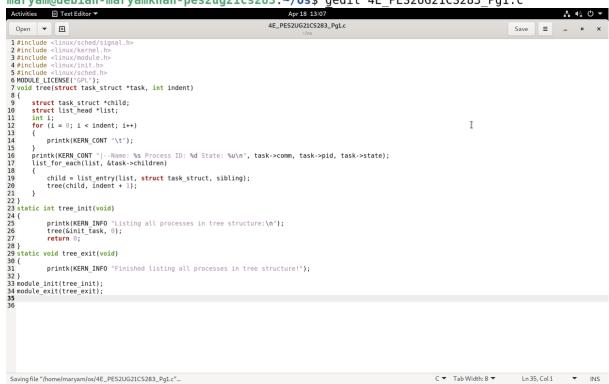# 4E_OS(UE21CS242B) Project
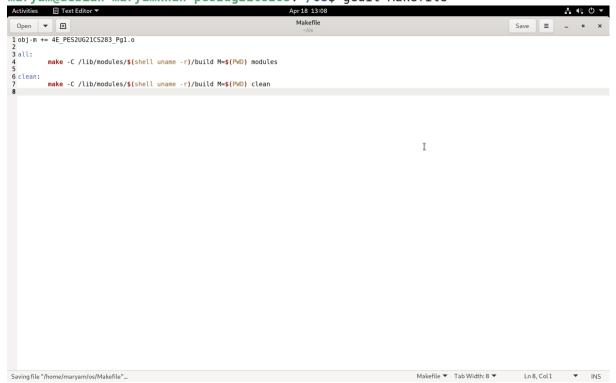
Name: Maryam Khan
SRN: PES2UG21CS283
Sem: 4   **Sec**: E

maryam@debian-maryamkhan-pes2ug21cs283:~/os$ gedit 4E_PES2UG21CS283_Pg1.c

```c
#include <linux/sched/signal.h>
#include <linux/kernel.h>
#include <linux/module.h>
#include <linux/init.h>
#include <linux/sched.h>
MODULE_LICENSE("GPL");
void tree(struct task_struct *task, int indent)
{
    struct task_struct *child;
    struct list_head *list;
    int i;
    for (i = 0; i < indent; i++)
    {
        printk(KERN_CONT "\t");
    }
    printk(KERN_CONT "|--Name: %s Process ID: %d State: %u\n", task->comm, task->pid, task->state);
    list_for_each(list, &task->children)
    {
        child = list_entry(list, struct task_struct, sibling);
        tree(child, indent + 1);
    }
}
static int tree_init(void)
{
        printk(KERN_INFO "Listing all processes in tree structure:\n");
        tree(&init_task, 0);
        return 0;
}
static void tree_exit(void)
{
        printk(KERN_INFO "Finished listing all processes in tree structure!");
}
module_init(tree_init);
module_exit(tree_exit);
```

Saving file "/home/maryam/os/4E_PES2UG21CS283_Pg1.c"...

maryam@debian-maryamkhan-pes2ug21cs283:~/os$ gedit Makefile

```makefile
obj-m += 4E_PES2UG21CS283_Pg1.o

all:
        make -C /lib/modules/$(shell uname -r)/build M=$(PWD) modules

clean:
        make -C /lib/modules/$(shell uname -r)/build M=$(PWD) clean
```
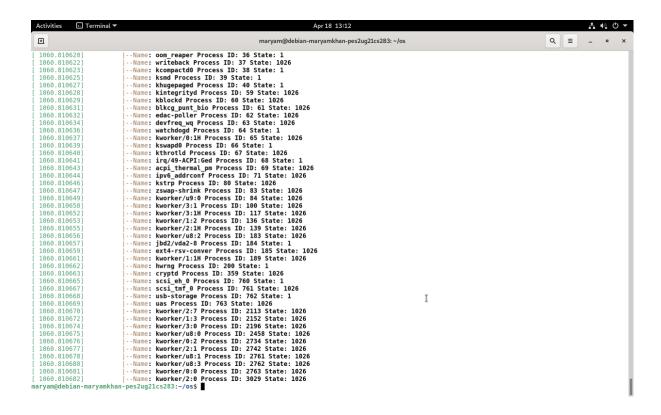
Saving file "/home/maryam/os/Makefile"...

