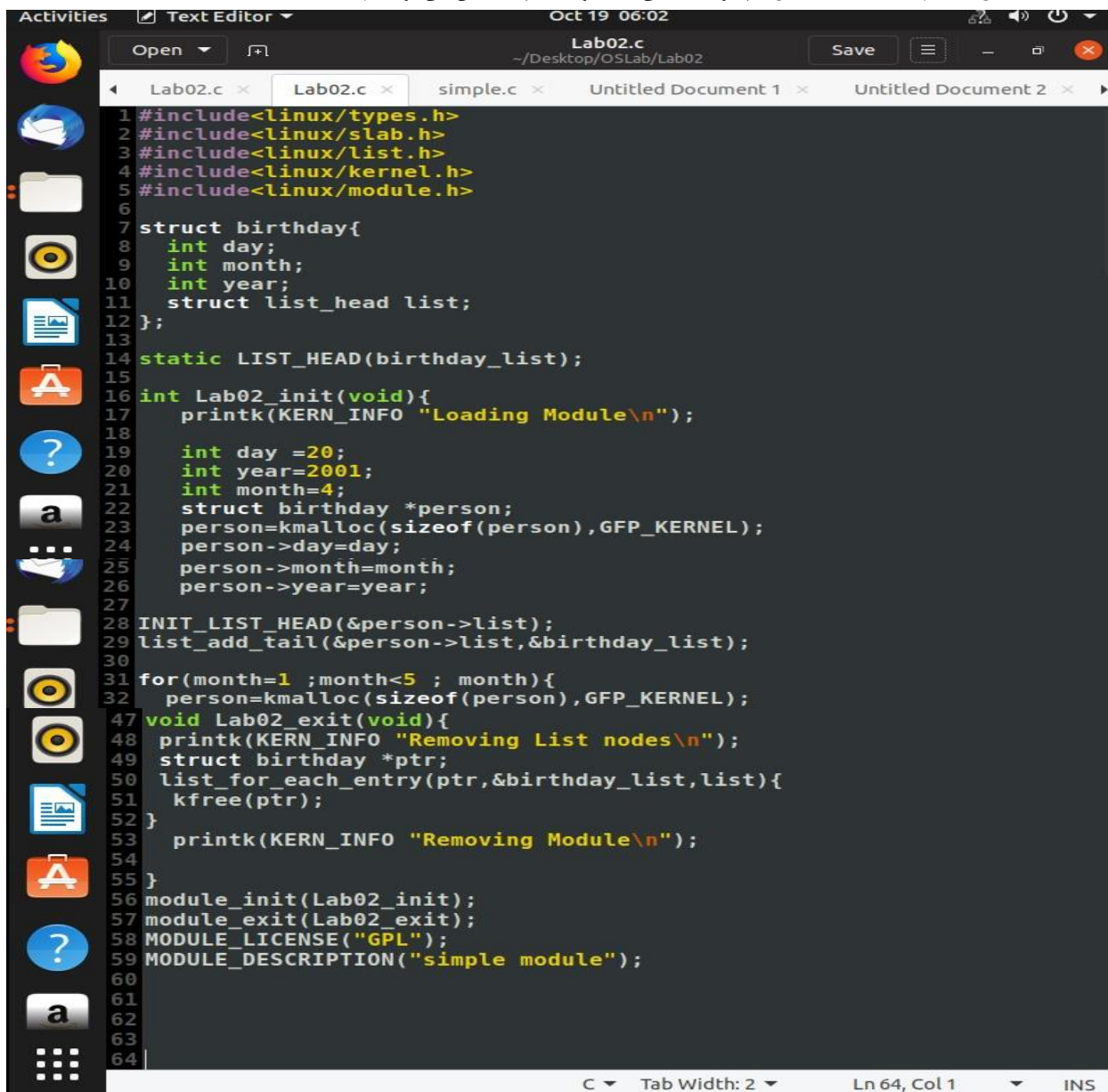


تمرین ها:تمرین 2

1- ابتدا یک فایل به اسم lab02 یک فایل با پسوند C. می سازیمو کد زیر را در آن می نویسیم.

