

Final Exam

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

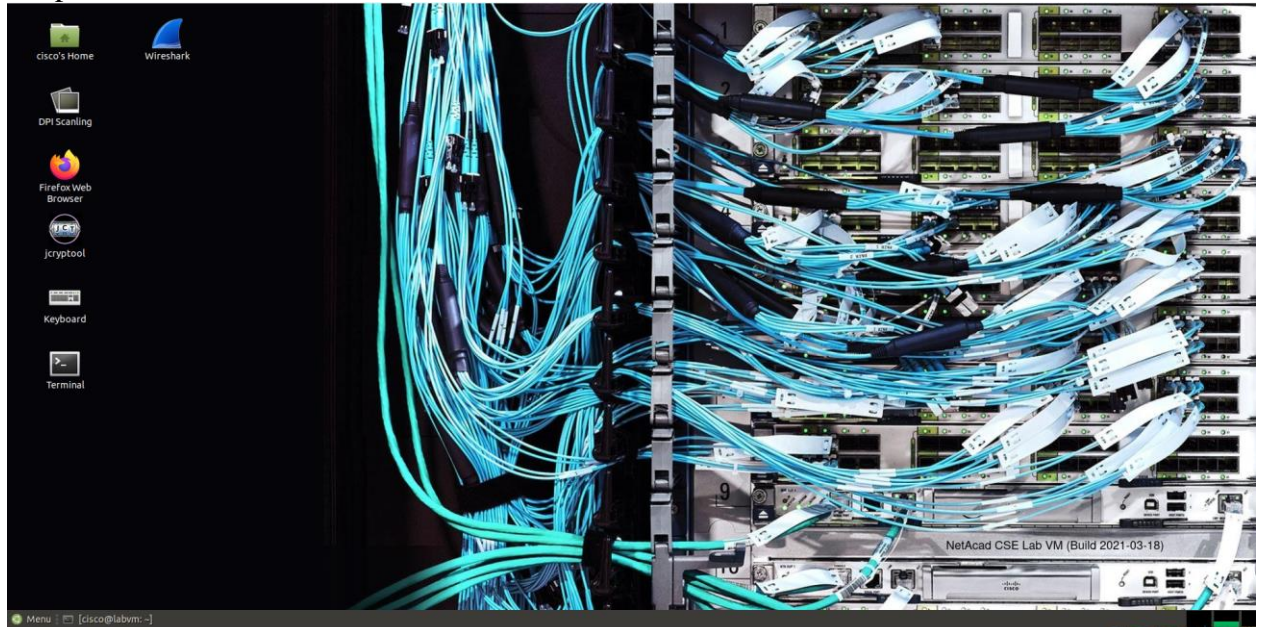
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Step-by-step task completion:

TASK 1:

