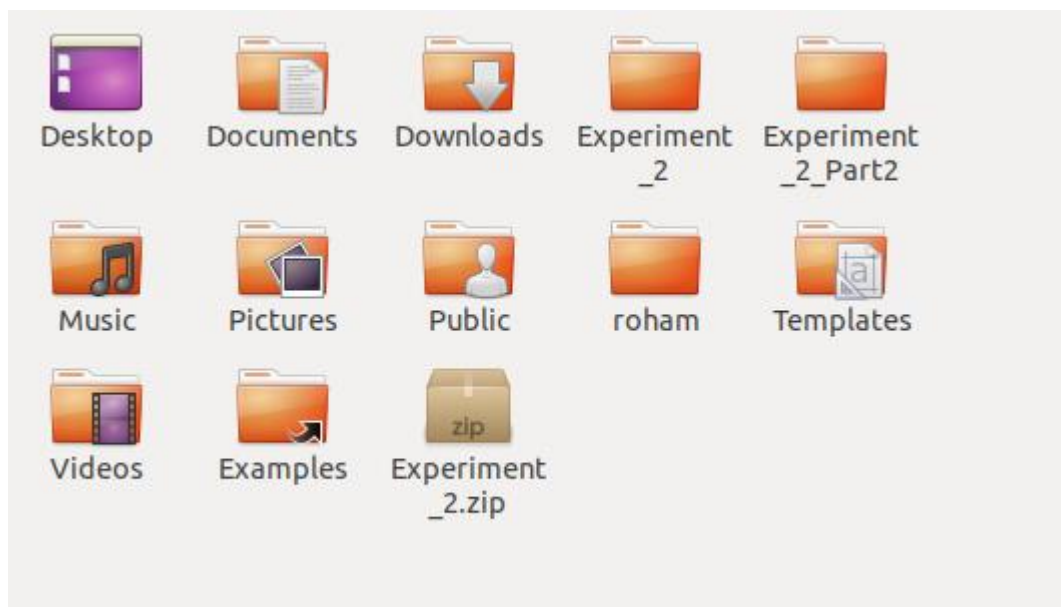


آزمایش 2

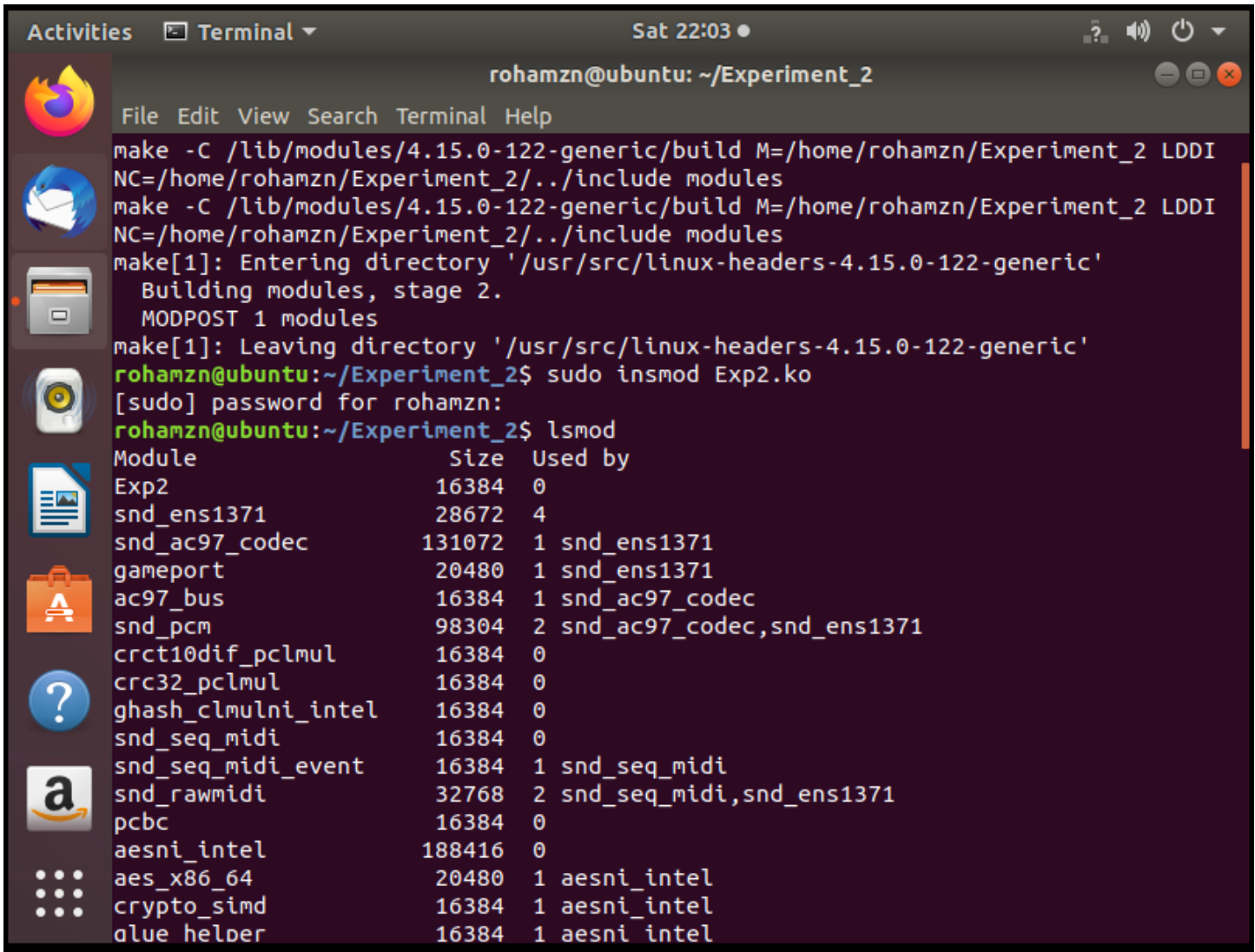
رهام زنده دل 9731088



قسمت اول پروژه در فایل Experiment_2 است و قسمت دوم در Experiment_2_Part2

```
Activities  Terminal  Sat 22:01  rohamzn@ubuntu: ~/Experiment_2
File Edit View Search Terminal Help
rohamzn@ubuntu:~/Experiment_2$ make
echo make -C /lib/modules/4.15.0-122-generic/build M=/home/rohamzn/Experiment_2
LDDINC=/home/rohamzn/Experiment_2/./include modules
make -C /lib/modules/4.15.0-122-generic/build M=/home/rohamzn/Experiment_2 LDDI
NC=/home/rohamzn/Experiment_2/./include modules
make -C /lib/modules/4.15.0-122-generic/build M=/home/rohamzn/Experiment_2 LDDI
NC=/home/rohamzn/Experiment_2/./include modules
make[1]: Entering directory '/usr/src/linux-headers-4.15.0-122-generic'
Building modules, stage 2.
MODPOST 1 modules
make[1]: Leaving directory '/usr/src/linux-headers-4.15.0-122-generic'
rohamzn@ubuntu:~/Experiment_2$ sudo insmod Exp2.ko
[sudo] password for rohamzn:
rohamzn@ubuntu:~/Experiment_2$
```

make و insmod برای قسمت اول به درستی کار می کند.



The image shows a terminal window titled "rohamzn@ubuntu: ~/Experiment_2". The window has a menu bar with "File", "Edit", "View", "Search", "Terminal", and "Help". The terminal output shows the following commands and their results:

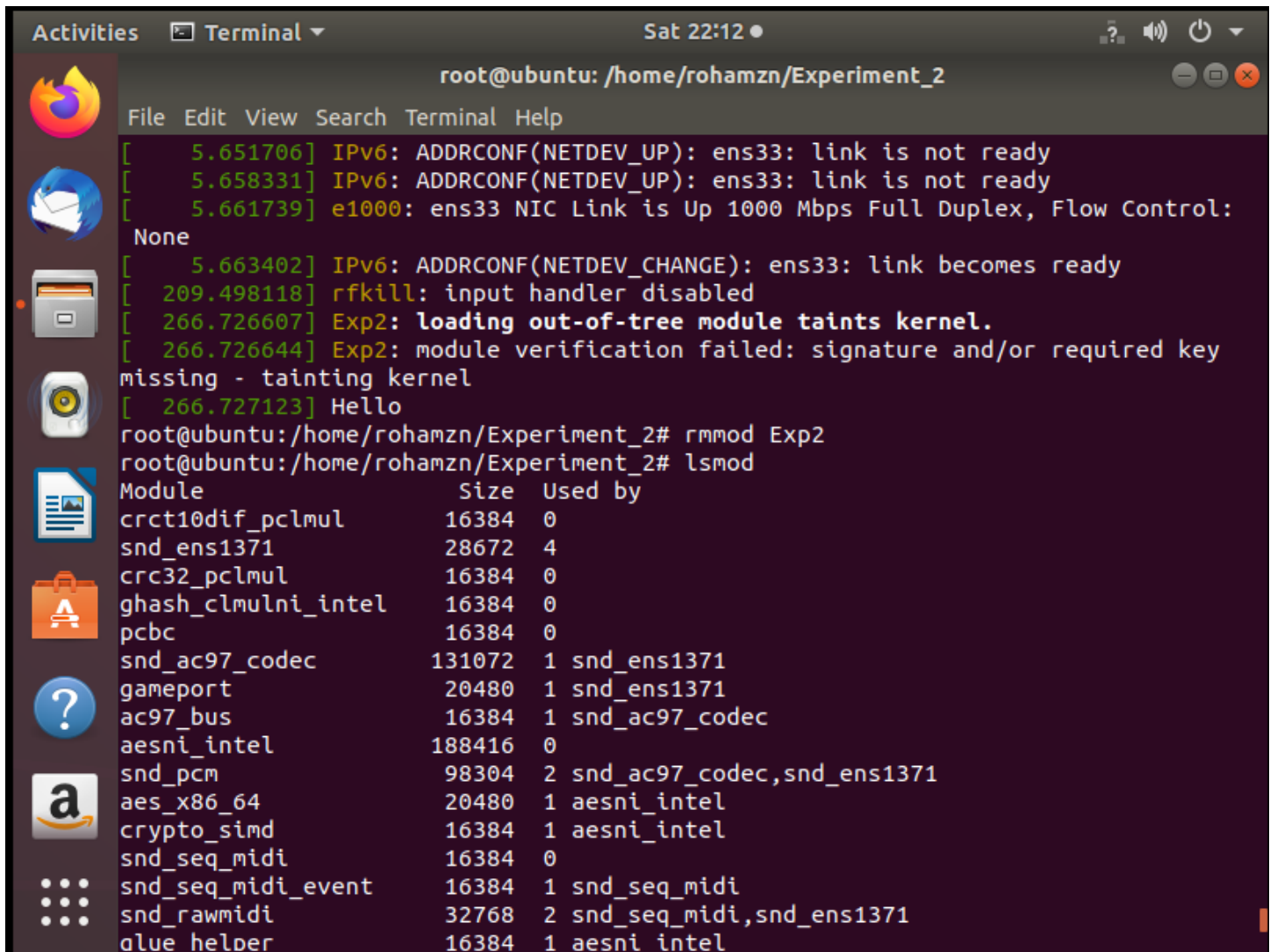
```
make -C /lib/modules/4.15.0-122-generic/build M=/home/rohamzn/Experiment_2 LDDI
NC=/home/rohamzn/Experiment_2/./include modules
make -C /lib/modules/4.15.0-122-generic/build M=/home/rohamzn/Experiment_2 LDDI
NC=/home/rohamzn/Experiment_2/./include modules
make[1]: Entering directory '/usr/src/linux-headers-4.15.0-122-generic'
Building modules, stage 2.
MODPOST 1 modules
make[1]: Leaving directory '/usr/src/linux-headers-4.15.0-122-generic'
rohamzn@ubuntu:~/Experiment_2$ sudo insmod Exp2.ko
[sudo] password for rohamzn:
rohamzn@ubuntu:~/Experiment_2$ lsmod
```

Module	Size	Used by
Exp2	16384	0
snd_ens1371	28672	4
snd_ac97_codec	131072	1 snd_ens1371
gameport	20480	1 snd_ens1371
ac97_bus	16384	1 snd_ac97_codec
snd_pcm	98304	2 snd_ac97_codec, snd_ens1371
crct10dif_pclmul	16384	0
crc32_pclmul	16384	0
ghash_clmulni_intel	16384	0
snd_seq_midi	16384	0
snd_seq_midi_event	16384	1 snd_seq_midi
snd_rawmidi	32768	2 snd_seq_midi, snd_ens1371
pcbc	16384	0
aesni_intel	188416	0
aes_x86_64	20480	1 aesni_intel
crypto_simd	16384	1 aesni_intel
alue helper	16384	1 aesni_intel