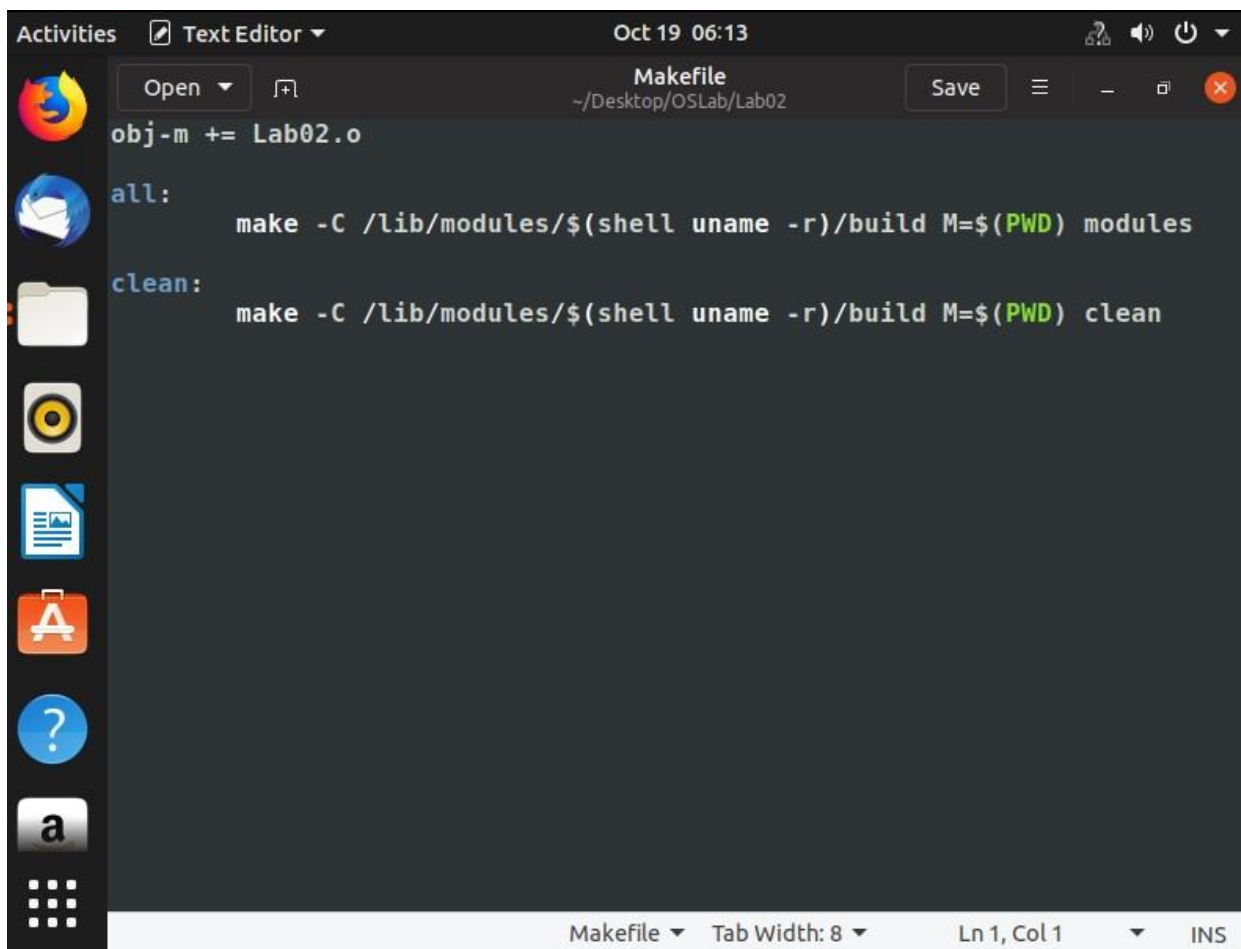


```

1 #include<linux/types.h>
2 #include<linux/slab.h>
3 #include<linux/list.h>
4 #include<linux/kernel.h>
5 #include<linux/module.h>
6
7 struct birthday{
8     int day;
9     int month;
10    int year;
11    struct list_head list;
12 };
13
14 static LIST_HEAD(birthday_list);
15
16 int Lab02_init(void){
17     printk(KERN_INFO "Loading Module\n");
18
19     int day =20;
20     int year=2001;
21     int month=4;
22     struct birthday *person;
23     person=kmalloc(sizeof(person),GFP_KERNEL);
24     person->day=day;
25     person->month=month;
26     person->year=year;
27
28     INIT_LIST_HEAD(&person->list);
29     list_add_tail(&person->list,&birthday_list);
30
31     for(month=1 ;month<5 ; month){
32         person=kmalloc(sizeof(person),GFP_KERNEL);
33
34         void Lab02_exit(void){
35             printk(KERN_INFO "Removing List nodes\n");
36             struct birthday *ptr;
37             list_for_each_entry(ptr,&birthday_list,list){
38                 kfree(ptr);
39             }
40             printk(KERN_INFO "Removing Module\n");
41         }
42     }
43
44     module_init(Lab02_init);
45     module_exit(Lab02_exit);
46     MODULE_LICENSE("GPL");
47     MODULE_DESCRIPTION("simple module");
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64

```

2- یک فایل به اسم Makefile در دایرکتوری مربوطه می سازیم و دستورات زیر را درون آن می نویسیم.