1. Open the Ubuntu linux

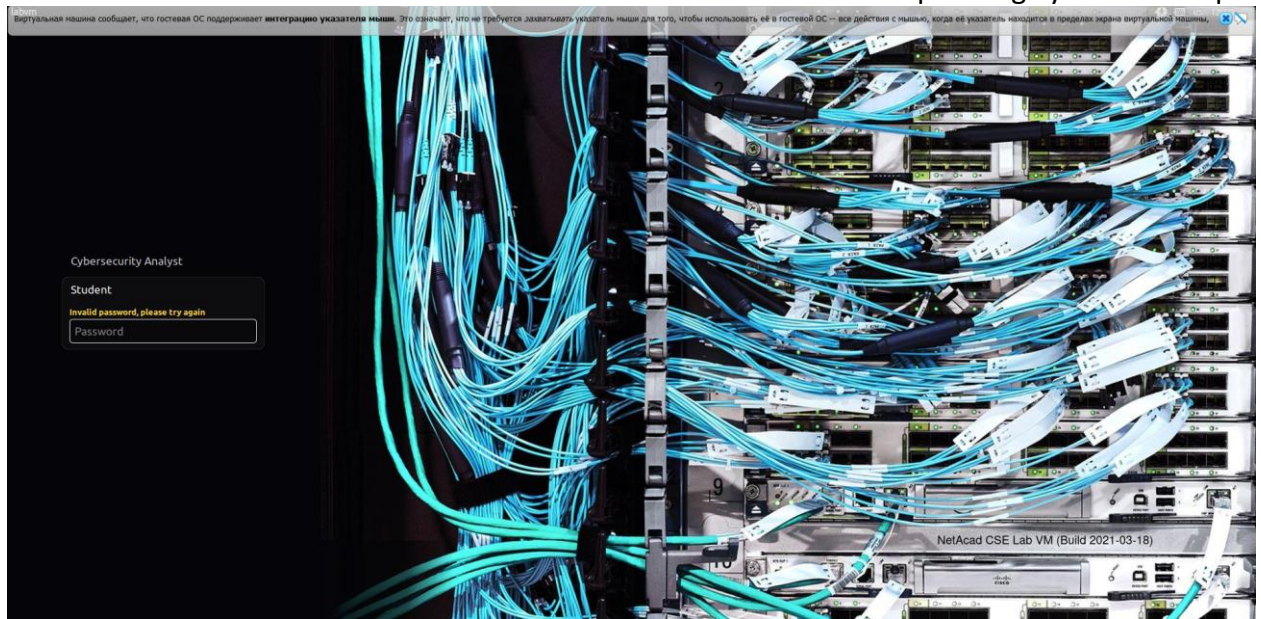


2. adding user named “student”

```
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 -s /bin/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

```

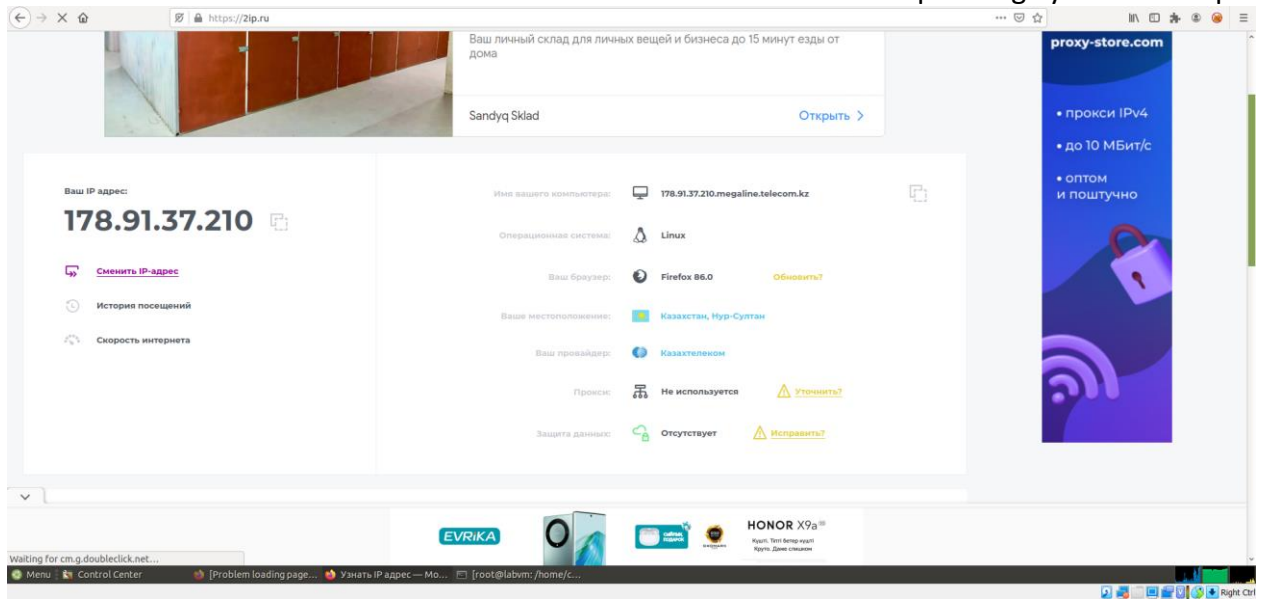
root@labvm:/home/cisco# sudo sysctl -w net.ipv4.ip_forward=1
net.ipv4.ip_forward = 1
root@labvm:/home/cisco#

root@labvm:/home/cisco# sudo iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE
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:



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

Имя вашего компьютера: 178.91.37.210.megaline.telecom.kz

Операционная система: Linux

Ваш браузер: Firefox 86.0 [Обновить?](#)

Ваше местоположение: Казахстан, Нур-Султан

Ваш провайдер: Казактелеком

Прокси: Не используется [Уточнить?](#)

Защита данных: Отсутствует [Исправить?](#)

proxy-store.com

- прокси IPv4
- до 10 МБит/с
- оптом и поштучно

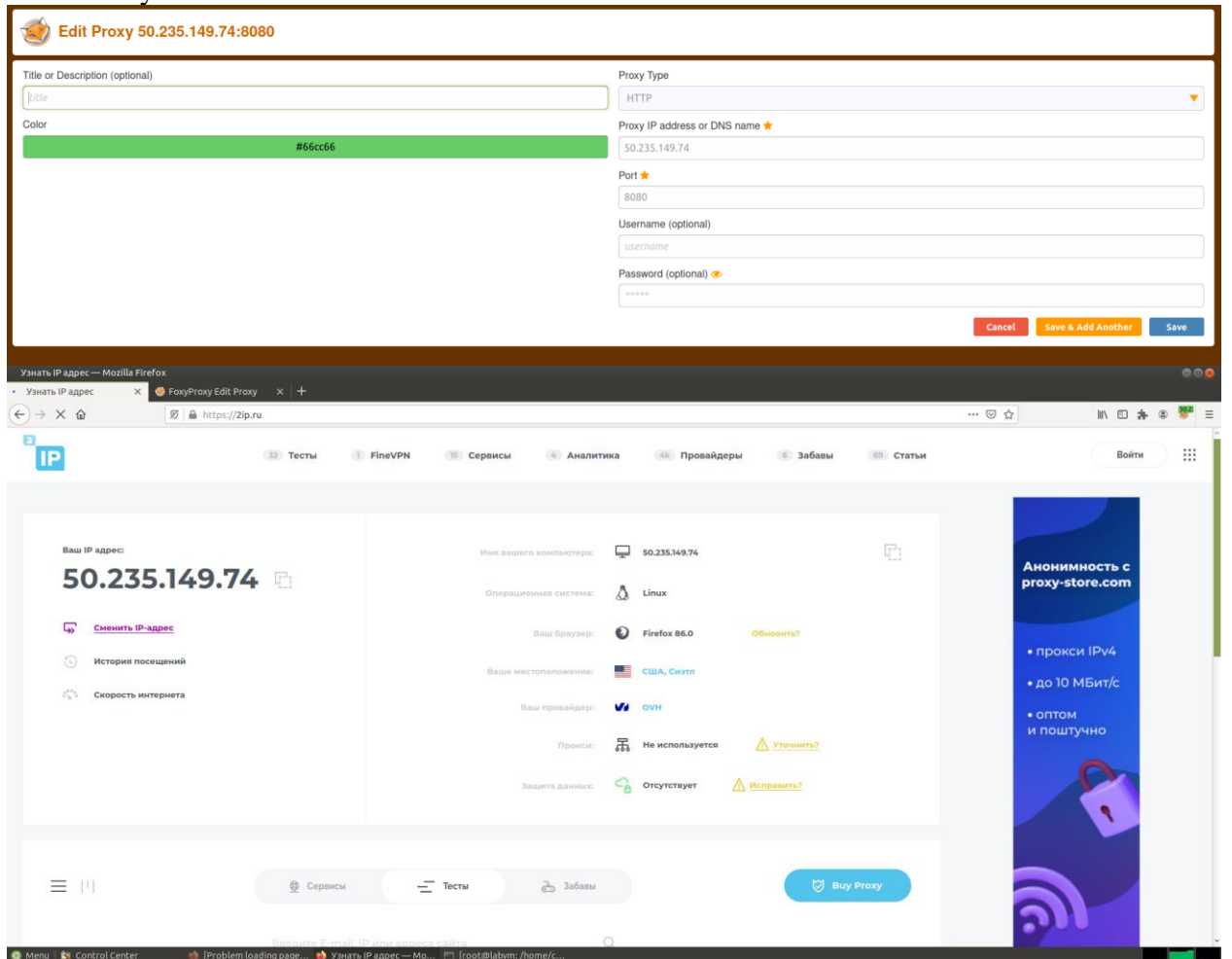
EVRIKA

HONOR X9a

Waiting for cm.g.doubleclick.net...

Menu Control Center [Problem loading page...] Узнать IP адрес — Мо... [root@labvm:/home/c/...

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

Узнать IP адрес

IP

Тесты FineVPN Сервисы Аналитика Провайдеры Забавы Статьи Войти

Ваш IP адрес:
50.235.149.74

[Сменить IP-адрес](#)

История посещений

Скорость интернета

Имя вашего компьютера: 50.235.149.74

Операционная система: Linux

Ваш браузер: Firefox 86.0 [Обновить?](#)

Ваше местоположение: США, Скотт

Ваш провайдер: OVH

Прокси: Не используется [Уточнить?](#)

Защита данных: Отсутствует [Исправить?](#)

