

# **COMPILING THE LATEST STABLE LINUX KERNEL AND DUAL BOOTING IT WITH THE CURRENT VERSION**

**Submitted by:**

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## **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.

## **Abstract:**

This report contains the complete process of compiling a latest stable Linux kernel and installing it alongside the current kernel version in Ubuntu 21.04 operating system. It demonstrates the process right from downloading the source code of the latest stable kernel v. 5.13.13, to dual booting it with the kernel v. 5.11.0-31-generic i.e., the compiled kernel can be loaded from the GRUB bootloader. Throughout the process, I have not used the install.sh script, instead, I have done everything manually. So, if you are using the commands `make` and `make install` then you might need to add and skip a few steps.

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## 1. Introduction

### 1.1 What is an Operating System?

An operating system is system software that manages computer hardware, software resources, and provides common services for computer programs. Your computer's operating system (OS) manages all of the software and hardware on the computer. Most of the time, there are several different computer programs running at the same time, and they all need to access your computer's central processing unit (CPU), memory, and storage. The operating system coordinates all of this to make sure each program gets what it needs. There are various types of Operating systems and Linux is one of them. Linux is an open-source operating system originally developed by Linus Torvalds.

### 1.2 What is a Linux Kernel?

The Linux® kernel is the main component of a Linux operating system (OS) and is the core interface between a computer's hardware and its processes. It communicates between the two, managing resources as efficiently as possible. The kernel is so named because—like a seed inside a hard shell—it exists within the OS and controls all the major functions of the hardware, whether it's a phone, laptop, server, or any other kind of computer.

### 1.3 What does a kernel do?

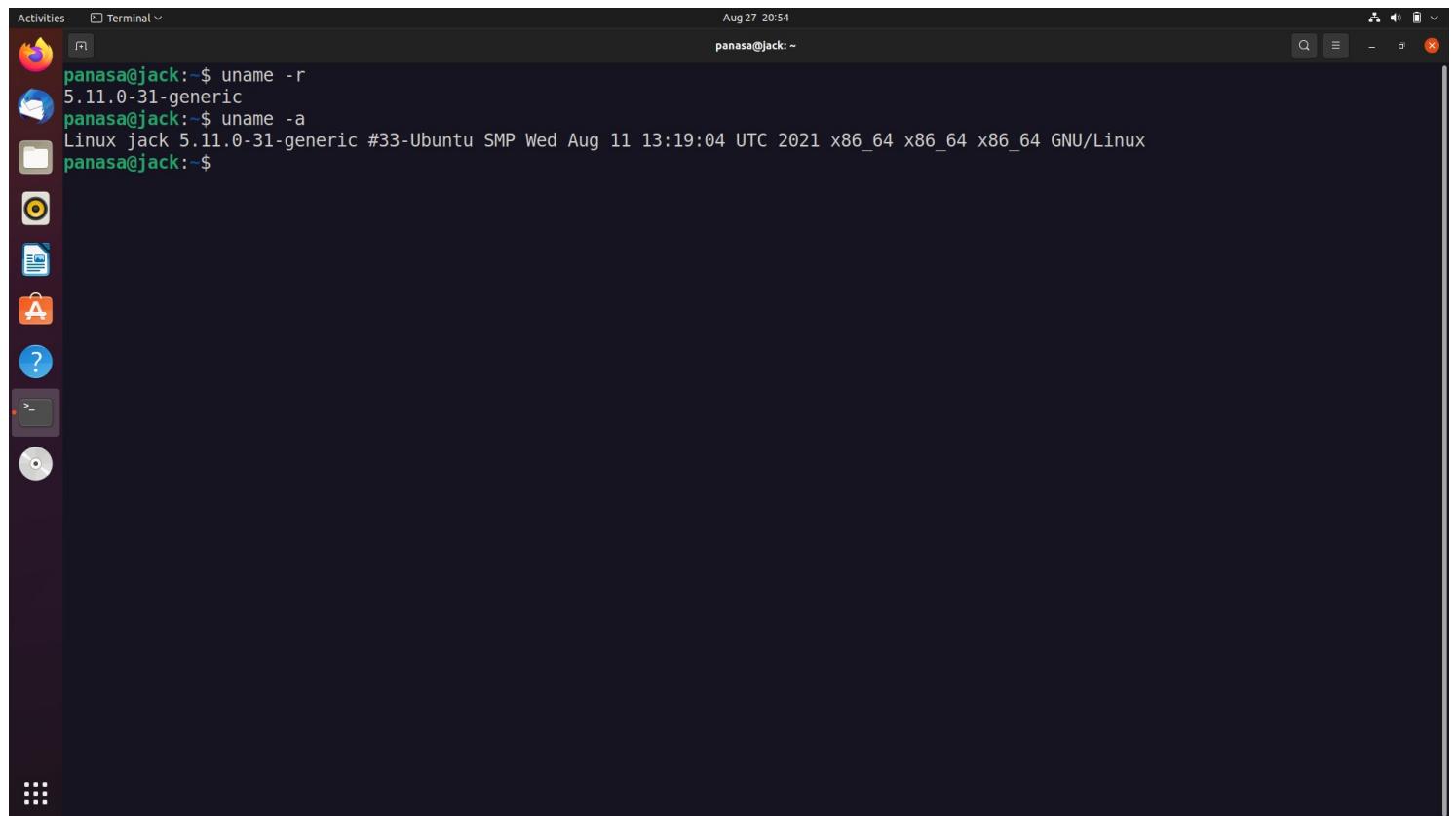
The kernel has 4 jobs:

1. Memory management: Keep track of how much memory is used to store what, and where.
2. Process management: Determine which processes can use the central processing unit (CPU), when, and for how long.
3. Device drivers: Act as mediator/interpreter between the hardware and processes.
4. System calls and security: Receive requests for service from the processes.

### System specifications:

<b>Kernel name</b>	Linux
<b>Host name</b>	jack
<b>Kernel release</b>	5.11.0-31-generic (kernel for the default Ubuntu 21.04 OS Image in Virtual box)
<b>Kernel version</b>	#33-Ubuntu SMP Wed Aug 11 13:19:04 UTC 2021
<b>Machine, processor, hardware platform</b>	x86_64
<b>Operating system</b>	GNU/Linux

The above details can be obtained from the command **uname -a**:

A screenshot of an Ubuntu desktop environment. On the left is a dock with icons for various applications like Dash, Home, Activities, Dash, and others. In the center is a terminal window titled 'Terminal' with the command 'uname -a' entered. The output shows the kernel version as 5.11.0-31-generic, the distribution as Linux jack 5.11.0-31-generic #33-Ubuntu SMP Wed Aug 11 13:19:04 UTC 2021, and the architecture as x86\_64 x86\_64 x86\_64 GNU/Linux. The terminal window has a dark theme and is running on an Xfce desktop environment.

## 2. Explanation and Methodology

Linux kernel compilation is majorly divided into five sections, downloading the kernel source code, configuring the kernel, compiling the source code, installing the kernel and finally updating the grub. Let us get into each one of them in detail.

### 2.1 Downloading the kernel source code

As stated earlier, Linux is an opensource operating system, which means the source codes are public and can be used, modified, distributed by everyone. The entities are termed as Linux distributions, shortly referred to as a "distro". Ex. Ubuntu, Monjaro, Pop!\_OS, Fedora, CentOS, Arch Linux, Kali Linux etc.

These distros come with a default stable kernel within them. But what we are looking for is to install another kernel version manually on one such distro.

