Operating System Concepts

Final Exam

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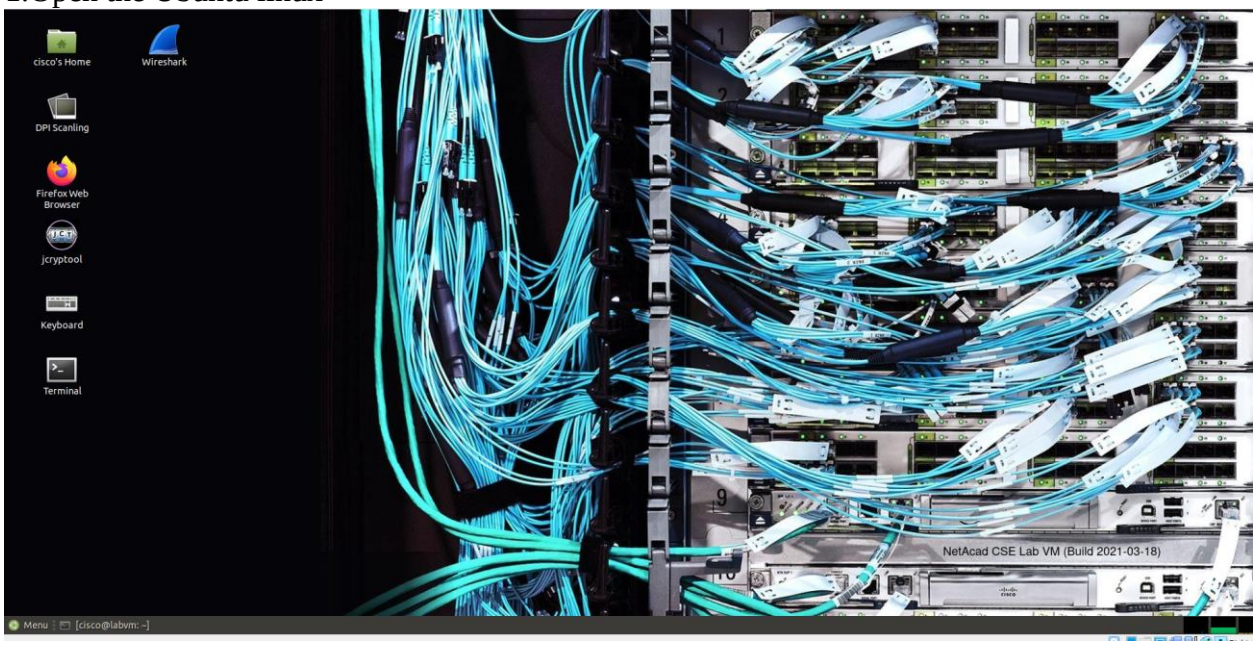
Link to the repository: https://github.com/dabdigaziz/operating-system-concepts-final

CONTENT

Step-by-step task completion:

TASK 1:

1.Open the Ubuntu linux

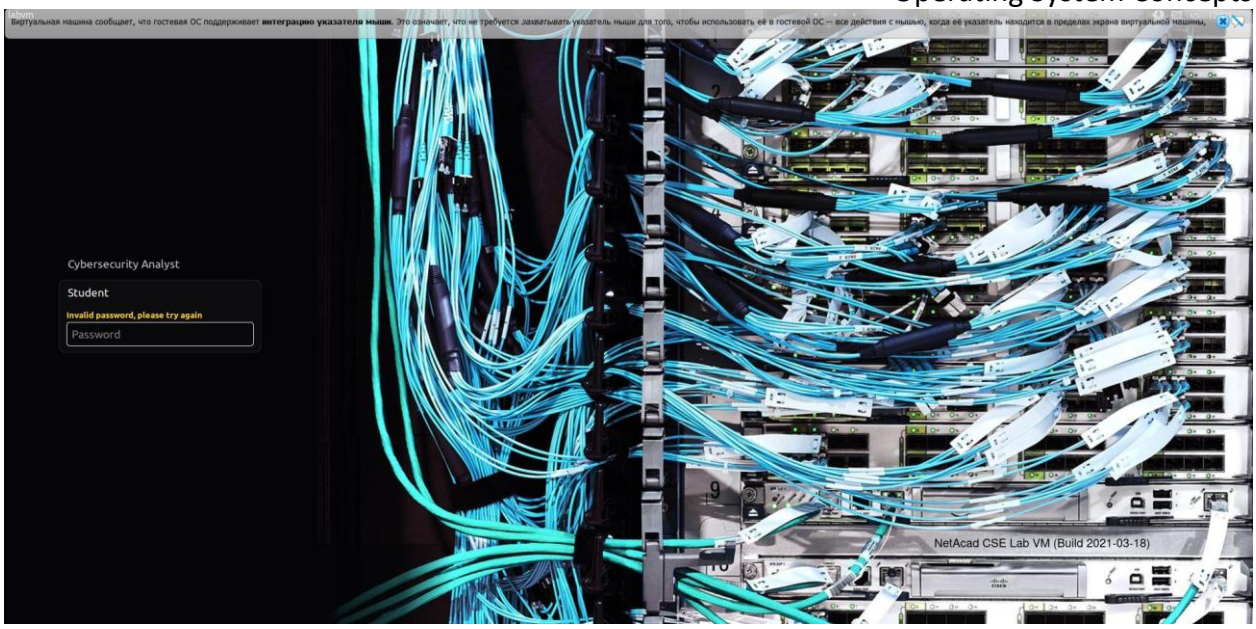


2. adding user named “student”

```
cisco@labvm:~$ sudo adduser student
Adding user `student' ...
Adding new group `student' (1005) ...
Adding new user `student' (1005) with group `student' ...
Creating home directory `/home/student' ...
Copying files from `/etc/skel' ...
New password:
Retype new password:
passwd: password updated successfully
Changing the user information for student
Enter the new value, or press ENTER for the default
        Full Name []: Student
        Room Number []: Student
        Work Phone []: Student
        Home Phone []: Student
        Other []: Student
Is the information correct? [Y/n] y
cisco@labvm:~$
```

```
cisco@labvm:~$ sudo usermod -aG sudo student
```

