Readme for Q3

Downloading the kernel headers with the following question sudo apt-get install linux-headers-generic linux/module.h>

A kind of header which provides essential macros and functions for defining and working with kernel modules. It includes macros like module_init and module_exit, which are used to specify initialization and cleanup functions for the module.

linux/kernel.h>

Includes macros importantly used for module initialisation and cleanup.

__init and __exit are under this header.

linux/sched/signal.h>

Important for working with task_struct data structure

All the function related to task control group and signal handling and process state information are under this header only.

Then in the proceeding lines we are giving the license of general purpose license.

Then providing authors name/ contributors of the module

Loading and unloading description is provided

Static keyword to limit the scope of function to current source file only.

Then we are using the task_struct data structure to count the number of running processes init macro to let kernel know that this funtion is for initialization purposes

Next function is for cleanup purposes specifically the __exit macro Kern_info is a log level. There are so many log levels it is just for printing purposes and not a warning

Then we are creating a makefile in which we are making hello.o our target and writing commands to make and clean the files

When we type make on the Terminal of ubuntu

```
kiopi@kiopi-virtual-machine:~/kiopi/my_module$ make
make -C /lib/modules/6.2.0-33-generic/build M=/home/kiopi/kiopi/my module module
make[1]: Entering directory '/usr/src/linux-headers-6.2.0-33-generic'
warning: the compiler differs from the one used to build the kernel
  The kernel was built by: x86 64-linux-qnu-qcc-11 (Ubuntu 11.4.0-1ubuntu1~22.04
) 11.4.0
 You are using:
                           gcc-11 (Ubuntu 11.4.0-1ubuntu1~22.04) 11.4.0
  CC [M] /home/kiopi/kiopi/my_module/hello.o
 MODPOST /home/kiopi/kiopi/my_module/Module.symvers
  CC [M] /home/kiopi/kiopi/my_module/hello.mod.o
  LD [M]
          /home/kiopi/kiopi/my module/hello.ko
  BTF [M] /home/kiopi/kiopi/my_module/hello.ko
Skipping BTF generation for /home/kiopi/kiopi/my_module/hello.ko due to unavaila
bility of vmlinux
make[1]: Leaving directory '/usr/src/linux-headers-6.2.0-33-generic'
```

Sudo insmod hello.ko to load in the kernel

```
make[1]: Leaving directory '/usr/src/linux-headers-6.2.0-33-generic'
kiopi@kiopi-virtual-machine:~/kiopi/my_module$ sudo insmod hello.ko
[sudo] password for kiopi:
kiopi@kiopi-virtual-machine:~/kiopi/my_module$ sudo dmesg
[ 0.0000000] Linux version 6.2.0-33-generic (buildd@lcy02-amd64-073)
DYNAMIC Thu Sep 7 10:33:52 UTC 2 (Ubuntu 6.2.0-33.33~22.04.1-generic
```

After it gets loaded to the kernel

Sudo dmesg to view the output of the module, dmesg for kernel logs

```
[ 593.411541] hello: module verification failed: signature and/or required key missing - tainting kernel [ 593.425855] Custom module loaded [ 593.425856] Custom module unloaded [ 773.369895] Custom module unloaded [ 773.369895] Custom module loaded [ 773.3698973] Number of running processes: 3 [ 810.332600] Custom module unloaded [ 2335.341968] e1000: ens33 NIC Link is Down [ 2339.3991593] e1000: ens33 NIC Link is Up 1000 Mbps Full Duplex, Flow Control: None [ 3262.833163] Module loading done [ 3262.835537] Number of running processes: 1 kiopi@kiopi-virtual-machine:~/kiopi/my_module$
```

For module cleanup

```
kiopi@kiopi-virtual-machine:~/kiopi/my_module$ sudo rmmod hello.ko
kiopi@kiopi-virtual-machine:~/kiopi/my_module$ sudo dmesg
```

```
[ 593.425855] Custom module loaded
[ 593.425930] Number of running processes: 2
[ 689.793276] Custom module unloaded
[ 773.369895] Custom module loaded
[ 773.369973] Number of running processes: 3
[ 810.332600] Custom module unloaded
[ 2335.341968] e1000: ens33 NIC Link is Down
[ 2339.391593] e1000: ens33 NIC Link is Up 1000 Mbps Full Duplex, Flow Control: None
[ 3262.833163] Module loading done
[ 3262.835537] Number of running processes: 1
[ 3424.523436] Module Cleanup done
[ 3456.839335] Module loading done
[ 3456.840507] Number of running processes: 1
[ 3495.214811] Module Cleanup done
```

Sudo Ismod to show all the list of the modules

```
ule$ sudo lsmod
Module
                          Size Used by
nfnetlink
                         24576
                                0
isofs
                         57344
vsock loopback
                         16384 0
vmw_vsock_virtio_transport_common
                                        57344 1 vsock loopback
vmw_vsock_vmci_transport
                             45056 2
                         57344 7 vmw_vsock_virtio_transport_common,vsock_loopback,vmw_vsock_vmci_transport
vsock
snd_ens1371
                         36864
binfmt_misc
                         24576
snd_ac97_codec
                        200704
                                1 snd_ens1371
                                1 snd_ens1371
1 snd_ac97_codec
gameport
                         24576
ac97_bus
                         16384
snd_pcm
                        192512
                                2 snd_ac97_codec,snd_ens1371
nls_iso8859_1
                         16384
intel_rapl_msr
intel_rapl_common
                         20480
                         40960
                                1 intel_rapl_msr
vmw_balloon
snd_seq_midi
crct10dif_pclmul
                         28672 0
                         20480
                         16384
snd_seq_midi_event
                         16384
                                1 snd_seq_midi
polyval_clmulni
                         16384
                                0
polyval_generic
ghash_clmulni_intel
                                1 polyval_clmulni
                         16384
                         16384 0
sha512_ssse3
aesni_intel
                         53248
                        397312
                                0
                                1 aesni_intel
crypto_simd
                         20480
                                2 crypto_simd,ghash_clmulni_intel
cryptd
                         28672
rapl
                         20480
snd_rawmidi
                         53248
                                2 snd_seq_midi,snd_ens1371
snd_seq
                         94208
                                2 snd_seq_midi,snd_seq_midi_event
snd_seq_device
snd_timer
                                3 snd_seq,snd_seq_midi,snd_rawmidi
2 snd_seq,snd_pcm
                         16384
                         49152
                         32768
iovdev
input_leds
                         16384
serio_raw
                         20480
                        135168
                                11 snd_seq,snd_seq_device,snd_timer,snd_ac97_codec,snd_pcm,snd_rawmidi,snd_ens1371
snd
soundcore
                         16384
vmw_vmci
                        106496
                                 2 vmw_balloon,vmw_vsock_vmci_transport
mac_hid
                         16384
                         24576
sch_fq_codel
vmwgfx
                        438272
drm_ttm_helper
                         16384
                                1 vmwqfx
                        110592
                                2 vmwgfx,drm_ttm_helper
ttm
```