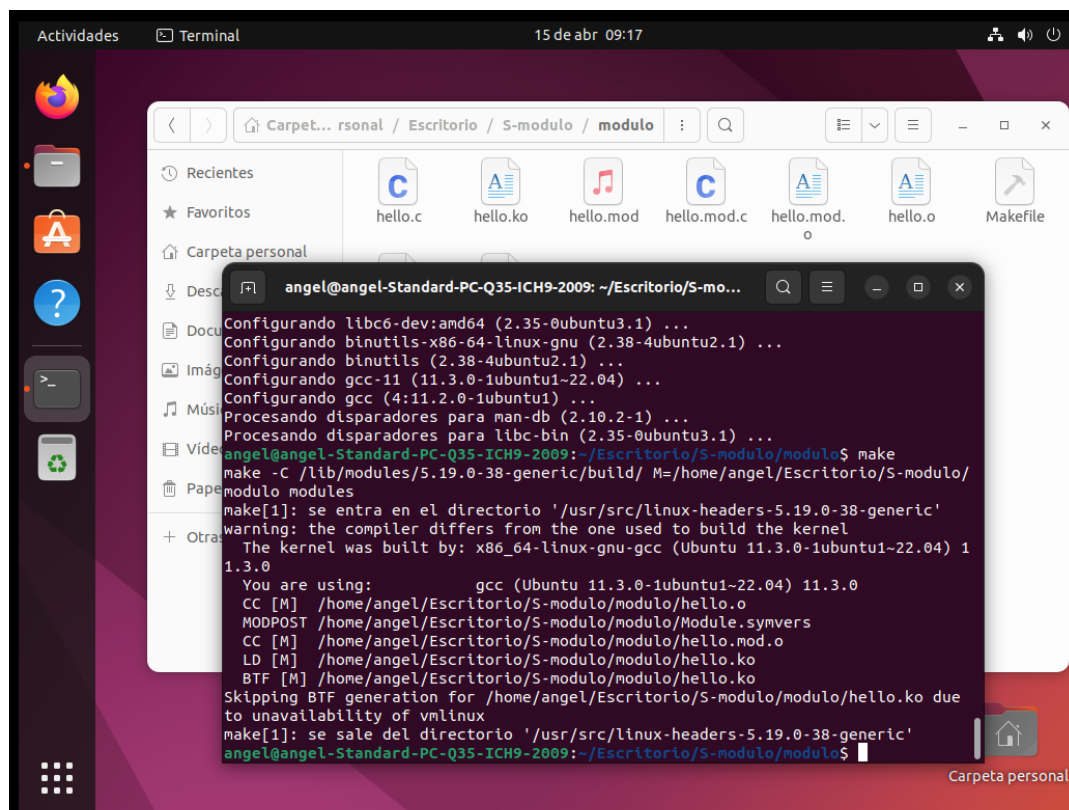
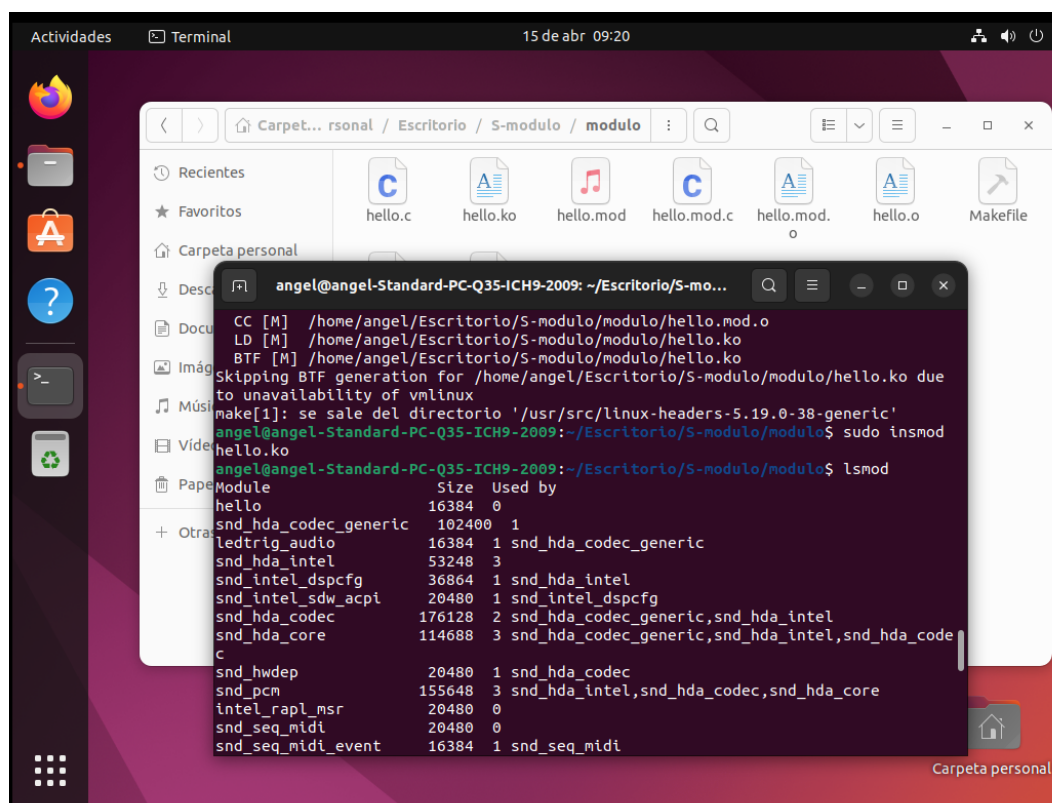


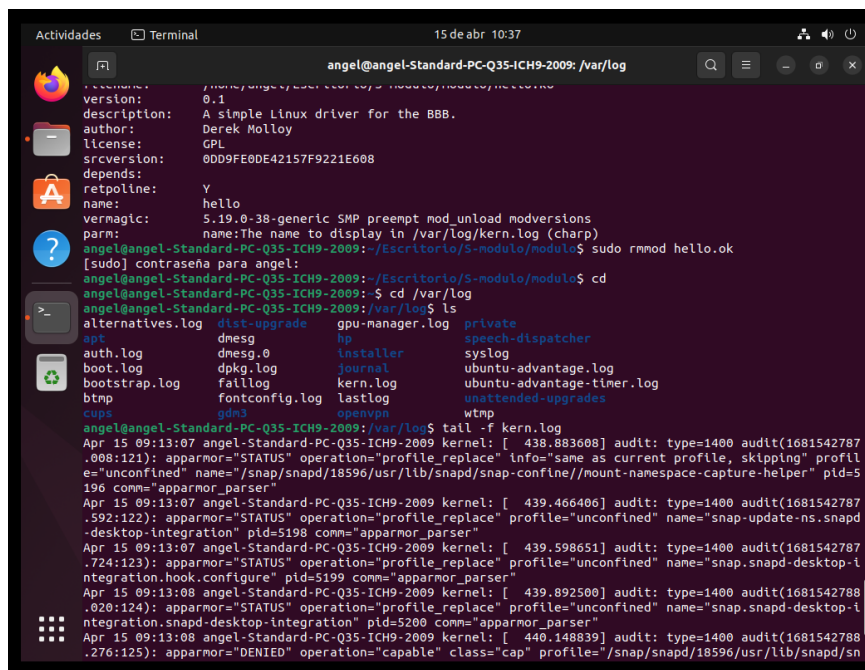
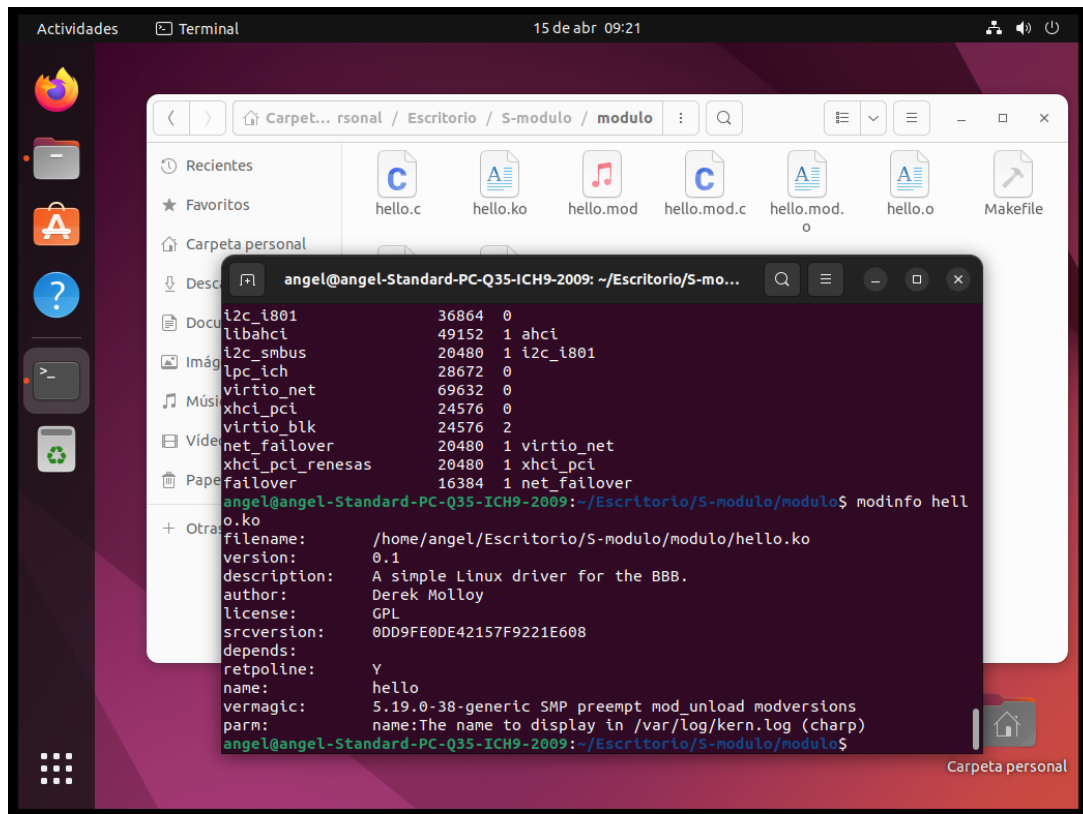
-Primero, realizamos el ejemplo descrito en el tutorial



```
angel@angel-Standard-PC-Q35-ICH9-2009: ~/Escritorio/S-modulo/modulo$ make
Configurando libc6-dev:amd64 (2.35-0ubuntu3.1) ...
Configurando binutils-x86-64-linux-gnu (2.38-4ubuntu2.1) ...
Configurando binutils (2.38-4ubuntu2.1) ...
Configurando gcc-11 (11.3.0-1ubuntu1~22.04) ...
Configurando gcc (4:11.2.0-1ubuntu1) ...
Procesando disparadores para man-db (2.10.2-1) ...
Procesando disparadores para libc-bin (2.35-0ubuntu3.1) ...
angel@angel-Standard-PC-Q35-ICH9-2009:~/Escritorio/S-modulo/modulo$ make
make -C /lib/modules/5.19.0-38-generic/build/ M=/home/angel/Escritorio/S-modulo/
modulo modules
make[1]: se entra en el directorio '/usr/src/linux-headers-5.19.0-38-generic'
warning: the compiler differs from the one used to build the kernel