```
maryam@debian-maryamkhan-pes2ug21cs283:~/os$ make
maryam@debian-maryamkhan-pes2ug21cs283:~/os$ sudo insmod 4E_PES2UG21CS283_Pg1.ko
[sudo] password for maryam:
maryam@debian-maryamkhan-pes2ug21cs283:~/os$ sudo dmesg
```

```
Activities        Terminal ▾                                    Apr 18 13:10

  ⊞                              maryam@debian-maryamkhan-pes2ug21cs283: ~/os

make[1]: Leaving directory '/usr/src/linux-headers-5.10.0-21-arm64'
maryam@debian-maryamkhan-pes2ug21cs283:~/os$ sudo insmod 4E_PES2UG21CS283_Pg1.ko
[sudo] password for maryam:
maryam@debian-maryamkhan-pes2ug21cs283:~/os$ sudo dmesg
[    0.000000] Booting Linux on physical CPU 0x0000000000 [0x00000000]
[    0.000000] Linux version 5.10.0-21-arm64 (debian-kernel@lists.debian.org) (gcc-10 (Debian 10.2.1-6) 10.2.1 20210110, GNU ld (GNU Binutils for Debian) 2.35
.2) #1 SMP Debian 5.10.162-1 (2023-01-21)
[    0.000000] efi: EFI v2.70 by EDK II
[    0.000000] efi: SMBIOS 3.0=0x13f810000 MEMATTR=0x13e803018 ACPI 2.0=0x13c150018 MOKvar=0x13e800000 RNG=0x13c15e698 MEMRESERVE=0x13c481118
[    0.000000] efi: seeding entropy pool
[    0.000000] random: crng init done
[    0.000000] secureboot: Secure boot disabled
[    0.000000] ACPI: Early table checksum verification disabled
[    0.000000] ACPI: RSDP 0x000000013C150018 000024 (v02 BOCHS )
[    0.000000] ACPI: XSDT 0x000000013C15FE98 00006C (v01 BOCHS  BXPC      00000001      01000013)
[    0.000000] ACPI: FACP 0x000000013C15FA98 000114 (v06 BOCHS  BXPC      00000001 BXPC 00000001)
[    0.000000] ACPI: DSDT 0x000000013C157518 001470 (v02 BOCHS  BXPC      00000001 BXPC 00000001)
[    0.000000] ACPI: APIC 0x000000013C15FC18 00019C (v04 BOCHS  BXPC      00000001 BXPC 00000001)
[    0.000000] ACPI: PPTT 0x000000013C15D898 00009C (v02 BOCHS  BXPC      00000001 BXPC 00000001)
[    0.000000] ACPI: GTDT 0x000000013C15E818 000060 (v02 BOCHS  BXPC      00000001 BXPC 00000001)
[    0.000000] ACPI: MCFG 0x000000013C15E918 00003C (v01 BOCHS  BXPC      00000001 BXPC 00000001)
[    0.000000] ACPI: SPCR 0x000000013C15FF98 000050 (v02 BOCHS  BXPC      00000001 BXPC 00000001)
[    0.000000] ACPI: DBG2 0x000000013C15E418 000057 (v00 BOCHS  BXPC      00000001 BXPC 00000001)
[    0.000000] ACPI: IORT 0x000000013C15E718 000080 (v03 BOCHS  BXPC      00000001 BXPC 00000001)
[    0.000000] ACPI: BGRT 0x000000013C15E498 000038 (v01 INTEL  EDK2      00000002      01000013)
[    0.000000] ACPI: SPCR: console: pl011,mmio,0x9000000,9600
[    0.000000] ACPI: NUMA: Failed to initialise from firmware
[    0.000000] NUMA: Faking a node at [mem 0x0000000040000000-0x000000013fffffff]
[    0.000000] NUMA: NODE_DATA [mem 0x13f64ab00-0x13f64cfff]
[    0.000000] Zone ranges:
[    0.000000]   DMA      [mem 0x0000000040000000-0x00000000ffffffff]
[    0.000000]   DMA32    empty
[    0.000000]   Normal   [mem 0x0000000100000000-0x000000013fffffff]
[    0.000000] Movable zone start for each node
[    0.000000] Early memory node ranges
[    0.000000]   node   0: [mem 0x0000000040000000-0x000000013c15ffff]
[    0.000000]   node   0: [mem 0x000000013c160000-0x000000013c47ffff]
[    0.000000]   node   0: [mem 0x000000013c480000-0x000000013f75ffff]
[    0.000000]   node   0: [mem 0x000000013f760000-0x000000013f7effff]
[    0.000000]   node   0: [mem 0x000000013f7f0000-0x000000013f7fffff]
[    0.000000]   node   0: [mem 0x000000013f800000-0x000000013f91ffff]
[    0.000000]   node   0: [mem 0x000000013f920000-0x000000013fffffff]
[    0.000000] Initmem setup node 0 [mem 0x0000000040000000-0x000000013fffffff]
[    0.000000] On node 0 totalpages: 1048576
[    0.000000]   DMA zone: 12288 pages used for memmap
[    0.000000]   DMA zone: 0 pages reserved
```

```
Activities        Terminal ▾                                    Apr 18 13:12

  ⊞                              maryam@debian-maryamkhan-pes2ug21cs283: ~/os

[ 1042.092505] Finished listing all processes in dfs order.
