

CS3003D: Operating Systems

ASSIGNMENT 1

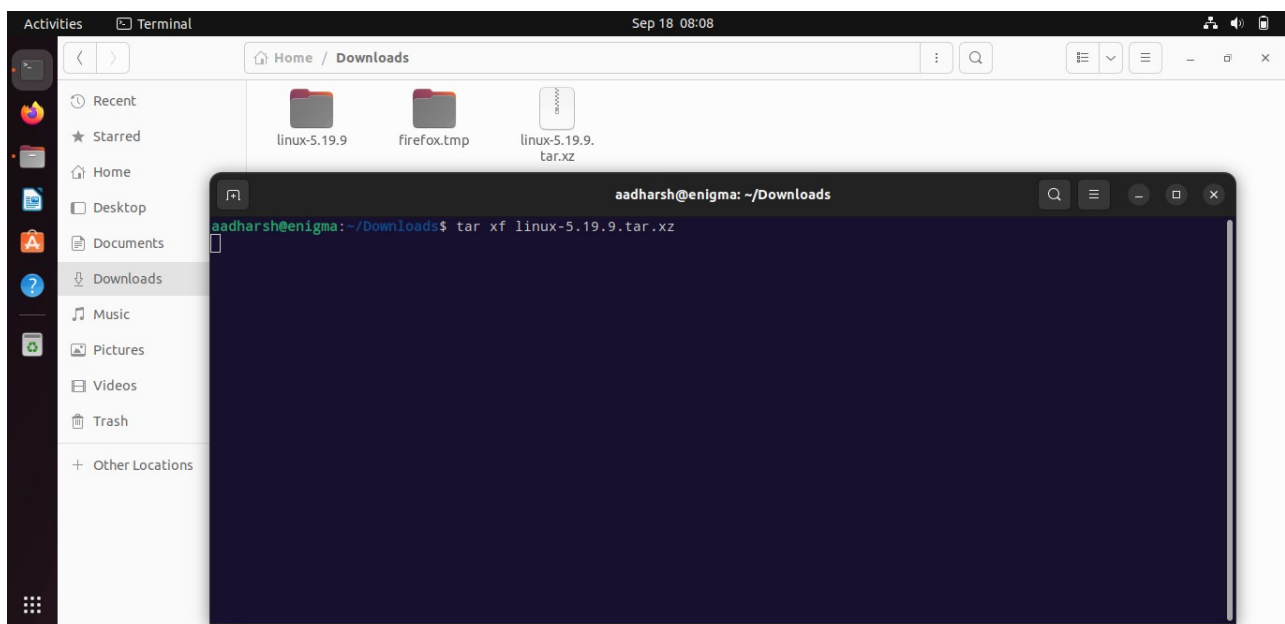
Problem Statement: Download the latest stable Linux kernel from kernel.org, compile it, and dual boot it with your current Linux version. Your current version as well as the new version should be present in the grub-menu.

Methodology: I have Ubuntu 22.04 installed as a VM in VirtualBox running kernel version 5.15.0. In this assignment I downloaded the source code of kernel 5.19.9 and dual booted it with my existing kernel.

Procedure:

1. Download the tar archive file of kernel-5.19.9.
2. Extract the tar archive.

```
tar xf linux-5.19.9.tar.xz
```

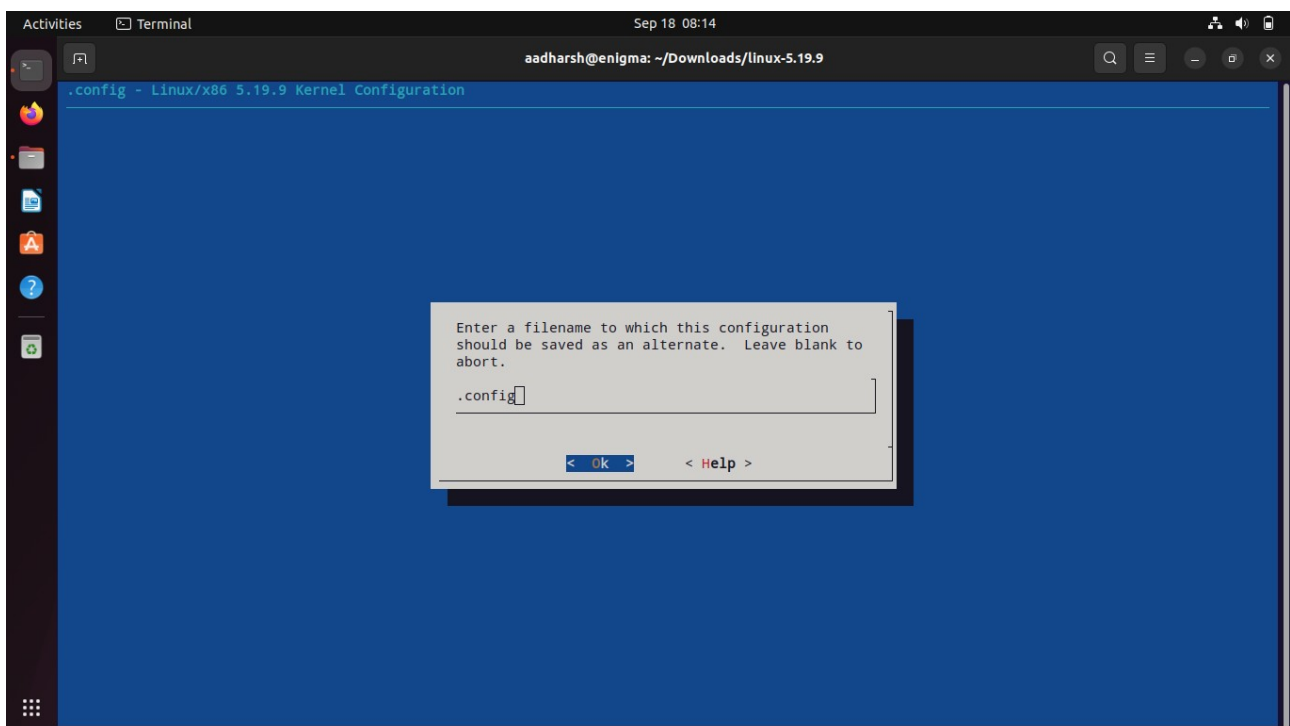
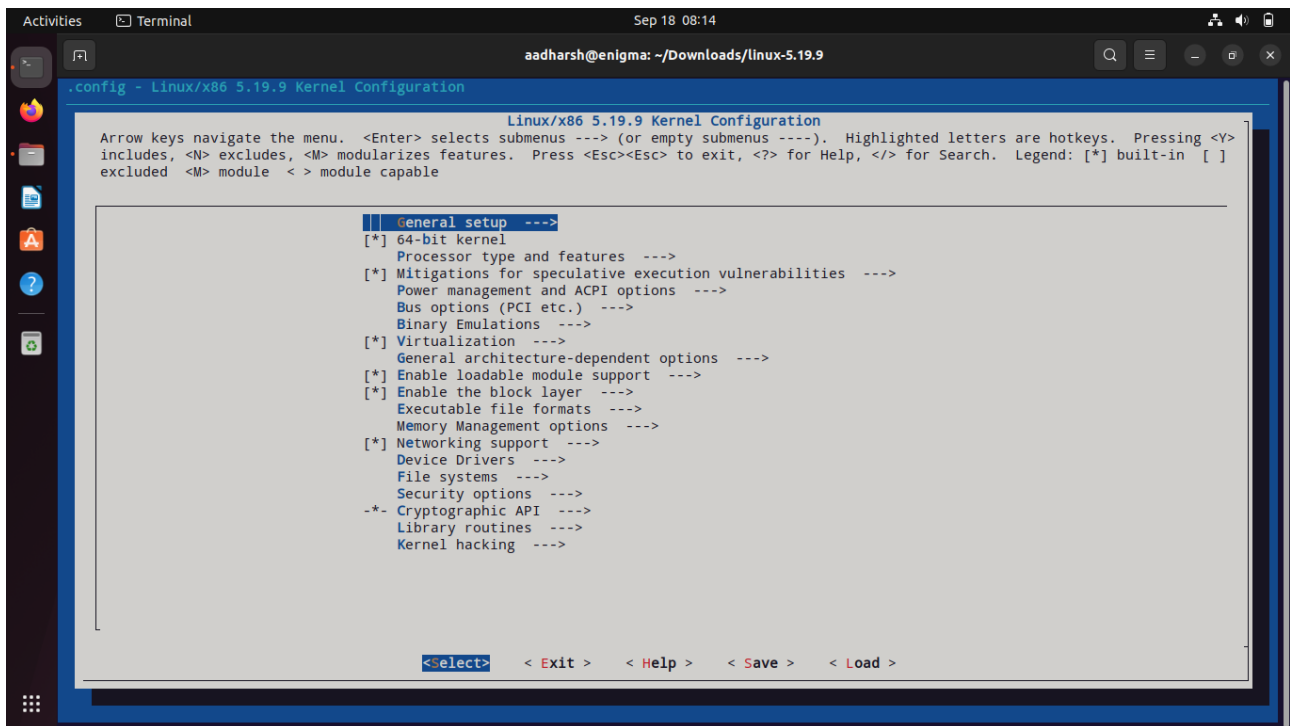


