



Exercise - 5

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CED17I017

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Write a C program, compile it as module, insert into kernel, check message in log, remove module from kernel

Here I have written a simple module :

HelloWorld.c

```
#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");
MODULE_AUTHOR("Firoz Mohammad");
MODULE_DESCRIPTION("A simple Hello world LKM!");
MODULE_VERSION("2.3.0");

static int __init hello_start(void)
{
    printk(KERN_INFO "Loading Hello World module...\n");
    printk(KERN_INFO "My First Hello world Module\n");
    return 0;
}

static void __exit hello_end(void)
{
    printk(KERN_INFO "Goodbye Firoz\n");
}

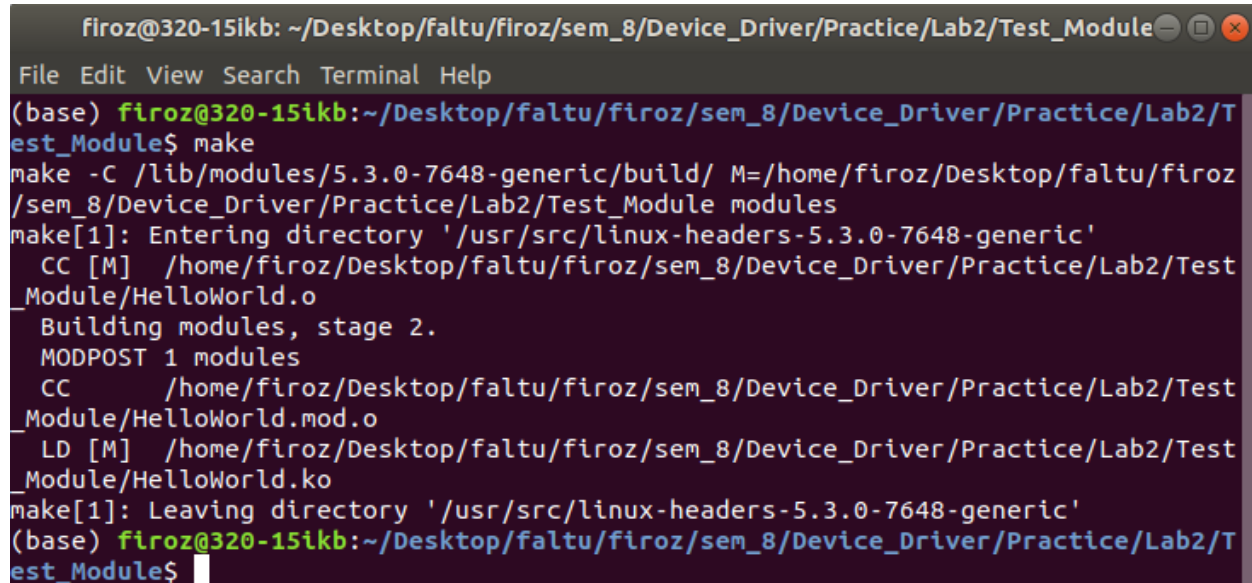
module_init(hello_start);
module_exit(hello_end);
```

Obviously we can not compile this module , for this we would need a Makefile

Makefile

```
obj-m = HelloWorld.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
```

Now, after running “make” , we will get the “HelloWorld.ko” and others related file.



```
firoz@320-15ikb: ~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module
File Edit View Search Terminal Help
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$ make
make -C /lib/modules/5.3.0-7648-generic/build/ M=/home/firoz/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module modules
make[1]: Entering directory '/usr/src/linux-headers-5.3.0-7648-generic'
  CC [M] /home/firoz/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module/HelloWorld.o
Building modules, stage 2.
MODPOST 1 modules
  CC /home/firoz/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module/HelloWorld.mod.o
  LD [M] /home/firoz/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module/HelloWorld.ko
make[1]: Leaving directory '/usr/src/linux-headers-5.3.0-7648-generic'
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$
```