[ 1060.810372] Listing all processes in tree structure:
[ 1060.810377] |--Name: swapper/0 Process ID: 0 State: 0
[ 1060.810377]  |--Name: systemd Process ID: 1 State: 1
[ 1060.810379]      |--Name: systemd-journal Process ID: 225 State: 1
[ 1060.810381]      |--Name: systemd-udevd Process ID: 248 State: 1
[ 1060.810382]      |--Name: systemd-timesyn Process ID: 427 State: 1
[ 1060.810384]      |--Name: accounts-daemon Process ID: 437 State: 1
[ 1060.810385]      |--Name: avahi-daemon Process ID: 439 State: 1
[ 1060.810386]          |--Name: avahi-daemon Process ID: 453 State: 1
[ 1060.810388]      |--Name: cron Process ID: 440 State: 1
[ 1060.810390]      |--Name: dbus-daemon Process ID: 441 State: 1
[ 1060.810391]      |--Name: NetworkManager Process ID: 442 State: 1
[ 1060.810393]      |--Name: polkitd Process ID: 445 State: 1
[ 1060.810394]      |--Name: rsyslogd Process ID: 446 State: 1
[ 1060.810396]      |--Name: switcheroo-cont Process ID: 447 State: 1
[ 1060.810397]      |--Name: systemd-logind Process ID: 448 State: 1
[ 1060.810399]      |--Name: udisksd Process ID: 449 State: 1
[ 1060.810400]      |--Name: wpa_supplicant Process ID: 450 State: 1
[ 1060.810402]      |--Name: ModemManager Process ID: 494 State: 1
[ 1060.810404]      |--Name: cupsd Process ID: 497 State: 1
[ 1060.810405]          |--Name: dbus Process ID: 531 State: 1
[ 1060.810407]          |--Name: dbus Process ID: 533 State: 1
[ 1060.810409]          |--Name: dbus Process ID: 534 State: 1
[ 1060.810410]          |--Name: dbus Process ID: 535 State: 1
[ 1060.810412]          |--Name: dbus Process ID: 539 State: 1
[ 1060.810414]          |--Name: dbus Process ID: 540 State: 1
[ 1060.810415]          |--Name: dbus Process ID: 545 State: 1
[ 1060.810417]      |--Name: named Process ID: 498 State: 1
[ 1060.810419]      |--Name: unattended-upgr Process ID: 503 State: 1
[ 1060.810421]      |--Name: sshd Process ID: 528 State: 1
[ 1060.810423]      |--Name: gdm3 Process ID: 537 State: 1
[ 1060.810424]          |--Name: gdm-session-wor Process ID: 1011 State: 1
[ 1060.810426]              |--Name: gdm-x-session Process ID: 1121 State: 1
[ 1060.810428]                  |--Name: Xorg Process ID: 1123 State: 0
[ 1060.810430]                  |--Name: gnome-session-b Process ID: 1128 State: 1
[ 1060.810432]                      |--Name: ssh-agent Process ID: 1185 State: 1
[ 1060.810434]      |--Name: cups-browsed Process ID: 546 State: 1
[ 1060.810436]      |--Name: rtkit-daemon Process ID: 582 State: 1
[ 1060.810437]      |--Name: upowerd Process ID: 688 State: 1
[ 1060.810438]      |--Name: packagekitd Process ID: 793 State: 1
[ 1060.810440]      |--Name: colord Process ID: 923 State: 1
[ 1060.810441]      |--Name: spice-vdagentd Process ID: 981 State: 1
[ 1060.810443]      |--Name: agetty Process ID: 1009 State: 1
[ 1060.810445]      |--Name: systemd Process ID: 1016 State: 1
[ 1060.810447]          |--Name: (sd-pam) Process ID: 1017 State: 1
```

```
[ 1060.810620]          |--Name: oom_reaper Process ID: 36 State: 1
[ 1060.810622]          |--Name: writeback Process ID: 37 State: 1026
[ 1060.810623]          |--Name: kcompactd0 Process ID: 38 State: 1
[ 1060.810625]          |--Name: ksmd Process ID: 39 State: 1
[ 1060.810627]          |--Name: khugepaged Process ID: 40 State: 1
[ 1060.810628]          |--Name: kintegrityd Process ID: 59 State: 1026
[ 1060.810629]          |--Name: kblockd Process ID: 60 State: 1026
[ 1060.810631]          |--Name: blkcg_punt_bio Process ID: 61 State: 1026