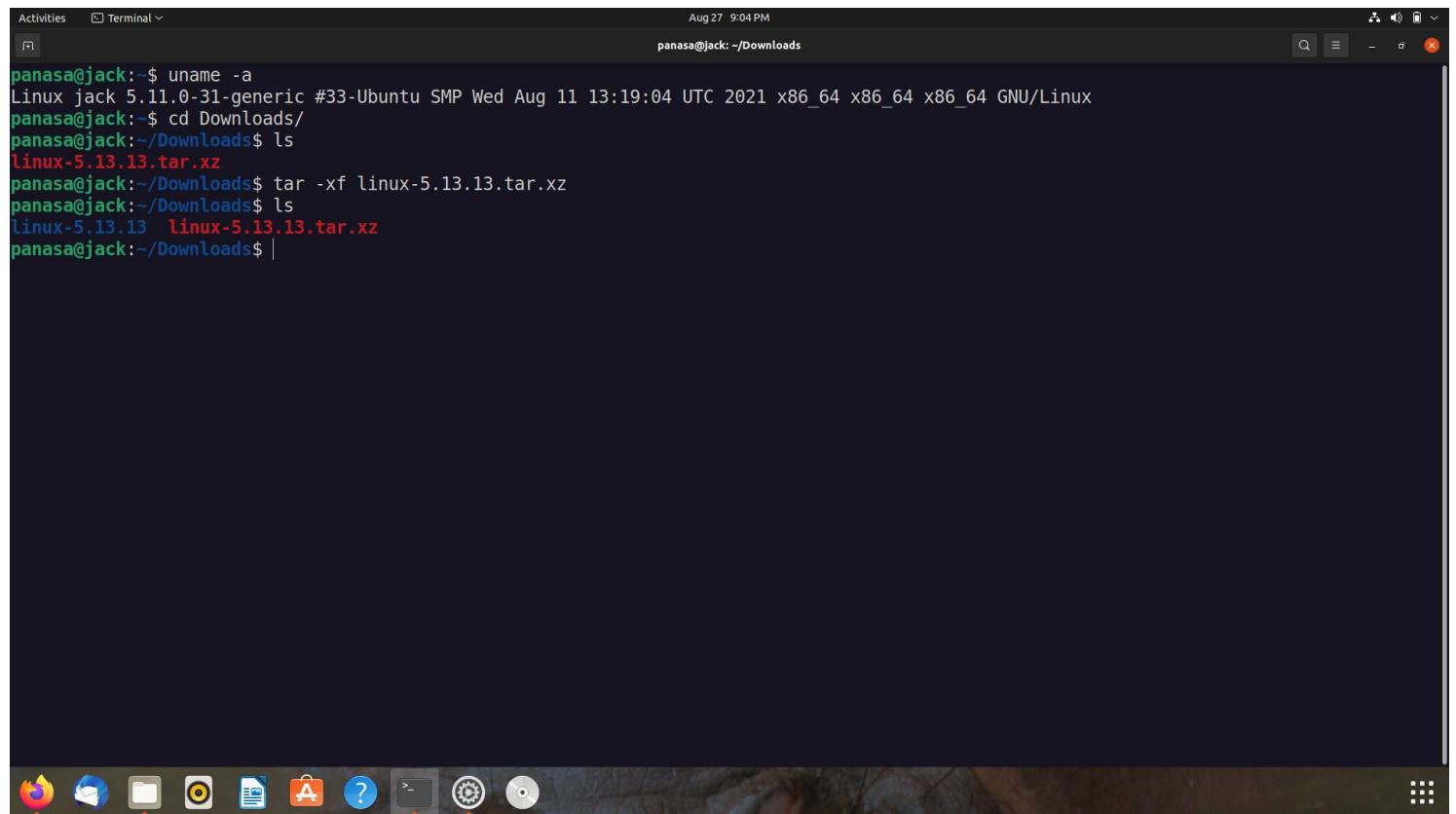
At the time of making this report the stable kernel version was 5.13.13

Download the source code using **wget**:

```
$ wget https://cdn.kernel.org/pub/linux/kernel/v5.x/linux-5.13.13.tar.xz
```

Decompress the archive using **tar**:

```
$ tar -xf linux-5.13.13.tar.xz
```



A screenshot of a Linux desktop environment showing a terminal window. The terminal window has a dark background and contains the following command-line session:

```
Activities Terminal Aug 27 9:04 PM
panasa@jack: ~/Downloads
panasa@jack:~$ uname -a
Linux jack 5.11.0-31-generic #33-Ubuntu SMP Wed Aug 11 13:19:04 UTC 2021 x86_64 x86_64 x86_64 GNU/Linux
panasa@jack:~$ cd Downloads/
panasa@jack:~/Downloads$ ls
linux-5.13.13.tar.xz
panasa@jack:~/Downloads$ tar -xf linux-5.13.13.tar.xz
panasa@jack:~/Downloads$ ls
linux-5.13.13  linux-5.13.13.tar.xz
panasa@jack:~/Downloads$
```

The desktop interface below the terminal shows a dock with various application icons.

## 2.2 Kernel configuration

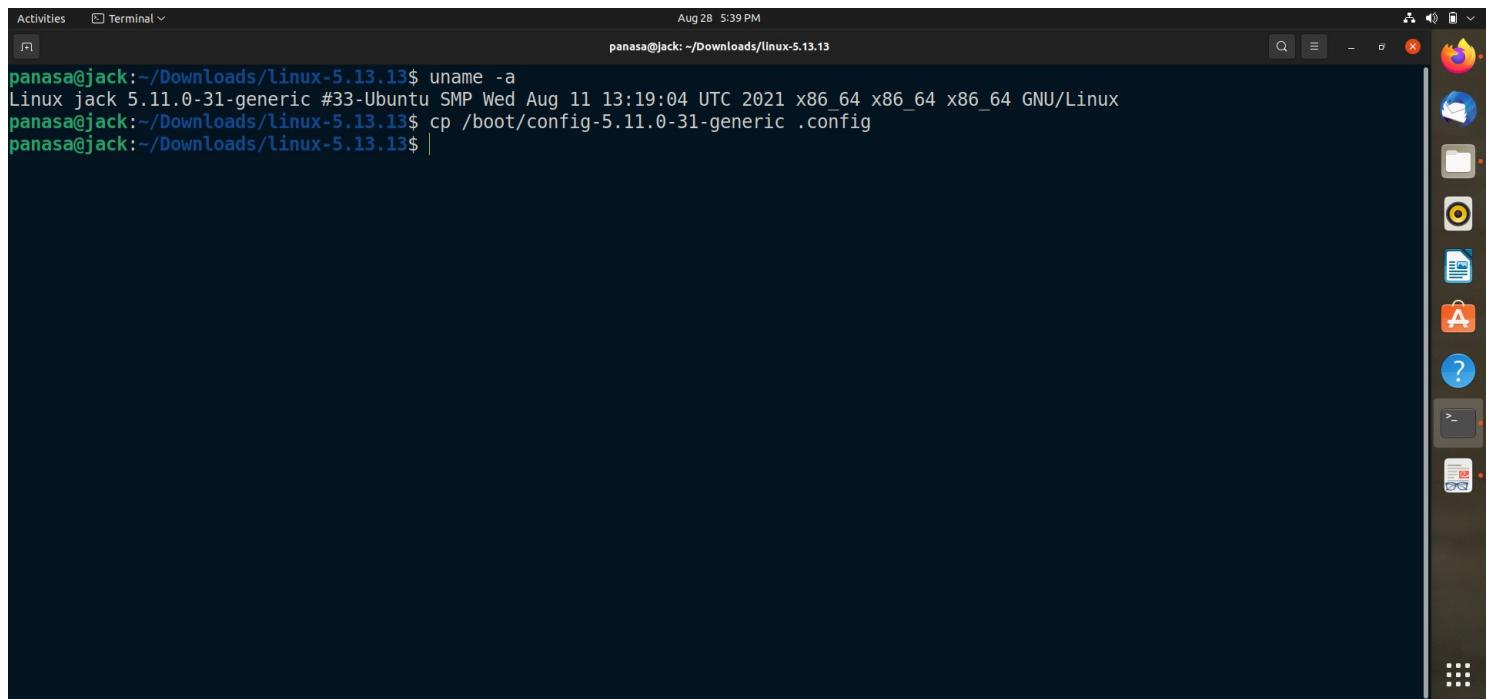
Before we actually compile the kernel, we must first configure which modules to include. There is actually a really easy way to do this. With a single command, you can copy the current kernel's config file and then use the tried and true menuconfig command to make any necessary changes. To do this

### (a) Copy the existing kernel config file using the command:

Copy the existing kernel config file just in case you need to replace it in the event of a problem.