lsmod نیز به Exp2 را نشان می دهد.

```
Activities Terminal Sat 22:11
root@ubuntu: /home/rohamzn/Experiment_2
File Edit View Search Terminal Help
[ 4.494942] vmw_vmci 0000:00:07.7: Using capabilities 0xc
[ 4.495953] Guest personality initialized and is active
[ 4.495991] VMCI host device registered (name=vmci, major=10, minor=56)
[ 4.495992] Initialized host personality
[ 4.500721] NET: Registered protocol family 40
[ 4.709681] shpchp: Standard Hot Plug PCI Controller Driver version: 0.4
[ 4.833296] random: crng init done
[ 4.833297] random: 7 urandom warning(s) missed due to ratelimiting
[ 4.965180] RAPL PMU: API unit is 2^-32 Joules, 5 fixed counters, 1073741824
0 ms ovfl timer
[ 4.965182] RAPL PMU: hw unit of domain pp0-core 2^-0 Joules
[ 4.965182] RAPL PMU: hw unit of domain package 2^-0 Joules
[ 4.965183] RAPL PMU: hw unit of domain dram 2^-0 Joules
[ 4.965183] RAPL PMU: hw unit of domain pp1-gpu 2^-0 Joules
[ 4.965183] RAPL PMU: hw unit of domain psys 2^-0 Joules
[ 5.187789] AVX2 version of gcm_enc/dec engaged.
[ 5.187789] AES CTR mode by8 optimization enabled
[ 5.651706] IPv6: ADDRCONF(NETDEV_UP): ens33: link is not ready
[ 5.658331] IPv6: ADDRCONF(NETDEV_UP): ens33: link is not ready
[ 5.661739] e1000: ens33 NIC Link is Up 1000 Mbps Full Duplex, Flow Control:
None
[ 5.663402] IPv6: ADDRCONF(NETDEV_CHANGE): ens33: link becomes ready
[ 209.498118] rfkill: input handler disabled
[ 266.726607] Exp2: loading out-of-tree module taints kernel.
[ 266.726644] Exp2: module verification failed: signature and/or required key
missing - tainting kernel
[ 266.727123] Hello
root@ubuntu: /home/rohamzn/Experiment_2#
```

در dmesg نیز Hello به عنوان یک پیام از طرف Exp2 موقع load شدن فرستاده شده است.