[ 1060.810632]          |--Name: edac-poller Process ID: 62 State: 1026
[ 1060.810634]          |--Name: devfreq_wq Process ID: 63 State: 1026
[ 1060.810636]          |--Name: watchdogd Process ID: 64 State: 1
[ 1060.810637]          |--Name: kworker/0:1H Process ID: 65 State: 1026
[ 1060.810639]          |--Name: kswapd0 Process ID: 66 State: 1
[ 1060.810640]          |--Name: kthrotld Process ID: 67 State: 1026
[ 1060.810641]          |--Name: irq/49-ACPI:Ged Process ID: 68 State: 1
[ 1060.810643]          |--Name: acpi_thermal_pm Process ID: 69 State: 1026
[ 1060.810644]          |--Name: ipv6_addrconf Process ID: 71 State: 1026
[ 1060.810646]          |--Name: kstrp Process ID: 80 State: 1026
[ 1060.810647]          |--Name: zswap-shrink Process ID: 83 State: 1026
[ 1060.810649]          |--Name: kworker/u9:0 Process ID: 84 State: 1026
[ 1060.810650]          |--Name: kworker/3:1 Process ID: 100 State: 1026
[ 1060.810652]          |--Name: kworker/3:1H Process ID: 117 State: 1026
[ 1060.810653]          |--Name: kworker/1:2 Process ID: 136 State: 1026
[ 1060.810655]          |--Name: kworker/2:1H Process ID: 139 State: 1026
[ 1060.810656]          |--Name: kworker/u8:2 Process ID: 183 State: 1026
[ 1060.810657]          |--Name: jbd2/vda2-8 Process ID: 184 State: 1
[ 1060.810659]          |--Name: ext4-rsv-conver Process ID: 185 State: 1026
[ 1060.810661]          |--Name: kworker/1:1H Process ID: 189 State: 1026
[ 1060.810662]          |--Name: hwrng Process ID: 200 State: 1
[ 1060.810663]          |--Name: cryptd Process ID: 359 State: 1026
[ 1060.810665]          |--Name: scsi_eh_0 Process ID: 760 State: 1
[ 1060.810667]          |--Name: scsi_tmf_0 Process ID: 761 State: 1026
[ 1060.810668]          |--Name: usb-storage Process ID: 762 State: 1
[ 1060.810669]          |--Name: uas Process ID: 763 State: 1026
[ 1060.810670]          |--Name: kworker/2:7 Process ID: 2113 State: 1026
[ 1060.810672]          |--Name: kworker/1:3 Process ID: 2152 State: 1026
[ 1060.810674]          |--Name: kworker/3:0 Process ID: 2196 State: 1026
[ 1060.810675]          |--Name: kworker/u8:0 Process ID: 2458 State: 1026
[ 1060.810676]          |--Name: kworker/0:2 Process ID: 2734 State: 1026
[ 1060.810677]          |--Name: kworker/2:1 Process ID: 2742 State: 1026
[ 1060.810678]          |--Name: kworker/u8:1 Process ID: 2761 State: 1026
[ 1060.810680]          |--Name: kworker/u8:3 Process ID: 2762 State: 1026
[ 1060.810681]          |--Name: kworker/0:0 Process ID: 2763 State: 1026
[ 1060.810682]          |--Name: kworker/2:0 Process ID: 3029 State: 1026
maryam@debian-maryamkhan-pes2ug21cs283:~/os$ █
```

maryam@debian-maryamkhan-pes2ug21cs283:~/os$ `lsmod`

[1060.810680]	|--Name: kworker/u8:3 Process ID: 2762 State: 1026	
[1060.810681]	|--Name: kworker/0:0 Process ID: 2763 State: 1026	
[1060.810682]	|--Name: kworker/2:0 Process ID: 3029 State: 1026	

maryam@debian-maryamkhan-pes2ug21cs283:~/os$ lsmod

```
Module                 Size  Used by
4E_PES2UG21CS283_Pg1   16384  0
sr_mod                 32768  0
cdrom                  61440  1 sr_mod
sg                     49152  0
uinput                 28672  1
uas                    28672  0
usb_storage            73728  1 uas
scsi_mod              221184  4 usb_storage,uas,sg,sr_mod
joydev                 32768  0
hid_generic            16384  0
usbhid                 61440  0
hid                   131072  2 usbhid,hid_generic
rfkill                 28672  3
snd_hda_codec_generic  77824  1