**cp /boot/config-\$(uname -r) .config**

(Since the version might be slightly different, give uname -r).



A screenshot of a Linux terminal window titled "Terminal". The window shows a command-line session:

```
Activities Terminal Aug 28 5:39 PM panasa@jack: ~/Downloads/linux-5.13.13$ uname -a Linux jack 5.11.0-31-generic #33-Ubuntu SMP Wed Aug 11 13:19:04 UTC 2021 x86_64 x86_64 x86_64 GNU/Linux panasa@jack:~/Downloads/linux-5.13.13$ cp /boot/config-5.11.0-31-generic .config panasa@jack:~/Downloads/linux-5.13.13$ |
```

The terminal is part of a desktop environment, as evidenced by the docked application icons on the right side.

### (b) To configure the kernel use the command:

Now, before we compile the kernel, we need to make sure we configure it. This is because you need to specify which modules you want to be installed and which to not. You have the option of just sticking with the configuration offered by the kernel itself or to alter the existing configuration or add your own, we will use the default configuration. Run the following command,

#### **make menuconfig**

This command will open up a configuration tool that allows you to go through every module available and enable or disable what you need or don't need.

```
Activities Terminal Aug 28 5:46 PM panasa@jack: ~/Downloads/linux-5.13.13$ Setting up libncurses-dev:amd64 (6.2+20201114-2build1) ... Processing triggers for man-db (2.9.4-2) ... panasa@jack:~/Downloads/linux-5.13.13$ make menuconfig UPD scripts/kconfig/mconf-cfg HOSTCC scripts/kconfig/mconf.o HOSTCC scripts/kconfig/lxdialog/checklist.o HOSTCC scripts/kconfig/lxdialog/inputbox.o HOSTCC scripts/kconfig/lxdialog/menubox.o HOSTCC scripts/kconfig/lxdialog/textbox.o HOSTCC scripts/kconfig/lxdialog/util.o HOSTCC scripts/kconfig/lxdialog/yesno.o HOSTLD scripts/kconfig/mconf .config:2598:warning: symbol value 'm' invalid for PVPANIC .config:8618:warning: symbol value 'm' invalid for ASHMEM .config:9653:warning: symbol value 'm' invalid for ANDROID_BINDER_IPC .config:9654:warning: symbol value 'm' invalid for ANDROID_BINDERFS *** End of the configuration. *** Execute 'make' to start the build or try 'make help'. panasa@jack:~/Downloads/linux-5.13.13$ panasa@jack:~/Downloads/linux-5.13.13$
```

```
Activities Terminal Aug 28 5:42 PM panasa@jack: ~/Downloads/linux-5.13.13$ .config - Linux/x86 5.13.13 Kernel Configuration Linux/x86 5.13.13 Kernel Configuration Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty submenus ----). Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in [ ] excluded <M> module capable
```

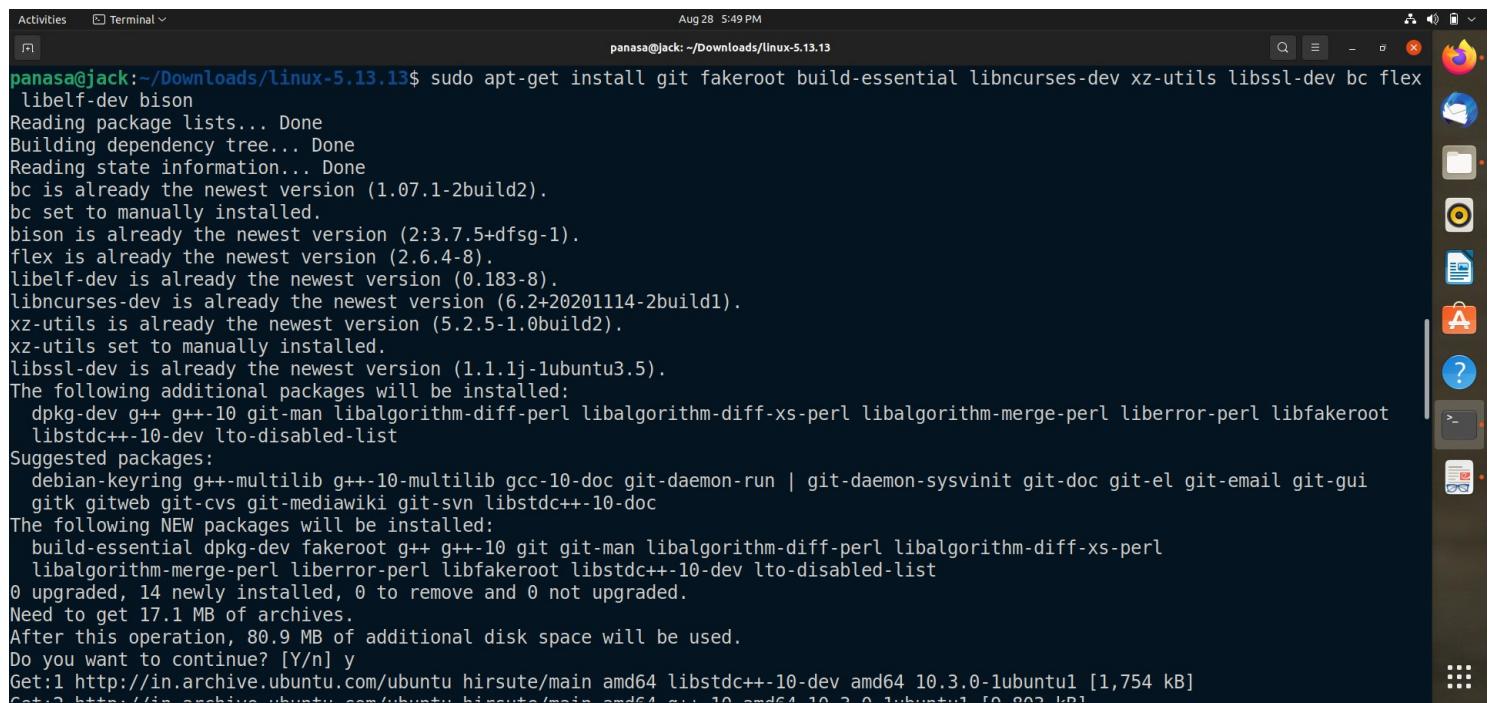
```
| General setup --->
[*] 64-bit kernel
    Processor type and features --->
    Power management and ACPI options --->
    Bus options (PCI etc.) --->
    Binary Emulations --->
    Firmware Drivers --->
[*] Virtualization --->
    General architecture-dependent options --->
[*] Enable loadable module support --->
[*] Enable the block layer --->
    IO Schedulers --->
    Executable file formats --->
    Memory Management options --->
[*] Networking support --->
    Device Drivers --->
    File systems --->
    Security options --->
    Cryptographic API --->
    Library routines --->
v(+)
```