We logged in by user “student”



Entered “whoami” To check username

```
student@labvm:/home/cisco$ whoami
student
student@labvm:/home/cisco$ uname -r
5.4.0-67-generic
student@labvm:/home/cisco$ uname
Linux
student@labvm:/home/cisco$ S
```

TASK 2:

Direct IP connection
installing network-manager

```
root@labvm:/home/cisco# apt-get install network-manager
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  libbluetooth3 libnm0 network-manager-pptp
Suggested packages:
  libteam-utils
The following NEW packages will be installed:
  libbluetooth3 network-manager network-manager-pptp
The following packages will be upgraded:
  libnm0
1 upgraded, 3 newly installed, 0 to remove and 487 not upgraded.
Need to get 2,315 kB of archives.
After this operation, 8,100 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://archive.ubuntu.com/ubuntu focal-updates/main amd64 libbluetooth3 am
d64 5.53-0ubuntu3.6 [60.6 kB]
Get:2 http://archive.ubuntu.com/ubuntu focal-updates/main amd64 libnm0 amd64 1.2
2.10-1ubuntu2.3 [370 kB]
Get:3 http://archive.ubuntu.com/ubuntu focal-updates/main amd64 network-manager
amd64 1.22.10-1ubuntu2.3 [1,855 kB]
```

```
cisco@labvm:~$ ip link show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN mode DEFAULT
 group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP mo
de DEFAULT group default qlen 1000
    link/ether 08:00:27:c7:75:0b brd ff:ff:ff:ff:ff:ff
cisco@labvm:~$
```

```
cisco@labvm:~$ sudo dhcpcd enp0s3
[sudo] password for cisco:
dhcpcd already running on pid 6119 (/run/dhcpcd-enp0s3.pid)
cisco@labvm:~$
```

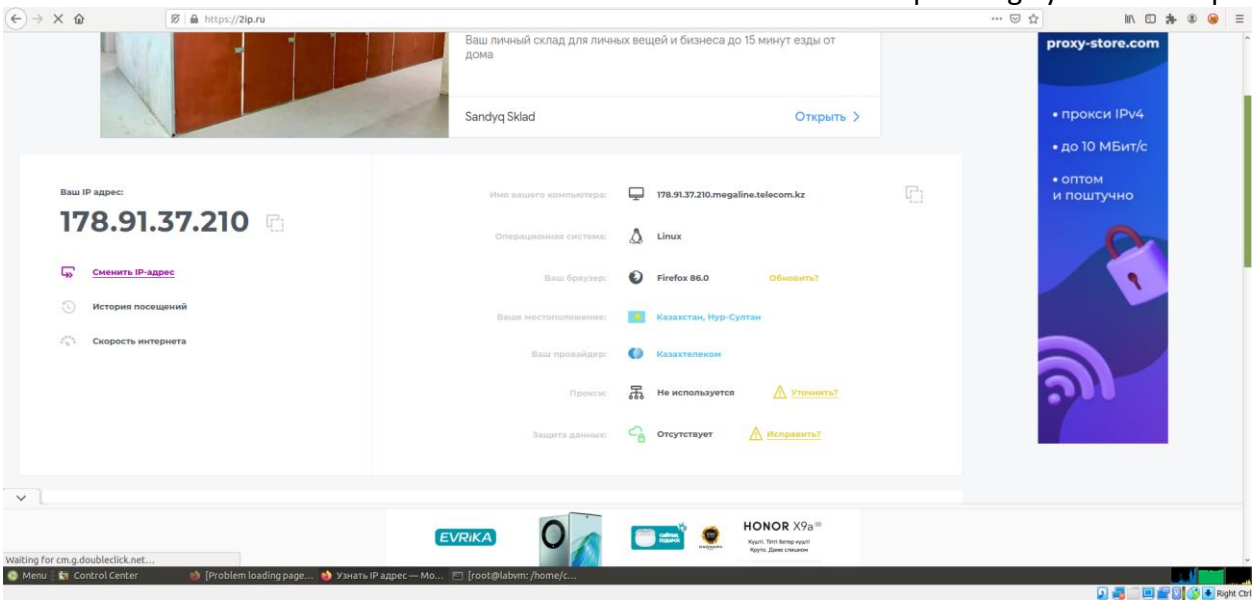
```
cisco@labvm:~$ ip link show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN mode DEFAULT
 group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP mo
de DEFAULT group default qlen 1000
    link/ether 08:00:27:c7:75:0b brd ff:ff:ff:ff:ff:ff
cisco@labvm:~$
```

```
root@labvm:/home/cisco# ping google.com -c3
PING google.com (64.233.165.138) 56(84) bytes of data.
64 bytes from lg-in-f138.1e100.net (64.233.165.138): icmp_seq=1 ttl=108 time=57.
0 ms
64 bytes from lg-in-f138.1e100.net (64.233.165.138): icmp_seq=2 ttl=108 time=55.
8 ms
64 bytes from lg-in-f138.1e100.net (64.233.165.138): icmp_seq=3 ttl=108 time=56.
9 ms

--- google.com ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2005ms
rtt min/avg/max/mdev = 55.754/56.564/56.995/0.573 ms
root@labvm:/home/cisco#
```