ledtrig_audio          16384  1 snd_hda_codec_generic
nls_ascii              16384  1
nls_cp437              20480  1
aes_ce_blk             36864  0
crypto_simd            24576  1 aes_ce_blk
cryptd                 24576  1 crypto_simd
vfat                   28672  1
aes_ce_cipher          20480  1 aes_ce_blk
fat                    81920  1 vfat
ghash_ce               24576  0
gf128mul               16384  1 ghash_ce
snd_hda_intel          45056  3
libaes                 16384  3 aes_ce_cipher,ghash_ce,aes_ce_blk
snd_intel_dspcfg       20480  1 snd_hda_intel
snd_hda_codec         126976  2 snd_hda_codec_generic,snd_hda_intel
sha3_ce                20480  0
snd_hda_core           86016  3 snd_hda_codec_generic,snd_hda_intel,snd_hda_codec
sha3_generic           16384  1 sha3_ce
snd_hwdep              20480  1 snd_hda_codec
sha512_ce              24576  0
sha512_arm64           20480  1 sha512_ce
snd_pcm               114688  3 snd_hda_intel,snd_hda_codec,snd_hda_core
sha2_ce                20480  0
snd_timer              40960  1 snd_pcm
sha256_arm64           28672  1 sha2_ce
sha1_ce                20480  0
snd                    94208  12 snd_hda_codec_generic,snd_hwdep,snd_hda_intel,snd_hda_codec,snd_timer,snd_pcm
```

maryam@debian-maryamkhan-pes2ug21cs283:~/os$ `sudo rmmod 4E_PES2UG21CS283_Pg1.c`

```
virtio_mmio            24576  0
virtio_ring            28672  8 virtio_rng,virtio_mmio,virtio_console,9pnet_virtio,virtio_gpu,virtio_pci,virtio_blk,virtio_net
virtio                 20480  8 virtio_rng,virtio_mmio,virtio_console,9pnet_virtio,virtio_gpu,virtio_pci,virtio_blk,virtio_net
```
maryam@debian-maryamkhan-pes2ug21cs283:~/os$ sudo rmmod 4E_PES2UG21CS283_Pg1.ko
maryam@debian-maryamkhan-pes2ug21cs283:~/os$ lsmod
```
Module                 Size  Used by
sr_mod                 32768  0
cdrom                  61440  1 sr_mod
sg                     49152  0
uinput                 28672  1
uas                    28672  0
usb_storage            73728  1 uas
scsi_mod              221184  4 usb_storage,uas,sg,sr_mod
joydev                 32768  0
hid_generic            16384  0
usbhid                 61440  0
hid                   131072  2 usbhid,hid_generic
rfkill                 28672  3
snd_hda_codec_generic  77824  1
ledtrig_audio          16384  1 snd_hda_codec_generic
nls_ascii              16384  1
nls_cp437              20480  1
aes_ce_blk             36864  0
crypto_simd            24576  1 aes_ce_blk
cryptd                 24576  1 crypto_simd
vfat                   28672  1
aes_ce_cipher          20480  1 aes_ce_blk
fat                    81920  1 vfat
ghash_ce               24576  0
gf128mul               16384  1 ghash_ce
snd_hda_intel          45056  3
libaes                 16384  3 aes_ce_cipher,ghash_ce,aes_ce_blk
snd_intel_dspcfg       20480  1 snd_hda_intel
snd_hda_codec         126976  2 snd_hda_codec_generic,snd_hda_intel
sha3_ce                20480  0
snd_hda_core           86016  3 snd_hda_codec_generic,snd_hda_intel,snd_hda_codec
sha3_generic           16384  1 sha3_ce
snd_hwdep              20480  1 snd_hda_codec
sha512_ce              24576  0
sha512_arm64           20480  1 sha512_ce
snd_pcm               114688  3 snd_hda_intel,snd_hda_codec,snd_hda_core
sha2_ce                20480  0
snd_timer              40960  1 snd_pcm
sha256_arm64           28672  1 sha2_ce
sha1_ce                20480  0
snd                    94208  12 snd_hda_codec_generic,snd_hwdep,snd_hda_intel,snd_hda_codec,snd_timer,snd_pcm
```