به نام خدا

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```
rezaee_98411387@98411387:~$ cd /lib/modules
rezaee_98411387@98411387:/lib/modules$ lsmod
Module                   Size  Used by
cpuid                    16384  0
intel_powerclamp         16384  0
crct10dif_pclmul         16384  0
crc32_pclmul             16384  0
ghash_clmulni_intel      16384  0
snd_intel8x0             40960  2
snd_ac97_codec          131072  1 snd_intel8x0
ac97_bus                 16384  1 snd_ac97_codec
snd_pcm                  98304  2 snd_intel8x0,snd_ac97_codec
pcbc                     16384  0
snd_seq_midi             16384  0
snd_seq_midi_event       16384  1 snd_seq_midi
snd_rawmidi              32768  1 snd_seq_midi
aesni_intel             188416  0
aes_x86_64               20480  1 aesni_intel
crypto_simd              16384  1 aesni_intel
glue_helper              16384  1 aesni_intel
snd_seq                  65536  2 snd_seq_midi,snd_seq_midi_event
cryptd                   24576  3 crypto_simd,ghash_clmulni_intel,aesni_intel
input_leds               16384  0
snd_seq_device           16384  3 snd_seq,snd_seq_midi,snd_rawmidi
```

```c
#include <linux/init.h>
#include <linux/kernel.h>
#include <linux/module.h>

int simple_init(void)
{
        printk(KERN_INFO "Loading Module\n");
        return 0;
}

void simple_exit(void)
{
        printk(KERN_INFO "Removing Module\n");
}

module_init(simple_init);
module_exit(simple_exit);
MODULE_LICENSE("GPL");
MODULE_DESCRIPTION("simple module");
MODULE_AUTHOR("SGG");
```

```makefile
obj-m += hw11.o
all:
        make -C /lib/modules/$(shell uname -r)/build M=$(shell pwd) modules
clean:
        make -C /lib/modules/$(shell uname -r)/build M=$(shell pwd) clean
```

```
rezaee_98411387@98411387:/lib/modules$ sudo make
make -C /lib/modules/4.15.0-112-generic/build M=/lib/modules modules
make[1]: Entering directory '/usr/src/linux-headers-4.15.0-112-generic'
  CC [M]  /lib/modules/hw11.o
  Building modules, stage 2.
  MODPOST 1 modules
  CC      /lib/modules/hw11.mod.o
  LD [M]  /lib/modules/hw11.ko
make[1]: Leaving directory '/usr/src/linux-headers-4.15.0-112-generic'
```

```
rezaee_98411387@98411387:/lib/modules$ sudo make
make -C /lib/modules/4.15.0-112-generic/build M=/lib/modules modules
make[1]: Entering directory '/usr/src/linux-headers-4.15.0-112-generic'
  CC [M]  /lib/modules/hw11.o
  Building modules, stage 2.
  MODPOST 1 modules
  CC      /lib/modules/hw11.mod.o
  LD [M]  /lib/modules/hw11.ko
make[1]: Leaving directory '/usr/src/linux-headers-4.15.0-112-generic'
rezaee_98411387@98411387:/lib/modules$ sudo insmod hw11.ko
rezaee_98411387@98411387:/lib/modules$ dmesg
[    0.000000] Linux version 4.15.0-112-generic (buildd@lcy01-amd64-021) (gcc ve
rsion 5.4.0 20160609 (Ubuntu 5.4.0-6ubuntu1~16.04.12)) #113~16.04.1-Ubuntu SMP F
ri Jul 10 04:37:08 UTC 2020 (Ubuntu 4.15.0-112.113~16.04.1-generic 4.15.18)
[    0.000000] Command line: BOOT_IMAGE=/boot/vmlinuz-4.15.0-112-generic root=UU
ID=0c35cd9f-f208-4dc8-94d6-0d0e92625234 ro quiet splash
[    0.000000] KERNEL supported cpus:
[    0.000000]   Intel GenuineIntel
[    0.000000]   AMD AuthenticAMD
[    0.000000]   Centaur CentaurHauls
[    0.000000] x86/fpu: Supporting XSAVE feature 0x001: 'x87 floating point regi
sters'
[    0.000000] x86/fpu: Supporting XSAVE feature 0x002: 'SSE registers'
[    0.000000] x86/fpu: Supporting XSAVE feature 0x004: 'AVX registers'
```

