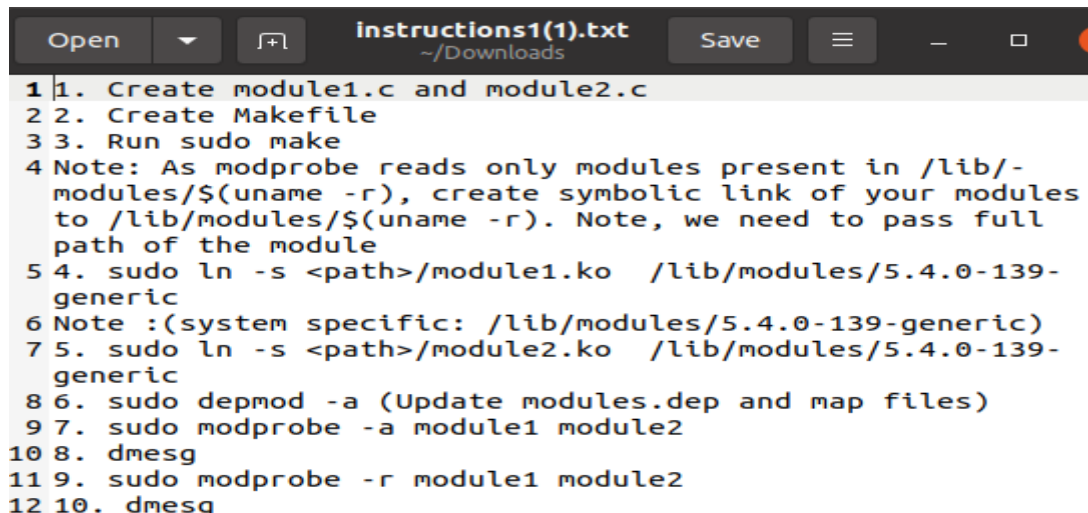# DEVICE DRIVERS LAB 6

DONE BY:
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CS20B1057

1)

Make File

```
1 obj-m := module1.o
2 obj-m += module2.o
3
4 all:
5        make -C /lib/modules/$(shell uname -r)/build M=$(shell pwd) modules
6 clean:
7        make -C /lib/modules/$(shell uname -r)/build M=$(shell pwd) clean
```
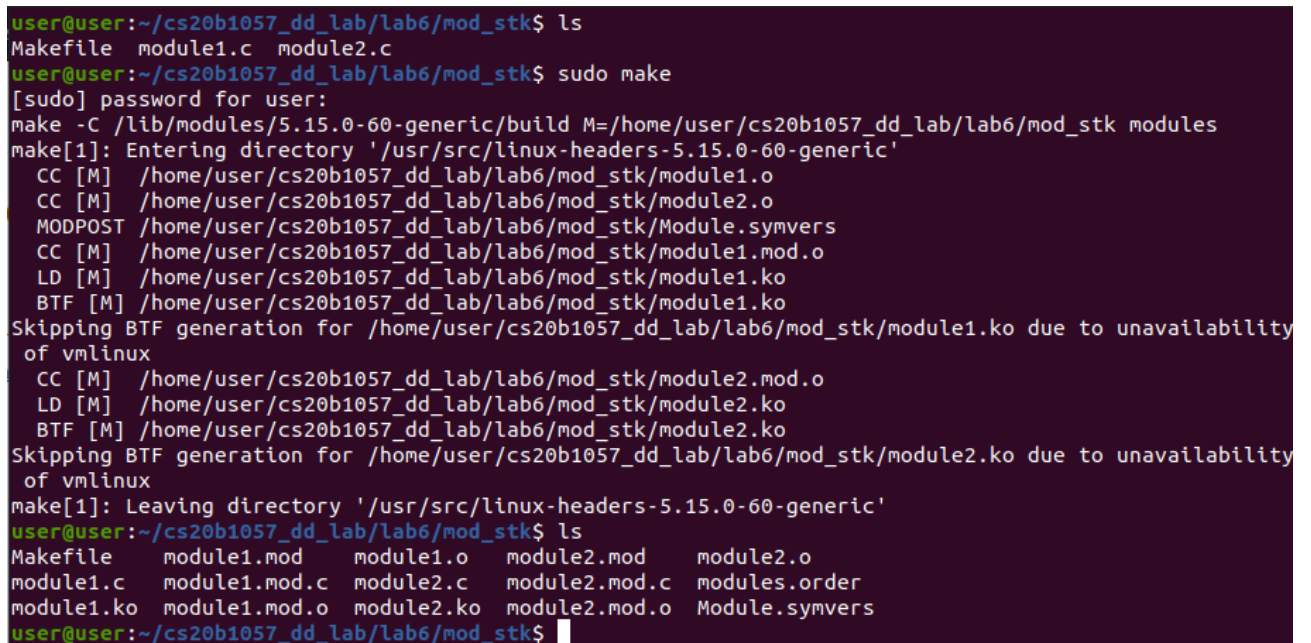
Program Instructions

```
instructions1(1).txt
~/Downloads

1 1. Create module1.c and module2.c
2 2. Create Makefile
3 3. Run sudo make
4 Note: As modprobe reads only modules present in /lib/-
  modules/$(uname -r), create symbolic link of your modules
  to /lib/modules/$(uname -r). Note, we need to pass full
  path of the module
5 4. sudo ln -s <path>/module1.ko  /lib/modules/5.4.0-139-
  generic
6 Note :(system specific: /lib/modules/5.4.0-139-generic)
7 5. sudo ln -s <path>/module2.ko  /lib/modules/5.4.0-139-
  generic
8 6. sudo depmod -a (Update modules.dep and map files)
9 7. sudo modprobe -a module1 module2
10 8. dmesg
11 9. sudo modprobe -r module1 module2
12 10. dmesg
```