Сервисы Тесты Забавы Buy Proxy

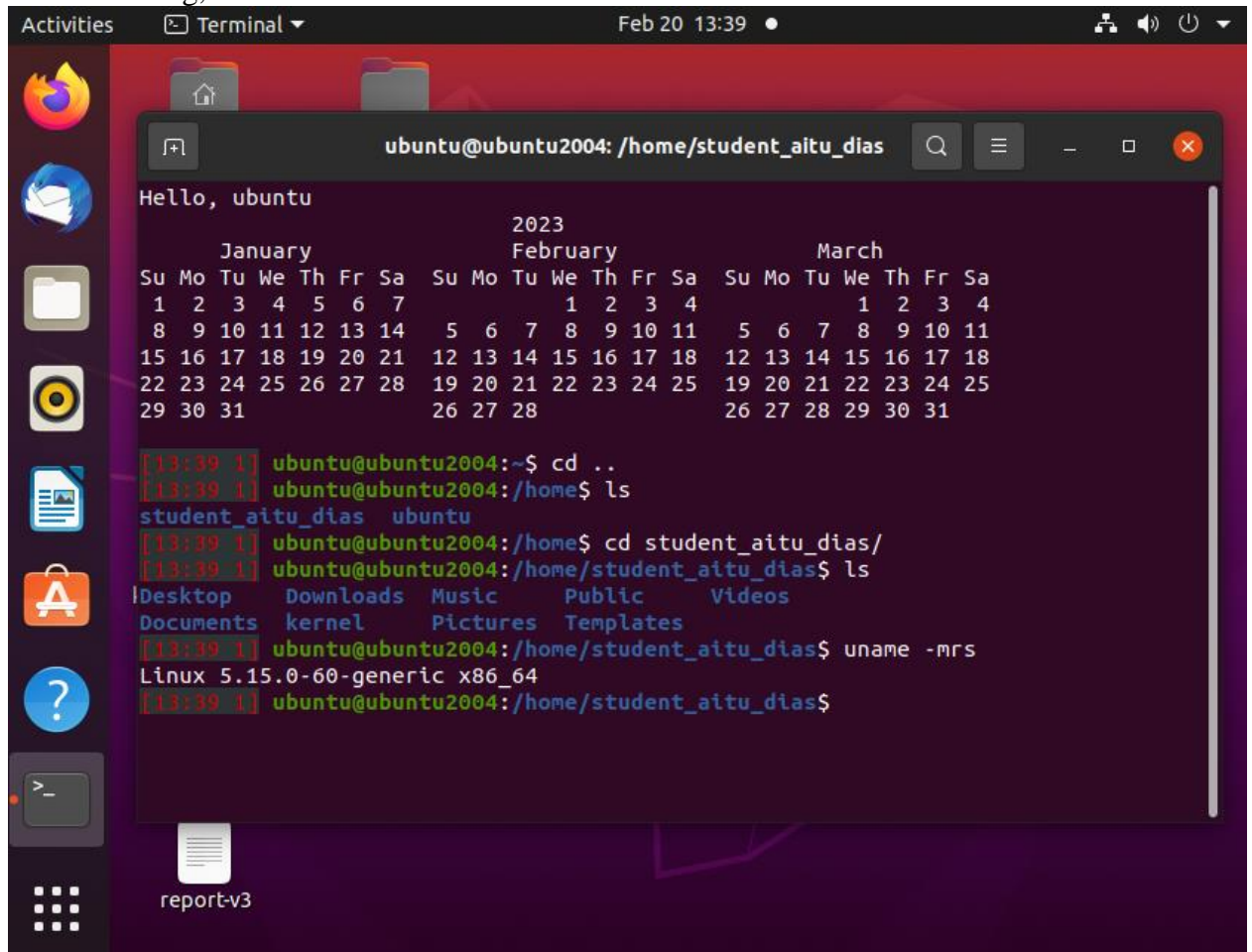
Анонимность с proxy-store.com

- прокси IPv4
- до 10 МБит/с
- оптом и поштучно

Menu Control Center [Problem loading page...] Узнать IP адрес — Мо... [root@labvm:/home/c/...

TASK 3:

Before starting, our kernel module is



```

ubuntu@ubuntu2004: /home/student_aitu_dias
Hello, ubuntu
2023
January February March
Su Mo Tu We Th Fr Sa Su Mo Tu We Th Fr Sa Su Mo Tu We Th Fr Sa
1 2 3 4 5 6 7 5 6 7 8 9 10 11 1 2 3 4
8 9 10 11 12 13 14 12 13 14 15 16 17 18 5 6 7 8 9 10 11
15 16 17 18 19 20 21 19 20 21 22 23 24 25 12 13 14 15 16 17 18
22 23 24 25 26 27 28 26 27 28 26 27 28 29 30 31
29 30 31

[13:39 ~] ubuntu@ubuntu2004:~$ cd ..
[13:39 ~] ubuntu@ubuntu2004:/home$ ls
student_aitu_dias  ubuntu
[13:39 ~] ubuntu@ubuntu2004:/home$ cd student_aitu_dias/
[13:39 ~] ubuntu@ubuntu2004:/home/student_aitu_dias$ ls
Desktop  Downloads  Music      Public     Videos
Documents  kernel     Pictures  Templates
[13:39 ~] ubuntu@ubuntu2004:/home/student_aitu_dias$ uname -mrs
Linux 5.15.0-60-generic x86_64
[13:39 ~] ubuntu@ubuntu2004:/home/student_aitu_dias$
  