The kernel was built by: x86_64-linux-gnu-gcc (Ubuntu 11.3.0-1ubuntu1~22.04) 1
1.3.0
You are using: gcc (Ubuntu 11.3.0-1ubuntu1~22.04) 11.3.0
CC [M] /home/angel/Escritorio/S-modulo/modulo/hello.o
MODPOST /home/angel/Escritorio/S-modulo/modulo/Module.symvers
CC [M] /home/angel/Escritorio/S-modulo/modulo/hello.mod.o
LD [M] /home/angel/Escritorio/S-modulo/modulo/hello.ko
BTF [M] /home/angel/Escritorio/S-modulo/modulo/hello.ko
Skipping BTF generation for /home/angel/Escritorio/S-modulo/modulo/hello.ko due
to unavailability of vmlinux
make[1]: se sale del directorio '/usr/src/linux-headers-5.19.0-38-generic'
angel@angel-Standard-PC-Q35-ICH9-2009:~/Escritorio/S-modulo/modulo$
```



```
angel@angel-Standard-PC-Q35-ICH9-2009:~/Escritorio/S-modulo/modulo$ sudo insmod
hello.ko
angel@angel-Standard-PC-Q35-ICH9-2009:~/Escritorio/S-modulo/modulo$ lsmod
Module                  Size  Used by
hello                   16384  0
snd_hda_codec_generic   102400  1
ledtrig_audio           16384  1 snd_hda_codec_generic