3. Navigate to the extracted directory.

```
cd linux-5.19.9
```

4. Copy existing kernel config file to the extracted directory and use *menuconfig* to make necessary changes. I have not made any changes to the .config file.

```
cp /boot/config-$(uname -r) .config  
make menuconfig
```



5. Now compile the kernel.

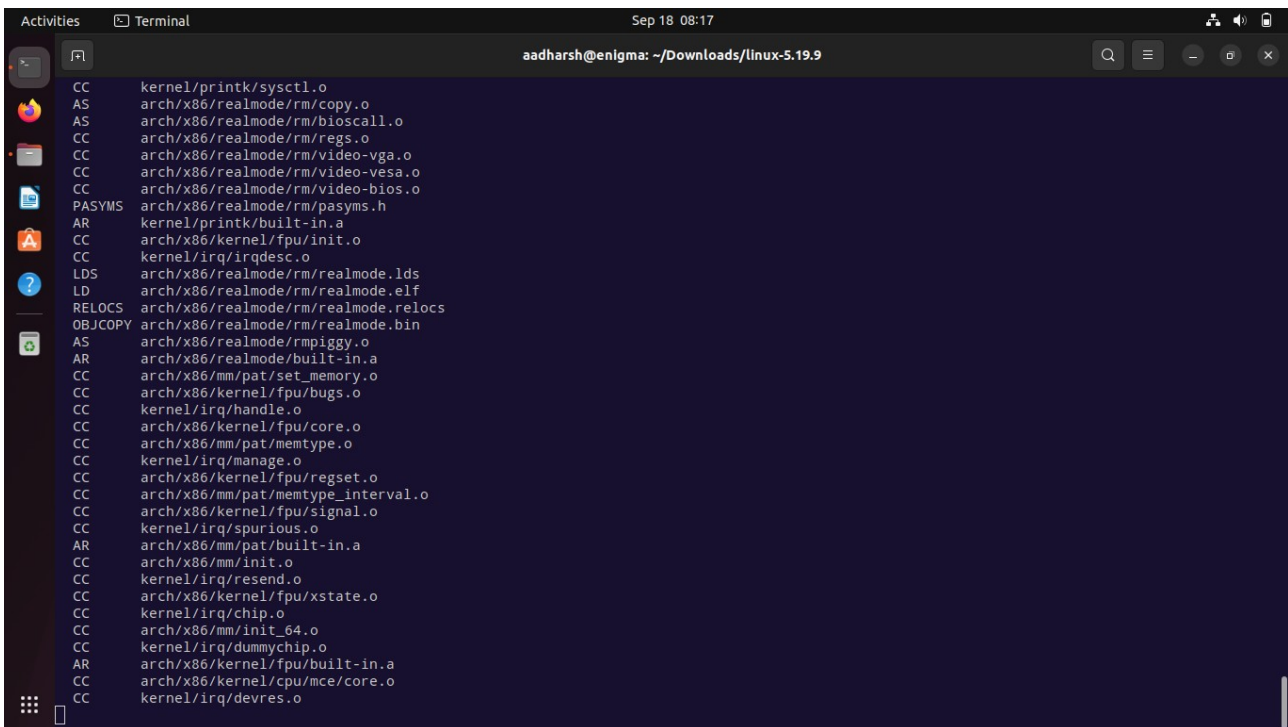
```
make
```

6. Install kernel modules.

```
make modules_install
```

7. Copy the kernel and .config file to the /boot folder and to generate the system.map file which stores the kernel symbol table.

```
make install
```



```
CC      kernel/printk/sysctl.o
AS      arch/x86/realmode/rm/copy.o
AS      arch/x86/realmode/rm/bioscall.o
CC      arch/x86/realmode/rm/regs.o
CC      arch/x86/realmode/rm/video-vga.o
CC      arch/x86/realmode/rm/video-vesa.o
CC      arch/x86/realmode/rm/video-bios.o
CC      arch/x86/realmode/rm/pasyms.h
CC      arch/x86/realmode/rm/realmode.lds
CC      arch/x86/realmode/rm/realmode.elf
CC      arch/x86/realmode/rm/realmode.relocs
CC      arch/x86/realmode/rm/realmode.bin
CC      arch/x86/realmode/rmpiggy.o
CC      arch/x86/realmode/built-in.a
CC      arch/x86/mm/pat/set_memory.o
CC      arch/x86/kernel/fpu/bugs.o
CC      kernel/irq/handle.o
CC      arch/x86/kernel/fpu/core.o
CC      arch/x86/mm/pat/memtype.o
CC      kernel/irq/manage.o
CC      arch/x86/kernel/fpu/regset.o
CC      arch/x86/mm/pat/memtype_interval.o
CC      arch/x86/kernel/fpu/signal.o