```

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  modules.order  net  README  scripts  System.map  virt  vmlinux.map
certs  crypto  fs  ipc  kernel  MAINTAINERS  modules.builtin  modules.order  README  security  tools  vmlinux  vmlinux.o
```

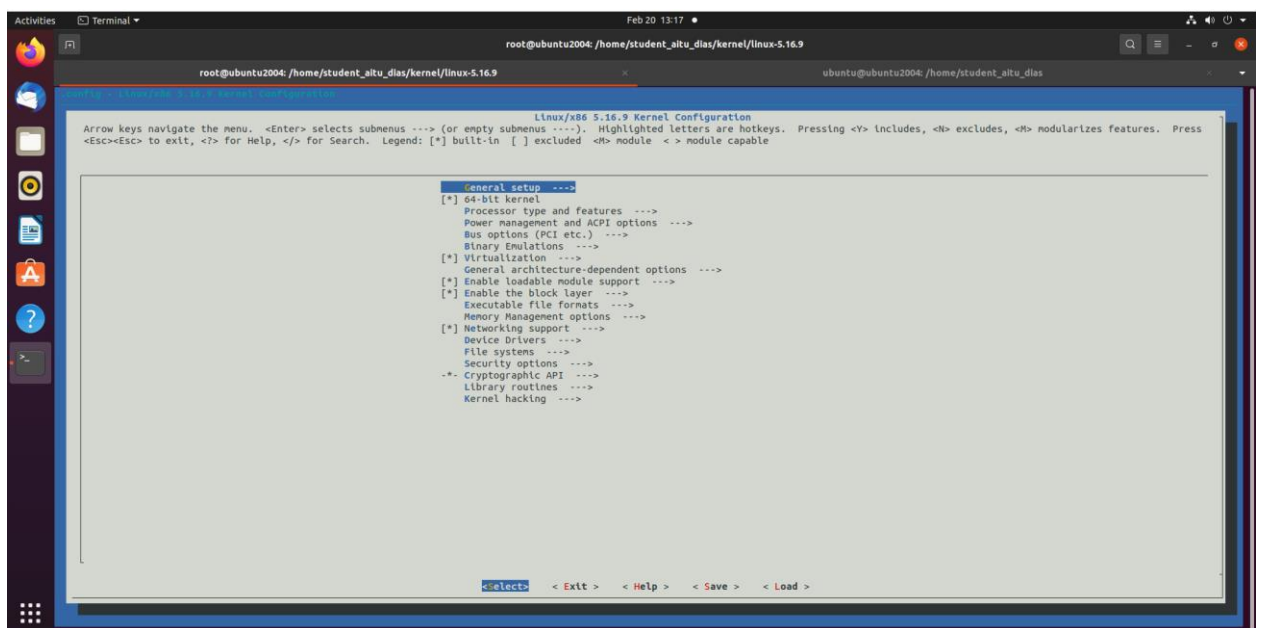
Step 2. Install the required compilers and other tools

```
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)
```



```

root@ubuntu2004: /home/student_altu_dias/kernel/linux-5.16.9
Selecting previously unselected package zstd.
(Reading database ... 266617 files and directories currently installed.)
Preparing to unpack .../zstd_1.4.4+dfsg-3ubuntu0.1_and04.deb ...
Unpacking zstd (1.4.4+dfsg-3ubuntu0.1) ...
Setting up zstd (1.4.4+dfsg-3ubuntu0.1) ...
Processing triggers for man-db (2.9.1-1) ...
root@ubuntu2004: /home/student_altu_dias/kernel/linux-5.16.9# make -j $(nproc)
DESCEND objtool
CALL scripts/atomlc/check-atomlcs.sh
CALL scripts/checksyscalls.sh
CHK include/generated/compile.h
CHK kernel/kheaders_data.tar.xz
CPUSTR arch/x86/boot/cpustr.h
ZSTD22 arch/x86/boot/compressed/vmlinux.bin.zst
HWCOPY arch/x86/boot/compressed/piggy.o