snd_hda_intel            53248  3
snd_intel_dspcfg         36864  1 snd_hda_intel
snd_intel_sdw_acpi       20480  1 snd_intel_dspcfg
snd_hda_codec           176128  2 snd_hda_codec_generic,snd_hda_intel
snd_hda_core            114688  3 snd_hda_codec_generic,snd_hda_intel,snd_hda_code
c
snd_hwdep               20480  1 snd_hda_codec
snd_pcm                 155648  3 snd_hda_intel,snd_hda_codec,snd_hda_core
intel_rapl_msrm         20480  0
snd_seq_midi             20480  0
snd_seq_midi_event      16384  1 snd_seq_midi
```

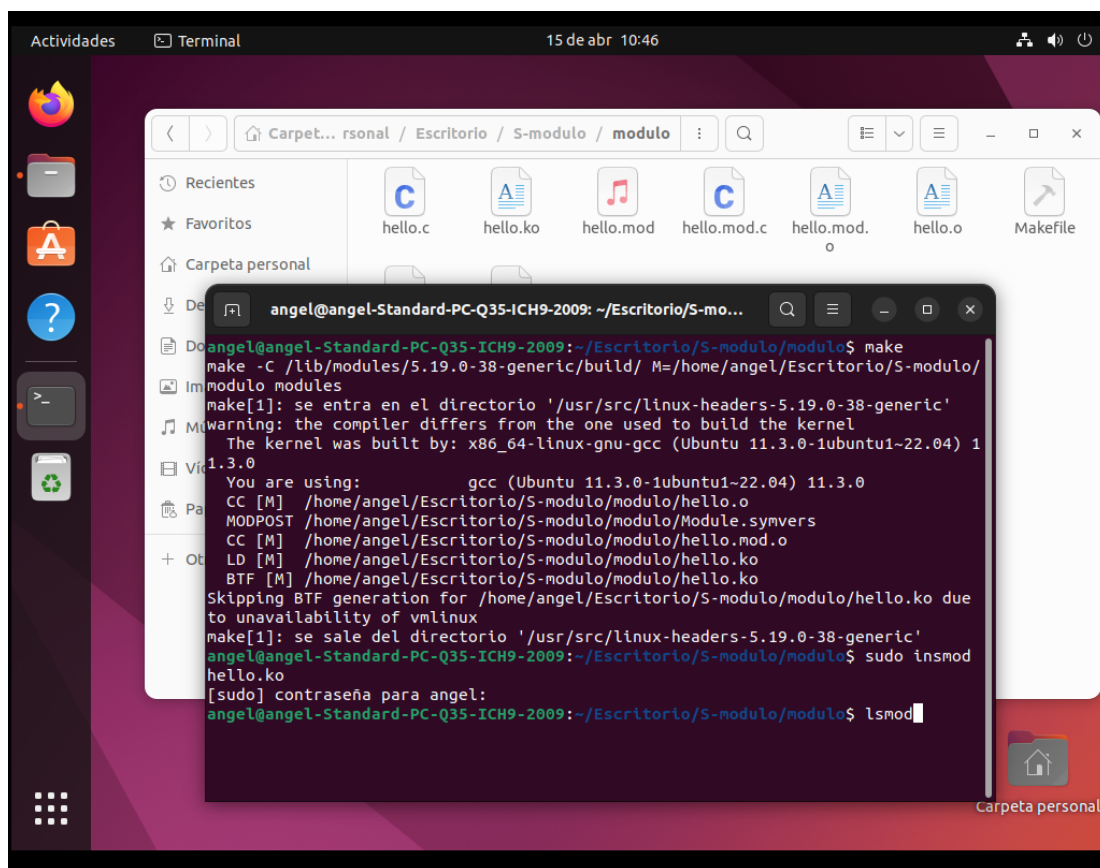
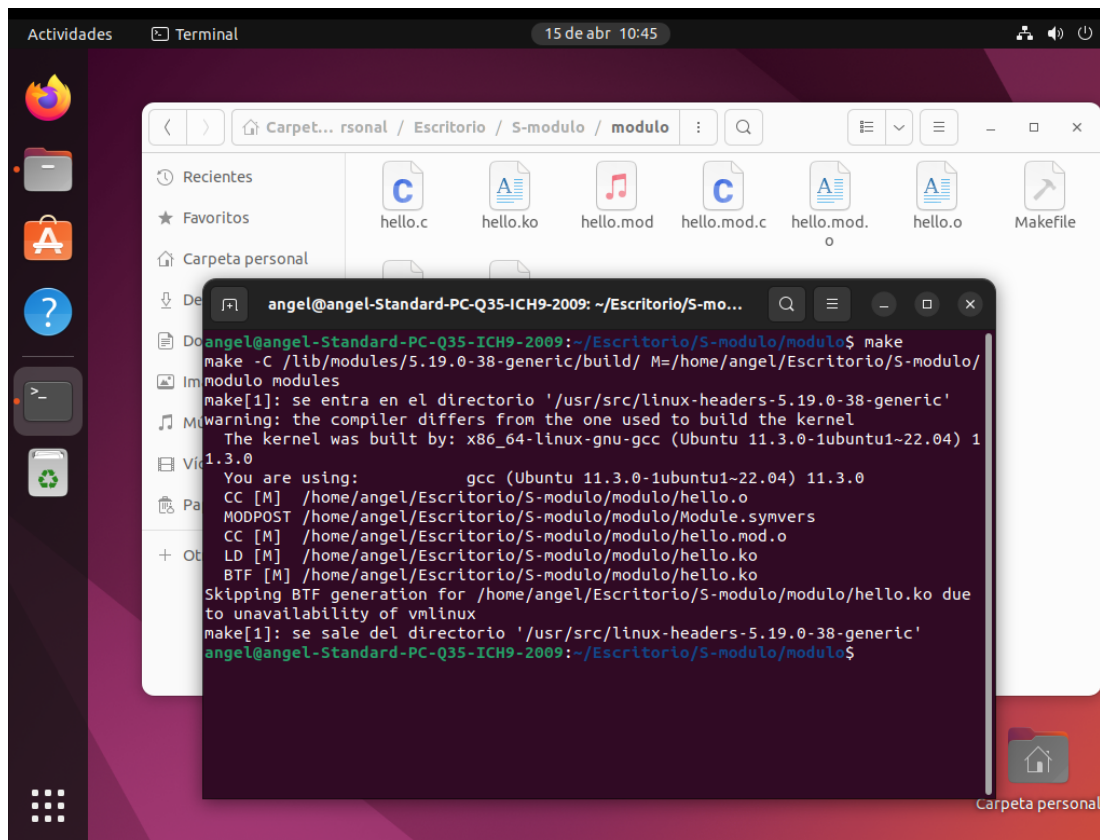


```
Actividades Terminal 15 de abr 10:36
angel@angel-Standard-PC-Q35-ICH9-2009: /var/log$ ls
alternatives.log  dmesg      gpu-manager.log  private
apt               dmesg.0    hp               speech-dispatcher
auth.log          dpkg.log   installer        syslog
boot.log          faillog    journal          ubuntu-advantage.log