A screenshot of a Linux desktop environment. On the left is a vertical dock with icons for Firefox, a mail client, a file manager, a CD/DVD player, a document viewer, the App Store, a help icon, and an application icon labeled 'a'. The main window is a text editor titled 'Text Editor' with a timestamp 'Oct 19 06:13'. The editor is open to a file named 'Makefile' located at '~/Desktop/OSLab/Lab02'. The file content is as follows:

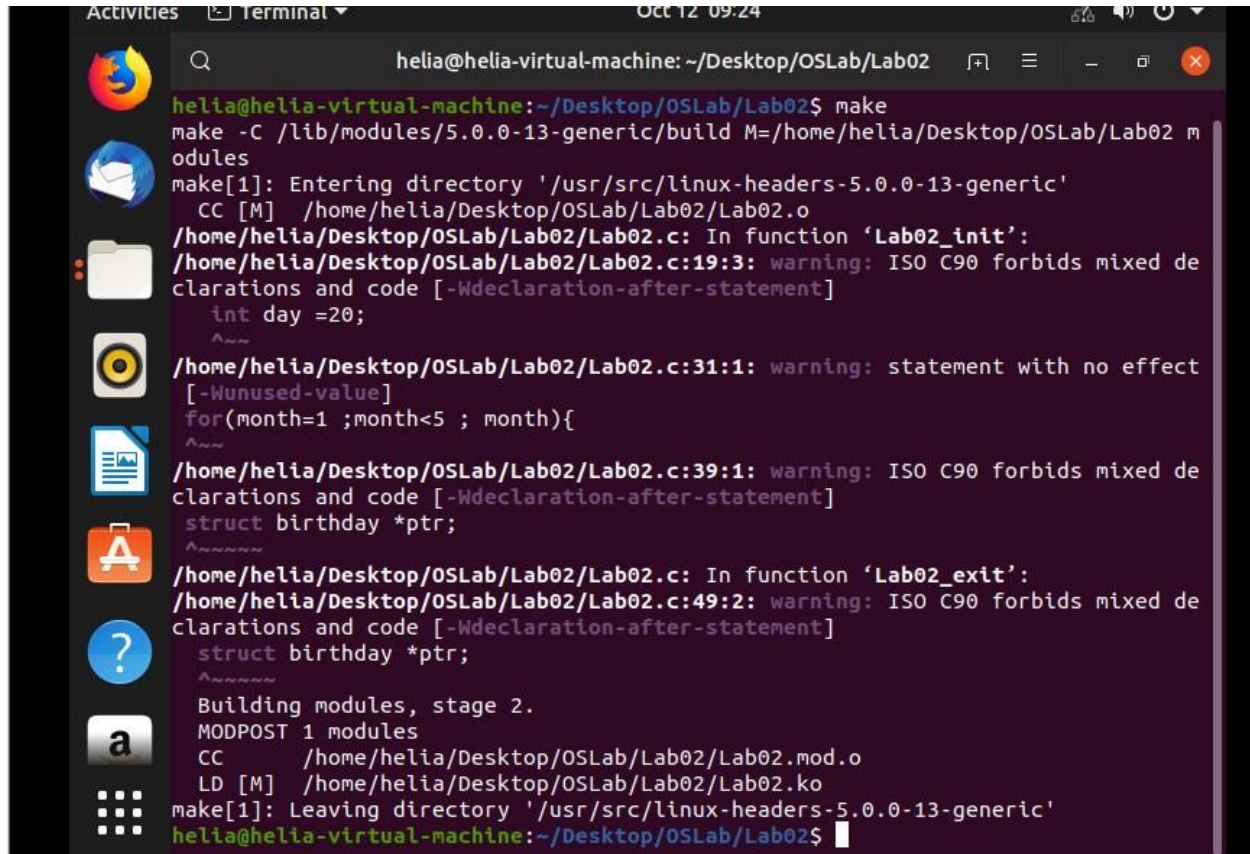
```
obj-m += Lab02.o

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 status bar at the bottom of the editor shows 'Makefile', 'Tab Width: 8', 'Ln 1, Col 1', and 'INS'.