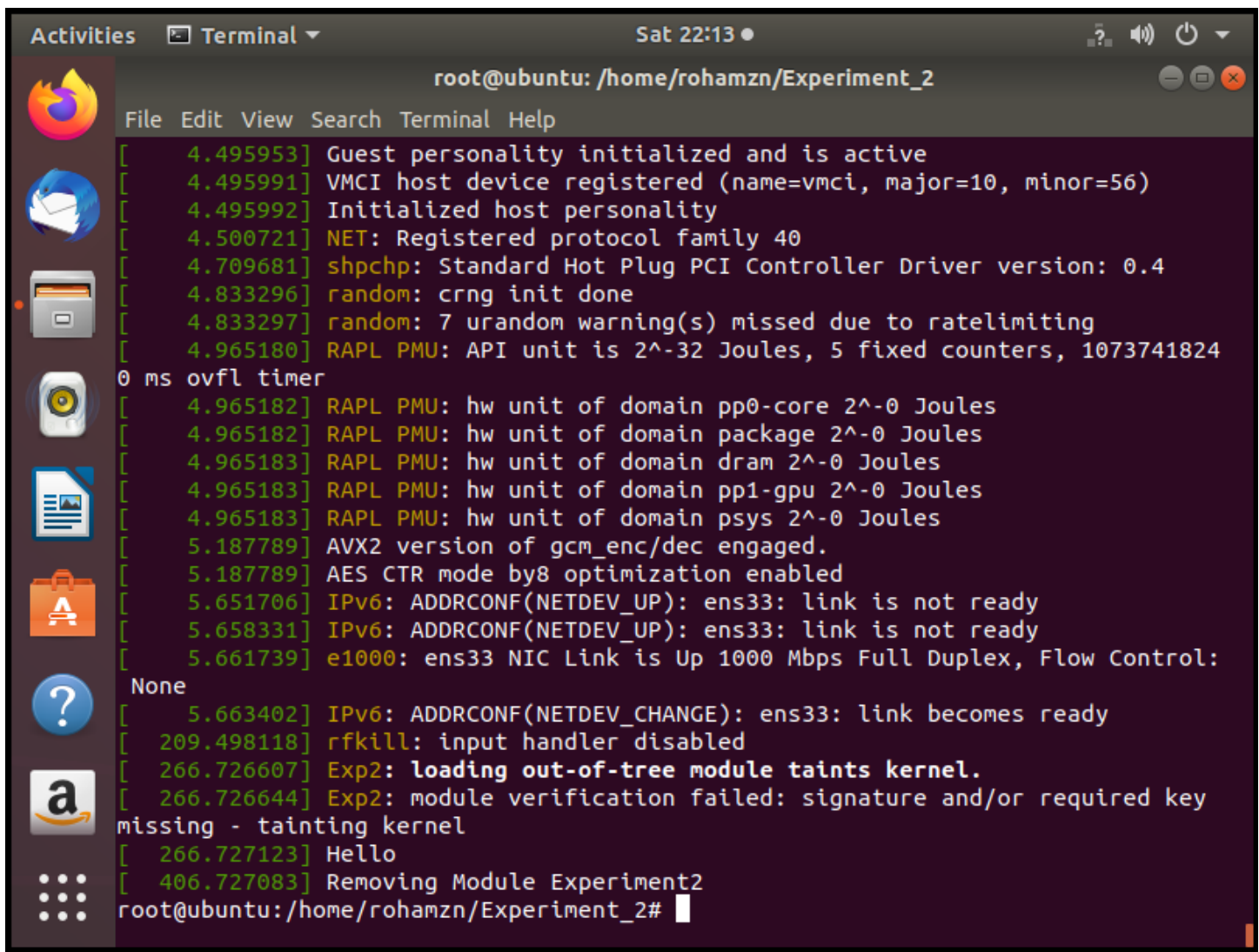


The screenshot shows a terminal window titled "Terminal" with the prompt "root@ubuntu: /home/rohamzn/Experiment_2". The terminal displays the following output:

```
[ 5.651706] IPv6: ADDRCONF(NETDEV_UP): ens33: link is not ready
[ 5.658331] IPv6: ADDRCONF(NETDEV_UP): ens33: link is not ready
[ 5.661739] e1000: ens33 NIC Link is Up 1000 Mbps Full Duplex, Flow Control:
None
[ 5.663402] IPv6: ADDRCONF(NETDEV_CHANGE): ens33: link becomes ready
[ 209.498118] rfkill: input handler disabled
[ 266.726607] Exp2: loading out-of-tree module taints kernel.
[ 266.726644] Exp2: module verification failed: signature and/or required key
missing - tainting kernel
[ 266.727123] Hello
root@ubuntu:/home/rohamzn/Experiment_2# rmmod Exp2
root@ubuntu:/home/rohamzn/Experiment_2# lsmod
```

Module	Size	Used by
crct10dif_pclmul	16384	0
snd_ens1371	28672	4
crc32_pclmul	16384	0
ghash_clmulni_intel	16384	0
pcbc	16384	0
snd_ac97_codec	131072	1 snd_ens1371
gameport	20480	1 snd_ens1371
ac97_bus	16384	1 snd_ac97_codec
aesni_intel	188416	0
snd_pcm	98304	2 snd_ac97_codec,snd_ens1371
aes_x86_64	20480	1 aesni_intel
crypto_simd	16384	1 aesni_intel
snd_seq_midi	16384	0
snd_seq_midi_event	16384	1 snd_seq_midi
snd_rawmidi	32768	2 snd_seq_midi,snd_ens1371
blue helper	16384	1 aesni intel

Exp2, rmmod را از لیست module های هسته حذف می کند.