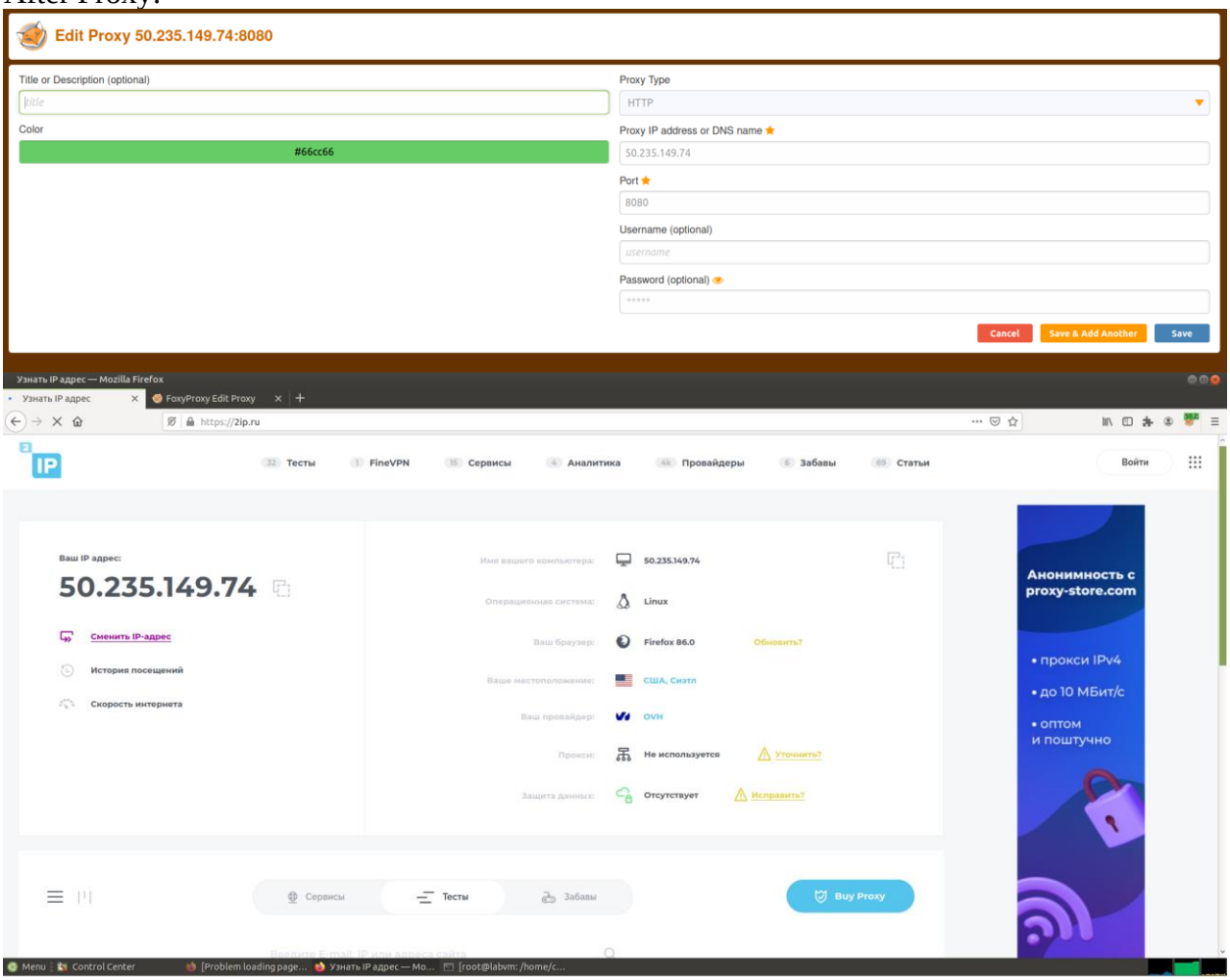
connection via NAT

```
root@labvm:/home/cisco# sudo sysctl -w net.ipv4.ip_forward=1
net.ipv4.ip_forward = 1
root@labvm:/home/cisco#
root@labvm:/home/cisco# sudo iptables -t nat -A POSTROUTING -o eth0 -j MASQUERAD
E
root@labvm:/home/cisco# sudo iptables -A FORWARD -i eth1 -j ACCEPT
root@labvm:/home/cisco# iptables -vnL -t nat
root@labvm:/home/cisco# iptables -vnL -t nat
Chain PREROUTING (policy ACCEPT 450 packets, 56966 bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain INPUT (policy ACCEPT 279 packets, 40921 bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain OUTPUT (policy ACCEPT 20 packets, 1786 bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain POSTROUTING (policy ACCEPT 20 packets, 1786 bytes)
 pkts bytes target     prot opt in     out     source               destination
    0     0 MASQUERADE  all  --  *      eth0    0.0.0.0/0            0.0.0.0/0

root@labvm:/home/cisco#
```

connection via PROXY:
Before PROXY:

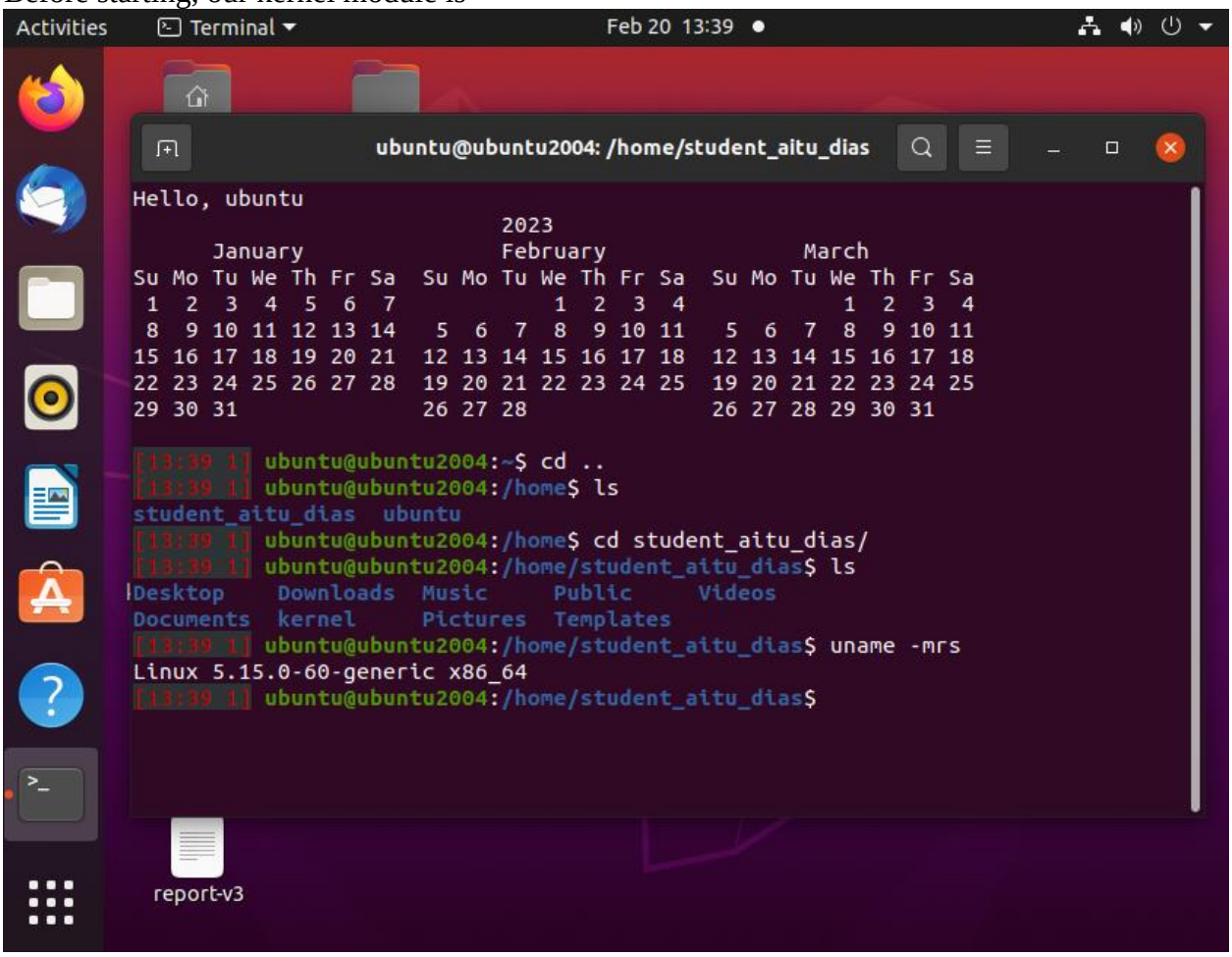

https://2ip.ru
Ваш личный склад для личных вещей и бизнеса до 15 минут езды от дома
Sandyq Sklad
Открыть
Ваш IP адрес:
178.91.37.210
Сменить IP-адрес
История посещений
Скорость интернета
178.91.37.210.megaline.telecom.kz
Linux
Firefox 86.0
Обновить?
Казахстан, Нур-Султан
Казахтелеком
Не используется
Уточнить?
Отсутствует
Исправить?
proxy-store.com
• прокси IPv4
• до 10 МБит/с
• оптом и поштучно
EVRIKA
HONOR X9a

After Proxy:


Edit Proxy 50.235.149.74:8080
Title or Description (optional)
Color
#66cc66
Proxy Type
HTTP
Proxy IP address or DNS name
50.235.149.74
Port
8080
Username (optional)
Password (optional)
Cancel
Save & Add Another
Save
Узнать IP адрес — Mozilla Firefox
FoxyProxy Edit Proxy
https://2ip.ru
Ваш IP адрес:
50.235.149.74
Сменить IP-адрес
История посещений
Скорость интернета
Linux
Firefox 86.0
США, Сиэтл
OVH
Не используется
Отсутствует
Анонимность с proxy-store.com
• прокси IPv4
• до 10 МБит/с
• оптом и поштучно
Buy Proxy

TASK 3:

Before starting, our kernel module is



Step 1. Set-up the environment

Download Kernel 5.16.9 source code

wget https://cdn.kernel.org/pub/linux/kernel/v5.x/linux-5.16.9.tar.xz

Step 1.2. Extract xz file

unxz -v linux-5.16.9.tar.xz

Step 1.3. Verify sign key

wget https://cdn.kernel.org/pub/linux/kernel/v5.x/linux-5.16.9.tar.sign

gpg --verify linux-5.16.9.tar.sign

```
root@ubuntu2004:/home/student_aitu_dias/kernel# gpg --verify linux-5.16.9.tar.sign
gpg: assuming signed data in 'linux-5.16.9.tar'
gpg: Signature made Fri 11 Feb 2022 03:27:25 AM EST
gpg:                using RSA key 647F28654894E3BD457199BE38DBBDC86092693E
gpg: Can't check signature: No public key
root@ubuntu2004:/home/student_aitu_dias/kernel#
```