<Select> < Exit > < Help > < Save > < Load >

## 2.2.1 Installing the requirements

In order to compile the kernel, we'll need to first install a few requirements. This can be done with a single command:

```
sudo apt-get install git fakeroot build-essential libncurses-dev xz-utils libssl-dev bc flex libelf-dev bison
```



```
Activities Terminal Aug 28 5:49 PM panasa@jack: ~/Downloads/Linux-5.13.13$ sudo apt-get install git fakeroot build-essential libncurses-dev xz-utils libssl-dev bc flex libelf-dev bison
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
bc is already the newest version (1.07.1-2build2).
bc set to manually installed.
bison is already the newest version (2:3.7.5+dfsg-1).
flex is already the newest version (2.6.4-8).
libelf-dev is already the newest version (0.183-8).
libncurses-dev is already the newest version (6.2+20201114-2build1).
xz-utils is already the newest version (5.2.5-1.0build2).
xz-utils set to manually installed.
libssl-dev is already the newest version (1.1.1j-1ubuntu3.5).
The following additional packages will be installed:
  dpkg-dev g++-g++-10 git-man libalgorithm-diff-perl libalgorithm-diff-xs-perl libalgorithm-merge-perl liberror-perl libfakeroot
  libstdc++-10-dev lto-disabled-list
Suggested packages:
  debian-keyring g++-multilib g++-10-multilib gcc-10-doc git-daemon-run | git-daemon-sysvinit git-doc git-el git-email git-gui
  gitk gitweb git-cvs git-mediawiki git-svn libstdc++-10-doc
The following NEW packages will be installed:
  build-essential dpkg-dev fakeroot g++-g++-10 git git-man libalgorithm-diff-perl libalgorithm-diff-xs-perl
  libalgorithm-merge-perl liberror-perl libfakeroot libstdc++-10-dev lto-disabled-list
0 upgraded, 14 newly installed, 0 to remove and 0 not upgraded.
Need to get 17.1 MB of archives.
After this operation, 80.9 MB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://in.archive.ubuntu.com/ubuntu hirsute/main amd64 libstdc++-10-dev amd64 10.3.0-1ubuntu1 [1,754 kB]
Get:2 http://in.archive.ubuntu.com/ubuntu hirsute/main amd64 g++-g++-10 amd64 10.3.0-1ubuntu1 [0.802 kB]
```

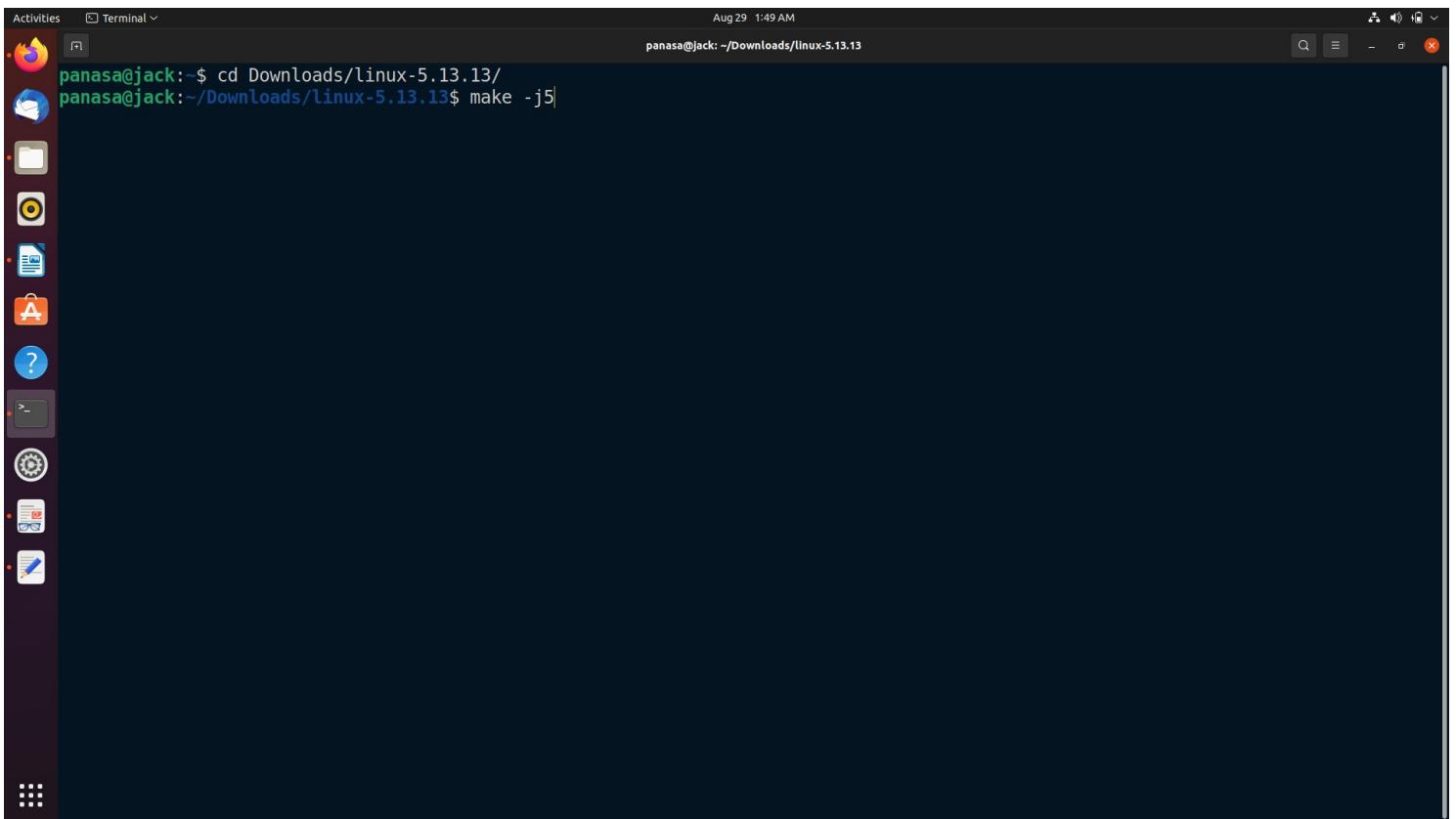
## 2.3 Kernel compilation and installation

Now it's time to actually compile the kernel. The first step is to compile using the make command. Here we can customize the number of threads you are allocating for the compile/install process by using the -j parameter.

**make -j 5**

The -j parameter is to customize the number of threads you are allocating for the compile/install process.

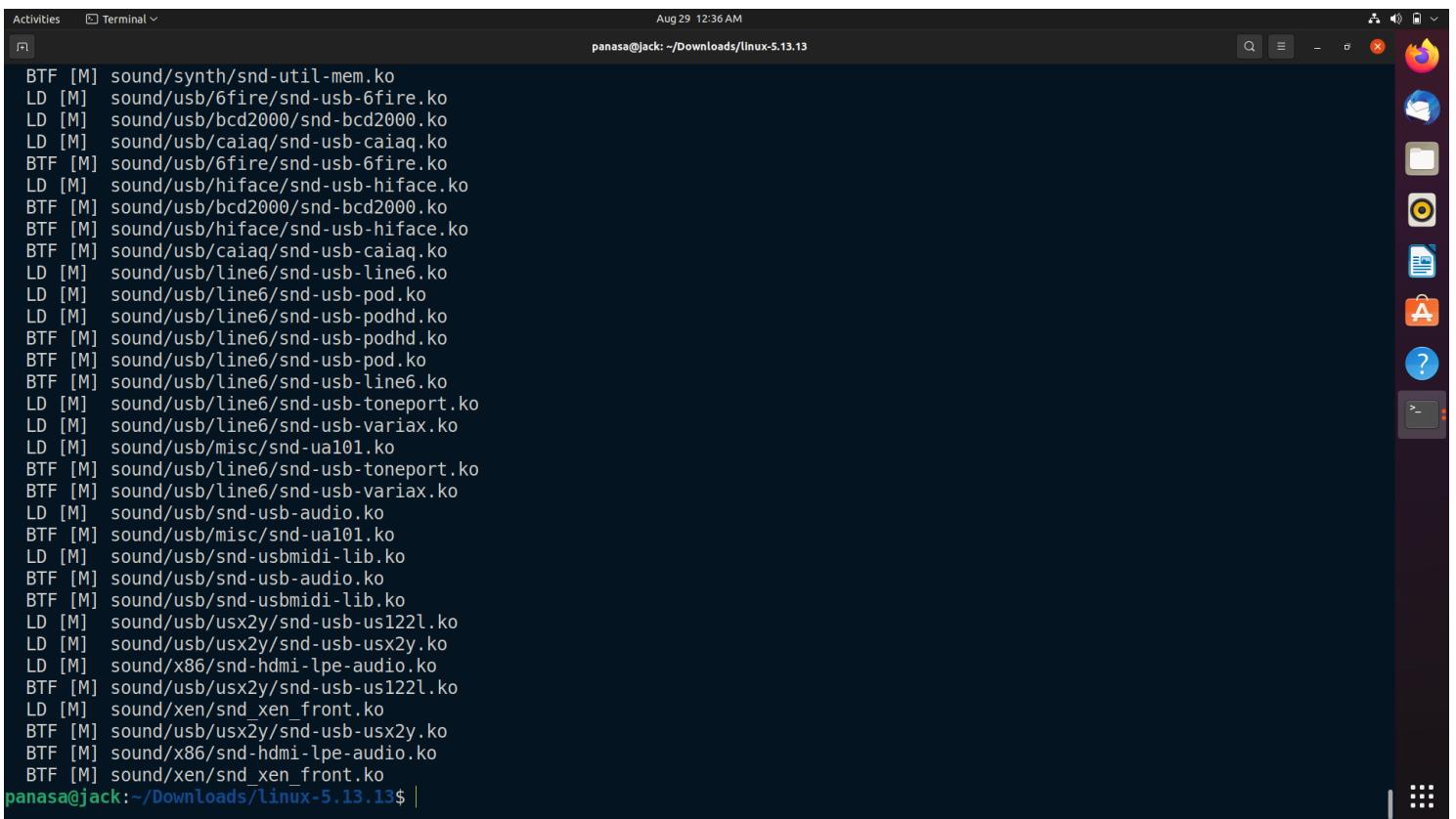
So issue make and then answer the necessary questions (optional if the configuration was saved in the text-based menu). The questions asked will be determined by what kernel you're upgrading from and what kernel you're upgrading to. The compilation process will mostly look like this -