bootstrap.log     fontconfig.log  lastlog         ubuntu-advantage-timer.log
btm               gdm3       openvpn          unattended-upgrades
cups              gdm3       openvpn          wtmp

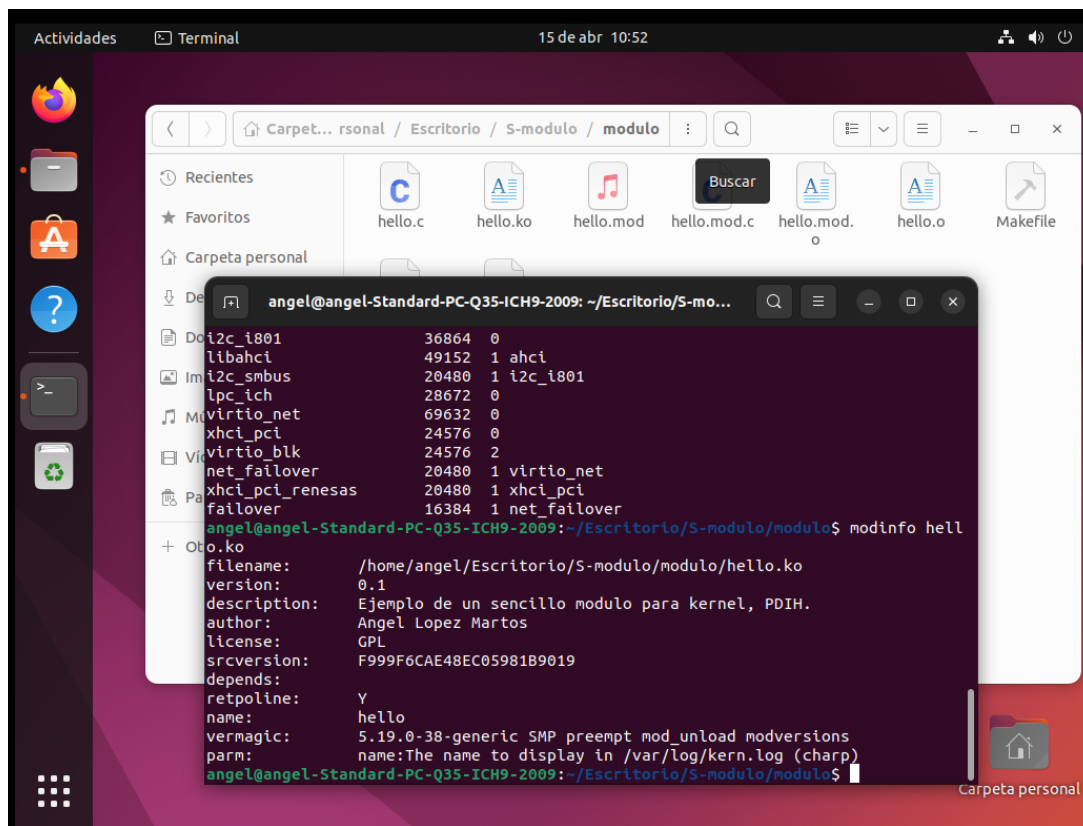
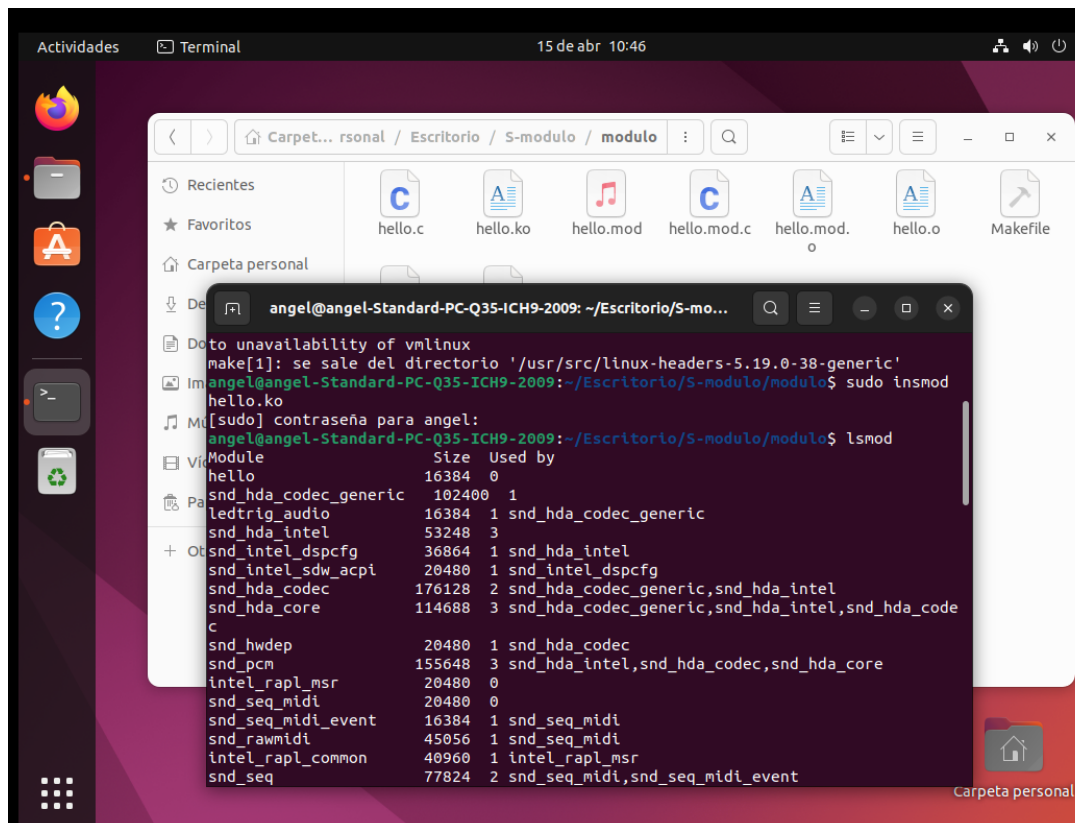
angel@angel-Standard-PC-Q35-ICH9-2009: /var/log$ tail -f kern.log
Apr 15 09:13:07 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 438.883608] audit: type=1400 audit(1681542787.008:121): apparmor="STATUS" operation="profile_replace" info="same as current profile, skipping" profile="unconfined" name="/snap/snapd/18596/usr/lib/snapd/snap-confine/mount-namespaces-capture-helper" pid=5196 comm="apparmor_parser"
Apr 15 09:13:07 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 439.466406] audit: type=1400 audit(1681542787.592:122): apparmor="STATUS" operation="profile_replace" profile="unconfined" name="snap-update-ns.snapd-desktop-integration" pid=5198 comm="apparmor_parser"