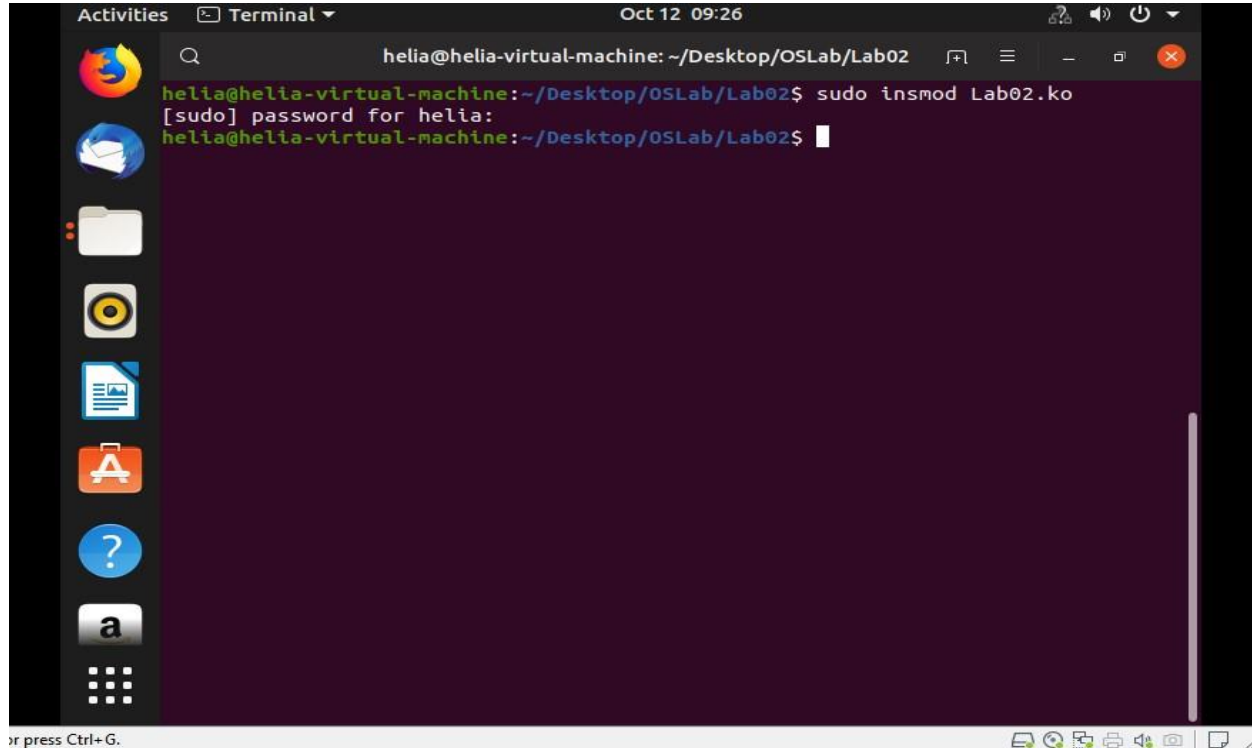
3- برای کامپایل از دستور `make` استفاده می کنیم و فایل `.c` را کامپایل کرده و به فایل `.ko` تبدیل می کنیم.