CC      kernel/irq/spurious.o
CC      arch/x86/mm/pat/built-in.a
CC      arch/x86/mm/init.o
CC      kernel/irq/resend.o
CC      arch/x86/kernel/fpu/xstate.o
CC      kernel/irq/chip.o
CC      arch/x86/mm/init_64.o
CC      kernel/irq/dummychip.o
CC      arch/x86/kernel/fpu/built-in.a
CC      arch/x86/kernel/cpu/mce/core.o
CC      kernel/irq/devres.o
```

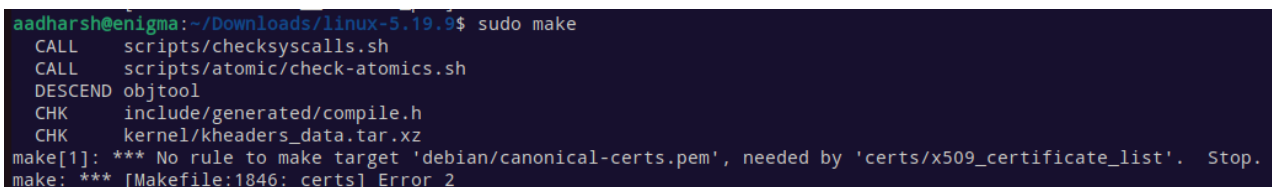
8. While executing the *make* command, I encountered the following error.

fatal error: libelf.h: No such file or directory

It was solved by installing libelf package.

```
sudo apt install libelf-dev
```

9. When *make* command was executed again, I got the following error.



```
aadharsh@enigma:~/Downloads/linux-5.19.9$ sudo make
CALL    scripts/checksyscalls.sh
CALL    scripts/atomic/check-atomics.sh
DESCEND objtool
CHK      include/generated/compile.h
CHK      kernel/kheaders_data.tar.xz
make[1]: *** No rule to make target 'debian/canonical-certs.pem', needed by 'certs/x509_certificate_list'. Stop.
make: *** [Makefile:1846: certs] Error 2
```

To solve this, I installed Ubuntu linux kernel sources and copied the certificates to /usr/local/src/debian/.

```
sudo mkdir -p /usr/local/src/debian
sudo apt install linux-source
sudo cp -v /usr/src/linux-source-*/debian/canonical-*.pem /usr/local/src/debian/
sudo apt purge linux-source*
```

Copy the certificates from `/usr/local/src/debian/` to current folder.