A screenshot of a Linux desktop environment, likely Ubuntu, showing a terminal window titled "Terminal". The terminal window has a dark background and contains the following command-line session:

```
Activities Terminal Aug 29 1:49 AM panasa@jack: ~/Downloads/linux-5.13.13 panasa@jack:~/Downloads/linux-5.13.13$ make -j5
```

The desktop interface includes a vertical dock on the left with icons for various applications like a browser, file manager, and system settings. The top bar shows the date and time as "Aug 29 1:49 AM" and the user as "panasa@jack".



A screenshot of a Linux desktop environment, likely Ubuntu, showing a terminal window titled "Terminal". The terminal window has a dark background and displays a log of kernel module loading. The log shows numerous modules being loaded, mostly from the "sound" directory, with some from "usb" and "xen" directories. The log ends with the command "make -j5" at the bottom.

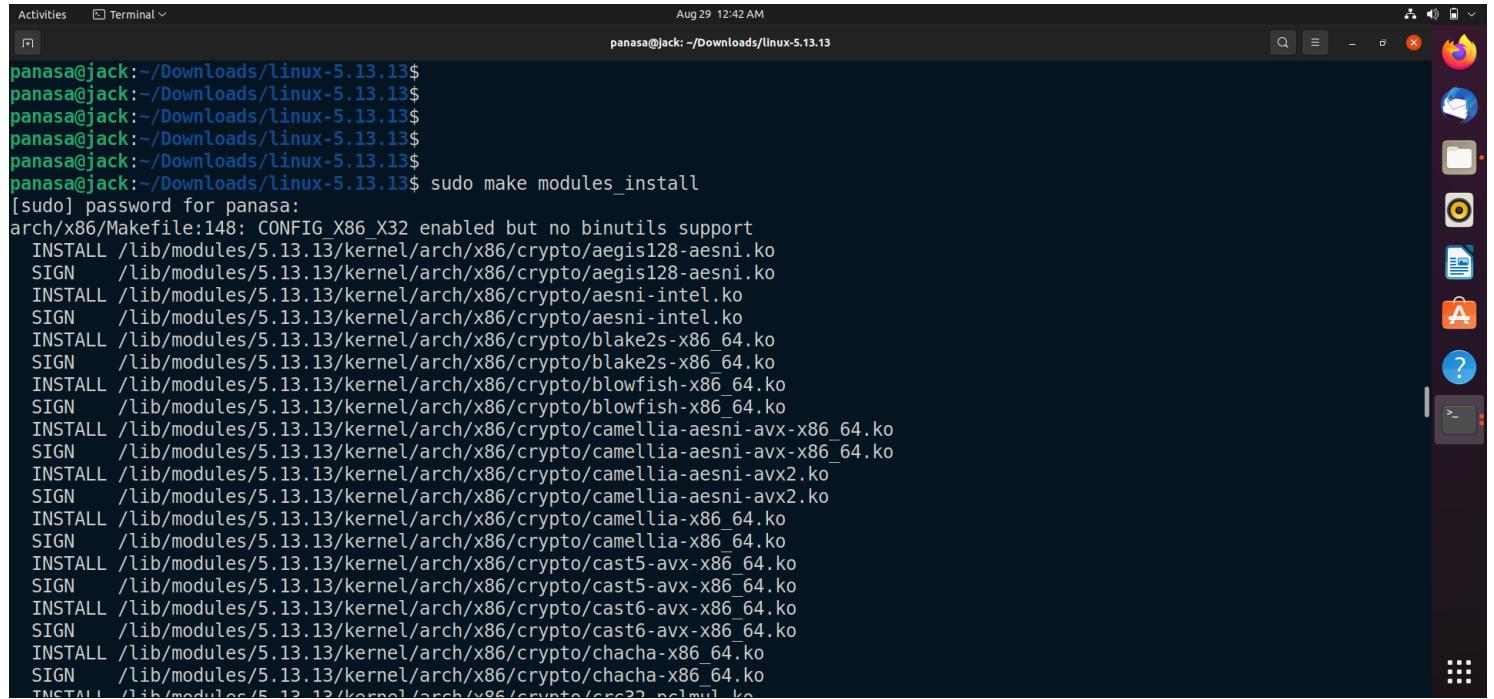
```
Activities Terminal Aug 29 12:36 AM panasa@jack: ~/Downloads/linux-5.13.13 panasa@jack:~/Downloads/linux-5.13.13$ make -j5
```

The desktop interface includes a vertical dock on the right with icons for various applications like a browser, file manager, and system settings. The top bar shows the date and time as "Aug 29 12:36 AM" and the user as "panasa@jack".