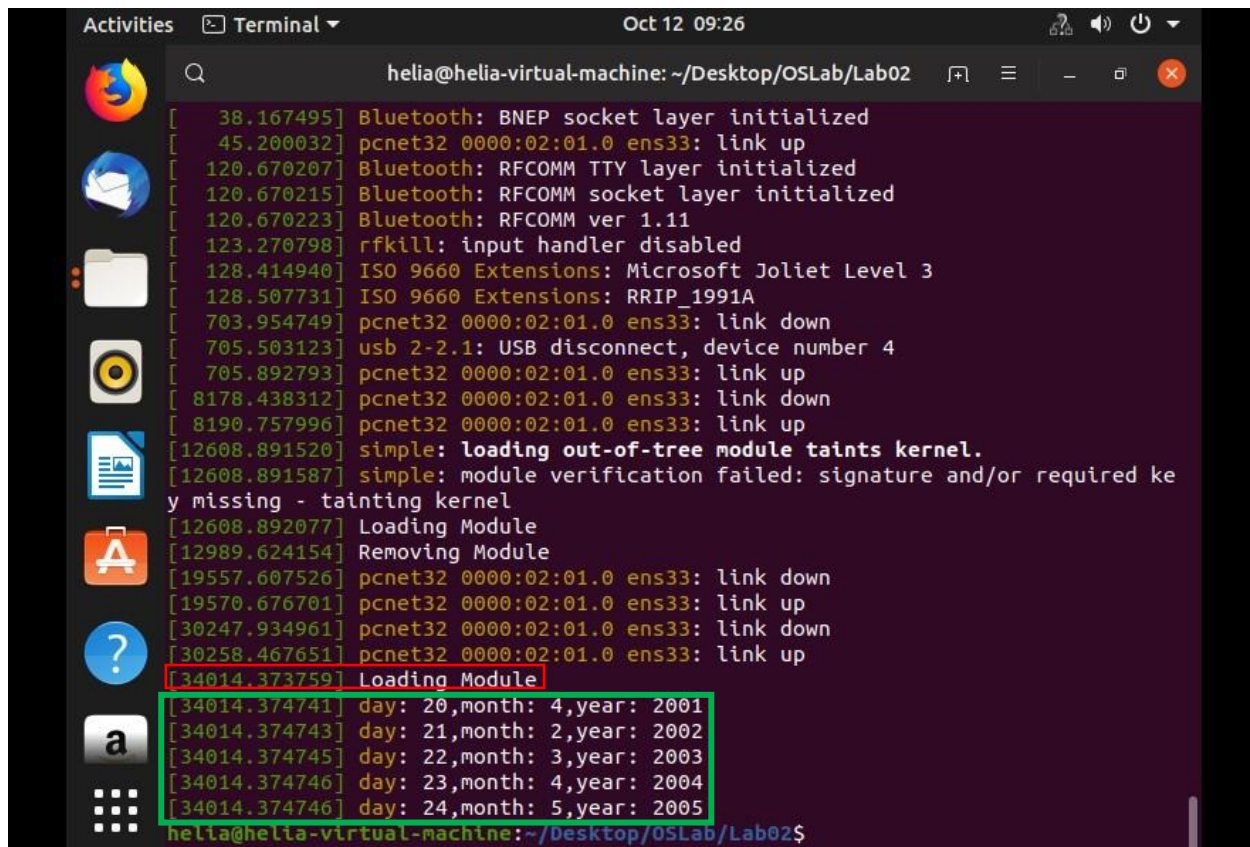
The screenshot shows a terminal window titled "Terminal" with the prompt "helia@helia-virtual-machine: ~/Desktop/OSLab/Lab02". The user has entered the command `make`. The output shows the compilation process for a kernel module. It starts with `make -C /lib/modules/5.0.0-13-generic/build M=/home/helia/Desktop/OSLab/Lab02 modules`. Then, it enters the directory `/usr/src/linux-headers-5.0.0-13-generic` and compiles `Lab02.o` from `Lab02.c`. There are several warnings from the compiler, including "ISO C90 forbids mixed declarations and code" and "statement with no effect". The compilation of `Lab02.o` is successful. Then, it builds the module `Lab02.ko` using `LD [M] /home/helia/Desktop/OSLab/Lab02/Lab02.ko`. Finally, it leaves the directory and returns to the prompt.