AS arch/x86/boot/compressed/piggy.o
LD arch/x86/boot/compressed/vmlinux
CC arch/x86/boot/main.o
CC arch/x86/boot/memory.o
CC arch/x86/boot/pm.o
AS arch/x86/boot/pmjump.o
CC arch/x86/boot/pmprint.o
CC arch/x86/boot/regs.o
CC arch/x86/boot/string.o
CC arch/x86/boot/tty.o
CC arch/x86/boot/video.o
CC arch/x86/boot/video-node.o
CC arch/x86/boot/version.o
CC arch/x86/boot/video-vga.o
CC arch/x86/boot/video-vesa.o
CC arch/x86/boot/video-vtos.o
OBJCOPY arch/x86/boot/vmlinux.bin
HOSTCC arch/x86/boot/tools/build
CC arch/x86/boot/cpu.o
ZOFFSET arch/x86/boot/zoffset.h
AS arch/x86/boot/header.o
LD arch/x86/boot/setup.elf
OBJCOPY arch/x86/boot/setup.bin
BUILD arch/x86/boot/bzImage
Kernel arch/x86/boot/bzImage is ready (#2)
root@ubuntu2004: /home/student_altu_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  LICENSE  mm  modules-only.symvers  net  scripts  system.map  virt  vmlinux.map
certs  crypto  fs  kernel  MAINTAINERS  modules.builtin  modules.order  README  security  tools  vmlinux  vmlinux.o
root@ubuntu2004: /home/student_altu_dias/kernel/linux-5.16.9#

```

Step 5. Install the Kernel Linux module sudo make modules_install