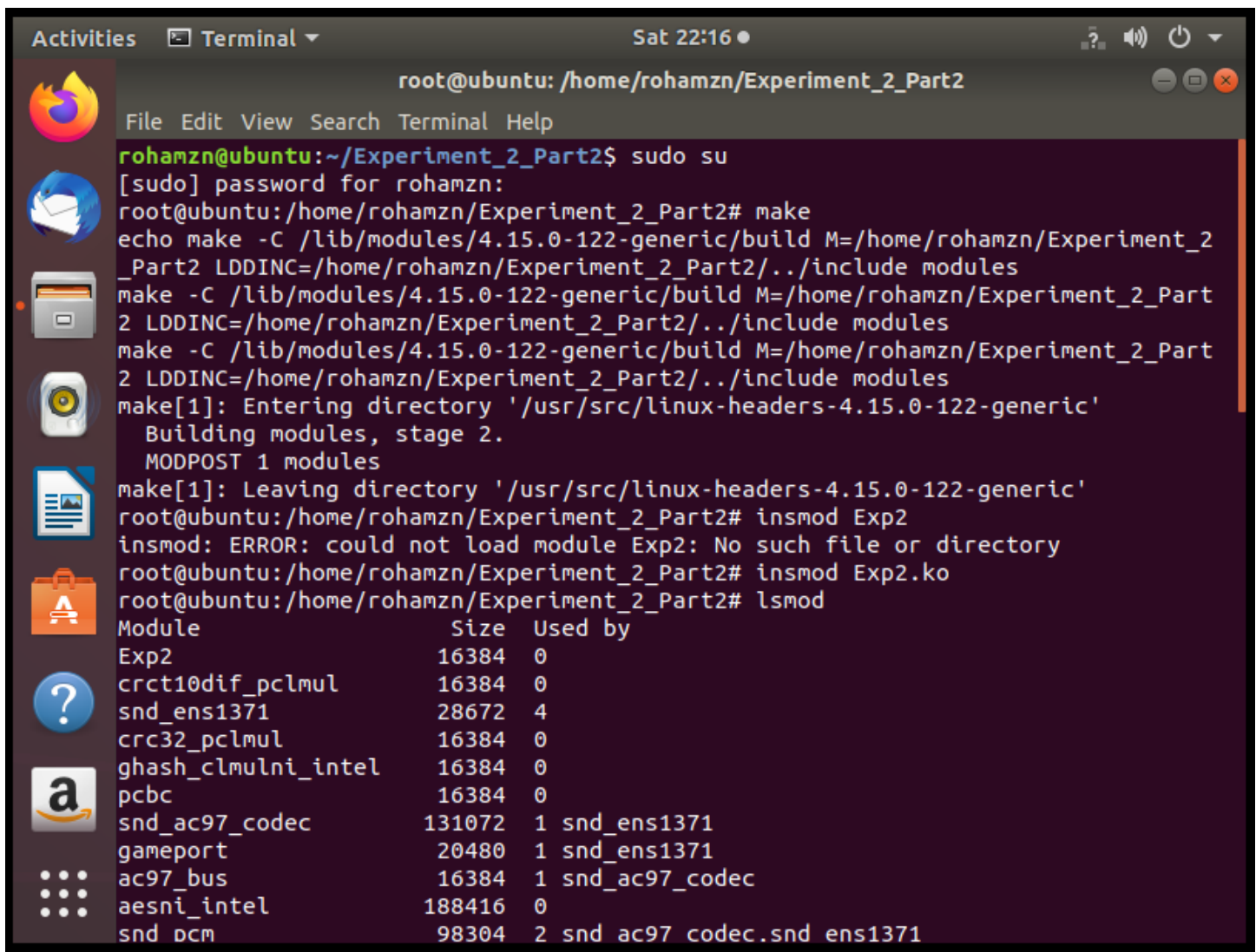


The image shows a terminal window titled "root@ubuntu: /home/rohamzn/Experiment_2". The window displays a series of kernel boot logs and system messages. The logs include timestamps in brackets followed by messages such as "Guest personality initialized and is active", "VMCI host device registered", "shpchp: Standard Hot Plug PCI Controller Driver version: 0.4", "random: crng init done", "RAPL PMU: API unit is 2^-32 Joules", "AVX2 version of gcm_enc/dec engaged", "AES CTR mode by8 optimization enabled", "IPv6: ADDRCONF(NETDEV_UP): ens33: link is not ready", "e1000: ens33 NIC Link is Up 1000 Mbps Full Duplex, Flow Control: None", "IPv6: ADDRCONF(NETDEV_CHANGE): ens33: link becomes ready", "rfkill: input handler disabled", "Exp2: loading out-of-tree module taints kernel.", "Exp2: module verification failed: signature and/or required key missing - tainting kernel", "Hello", and "Removing Module Experiment2". The terminal ends with the prompt "root@ubuntu:/home/rohamzn/Experiment_2#".

```
root@ubuntu: /home/rohamzn/Experiment_2
[ 4.495953] Guest personality initialized and is active
[ 4.495991] VMCI host device registered (name=vmci, major=10, minor=56)
[ 4.495992] Initialized host personality
[ 4.500721] NET: Registered protocol family 40
[ 4.709681] shpchp: Standard Hot Plug PCI Controller Driver version: 0.4
[ 4.833296] random: crng init done
[ 4.833297] random: 7 urandom warning(s) missed due to ratelimiting
[ 4.965180] RAPL PMU: API unit is 2^-32 Joules, 5 fixed counters, 1073741824
0 ms ovfl timer
[ 4.965182] RAPL PMU: hw unit of domain pp0-core 2^-0 Joules
[ 4.965182] RAPL PMU: hw unit of domain package 2^-0 Joules
[ 4.965183] RAPL PMU: hw unit of domain dram 2^-0 Joules
[ 4.965183] RAPL PMU: hw unit of domain pp1-gpu 2^-0 Joules
[ 4.965183] RAPL PMU: hw unit of domain psys 2^-0 Joules