```
helia@helia-virtual-machine: ~/Desktop/OSLab/Lab02
helia@helia-virtual-machine:~/Desktop/OSLab/Lab02$ make
make -C /lib/modules/5.0.0-13-generic/build M=/home/helia/Desktop/OSLab/Lab02 modules
make[1]: Entering directory '/usr/src/linux-headers-5.0.0-13-generic'
CC [M] /home/helia/Desktop/OSLab/Lab02/Lab02.o
/home/helia/Desktop/OSLab/Lab02/Lab02.c: In function 'Lab02_init':
/home/helia/Desktop/OSLab/Lab02/Lab02.c:19:3: warning: ISO C90 forbids mixed de
clarations and code [-Wdeclaration-after-statement]
    int day =20;
    ^
/home/helia/Desktop/OSLab/Lab02/Lab02.c:31:1: warning: statement with no effect
[-Wunused-value]
    for(month=1 ;month<5 ; month){
    ^
/home/helia/Desktop/OSLab/Lab02/Lab02.c:39:1: warning: ISO C90 forbids mixed de
clarations and code [-Wdeclaration-after-statement]
    struct birthday *ptr;
    ^
/home/helia/Desktop/OSLab/Lab02/Lab02.c: In function 'Lab02_exit':
/home/helia/Desktop/OSLab/Lab02/Lab02.c:49:2: warning: ISO C90 forbids mixed de
clarations and code [-Wdeclaration-after-statement]
    struct birthday *ptr;
    ^
Building modules, stage 2.
MODPOST 1 modules
CC      /home/helia/Desktop/OSLab/Lab02/Lab02.mod.o
LD [M]  /home/helia/Desktop/OSLab/Lab02/Lab02.ko
make[1]: Leaving directory '/usr/src/linux-headers-5.0.0-13-generic'
helia@helia-virtual-machine:~/Desktop/OSLab/Lab02$
```

4- با استفاده از دستور insomd ماژول های هسته را بارگذاری کرده و با استفاده از دستور dmesg محتوای پنج تاریخ را می بینیم.



```
Oct 12 09:26
helia@helia-virtual-machine: ~/Desktop/OSLab/Lab02
helia@helia-virtual-machine:~/Desktop/OSLab/Lab02$ sudo insmod Lab02.ko
[sudo] password for helia:
helia@helia-virtual-machine:~/Desktop/OSLab/Lab02$
```



```
Oct 12 09:26
helia@helia-virtual-machine: ~/Desktop/OSLab/Lab02
[ 38.167495] Bluetooth: BNEP socket layer initialized
[ 45.200032] pcnet32 0000:02:01.0 ens33: link up
[ 120.670207] Bluetooth: RFCOMM ITTY layer initialized
[ 120.670215] Bluetooth: RFCOMM socket layer initialized
[ 120.670223] Bluetooth: RFCOMM ver 1.11
[ 123.270798] rkill: input handler disabled
[ 128.414940] ISO 9660 Extensions: Microsoft Joliet Level 3
[ 128.507731] ISO 9660 Extensions: RRIP_1991A
[ 703.954749] pcnet32 0000:02:01.0 ens33: link down
[ 705.503123] usb 2-2.1: USB disconnect, device number 4
[ 705.892793] pcnet32 0000:02:01.0 ens33: link up
[ 8178.438312] pcnet32 0000:02:01.0 ens33: link down
[ 8190.757996] pcnet32 0000:02:01.0 ens33: link up
[12608.891520] simple: loading out-of-tree module taints kernel.
[12608.891587] simple: module verification failed: signature and/or required ke
y missing - tainting kernel
[12608.892077] Loading Module
[12989.624154] Removing Module
[19557.607526] pcnet32 0000:02:01.0 ens33: link down
[19570.676701] pcnet32 0000:02:01.0 ens33: link up
[30247.934961] pcnet32 0000:02:01.0 ens33: link down
[30258.467651] pcnet32 0000:02:01.0 ens33: link up
[34014.373759] Loading Module
[34014.374741] day: 20,month: 4,year: 2001
[34014.374743] day: 21,month: 2,year: 2002
[34014.374745] day: 22,month: 3,year: 2003
[34014.374746] day: 23,month: 4,year: 2004
[34014.374746] day: 24,month: 5,year: 2005
helia@helia-virtual-machine:~/Desktop/OSLab/Lab02$
```


5- با استفاده از دستور `rmmod` ماژول ساخته شده را ریمیداریم و سپس `dmesg` را می نویسم، می بینیم که پیام مورد نظر ما در بافر نمایش داده شده است.