```

root@ubuntu2004: /home/student_altu_dias/kernel/linux-5.16.9
INSTALL /lib/modules/5.16.9/kernel/drivers/char/lpnt/lpnt_st.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/lpnt/lpnt_st.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/lpnt/lpnt_sstf.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/lpnt/lpnt_sstf.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/lpnt/lpnt_watchdog.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/lpnt/lpnt_watchdog.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/lp.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/lp.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/mwave/mwave.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/mwave/mwave.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/nvram.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/nvram.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/pcncl/a/cn4000_cs.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/pcncl/a/cn4000_cs.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/pcncl/a/cn4040_cs.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/pcncl/a/cn4040_cs.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/pcncl/a/scr24x_cs.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/pcncl/a/scr24x_cs.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/pcncl/a/synclink_cs.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/pcncl/a/synclink_cs.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/ppdev.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/ppdev.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/tcl.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/tcl.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/tpm/st33zp24/tpm_st33zp24.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/tpm/st33zp24/tpm_st33zp24.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/tpm/st33zp24/tpm_st33zp24_t12c.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/tpm/st33zp24/tpm_st33zp24_t12c.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/tpm/st33zp24/tpm_st33zp24_spt.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/tpm/st33zp24/tpm_st33zp24_spt.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_atmel.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_atmel.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_l2c_atmel.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_l2c_atmel.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_l2c_infineon.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_l2c_infineon.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_l2c_nuvoton.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_l2c_nuvoton.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_infineon.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_infineon.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_nsc.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_nsc.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_tis_l2c_cr50.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_tis_l2c_cr50.ko
INSTALL /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_tis_spt.ko
SIGN /lib/modules/5.16.9/kernel/drivers/char/tpm/tpm_tis_spt.ko

```

The image shows a dual-pane terminal window titled "Activities | Terminal". The top bar indicates the date and time as "Feb 20 13:24 •". Both panes show the same directory path: "root@ubuntu2004: /home/student_altu_dias/kernel/linux-5.16.9". The left pane displays a vertical list of kernel modules being installed, each preceded by the word "INSTALL". These include modules like snd-soc-xlnx-spdif.ko, snd-soc-xlnx.ko, snd-soc-xtfpga-lz.ko, snd-synth-emux-snd-emux-synth.ko, snd-util-men.ko, snd-usb-fir.ko, snd-bcd2008.ko, snd-catad.ko, snd-hiface.ko, snd-l1neof.snd-usb-l1neof.ko, snd-pod.ko, snd-variax.ko, snd-usi22l.ko, snd-usi22n.ko, snd-xen-front.ko, and xen_snd_front.ko. The right pane shows the output of the installation process, displaying "SIGN" messages for each module listed in the left pane, indicating they have been successfully signed.

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

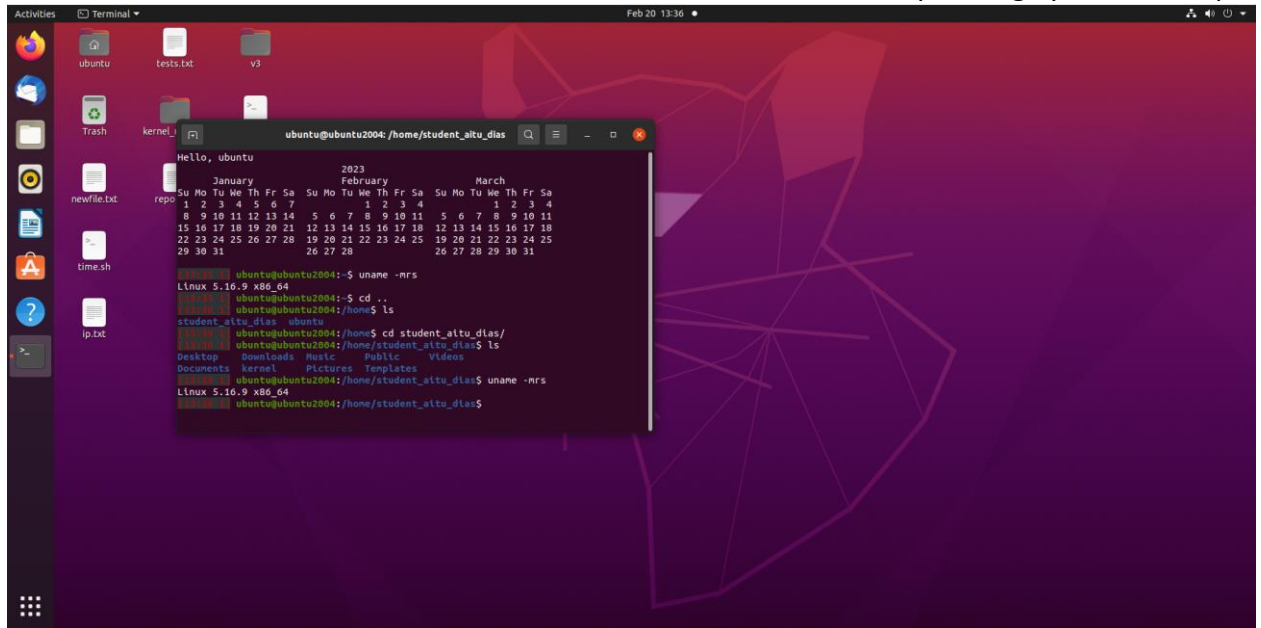
```