Running sudo make

```
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$ ls
Makefile  module1.c  module2.c
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$ sudo make
[sudo] password for user:
make -C /lib/modules/5.15.0-60-generic/build M=/home/user/cs20b1057_dd_lab/lab6/mod_stk modules
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-60-generic'
  CC [M]  /home/user/cs20b1057_dd_lab/lab6/mod_stk/module1.o
  CC [M]  /home/user/cs20b1057_dd_lab/lab6/mod_stk/module2.o
  MODPOST /home/user/cs20b1057_dd_lab/lab6/mod_stk/Module.symvers
  CC [M]  /home/user/cs20b1057_dd_lab/lab6/mod_stk/module1.mod.o
  LD [M]  /home/user/cs20b1057_dd_lab/lab6/mod_stk/module1.ko
  BTF [M] /home/user/cs20b1057_dd_lab/lab6/mod_stk/module1.ko
Skipping BTF generation for /home/user/cs20b1057_dd_lab/lab6/mod_stk/module1.ko due to unavailability
 of vmlinux
  CC [M]  /home/user/cs20b1057_dd_lab/lab6/mod_stk/module2.mod.o
  LD [M]  /home/user/cs20b1057_dd_lab/lab6/mod_stk/module2.ko
  BTF [M] /home/user/cs20b1057_dd_lab/lab6/mod_stk/module2.ko
Skipping BTF generation for /home/user/cs20b1057_dd_lab/lab6/mod_stk/module2.ko due to unavailability
 of vmlinux
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-60-generic'
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$ ls
Makefile     module1.mod     module1.o    module2.mod     module2.o
module1.c    module1.mod.c   module2.c    module2.mod.c   modules.order
module1.ko   module1.mod.o   module2.ko   module2.mod.o   Module.symvers
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$
```

Using command : sudo ln -s <path>/module1.ko /lib/modules/5.15.0-60-generic
(NOTE : I used 5.15.0-60-generic module)

I used
sudo ln -s $(pwd)/module1.ko /lib/modules/$(uname -r)
sudo ln -s $(pwd)/module2.ko /lib/modules/$(uname -r)

```
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$ sudo ln -s $(pwd)/module1.ko /lib/mod
ules/$(uname -r)
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$ sudo ln -s $(pwd)/module2.ko /lib/mod
ules/$(uname -r)
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$
```

sudo depmod -a (Update modules.dep and map files)

sudo modprobe -a module1 module2

```
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$ sudo depmod -a
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$ sudo modprobe -a module1 module2
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$ sudo modprobe -a module1 module2
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$ dmesg
[    0.000000] microcode: microcode updated early to revision 0x54, date = 2022-
03-17
```

dmesg

```
[ 4288.397419] module1_init: In init
[ 4288.397999] module2_init: In init
[ 4288.398003] myadd: Adding 3 with 5      Result:8
[ 4288.398006] module2_init: Add:8
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$
```

sudo modprobe -r module1 module2
(NOTE : Since module2 is using module1 ,if we try to remove module1 first
we get an error. Hence we need to remove module2 first)

Trying to remove module1 (Got an error)

```
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$ sudo modprobe -r module1 module2
modprobe: FATAL: Module module1 is in use.
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$
```