Step 1.4. Set-up recovery key

gpg --recv-keys 79BE3E4300411886

```
root@ubuntu2004:/home/student_aitu_dias/kernel# gpg --recv-keys 79BE3E4300411886
gpg: key 79BE3E4300411886: new key but contains no user ID - skipped
gpg: Total number processed: 1
gpg:           w/o user IDs: 1
root@ubuntu2004:/home/student_aitu_dias/kernel# gpg --verify linux-5.16.9.tar.sign
gpg: assuming signed data in 'linux-5.16.9.tar'
gpg: Signature made Fri 11 Feb 2022 03:27:25 AM EST
gpg:                using RSA key 647F28654894E3BD457199BE38DBBDC86092693E
gpg: Can't check signature: No public key
```

Step 1.5. Extract tar file

tar xvf linux-5.16.9.tar

```
root@ubuntu2004:/home/student_aitu_dias/kernel# ls
linux-5.16.9  linux-5.16.9.tar  linux-5.16.9.tar.sign
root@ubuntu2004:/home/student_aitu_dias/kernel#
```

Step 1.6. Configure the Linux kernel features and modules

cd linux-5.16.9

cp -v /boot/config-$(uname -r) .config

```
root@ubuntu2004:/home/student_aitu_dias/kernel# cd linux-5.16.9
root@ubuntu2004:/home/student_aitu_dias/kernel/linux-5.16.9# ls
arch    COPYING  Documentation  include  Kbuild   lib          Makefile         modules.builtin.modinfo  Module.symvers  samples   sound       usr      vmlinux-gdb.py  vmlinux.symvers
block   CREDITS  drivers        init     Kconfig  LICENSES     mm               modules-only.symvers     net             scripts   System.map  virt     vmlinux.map
certs   crypto   fs             ipc      kernel   MAINTAINERS  modules.builtin  modules.order            README          security  tools       vmlinux  vmlinux.o
root@ubuntu2004:/home/student_aitu_dias/kernel/linux-5.16.9#
```

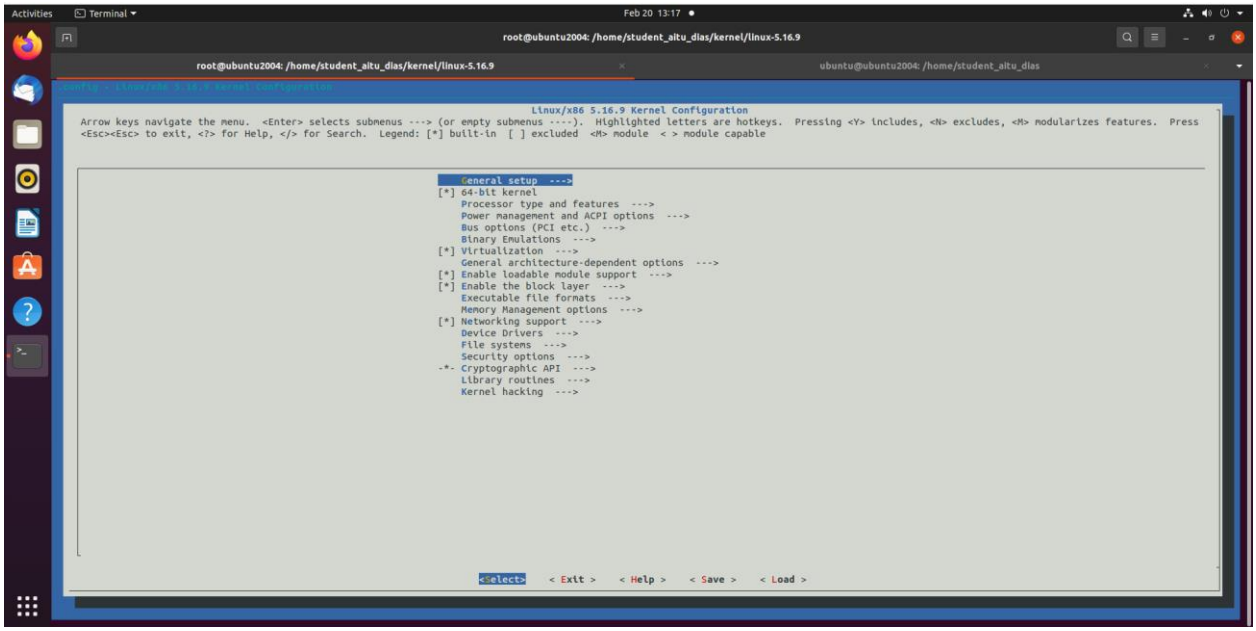
Step 2. Install the required compilers and other tools

sudo apt-get install build-essential libncurses-dev bison flex libssl-dev libelf-dev

```
root@ubuntu2004:/home/student_aitu_dias/kernel/linux-5.16.9# sudo apt-get install build-essential libncurses-dev bison flex libssl-dev libelf-dev
Reading package lists... Done
Building dependency tree
Reading state information... Done
bison is already the newest version (2:3.5.1+dfsg-1).
flex is already the newest version (2.6.4-6.2).
libelf-dev is already the newest version (0.176-1.1build1).
libncurses-dev is already the newest version (6.2-0ubuntu2).
build-essential is already the newest version (12.8ubuntu1.1).
libssl-dev is already the newest version (1.1.1f-1ubuntu2.17).
0 upgraded, 0 newly installed, 0 to remove and 103 not upgraded.
root@ubuntu2004:/home/student_aitu_dias/kernel/linux-5.16.9#
```