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-21045 ASADULLA ABDULLA, DIAS ABDIGAIZIYOV, SMAGULOV ASLANBEK, ZHUMAGAIZIYEV KUANYSH
```

Step 8. Reboot and run by new kernel



The screenshot shows a Linux desktop with a purple background. A terminal window is open, displaying a calendar for 2023 and system information. The terminal output is as follows:

```
Hello, ubuntu
2023
January February March
Su Mo Tu We Th Fr Sa Su Mo Tu We Th Fr Sa Su Mo Tu We Th Fr Sa
1 2 3 4 5 6 7 1 2 3 4 1 2 3 4
8 9 10 11 12 13 14 5 6 7 8 9 10 11 5 6 7 8 9 10 11
15 16 17 18 19 20 21 12 13 14 15 16 17 18 12 13 14 15 16 17 18
22 23 24 25 26 27 28 19 20 21 22 23 24 25 19 20 21 22 23 24 25
29 30 31 26 27 28 26 27 28 29 30 31

[11:25:41] ubuntu@ubuntu2004:~$ uname -mrs
Linux 5.16.9 x86_64
[11:25:41] ubuntu@ubuntu2004:~$ cd ..
[11:25:42] ubuntu@ubuntu2004:~/home$ ls
student_aitu_dias  ubuntu
[11:25:42] ubuntu@ubuntu2004:~/home$ cd student_aitu_dias/
[11:25:42] ubuntu@ubuntu2004:~/home/student_aitu_dias$ ls
Desktop  Downloads  Music  Public  Videos
Documents  kernel  Pictures  Templates
[11:25:42] ubuntu@ubuntu2004:~/home/student_aitu_dias$ uname -mrs
Linux 5.16.9 x86_64
[11:25:42] ubuntu@ubuntu2004:~/home/student_aitu_dias$
```

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.