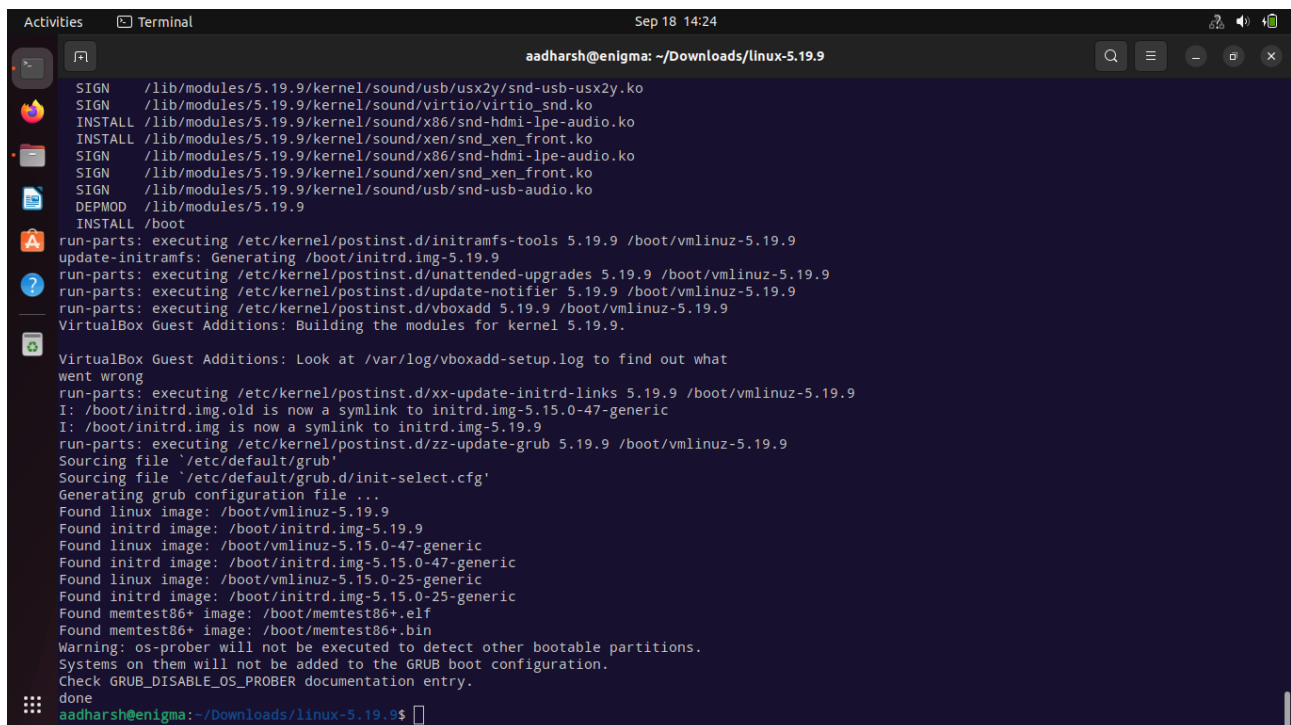
```
cp -vrd /usr/local/src/debian .
```

10. After the successful execution of above commands, create a new initramfs image for the newly installed kernel 5.19.9.

```
update-initramfs -c -k 5.19.9
```