```
Activities Terminal Oct 12 09:48
helia@helia-virtual-machine: ~/Desktop/OSLab/Lab02
ration="profile_load" profile="unconfined" name="man_filter" pid=737 comm="appa
rmor_parser"
[ 60.371911] audit: type=1400 audit(1634046097.254:25): apparmor="STATUS" ope
ration="profile_load" profile="unconfined" name="man_groff" pid=737 comm="appar
mor_parser"
[ 60.432974] audit: type=1400 audit(1634046097.318:26): apparmor="STATUS" ope
ration="profile_load" profile="unconfined" name="/usr/sbin/ippusbxd" pid=740 co
mm="apparmor_parser"
[ 73.254382] Bluetooth: BNEP (Ethernet Emulation) ver 1.3
[ 73.254383] Bluetooth: BNEP filters: protocol multicast
[ 73.254387] Bluetooth: BNEP socket layer initialized
[ 78.186575] pcnet32 0000:02:01.0 ens33: link up
[ 190.164432] Bluetooth: RFCOMM TTY layer initialized
[ 190.164438] Bluetooth: RFCOMM socket layer initialized
[ 190.164444] Bluetooth: RFCOMM ver 1.11
[ 194.647385] rfkill: input handler disabled
[ 200.215096] ISO 9660 Extensions: Microsoft Joliet Level 3
[ 200.357443] ISO 9660 Extensions: RRIP_1991A
[ 308.944689] Lab02: loading out-of-tree module taints kernel.
[ 308.944737] Lab02: module verification failed: signature and/or required key
missing - tainting kernel
[ 308.946931] Loading Module
[ 308.946933] day: 20,month: 4,year: 2001
[ 308.946934] day: 21,month: 2,year: 2002
[ 308.946934] day: 22,month: 3,year: 2003
[ 308.946934] day: 23,month: 4,year: 2004
[ 308.946935] day: 24,month: 5,year: 2005
helia@helia-virtual-machine:~/Desktop/OSLab/Lab02$ sudo rmmod Lab02.ko
helia@helia-virtual-machine:~/Desktop/OSLab/Lab02$ dmesg
```

```
Activities Terminal Oct 12 09:49
helia@helia-virtual-machine: ~/Desktop/OSLab/Lab02
[ 60.371911] audit: type=1400 audit(1634046097.254:25): apparmor="STATUS" ope
ration="profile_load" profile="unconfined" name="man_groff" pid=737 comm="appar
mor_parser"
[ 60.432974] audit: type=1400 audit(1634046097.318:26): apparmor="STATUS" ope
ration="profile_load" profile="unconfined" name="/usr/sbin/ippusbxd" pid=740 co
mm="apparmor_parser"
[ 73.254382] Bluetooth: BNEP (Ethernet Emulation) ver 1.3
[ 73.254383] Bluetooth: BNEP filters: protocol multicast
[ 73.254387] Bluetooth: BNEP socket layer initialized
[ 78.186575] pcnet32 0000:02:01.0 ens33: link up
[ 190.164432] Bluetooth: RFCOMM TTY layer initialized
[ 190.164438] Bluetooth: RFCOMM socket layer initialized
[ 190.164444] Bluetooth: RFCOMM ver 1.11
[ 194.647385] rfkill: input handler disabled
[ 200.215096] ISO 9660 Extensions: Microsoft Joliet Level 3
[ 200.357443] ISO 9660 Extensions: RRIP_1991A
[ 308.944689] Lab02: loading out-of-tree module taints kernel.
[ 308.944737] Lab02: module verification failed: signature and/or required key
missing - tainting kernel
[ 308.946931] Loading Module
[ 308.946933] day: 20,month: 4,year: 2001
[ 308.946934] day: 21,month: 2,year: 2002
[ 308.946934] day: 22,month: 3,year: 2003
[ 308.946934] day: 23,month: 4,year: 2004
[ 308.946935] day: 24,month: 5,year: 2005
[ 445.054768] Removing List nodes
[ 445.054770] Removing Module
helia@helia-virtual-machine:~/Desktop/OSLab/Lab02$
```