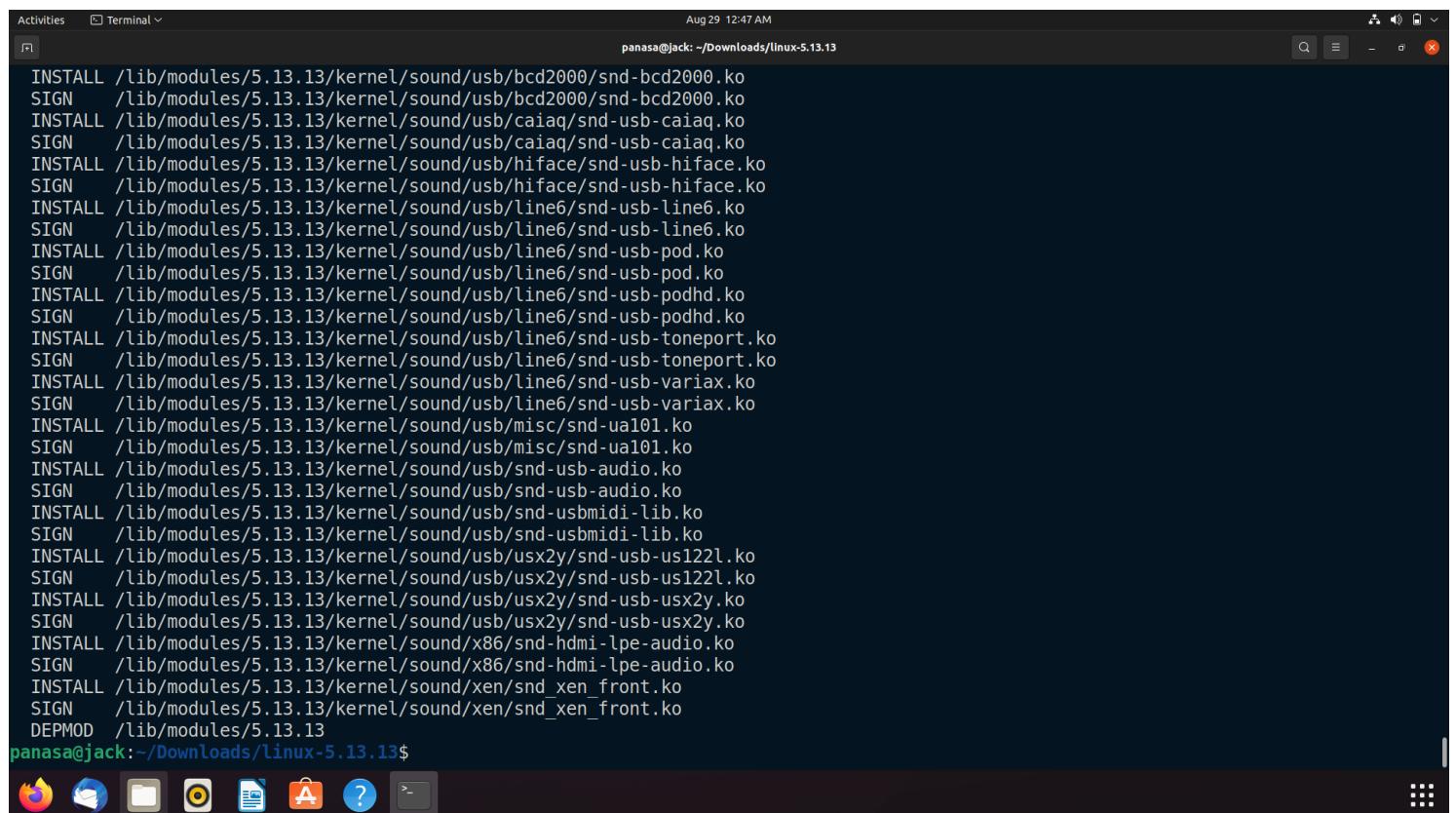
On completing this, you can install the modules you've enabled with the command:

## 2.4 sudo make modules\_install

The installation process will mostly look like this -



```
panasa@jack:~/Downloads/linux-5.13.13$ 
panasa@jack:~/Downloads/linux-5.13.13$ 
panasa@jack:~/Downloads/linux-5.13.13$ 
panasa@jack:~/Downloads/linux-5.13.13$ 
panasa@jack:~/Downloads/linux-5.13.13$ 
panasa@jack:~/Downloads/linux-5.13.13$ sudo make modules_install
[sudo] password for panasa:
arch/x86/Makefile:148: CONFIG_X86_X32 enabled but no binutils support
  INSTALL /lib/modules/5.13.13/kernel/arch/x86/crypto/aegis128-aesni.ko
  SIGN   /lib/modules/5.13.13/kernel/arch/x86/crypto/aegis128-aesni.ko
  INSTALL /lib/modules/5.13.13/kernel/arch/x86/crypto/aesni-intel.ko
  SIGN   /lib/modules/5.13.13/kernel/arch/x86/crypto/aesni-intel.ko
  INSTALL /lib/modules/5.13.13/kernel/arch/x86/crypto/blake2s-x86_64.ko
  SIGN   /lib/modules/5.13.13/kernel/arch/x86/crypto/blake2s-x86_64.ko
  INSTALL /lib/modules/5.13.13/kernel/arch/x86/crypto/blowfish-x86_64.ko
  SIGN   /lib/modules/5.13.13/kernel/arch/x86/crypto/blowfish-x86_64.ko
  INSTALL /lib/modules/5.13.13/kernel/arch/x86/crypto/camellia-aesni-avx-x86_64.ko
  SIGN   /lib/modules/5.13.13/kernel/arch/x86/crypto/camellia-aesni-avx-x86_64.ko
  INSTALL /lib/modules/5.13.13/kernel/arch/x86/crypto/camellia-aesni-avx2.ko
  SIGN   /lib/modules/5.13.13/kernel/arch/x86/crypto/camellia-aesni-avx2.ko
  INSTALL /lib/modules/5.13.13/kernel/arch/x86/crypto/camellia-x86_64.ko
  SIGN   /lib/modules/5.13.13/kernel/arch/x86/crypto/camellia-x86_64.ko
  INSTALL /lib/modules/5.13.13/kernel/arch/x86/crypto/cast5-avx-x86_64.ko
  SIGN   /lib/modules/5.13.13/kernel/arch/x86/crypto/cast5-avx-x86_64.ko
  INSTALL /lib/modules/5.13.13/kernel/arch/x86/crypto/cast6-avx-x86_64.ko
  SIGN   /lib/modules/5.13.13/kernel/arch/x86/crypto/cast6-avx-x86_64.ko
  INSTALL /lib/modules/5.13.13/kernel/arch/x86/crypto/chacha-x86_64.ko
  SIGN   /lib/modules/5.13.13/kernel/arch/x86/crypto/chacha-x86_64.ko
  TMCALL /lib/modules/5.13.13/kernel/arch/x86/crypto/cryptomd-polmul.ko
```