[ 5.187789] AVX2 version of gcm_enc/dec engaged.
[ 5.187789] AES CTR mode by8 optimization enabled
[ 5.651706] IPv6: ADDRCONF(NETDEV_UP): ens33: link is not ready
[ 5.658331] IPv6: ADDRCONF(NETDEV_UP): ens33: link is not ready
[ 5.661739] e1000: ens33 NIC Link is Up 1000 Mbps Full Duplex, Flow Control:
None
[ 5.663402] IPv6: ADDRCONF(NETDEV_CHANGE): ens33: link becomes ready
[ 209.498118] rfkill: input handler disabled
[ 266.726607] Exp2: loading out-of-tree module taints kernel.
[ 266.726644] Exp2: module verification failed: signature and/or required key
missing - tainting kernel
[ 266.727123] Hello
[ 406.727083] Removing Module Experiment2
root@ubuntu:/home/rohamzn/Experiment_2#
```

در dmesg نیز پیام Removing Module Experiment2 که خودمان در کد داده ایم را می توان دید.

قسمت دوم



The image shows a terminal window titled "root@ubuntu: /home/rohamzn/Experiment_2_Part2". The user "rohamzn" runs "sudo su" to become root. Then, they run "make", which builds a kernel module "Exp2.ko". The output of "make" shows it entering the directory "/usr/src/linux-headers-4.15.0-122-generic" and building modules. After "make", the user runs "insmod Exp2", which fails with the error "ERROR: could not load module Exp2: No such file or directory". Then, they run "insmod Exp2.ko", which succeeds. Finally, they run "lsmod", which lists the loaded modules. The output of "lsmod" is as follows:

Module	Size	Used by
Exp2	16384	0
crct10dif_pclmul	16384	0
snd_ens1371	28672	4
crc32_pclmul	16384	0
ghash_clmulni_intel	16384	0
pcbc	16384	0
snd_ac97_codec	131072	1 snd_ens1371
gameport	20480	1 snd_ens1371
ac97_bus	16384	1 snd_ac97_codec
aesni_intel	188416	0
snd_pcm	98304	2 snd_ac97_codec.snd_ens1371

دوباره فرایند های make, insmod و lsmod را تکرار می کنیم(دقت شود که Exp2 در این آزمایش مربوط به قسمت دوم آزمایش در پوشه Experiment_2_Part2 است)