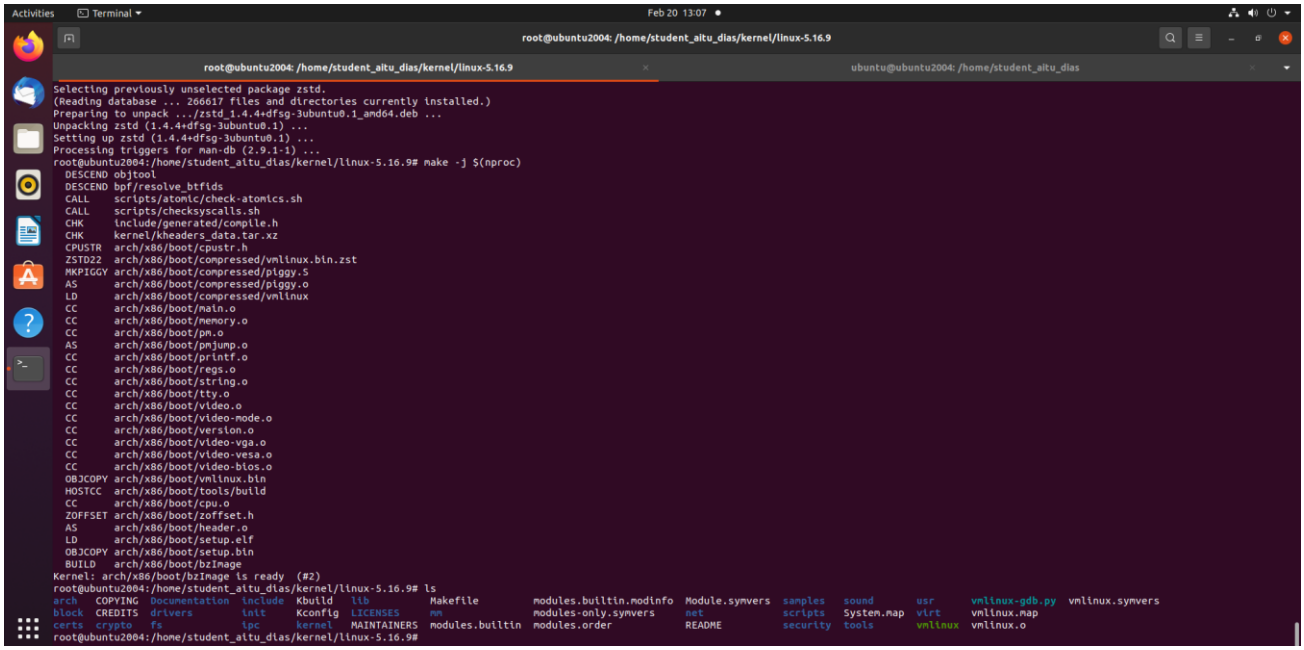
Step 3. Configuring the kernel module

make menuconfig



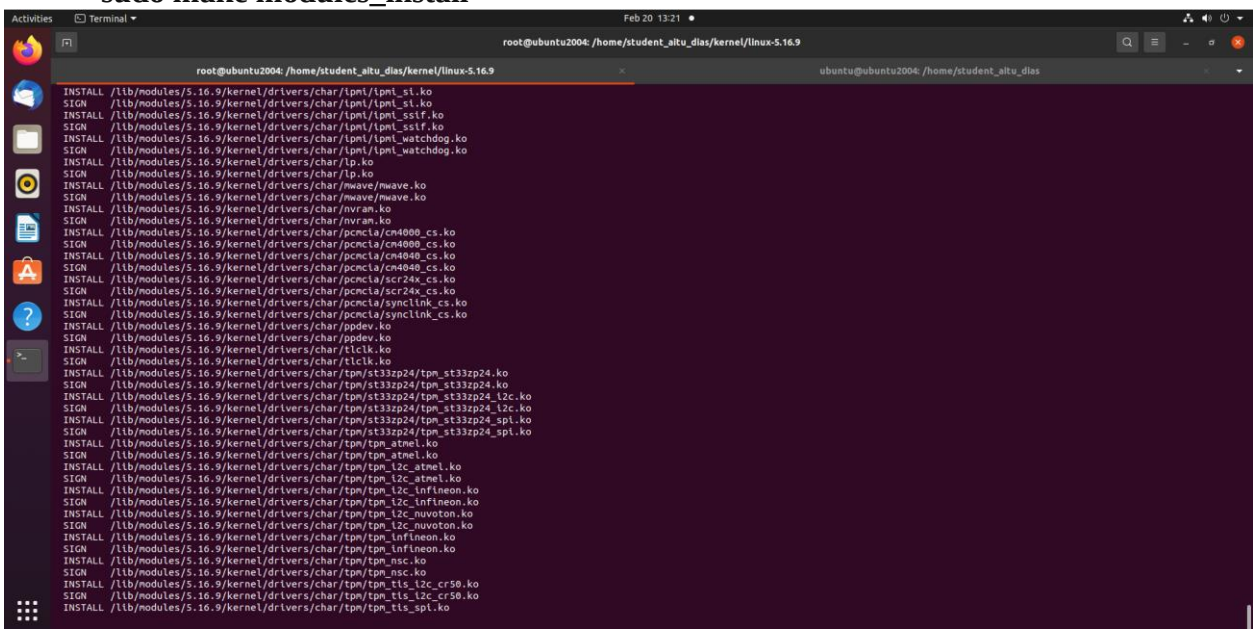
Step 4. Compile the kernel module

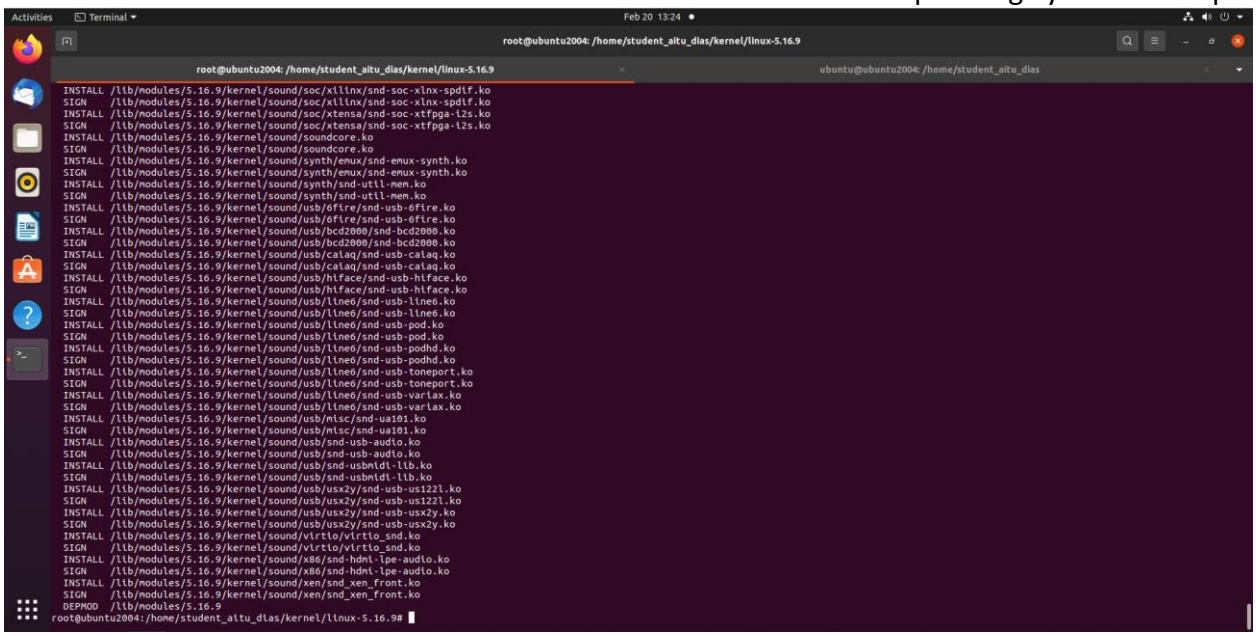
make -j $(nproc)



Step 5. Install the Kernel Linux module

sudo make modules_install





Step 6. Install the Linux Kernel

sudo make install

```
root@ubuntu2004:/home/student_aitu_dias/kernel/linux-5.16.9# sudo make install
arch/x86/Makefile:142: CONFIG_X86_X32 enabled but no binutils support
sh ./arch/x86/boot/install.sh 5.16.9 \
        arch/x86/boot/bzImage System.map "/boot"
run-parts: executing /etc/kernel/postinst.d/apt-auto-removal 5.16.9 /boot/vmlinuz-5.16.9
run-parts: executing /etc/kernel/postinst.d/dkms 5.16.9 /boot/vmlinuz-5.16.9
 * dkms: running auto installation service for kernel 5.16.9
run-parts: executing /etc/kernel/postinst.d/initramfs-tools 5.16.9 /boot/vmlinuz-5.16.9
update-initramfs: Generating /boot/initrd.img-5.16.9
I: The initramfs will attempt to resume from /dev/dm-1
I: (/dev/mapper/vgubuntu-swap_1)
I: Set the RESUME variable to override this.