Apr 15 09:13:07 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 439.598651] audit: type=1400 audit(1681542787.724:123): apparmor="STATUS" operation="profile_replace" profile="unconfined" name="snap.snapd-desktop-integration.hook.configure" pid=5199 comm="apparmor_parser"
Apr 15 09:13:08 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 439.892500] audit: type=1400 audit(1681542788.020:124): apparmor="STATUS" operation="profile_replace" profile="unconfined" name="snap.snapd-desktop-integration.snapd-desktop-integration" pid=5200 comm="apparmor_parser"
Apr 15 09:13:08 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 440.148839] audit: type=1400 audit(1681542788.276:125): apparmor="DENIED" operation="capable" class="cap" profile="/snap/snapd/18596/usr/lib/snapd/snap-confine" pid=5216 comm="snap-confine" capability=12 capname="net_admin"
Apr 15 09:13:09 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 440.930182] audit: type=1326 audit(1681542789.056:126): audit=1000 uid=1000 ses=3 subj=snap.snapd-desktop-integration.snapd-desktop-integration pid=5387 comm="snapd-desktop-i" exe="/snap/snapd-desktop-integration/57/usr/bin/snapd-desktop-integration" sig=0 arch=c000003e syscall=314 compat=0 ip=0x7f0f93e6da3d code=0x50000
Apr 15 09:20:15 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 867.266507] hello: loading out-of-tree module taints kernel.
Apr 15 09:20:15 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 867.266532] hello: module verification failed: signature and/or required key missing - tainting kernel
Apr 15 09:20:15 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 867.266689] EBB: Hello world from the BBB LKM!
Apr 15 10:36:07 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 5419.451512] EBB: Goodbye world from the BBB LKM!
```

A continuación, realizamos cambios en el LKM base

```
Actividades Editor de textos 15 de abr 10:44
hello.c
~/Escritorio/S/modulo/modulo Guardar
15
16 MODULE_LICENSE("GPL");          ///< The license type -- this affects runtime behavior
17 MODULE_AUTHOR("Angel Lopez Martos"); ///< The author -- visible when you use modinfo
18 MODULE_DESCRIPTION("Ejemplo de un sencillo modulo para kernel, PDIH."); ///< The description -- see modinfo
19 MODULE_VERSION("0.1");          ///< The version of the module
20
21 static char *name = "a todos";    ///< An example LKM argument -- default value is "world"
22 static char *name2 = "proxima";
23 module_param(name, charp, S_IRUGO); ///< Param desc. charp = char ptr, S_IRUGO can be read/not changed
24 MODULE_PARM_DESC(name, "The name to display in /var/log/kern.log"); ///< parameter description
25
26 /** @brief The LKM initialization function
27 * The static keyword restricts the visibility of the function to within this C file. The __init
28 * macro means that for a built-in driver (not a LKM) the function is only used at initialization
29 * time and that it can be discarded and its memory freed up after that point.