```
rezaee_98411387@98411387:/lib/modules$ sudo rmmod hw11
rezaee_98411387@98411387:/lib/modules$ sudo dmesg -c
[    0.000000] Linux version 4.15.0-112-generic (buildd@lcy01-amd64-021) (gcc ve
rsion 5.4.0 20160609 (Ubuntu 5.4.0-6ubuntu1~16.04.12)) #113~16.04.1-Ubuntu SMP F
ri Jul 10 04:37:08 UTC 2020 (Ubuntu 4.15.0-112.113~16.04.1-generic 4.15.18)
[    0.000000] Command line: BOOT_IMAGE=/boot/vmlinuz-4.15.0-112-generic root=UU
ID=0c35cd9f-f208-4dc8-94d6-0d0e92625234 ro quiet splash
[    0.000000] KERNEL supported cpus:
[    0.000000]   Intel GenuineIntel
[    0.000000]   AMD AuthenticAMD
[    0.000000]   Centaur CentaurHauls
[    0.000000] x86/fpu: Supporting XSAVE feature 0x001: 'x87 floating point regi
sters'
[    0.000000] x86/fpu: Supporting XSAVE feature 0x002: 'SSE registers'
[    0.000000] x86/fpu: Supporting XSAVE feature 0x004: 'AVX registers'
[    0.000000] x86/fpu: xstate_offset[2]:  576, xstate_sizes[2]:  256
[    0.000000] x86/fpu: Enabled xstate features 0x7, context size is 832 bytes,
using 'standard' format.
[    0.000000] e820: BIOS-provided physical RAM map:
[    0.000000] BIOS-e820: [mem 0x0000000000000000-0x000000000009fbff] usable
[    0.000000] BIOS-e820: [mem 0x000000000009fc00-0x000000000009ffff] reserved
[    0.000000] BIOS-e820: [mem 0x00000000000f0000-0x00000000000fffff] reserved
```

```c
#include <linux/list.h>
#include <linux/kernel.h>
#include <linux/slab.h>
#include <linux/types.h>
#include <linux/module.h>
#include <linux/init.h>

#define BIRTHDAYS_NUM    5

struct birthday {
    int day;
    int month;
    int year;
    struct list_head list;
};

LIST_HEAD(birthday_list);

int load_birthdays(void){

    struct birthday *person;
    int i = 0;
    for(i = 0; i < BIRTHDAYS_NUM; i++){
        person = kmalloc(sizeof(*person), GFP_KERNEL);
        person->day = 2 + i;
        person->month = 7 + i;
        person->year = 1995 + i;
        INIT_LIST_HEAD(&person->list);
        list_add_tail(&person->list, &birthday_list);
    }


    list_for_each_entry(person, &birthday_list, list) {
        printk(KERN_INFO "Birthday: %d/%d/%d\n", person->month, person->day,
person->year);
    }
    return 0;
}

int simple_init(void) {
  printk(KERN_INFO "Loading Module\n");
  load_birthdays();
  return 0;
}
int remove_birthdays(void) {
  struct birthday *ptr, *next;
  list_for_each_entry_safe(ptr, next, &birthday_list, list) {
      printk(KERN_INFO "Removing Birthday: %d/%d/%d\n", ptr->month, ptr->day,
ptr->year);
      list_del(&ptr->list);
      kfree(ptr);
  }
  return 0;
}

void simple_exit(void) {
    printk(KERN_INFO "Removing module\n");
    remove_birthdays();
    printk(KERN_INFO "Freed memory\n");
}
```

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```
module_init(simple_init);
module_exit(simple_exit);

MODULE_LICENSE("GPL");
MODULE_DESCRIPTION("Simple Module");
MODULE_AUTHOR("SGG");
```

```
rezaee_98411387@98411387:/lib/modules$ sudo make
[sudo] password for rezaee_98411387:
make -C /lib/modules/4.15.0-142-generic/build M=/lib/modules modules
make[1]: Entering directory '/usr/src/linux-headers-4.15.0-142-generic'
  CC [M]  /lib/modules/hw11.o
  Building modules, stage 2.
  MODPOST 1 modules
  CC      /lib/modules/hw11.mod.o
  LD [M]  /lib/modules/hw11.ko
make[1]: Leaving directory '/usr/src/linux-headers-4.15.0-142-generic'
```

```
rezaee_98411387@98411387:/lib/modules$ sudo insmod hw11.ko
rezaee_98411387@98411387:/lib/modules$ sudo dmesg
[  383.150516] Loading Module
[  383.150518] Birthday: 7/2/1995
[  383.150518] Birthday: 8/3/1996
[  383.150519] Birthday: 9/4/1997
[  383.150519] Birthday: 10/5/1998
[  383.150520] Birthday: 11/6/1999
```

```
rezaee_98411387@98411387:/lib/modules$ sudo insmod hw11.ko
rezaee_98411387@98411387:/lib/modules$ sudo dmesg
[  383.150516] Loading Module
[  383.150518] Birthday: 7/2/1995
[  383.150518] Birthday: 8/3/1996
[  383.150519] Birthday: 9/4/1997
[  383.150519] Birthday: 10/5/1998
[  383.150520] Birthday: 11/6/1999
rezaee_98411387@98411387:/lib/modules$ sudo rmmod hw11
rezaee_98411387@98411387:/lib/modules$ sudo dmesg -c
[  383.150516] Loading Module
[  383.150518] Birthday: 7/2/1995
[  383.150518] Birthday: 8/3/1996
[  383.150519] Birthday: 9/4/1997
[  383.150519] Birthday: 10/5/1998
[  383.150520] Birthday: 11/6/1999
[  457.463429] Removing module
[  457.463430] Removing Birthday: 7/2/1995
[  457.463431] Removing Birthday: 8/3/1996
[  457.463431] Removing Birthday: 9/4/1997
[  457.463431] Removing Birthday: 10/5/1998
[  457.463432] Removing Birthday: 11/6/1999
[  457.463432] Freed memory
rezaee_98411387@98411387:/lib/modules$
```