run-parts: executing /etc/kernel/postinst.d/unattended-upgrades 5.16.9 /boot/vmlinuz-5.16.9
run-parts: executing /etc/kernel/postinst.d/update-notifier 5.16.9 /boot/vmlinuz-5.16.9
run-parts: executing /etc/kernel/postinst.d/xx-update-initrd-links 5.16.9 /boot/vmlinuz-5.16.9
I: /boot/initrd.img.old is now a symlink to initrd.img-5.15.0-60-generic
I: /boot/initrd.img is now a symlink to initrd.img-5.16.9
run-parts: executing /etc/kernel/postinst.d/zz-update-grub 5.16.9 /boot/vmlinuz-5.16.9
Sourcing file `/etc/default/grub'
Sourcing file `/etc/default/grub.d/init-select.cfg'
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-5.16.9
Found initrd image: /boot/initrd.img-5.16.9
Found linux image: /boot/vmlinuz-5.15.0-60-generic
Found initrd image: /boot/initrd.img-5.15.0-60-generic
Found linux image: /boot/vmlinuz-5.15.0-58-generic
Found initrd image: /boot/initrd.img-5.15.0-58-generic
Found memtest86+ image: /boot/memtest86+.elf
Found memtest86+ image: /boot/memtest86+.bin
done
root@ubuntu2004:/home/student_aitu_dias/kernel/linux-5.16.9# S
```