30 * @return returns 0 if successful
31 */
32 static int __init helloBBB_init(void){
33     printk(KERN_INFO "EBB: Hola %s , aqui BBB LKM!\n", name);
34     return 0;
35 }
36
37 /** @brief The LKM cleanup function
38 * Similar to the initialization function, it is static. The __exit macro notifies that if this
39 * code is used for a built-in driver (not a LKM) that this function is not required.
40 */
41 static void __exit helloBBB_exit(void){
42     printk(KERN_INFO "EBB: Hasta la %s , aqui BBB LKM!\n", name2);
43 }
44
45 /** @brief A module must use the module_init() module_exit() macros from linux/init.h, which
46 * identify the initialization function at insertion time and the cleanup function (as
47 * listed above)
48 */
49 module_init(helloBBB_init);
50 module_exit(helloBBB_exit);
```







Actividades Terminal 15 de abr 10:53

angel@angel-Standard-PC-Q35-ICH9-2009: /var/log

```
angel@angel-Standard-PC-Q35-ICH9-2009:~/Escritorio/S-modulo/modulo$ sudo rmmod hello.ko
angel@angel-Standard-PC-Q35-ICH9-2009:~/Escritorio/S-modulo/modulo$ cd
angel@angel-Standard-PC-Q35-ICH9-2009:~$ ls
Descargas Documentos Escritorio Imágenes Música Plantillas Público snap Videos
angel@angel-Standard-PC-Q35-ICH9-2009:~$ cd /var/log
angel@angel-Standard-PC-Q35-ICH9-2009:/var/log$ ls
alternatives.log  cups          fontconfig.log  kern.log        ubuntu-advantage.log
apt               dist-upgrade  gdm3            lastlog         ubuntu-advantage-timer.log
auth.log          dmesg         gpu-manager.log  openvpn         unattended-upgrades
boot.log          dmesg.0       hp              private         wtmp
bootstrap.log     dpkg.log      installer       speech-dispatcher
btmtp             faillog       journal         syslog
angel@angel-Standard-PC-Q35-ICH9-2009:/var/log$ tail -f kern.log
Apr 15 09:13:07 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 439.598651] audit: type=1400 audit(1681542787.724:123): apparmor="STATUS" operation="profile_replace" profile="unconfined" name="snap.snapd-desktop-integration.hook.configure" pid=5199 comm="apparmor_parser"
Apr 15 09:13:08 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 439.892500] audit: type=1400 audit(1681542788.020:124): apparmor="STATUS" operation="profile_replace" profile="unconfined" name="snap.snapd-desktop-integration.hook.configure" pid=5200 comm="apparmor_parser"
Apr 15 09:13:08 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 440.148839] audit: type=1400 audit(1681542788.276:125): apparmor="DENIED" operation="capable" class="cap" profile="/snap/snapd/18596/usr/lib/snapd/snap-confine" pid=5216 comm="snap-confine" capability=12 capname="net_admin"
Apr 15 09:13:09 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 440.930182] audit: type=1326 audit(1681542789.056:126): auid=1000 uid=1000 gid=1000 ses=3 subj=snap.snapd-desktop-integration.snapd-desktop-integration pid=5387 comm="snapd-desktop-i" exe="/snap/snapd-desktop-integration/57/usr/bin/snapd-desktop-integration" sig=0 arch=c000003e syscall=314 compat=0 ip=0x7f0f93e6da3d code=0x50000
Apr 15 09:20:15 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 867.266507] hello: loading out-of-tree module taints kernel.
Apr 15 09:20:15 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 867.266532] hello: module verification failed : signature and/or required key missing - tainting kernel
Apr 15 09:20:15 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 867.266689] EBB: Hello world from the BBB LKM!
Apr 15 10:36:07 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 5419.451512] EBB: Goodbye world from the BBB LKM!
Apr 15 10:46:25 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 6037.663624] EBB: Hola a todos , aqui BBB LKM!
Apr 15 10:52:20 angel-Standard-PC-Q35-ICH9-2009 kernel: [ 6392.351498] EBB: Hasta la proxima , aqui BBB LKM!
```