Activities Terminal Sun 00:11 rohamzn@ubuntu: ~/Experiment_2_Part2

```
File Edit View Search Terminal Help
[ 6.348262] audit: type=1400 audit(1604822989.740:11): apparmor="STATUS" operation="profile_load" profile="unconfined" name="libreoffice-xpdfimport" pid=550 comm="apparmor_parser"
[ 6.933690] RAPL PMU: API unit is 2^-32 Joules, 5 fixed counters, 1073741824 0 ms ovfl timer
[ 6.933691] RAPL PMU: hw unit of domain pp0-core 2^-0 Joules
[ 6.933691] RAPL PMU: hw unit of domain package 2^-0 Joules
[ 6.933692] RAPL PMU: hw unit of domain dram 2^-0 Joules
[ 6.933692] RAPL PMU: hw unit of domain pp1-gpu 2^-0 Joules
[ 6.933692] RAPL PMU: hw unit of domain psys 2^-0 Joules
[ 7.013053] AVX2 version of gcm_enc/dec engaged.
[ 7.013054] AES CTR mode by8 optimization enabled
[ 8.122035] IPv6: ADDRCONF(NETDEV_UP): ens33: link is not ready
[ 8.130707] IPv6: ADDRCONF(NETDEV_UP): ens33: link is not ready
[ 8.132166] e1000: ens33 NIC Link is Up 1000 Mbps Full Duplex, Flow Control: None
[ 8.133455] IPv6: ADDRCONF(NETDEV_CHANGE): ens33: link becomes ready
[ 23.767858] rfkill: input handler disabled
[ 101.317516] Exp2: loading out-of-tree module taints kernel.
[ 101.317550] Exp2: module verification failed: signature and/or required key missing - tainting kernel
[ 101.319700] Hello Boiii
[ 101.319701] Person0
[ 101.319701] Person1
[ 101.319701] Person2
[ 101.319701] Person3
[ 101.319702] Person4
rohamzn@ubuntu:~/Experiment_2_Part2$
```

دmesg، پیام load شدن را چاپ کرده و لیست را به درستی چاپ می کند.

```
Activities Terminal ▾ Sun 00:12 ●
rohamzn@ubuntu: ~/Experiment_2_Part2
File Edit View Search Terminal Help
[ 6.933691] RAPL PMU: hw unit of domain pp0-core 2^0 Joules
[ 6.933691] RAPL PMU: hw unit of domain package 2^0 Joules
[ 6.933692] RAPL PMU: hw unit of domain dram 2^0 Joules
[ 6.933692] RAPL PMU: hw unit of domain pp1-gpu 2^0 Joules
[ 6.933692] RAPL PMU: hw unit of domain psys 2^0 Joules
[ 7.013053] AVX2 version of gcm_enc/dec engaged.
[ 7.013054] AES CTR mode by8 optimization enabled
[ 8.122035] IPv6: ADDRCONF(NETDEV_UP): ens33: link is not ready
[ 8.130707] IPv6: ADDRCONF(NETDEV_UP): ens33: link is not ready
[ 8.132166] e1000: ens33 NIC Link is Up 1000 Mbps Full Duplex, Flow Control:
None
[ 8.133455] IPv6: ADDRCONF(NETDEV_CHANGE): ens33: link becomes ready
[ 23.767858] rfkill: input handler disabled
[ 101.317516] Exp2: loading out-of-tree module taints kernel.
[ 101.317550] Exp2: module verification failed: signature and/or required key
missing - tainting kernel
[ 101.319700] Hello Boiii
[ 101.319701] Person0
[ 101.319701] Person1
[ 101.319701] Person2
[ 101.319701] Person3
[ 101.319702] Person4
[ 182.948200] Removing Person0
[ 182.948202] Removing Person1
[ 182.948202] Removing Person2
[ 182.948202] Removing Person3
[ 182.948203] Removing Person4
rohamzn@ubuntu:~/Experiment_2_Part2$
```

موقع `rmmod` نیز `dmesg` لیست را چاپ کرده و `remove` می کند.

Activities Text Editor Sun 00:27

Exp2.c
~/Experiment_2_Part2

Open Save

```
int i;
struct birthday *ptr;
for (i = 0 ; i < 5; i++)
{
    struct birthday *person;
    person = kmalloc(sizeof(person), GFP_KERNEL);
    person->day = i;
    person->month = 8;
    person->year = 1995;
    INIT_LIST_HEAD(&person->list);
    list_add_tail(&person->list, &birthday_list);
}
printk(KERN_INFO "Hello Boiii\n");
list_for_each_entry(ptr, &birthday_list, list) {
    printk(KERN_INFO "Person%d\n", ptr->day);
}
return 0;
}

void simple_exit(void)
{
    struct birthday *ptr;
    list_for_each_entry(ptr, &birthday_list, list) {
        printk(KERN_INFO "Removing Person%d\n", ptr->day);
        kfree(ptr);
    }
}
```

C Tab Width: 8 Ln 42, Col 48 INS