Removing module2 first (We dont get any error)

```
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$ sudo modprobe -r module2 module1
user@user:~/cs20b1057_dd_lab/lab6/mod_stk$
```

dmesg

```
[ 4288.397419] module1_init: In init
[ 4288.397999] module2_init: In init
[ 4288.398003] myadd: Adding 3 with 5     Result:8
[ 4288.398006] module2_init: Add:8
[ 4827.467486] module2_exit: In exit
[ 4827.496363] module1_exit: In exit
user@user:~/CS20b105/_dd_lab/Lab6/mod_stk$
```

Part-b

2) Symbol

Make File

```
1 obj-m := symbol.o
2
3 all:
4        make -C /lib/modules/$(shell uname -r)/
  build M=$(shell pwd) modules
5 clean:
6        make -C /lib/modules/$(shell uname -r)/
  build M=$(shell pwd) clean
```

Program instruction-2

```
1  cat /proc/kallsyms |grep module1 (To view
   symbols of dynamically loaded modules as well as
   builtin modules)
2  2. To view symbols of builtin modules-  cat /
   boot/System.map<version> |grep <builtin
   modulename>
3  3. create symbol.c
4  4. create Makefile
5  5. Insert module
6  6. cat /proc/kallsyms |grep print_jiffies
7 S
```

symbol.c

```
#include <linux/kernel.h>
#include <linux/module.h>
#include <linux/jiffies.h>

MODULE_LICENSE("GPL");

void print_jiffies(void)
{
   printk(KERN_INFO"%s: Jiffies:%ld\n",__func__, jiffies);
}

static int test_export_init(void)
{
   printk(KERN_INFO"%s: In init\n", __func__);
```

```
    return 0;
}

static void test_export_exit(void)
{
    printk(KERN_INFO"%s: In exit\n", __func__);
}

EXPORT_SYMBOL_GPL(print_jiffies);

module_init(test_export_init);
module_exit(test_export_exit);
```

cat /proc/kallsyms |grep module1 (To view symbols of dynamically loaded modules as well as builtin modules)

(Note : Here we used the builtin module "video")
Command used :~ cat /proc/kallsyms |grep video

Running make command

```
user@user:~/cs20b1057_dd_lab/lab6/sym_table$ make
make -C /lib/modules/5.15.0-67-generic/build M=/home/user/cs20b1057_dd_lab/lab6/
sym_table modules
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-67-generic'
  CC [M]  /home/user/cs20b1057_dd_lab/lab6/sym_table/symbol.o
  MODPOST /home/user/cs20b1057_dd_lab/lab6/sym_table/Module.symvers
  CC [M]  /home/user/cs20b1057_dd_lab/lab6/sym_table/symbol.mod.o
  LD [M]  /home/user/cs20b1057_dd_lab/lab6/sym_table/symbol.ko
  BTF [M] /home/user/cs20b1057_dd_lab/lab6/sym_table/symbol.ko
Skipping BTF generation for /home/user/cs20b1057_dd_lab/lab6/sym_table/symbol.ko
 due to unavailability of vmlinux
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-67-generic'
user@user:~/cs20b1057_dd_lab/lab6/sym_table$ ls
instruction2.txt    modules.order    symbol.ko     symbol.mod.o
instructions2.txt   Module.symvers   symbol.mod    symbol.o
Makefile            symbol.c         symbol.mod.c
user@user:~/cs20b1057_dd_lab/lab6/sym_table$
```

Inserting the module symbol.ko and checking by using dmesg command

```
user@user:~/cs20b1057_dd_lab/lab6/sym_table$ sudo insmod symbol.ko
user@user:~/cs20b1057_dd_lab/lab6/sym_table$ dmesg|tail -1
[ 1132.523992] test_export_init: In init
user@user:~/cs20b1057_dd_lab/lab6/sym_table$
```

Using cat /proc/kallsyms |grep print_jiffies

```
user@user:~/cs20b1057_dd_lab/lab6/sym_table$ sudo insmod symbol.ko
user@user:~/cs20b1057_dd_lab/lab6/sym_table$ dmesg|tail -1
[ 1132.523992] test_export_init: In init
user@user:~/cs20b1057_dd_lab/lab6/sym_table$ cat /proc/kallsyms |grep print_jiffies
0000000000000000 r __kstrtab_print_jiffies      [symbol]
0000000000000000 r __kstrtabns_print_jiffies    [symbol]
0000000000000000 r __ksymtab_print_jiffies      [symbol]
0000000000000000 t print_jiffies           [symbol]
user@user:~/cs20b1057_dd_lab/lab6/sym_table$
```