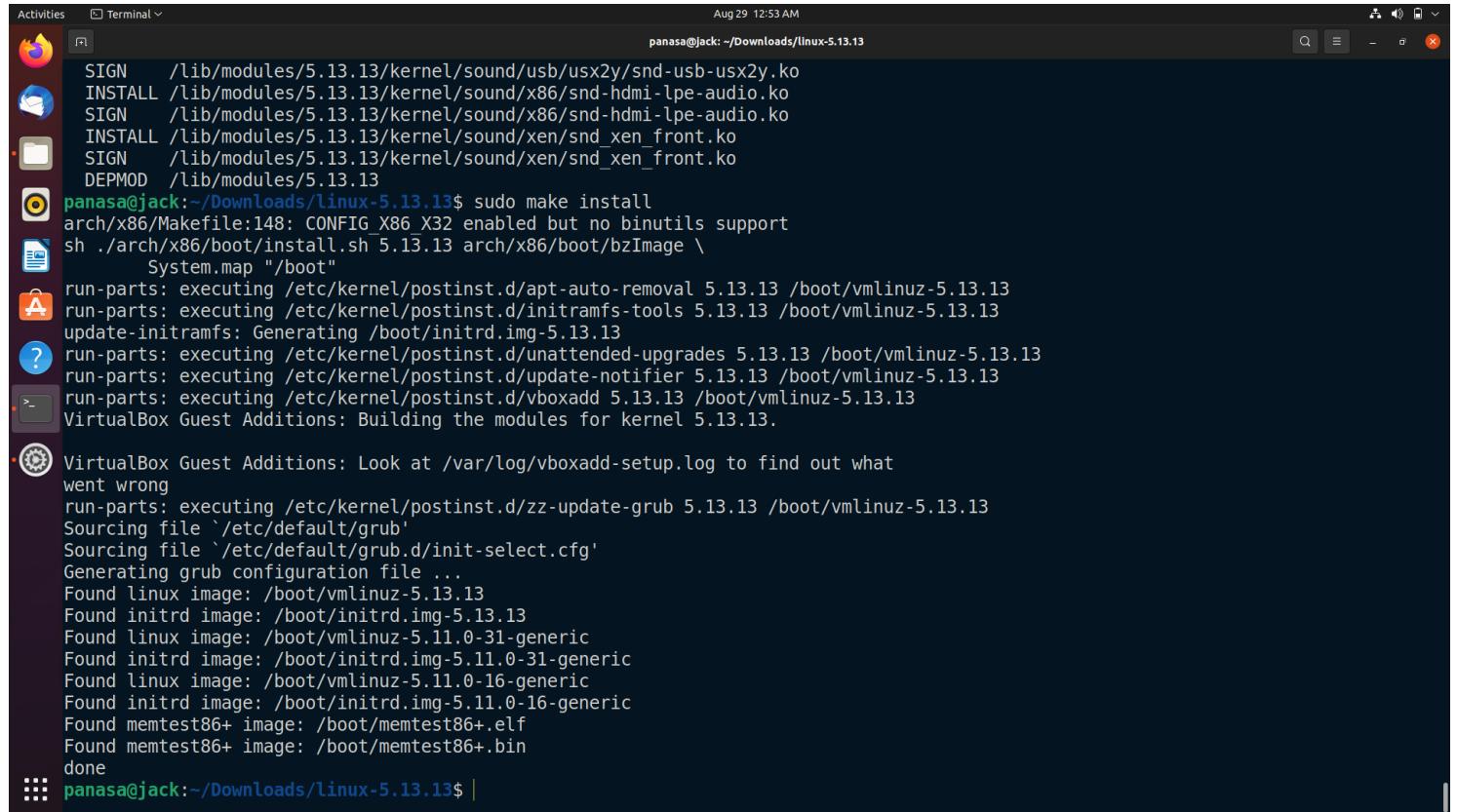


```
Activities Terminal Aug 29 12:47 AM panasa@jack: ~/Downloads/linux-5.13.13$ 
INSTALL /lib/modules/5.13.13/kernel/sound/usb/bcd2000/snd-bcd2000.ko
SIGN   /lib/modules/5.13.13/kernel/sound/usb/bcd2000/snd-bcd2000.ko
INSTALL /lib/modules/5.13.13/kernel/sound/usb/caiaq/snd-usb-caiaq.ko
SIGN   /lib/modules/5.13.13/kernel/sound/usb/caiaq/snd-usb-caiaq.ko
INSTALL /lib/modules/5.13.13/kernel/sound/usb/hiface/snd-usb-hiface.ko
SIGN   /lib/modules/5.13.13/kernel/sound/usb/hiface/snd-usb-hiface.ko
INSTALL /lib/modules/5.13.13/kernel/sound/usb/line6/snd-usb-line6.ko
SIGN   /lib/modules/5.13.13/kernel/sound/usb/line6/snd-usb-line6.ko
INSTALL /lib/modules/5.13.13/kernel/sound/usb/line6/snd-usb-pod.ko
SIGN   /lib/modules/5.13.13/kernel/sound/usb/line6/snd-usb-pod.ko
INSTALL /lib/modules/5.13.13/kernel/sound/usb/line6/snd-usb-podhd.ko
SIGN   /lib/modules/5.13.13/kernel/sound/usb/line6/snd-usb-podhd.ko
INSTALL /lib/modules/5.13.13/kernel/sound/usb/line6/snd-usb-toneport.ko
SIGN   /lib/modules/5.13.13/kernel/sound/usb/line6/snd-usb-toneport.ko
INSTALL /lib/modules/5.13.13/kernel/sound/usb/line6/snd-usb-variax.ko
SIGN   /lib/modules/5.13.13/kernel/sound/usb/line6/snd-usb-variax.ko
INSTALL /lib/modules/5.13.13/kernel/sound/usb/misc/snd-ua101.ko
SIGN   /lib/modules/5.13.13/kernel/sound/usb/misc/snd-ua101.ko
INSTALL /lib/modules/5.13.13/kernel/sound/usb/snd-usb-audio.ko
SIGN   /lib/modules/5.13.13/kernel/sound/usb/snd-usb-audio.ko
INSTALL /lib/modules/5.13.13/kernel/sound/usb/snd-usbmidi-lib.ko
SIGN   /lib/modules/5.13.13/kernel/sound/usb/snd-usbmidi-lib.ko
INSTALL /lib/modules/5.13.13/kernel/sound/usb/usx2y/snd-usb-usl22l.ko
SIGN   /lib/modules/5.13.13/kernel/sound/usb/usx2y/snd-usb-usl22l.ko
INSTALL /lib/modules/5.13.13/kernel/sound/usb/usx2y/snd-usb-usx2y.ko
SIGN   /lib/modules/5.13.13/kernel/sound/usb/usx2y/snd-usb-usx2y.ko
INSTALL /lib/modules/5.13.13/kernel/sound/x86/snd-hdmi-lpe-audio.ko
SIGN   /lib/modules/5.13.13/kernel/sound/x86/snd-hdmi-lpe-audio.ko
INSTALL /lib/modules/5.13.13/kernel/sound/xen/snd_xen_front.ko
SIGN   /lib/modules/5.13.13/kernel/sound/xen/snd_xen_front.ko
DEPMOD /lib/modules/5.13.13$
```

Now we install the kernel with the command:

## 2.5 sudo make install

The above process in itself updates the initramfs, which is responsible to look for kernels in the /boot/ folder and add them to the grub's configuration file, the command "make install" will also update the grub.cfg by default. So we don't need to manually edit the grub.cfg file. (GRUB is a multi-boot bootloader for most linux distros).



```
Activities Terminal Aug 29 12:53 AM panasa@jack: ~/Downloads/linux-5.13.13
SIGN    /lib/modules/5.13.13/kernel/sound/usb/usx2y/snd-usb-usx2y.ko
INSTALL /lib/modules/5.13.13/kernel/sound/x86/snd-hdmi-lpe-audio.ko
SIGN    /lib/modules/5.13.13/kernel/sound/x86/snd-hdmi-lpe-audio.ko
INSTALL /lib/modules/5.13.13/kernel/sound/xen/snd_xen_front.ko
SIGN    /lib/modules/5.13.13/kernel/sound/xen/snd_xen_front.ko
DEPMOD  /lib/modules/5.13.13
panasa@jack:~/Downloads/linux-5.13.13$ sudo make install
arch/x86/Makefile:148: CONFIG_X86_X32 enabled but no binutils support
sh ./arch/x86/boot/install.sh 5.13.13 arch/x86/boot/bzImage \
System.map "/boot"
run-parts: executing /etc/kernel/postinst.d/apt-auto-removal 5.13.13 /boot/vmlinuz-5.13.13
run-parts: executing /etc/kernel/postinst.d/initramfs-tools 5.13.13 /boot/vmlinuz-5.13.13
update-initramfs: Generating /boot/initrd.img-5.13.13
run-parts: executing /etc/kernel/postinst.d/unattended-upgrades 5.13.13 /boot/vmlinuz-5.13.13
run-parts: executing /etc/kernel/postinst.d/update-notifier 5.13.13 /boot/vmlinuz-5.13.13
run-parts: executing /etc/kernel/postinst.d/vboxadd 5.13.13 /boot/vmlinuz-5.13.13
VirtualBox Guest Additions: Building the modules for kernel 5.13.13.

VirtualBox Guest Additions: Look at /var/log/vboxadd-setup.log to find out what
went wrong
run-parts: executing /etc/kernel/postinst.d/zz-update-grub 5.13.13 /boot/vmlinuz-5.13.13
Sourcing file `/etc/default/grub'
Sourcing file `/etc/default/grub.d/init-select.cfg'
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-5.13.13
Found initrd image: /boot/initrd.img-5.13.13
Found linux image: /boot/vmlinuz-5.11.0-31-generic
Found initrd image: /boot/initrd.img-5.11.0-31-generic
Found linux image: /boot/vmlinuz-5.11.0-16-generic
Found initrd image: /boot/initrd.img-5.11.0-16-generic
Found memtest86+ image: /boot/memtest86+.elf
Found memtest86+ image: /boot/memtest86+.bin
done
panasa@jack:~/Downloads/linux-5.13.13$ |
```