11. Then execute the `update-grub` command which looks up the `/boot` directory and adds a grub menu entry for the new kernel.

```
sudo update-grub
```



```
Activities Terminal Sep 18 14:24
aadharsh@enigma: ~/Downloads/linux-5.19.9
SIGN /lib/modules/5.19.9/kernel/sound/usb/usb2y/snd-usb-usb2y.ko
SIGN /lib/modules/5.19.9/kernel/sound/virtio/virtio_snd.ko
INSTALL /lib/modules/5.19.9/kernel/sound/x86/snd-hdmi-lpe-audio.ko
INSTALL /lib/modules/5.19.9/kernel/sound/xen/snd_xen_front.ko
SIGN /lib/modules/5.19.9/kernel/sound/x86/snd-hdmi-lpe-audio.ko
SIGN /lib/modules/5.19.9/kernel/sound/xen/snd_xen_front.ko
SIGN /lib/modules/5.19.9/kernel/sound/usb/snd-usb-audio.ko
DEPMOD /lib/modules/5.19.9
INSTALL /boot
run-parts: executing /etc/kernel/postinst.d/initramfs-tools 5.19.9 /boot/vmlinuz-5.19.9
update-initramfs: Generating /boot/initrd.img-5.19.9
run-parts: executing /etc/kernel/postinst.d/unattended-upgrades 5.19.9 /boot/vmlinuz-5.19.9
run-parts: executing /etc/kernel/postinst.d/update-notifier 5.19.9 /boot/vmlinuz-5.19.9
run-parts: executing /etc/kernel/postinst.d/vboxadd 5.19.9 /boot/vmlinuz-5.19.9
VirtualBox Guest Additions: Building the modules for Kernel 5.19.9.
VirtualBox Guest Additions: Look at /var/log/vboxadd-setup.log to find out what
went wrong
run-parts: executing /etc/kernel/postinst.d/xx-update-initrd-links 5.19.9 /boot/vmlinuz-5.19.9
I: /boot/initrd.img.old is now a symlink to initrd.img-5.15.0-47-generic
I: /boot/initrd.img is now a symlink to initrd.img-5.19.9
run-parts: executing /etc/kernel/postinst.d/zz-update-grub 5.19.9 /boot/vmlinuz-5.19.9
Sourcing file '/etc/default/grub'
Sourcing file '/etc/default/grub.d/init-select.cfg'
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-5.19.9
Found initrd image: /boot/initrd.img-5.19.9
Found linux image: /boot/vmlinuz-5.15.0-47-generic
Found initrd image: /boot/initrd.img-5.15.0-47-generic
Found linux image: /boot/vmlinuz-5.15.0-25-generic
Found initrd image: /boot/initrd.img-5.15.0-25-generic
Found memtest86+ image: /boot/memtest86+.elf
Found memtest86+ image: /boot/memtest86+.bin
Warning: os-prober will not be executed to detect other bootable partitions.
Systems on them will not be added to the GRUB boot configuration.
Check GRUB_DISABLE_OS_PROBER documentation entry.
done
aadharsh@enigma:~/Downloads/linux-5.19.9$
```

12. On rebooting, the grub menu didn't show up. This was because the `GRUB_TIMEOUT` was set to 0 in the grub config file and hence the grub menu doesn't show up when the OS boots up. To solve this make the following changes in the `/etc/default/grub` file.

```
GRUB_TIMEOUT=10
GRUB_TIMEOUT_STYLE=menu
```

and run

```
sudo update-grub
```

13. On rebooting, the grub menu shows up and the new kernel version 5.19.9 is present among the boot options.

GNU GRUB version 2.06

```
*Ubuntu, with Linux 5.19.9
Ubuntu, with Linux 5.19.9 (recovery mode)
Ubuntu, with Linux 5.15.0-47-generic
Ubuntu, with Linux 5.15.0-47-generic (recovery mode)
Ubuntu, with Linux 5.15.0-25-generic
Ubuntu, with Linux 5.15.0-25-generic (recovery mode)
```

Use the ↑ and ↓ keys to select which entry is highlighted.
Press enter to boot the selected OS, `e' to edit the commands
before booting or `c' for a command-line. ESC to return previous
menu.