Inserting HelloWorld.ko module :

```
firoz@320-15ikb: ~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module
File Edit View Search Terminal Help
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$ sudo lsmod | grep "HelloWorld"
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$ sudo insmod HelloWorld.ko
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$ sudo lsmod | grep "HelloWorld"
HelloWorld                16384  0
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$ sudo lsmod
Module                    Size  Used by
HelloWorld                16384  0
rfcomm                    81920  4
xfrm_user                 36864  2
xfrm4_tunnel              16384  0
tunnel4                   16384  1 xfrm4_tunnel
```

As we can see , HelloWorld module has been inserted into the kernel.

Checking Module info :


```
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$ modinfo HelloWorld.ko
filename:                 /home/firoz/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module/HelloWorld.ko
version:                  2.3.0
description:              A simple Hello world LKM!
author:                   Firoz Mohammad
license:                  GPL
srcversion:               D7241B884F49D949CABFA94
depends:
retpoline:               Y
name:                     HelloWorld
vermagic:                 5.3.0-7648-generic SMP mod_unload
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$
```

Checking message on kernel log file :

```
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$ tail -n10 /var/log/kern.log
Mar 22 22:53:26 320-15ikb kernel: [ 48.275974] NET: Registered protocol family 15
Mar 22 22:53:27 320-15ikb kernel: [ 48.789626] Initializing XFRM netlink socket
Mar 22 22:53:48 320-15ikb kernel: [ 70.140276] Bluetooth: RFCOMM TTY layer initialized
Mar 22 22:53:48 320-15ikb kernel: [ 70.140281] Bluetooth: RFCOMM socket layer initialized
Mar 22 22:53:48 320-15ikb kernel: [ 70.140288] Bluetooth: RFCOMM ver 1.11
Mar 22 22:53:50 320-15ikb kernel: [ 72.591839] rfkill: input handler disabled
Mar 22 22:57:11 320-15ikb kernel: [ 273.126275] HelloWorld: loading out-of-tree module taints kernel.
Mar 22 22:57:11 320-15ikb kernel: [ 273.126306] HelloWorld: module verification failed: signature and/or required key missing - tainting kernel
Mar 22 22:57:11 320-15ikb kernel: [ 273.126522] Loading Hello World module...
Mar 22 22:57:11 320-15ikb kernel: [ 273.126523] My First Hello world Module
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$
```

Remove module from kernel :

```
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$ sudo rmmod HelloWorld
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$ lsmod grep | "HelloWorld"
Usage: lsmod
HelloWorld: command not found
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$ sudo lsmod | grep "HelloWorld"
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$ tail -n8 /var/log/kern.log
Mar 22 22:53:48 320-15ikb kernel: [ 70.140281] Bluetooth: RFCOMM socket layer initialized
Mar 22 22:53:48 320-15ikb kernel: [ 70.140288] Bluetooth: RFCOMM ver 1.11
Mar 22 22:53:50 320-15ikb kernel: [ 72.591839] rfkill: input handler disabled
Mar 22 22:57:11 320-15ikb kernel: [ 273.126275] HelloWorld: loading out-of-tree module taints kernel.
Mar 22 22:57:11 320-15ikb kernel: [ 273.126306] HelloWorld: module verification failed: signature and/or required key missing - tainting kernel
Mar 22 22:57:11 320-15ikb kernel: [ 273.126522] Loading Hello World module...
Mar 22 22:57:11 320-15ikb kernel: [ 273.126523] My First Hello world Module
Mar 22 23:09:17 320-15ikb kernel: [ 999.085356] Goodbye Firoz
(base) firoz@320-15ikb:~/Desktop/faltu/firoz/sem_8/Device_Driver/Practice/Lab2/Test_Module$
```



As we can see , output of lsmod (with module name "Helloworld") is empty it means HelloWorld module has been removed from kernel. Also "Goodbye Firoz" message has been logged in the log file as we wrote in the code with `__exit` compiler directive.