## 2.6 Update Grub file

Update this file which is in the directory : `sudo gedit /etc/default/grub`

`edit GRU_TIMEOUT_STYLE=menu`

`edit GRUB_TIMEOUT= k (where k>=10) for displaying purpose`

If you can't open grub menu you can implement these steps otherwise skip these

```
Activities Terminal Aug 29 9:53 AM
panasa@jack: ~
# note that you can use only modes which your graphic card supports via VBE
# you can see them in real GRUB with the command 'vbeinfo'
#GRUB_GFXMODE=640x480

# Uncomment if you don't want GRUB to pass "root=UUID=xxx" parameter to Linux
#GRUB_DISABLE_LINUX_UUID=true

# Uncomment to disable generation of recovery mode menu entries
#GRUB_DISABLE_RECOVERY="true"

# Uncomment to get a beep at grub start
#GRUB_INIT_TUNE="480 440 1"
panasa@jack:~$ 
? Help sa@jack:~$ 
panasa@jack:~$ 
panasa@jack:~$ 
panasa@jack:~$ 
panasa@jack:~$ 
panasa@jack:~$ 
panasa@jack:~$ sudo update-grub
[sudo] password for panasa:
Sourcing file `/etc/default/grub'
Sourcing file `/etc/default/grub.d/init-select.cfg'
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-5.13.13
Found initrd image: /boot/initrd.img-5.13.13
Found linux image: /boot/vmlinuz-5.11.0-31-generic
Found initrd image: /boot/initrd.img-5.11.0-31-generic
Found linux image: /boot/vmlinuz-5.11.0-16-generic
Found initrd image: /boot/initrd.img-5.11.0-16-generic
Found memtest86+ image: /boot/memtest86+.elf
Found memtest86+ image: /boot/memtest86+.bin
done
panasa@jack:~$ |
```

## 2.6 Reboot

You should ideally reboot the virtual machine after the completion of this stage.

Reboot your machine and hold the right shift key during boot process to access the GRUB bootloader menu, which will look like this -

GNU GRUB version 2.04

Ubuntu

\*Advanced options for Ubuntu

Memory test (memtest86+)

Memory test (memtest86+, serial console 115200)

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.

SHOT ON REDMI Y3  
AI DUAL CAMERA

Choose “Advanced options for Ubuntu” and you will be directed to a menu with the list of kernels available (default as well as custom ones that have been installed). Since we installed the latest version , this will be the first option.

GNU GRUB version 2.04

\*Ubuntu, with Linux 5.13.13

Ubuntu, with Linux 5.13.13 (recovery mode)

Ubuntu, with Linux 5.11.0-31-generic

Ubuntu, with Linux 5.11.0-31-generic (recovery mode)

Ubuntu, with Linux 5.11.0-16-generic

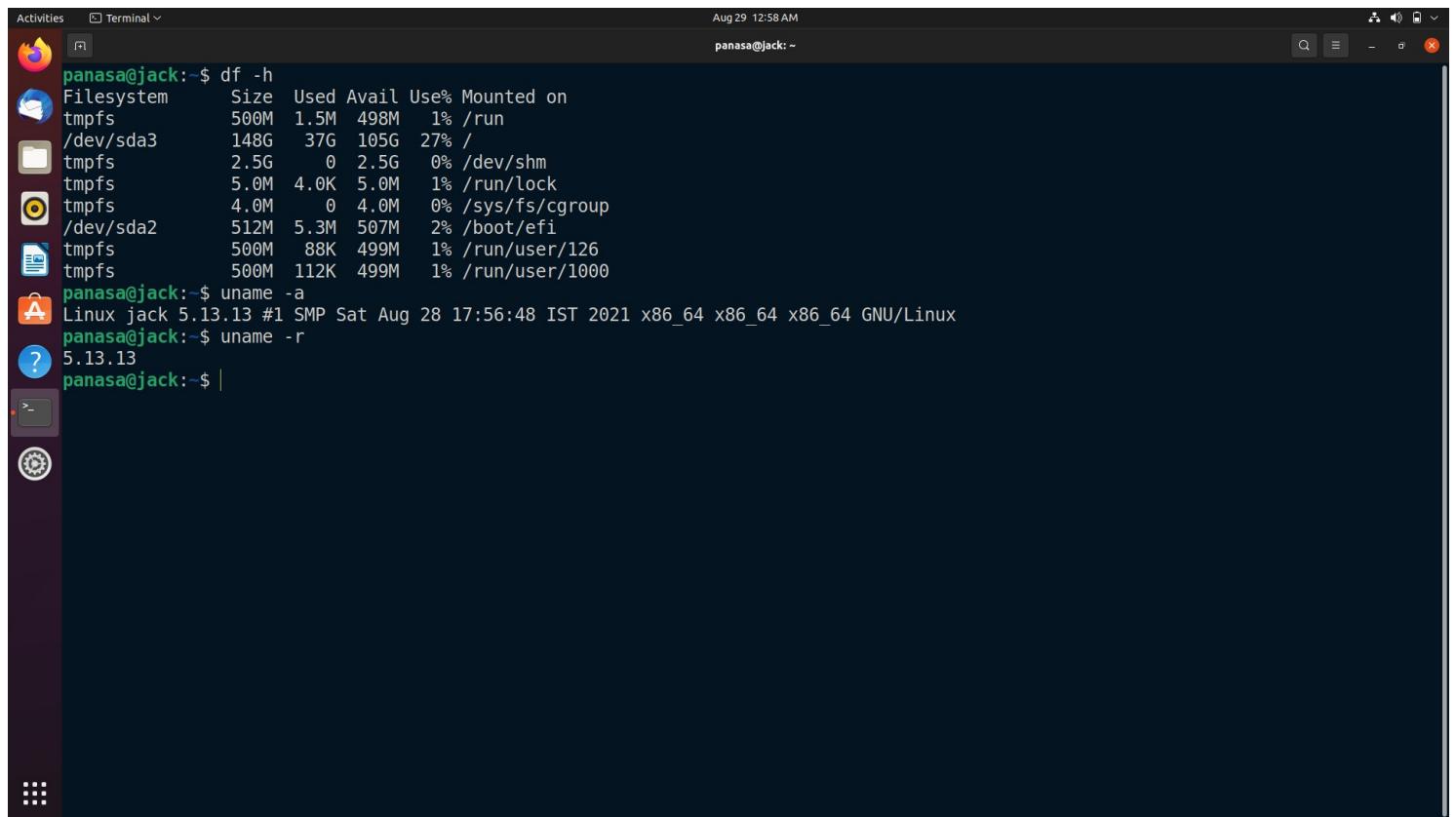
Ubuntu, with Linux 5.11.0-16-generic (recovery mode)

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.

SHOT ON REDMI Y3  
AI DUAL CAMERA

To show that the latest kernel is installed, run the command from the terminal:

**uname -r**



A screenshot of a Linux desktop environment, likely Ubuntu, showing a terminal window. The terminal output includes:

```
panasa@jack:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
tmpfs           500M  1.5M  498M  1% /run
/dev/sda3        148G  37G  105G  27% /
tmpfs            2.5G   0  2.5G  0% /dev/shm
tmpfs            5.0M  4.0K  5.0M  1% /run/lock
tmpfs            4.0M   0  4.0M  0% /sys/fs/cgroup
/dev/sda2        512M  5.3M  507M  2% /boot/efi
tmpfs            500M  88K  499M  1% /run/user/126
tmpfs            500M 112K  499M  1% /run/user/1000
panasa@jack:~$ uname -a
Linux jack 5.13.13 #1 SMP Sat Aug 28 17:56:48 IST 2021 x86_64 x86_64 x86_64 GNU/Linux
panasa@jack:~$ uname -r
5.13.13
panasa@jack:~$
```

### 3. Conclusion

We have successfully compiled and installed a new kernel alongside our current kernel.

### 4. Bibliography

[www.kernel.org](http://www.kernel.org)  
[courses.linuxchix.org](http://courses.linuxchix.org)  
[www.linfo.org](http://www.linfo.org)  
[linux.die.net](http://linux.die.net)  
[tldp.org](http://tldp.org)  
[titanwolf.org](http://titanwolf.org)  
[www.linuxquestions.org](http://www.linuxquestions.org)  
[askubuntu.com](http://askubuntu.com)  
[unix.stackexchange.com](http://unix.stackexchange.com)  
[opensource.com](http://opensource.com)  
[linuxdocs.org](http://linuxdocs.org)

\*\*\*\*\*THE END\*\*\*\*\*