/CED18I028Lab5.ko
version: 0.1
description: Hello World Kernal Modul Program
author: Kiran Thomas Cherian
license: GPL
srcversion: 783B25B6891DA1B13C2887F
depends:
retpoline: Y
name: CED18I028Lab5
vermagic: 4.19.0-6-amd64 SMP mod_unload modversions
kiran@LastNightmare00:~/sem8/DD/lab5
$ tail /var/log/kern.log
tail: cannot open '/var/log/kern.log' for reading: Permission denied
kiran@LastNightmare00:~/sem8/DD/lab5
$ sudo tail /var/log/kern.log
Feb 27 19:19:51 LastNightmare00 kernel: [ 69.419862] Bluetooth: L2CAP socket layer initialized
Feb 27 19:19:51 LastNightmare00 kernel: [ 69.419869] Bluetooth: SCO socket layer initialized
Feb 27 19:19:55 LastNightmare00 kernel: [ 72.818861] Bluetooth: BNEP (Ethernet Emulation) ver 1.3
Feb 27 19:19:55 LastNightmare00 kernel: [ 72.818862] Bluetooth: BNEP filters: protocol multicast
Feb 27 19:19:55 LastNightmare00 kernel: [ 72.818865] Bluetooth: BNEP socket layer initialized
Feb 27 19:34:05 LastNightmare00 kernel: [ 923.202395] Loading my module
Feb 27 19:34:05 LastNightmare00 kernel: [ 923.202396] Hello world by Kiran
Feb 27 19:35:15 LastNightmare00 kernel: [ 992.853897] Removing my module.bye..
Feb 27 19:35:27 LastNightmare00 kernel: [ 1004.896557] Loading my module
Feb 27 19:35:27 LastNightmare00 kernel: [ 1004.896558] Hello world by Kiran
kiran@LastNightmare00:~/sem8/DD/lab5
$
```

To unload the module, we run `rmmod`:

Now run the `tail` command to get the exit message.

```
Feb 27 19:19:51 LastNightmare00 kernel: [ 69.419862] Bluetooth: L2CAP socket layer initialized
Feb 27 19:19:51 LastNightmare00 kernel: [ 69.419869] Bluetooth: SCO socket layer initialized
Feb 27 19:19:55 LastNightmare00 kernel: [ 72.818861] Bluetooth: BNEP (Ethernet Emulation) ver 1.3
Feb 27 19:19:55 LastNightmare00 kernel: [ 72.818862] Bluetooth: BNEP filters: protocol multicast
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Feb 27 19:34:05 LastNightmare00 kernel: [ 923.202395] Loading my module
Feb 27 19:34:05 LastNightmare00 kernel: [ 923.202396] Hello world by Kiran
Feb 27 19:35:15 LastNightmare00 kernel: [ 992.853897] Removing my module.bye..
Feb 27 19:35:27 LastNightmare00 kernel: [ 1004.896557] Loading my module
Feb 27 19:35:27 LastNightmare00 kernel: [ 1004.896558] Hello world by Kiran
kiran@LastNightmare00:~/sem8/DD/lab5
$ sudo rmmod CED18I028Lab5
kiran@LastNightmare00:~/sem8/DD/lab5
$ sudo tail /var/log/kern.log
Feb 27 19:19:51 LastNightmare00 kernel: [ 69.419869] Bluetooth: SCO socket layer initialized
Feb 27 19:19:55 LastNightmare00 kernel: [ 72.818861] Bluetooth: BNEP (Ethernet Emulation) ver 1.3
Feb 27 19:19:55 LastNightmare00 kernel: [ 72.818862] Bluetooth: BNEP filters: protocol multicast
Feb 27 19:19:55 LastNightmare00 kernel: [ 72.818865] Bluetooth: BNEP socket layer initialized
Feb 27 19:34:05 LastNightmare00 kernel: [ 923.202395] Loading my module
Feb 27 19:34:05 LastNightmare00 kernel: [ 923.202396] Hello world by Kiran
Feb 27 19:35:15 LastNightmare00 kernel: [ 992.853897] Removing my module.bye..
Feb 27 19:35:27 LastNightmare00 kernel: [ 1004.896557] Loading my module
Feb 27 19:35:27 LastNightmare00 kernel: [ 1004.896558] Hello world by Kiran
Feb 27 19:37:18 LastNightmare00 kernel: [ 1116.010389] Removing my module.bye..
kiran@LastNightmare00:~/sem8/DD/lab5
$
```