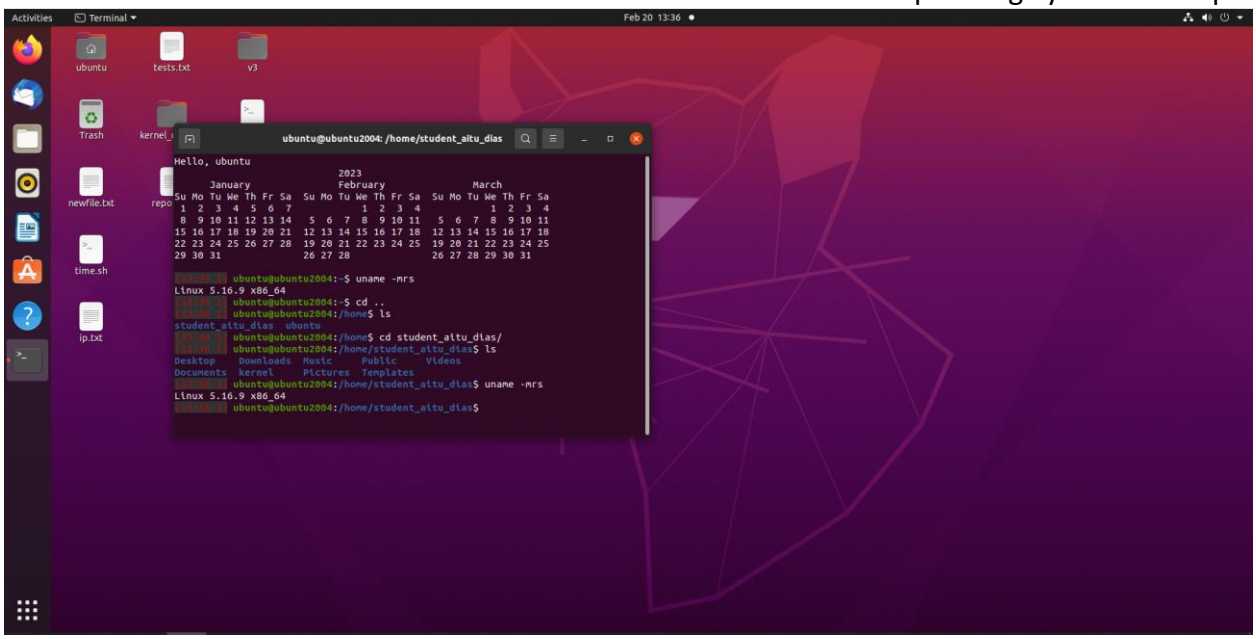
Step 7. Update grub config

sudo update-initramfs -c -k 5.16.9

sudo update-grub

```
root@ubuntu2004:/home/student_aitu_dias/kernel/linux-5.16.9# sudo update-initramfs -c -k 5.16.9
update-initramfs: Generating /boot/initrd.img-5.16.9
I: The initramfs will attempt to resume from /dev/dm-1
I: (/dev/mapper/vgubuntu-swap_1)
I: Set the RESUME variable to override this.
root@ubuntu2004:/home/student_aitu_dias/kernel/linux-5.16.9# sudo update-grub
Sourcing file `/etc/default/grub'
Sourcing file `/etc/default/grub.d/init-select.cfg'
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-5.16.9
Found initrd image: /boot/initrd.img-5.16.9
Found linux image: /boot/vmlinuz-5.15.0-60-generic
Found initrd image: /boot/initrd.img-5.15.0-60-generic
Found linux image: /boot/vmlinuz-5.15.0-58-generic
Found initrd image: /boot/initrd.img-5.15.0-58-generic
Found memtest86+ image: /boot/memtest86+.elf
Found memtest86+ image: /boot/memtest86+.bin
done
root@ubuntu2004:/home/student_aitu_dias/kernel/linux-5.16.9# THIS IS GROUP FROM CS-2104S ASADULLA ABIDILLA, DIAS ABDIGAZIZOV, SMAGULOV ASLANBEK, ZHUMAGAZIYEV KUANYSH
```

Step 8. Reboot and run by new kernel



Successfully our kernel module is upgraded to our custom module

Screenshots of the code compilation result:

CONCLUSION

Our final project for OSC required hard work as we needed to develop skills that are crucial for our future as cybersecurity specialists or system administrators. These skills included adding new users to the OS, establishing Internet connections using various methods, and building a Linux OS kernel using kernel modules. The creation of the Linux kernel module gave us a deeper understanding of the Linux kernel and its operations, allowing us to create unique drivers, expand the capabilities of the kernel and understand how the kernel and hardware interact. In general, these events taught us the various elements necessary for the administration of a Linux system. Each stage, from user management to Internet connection, requires a certain level of knowledge and understanding of the underlying systems and protocols. Thanks to this experience, we have learned valuable lessons and have a better understanding of how these concepts are applied in real-world scenarios.

In addition to the technical skills we acquired, this project also helped us develop important soft skills such as teamwork, time management and communication. Collaboration with our colleagues and knowledge sharing were crucial to the success of the project, and we learned how to balance our workload and effectively meet deadlines. We also honed our communication skills by presenting our work and ideas to our classmates and teachers.

In addition, this project allowed us to look into the rapidly developing world of cybersecurity and understand the importance of ensuring the security of systems. We realized the importance of vigilance and a proactive approach to ensuring the security of systems and protecting confidential information from cyber threats.

Overall, our final project for OSC was a valuable learning experience that prepared us for future challenges in cybersecurity and system administration. This not only provided us with technical skills, but also helped us develop important soft skills and a broader understanding of the importance of system security.