

Computer Architecture and Operating Systems - Monsoon 2019

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2018356

Assignment 0 - Part 1(Linux Kernel Compilation)

- First step was just to download VirtualBox latest version from <https://www.virtualbox.org/>. So after downloading this we download Ubuntu 14.10 server iso file from its official site.
- After setting up the virtual machine the we run it. To check the system information, we use `uname -a`.

• `uname -a` → prints the system information

Then we download the kernel from the given link mentioned in code.

`wget` - The non-interactive network downloader

```
parth@ubuntu:~$ uname -a
Linux ubuntu 3.13.0-24-generic #47-Ubuntu SMP Fri May 2 23:30:00 UTC 2014 x86_64
x86_64 x86_64 GNU/Linux
parth@ubuntu:~$ 
parth@ubuntu:~$ 
parth@ubuntu:~$ wget "https://cdn.kernel.org/pub/linux/kernel/v3.x/linux-3.16.7
.tar.xz"
```

- The download starts. Kernel is downloading.

```
parth@ubuntu:~$ uname -a
Linux ubuntu 3.13.0-24-generic #47-Ubuntu SMP Fri May 2 23:30:00 UTC 2014 x86_64
x86_64 x86_64 GNU/Linux
parth@ubuntu:~$ 
parth@ubuntu:~$ 
parth@ubuntu:~$ wget "https://cdn.kernel.org/pub/linux/kernel/v3.x/linux-3.16.71
.tar.xz"
--2019-08-08 23:36:38-- https://cdn.kernel.org/pub/linux/kernel/v3.x/linux-3.16
.71.tar.xz
Resolving cdn.kernel.org (cdn.kernel.org)... 151.101.65.176, 151.101.193.176, 15
1.101.129.176, ...
Connecting to cdn.kernel.org (cdn.kernel.org):151.101.65.176:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 81128780 (77M) [application/x-xz]
Saving to: 'linux-3.16.71.tar.xz'

1% [                               ] 1,264,746    115KB/s   eta 11m 28s
```

- Just to verify the kernel has been downloaded we just type ls to see kernel source.

ls — lists directory contents

```

parth@ubuntu:~$ uname -a
Linux ubuntu 3.13.0-24-generic #47-Ubuntu SMP Fri May 2 23:30:00 UTC 2014 x86_64
x86_64 x86_64 GNU/Linux
parth@ubuntu:~$ 
parth@ubuntu:~$ 
parth@ubuntu:~$ wget "https://cdn.kernel.org/pub/linux/kernel/v3.x/linux-3.16.71
.tar.xz"
--2019-08-08 23:36:38-- https://cdn.kernel.org/pub/linux/kernel/v3.x/linux-3.16
.71.tar.xz
Resolving cdn.kernel.org (cdn.kernel.org)... 151.101.65.176, 151.101.193.176, 15
1.101.129.176, ...
Connecting to cdn.kernel.org (cdn.kernel.org)|151.101.65.176|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 81128780 (77M) [application/x-xz]
Saving to: 'linux-3.16.71.tar.xz'

100%[=====>] 81,128,780 116KB/s in 11m 32s

2019-08-08 23:48:12 (114 KB/s) - 'linux-3.16.71.tar.xz' saved [81128780/81128780]

parth@ubuntu:~$ ls
linux-3.16.71.tar.xz
parth@ubuntu:~$ _

```

- Now we need to unzip the source file.

- tar xf -The GNU version of the tar archiving utility
- Here x is for extract from archive and f is for use the archive file.

```

parth@ubuntu:~$ uname -a
Linux ubuntu 3.13.0-24-generic #47-Ubuntu SMP Fri May 2 23:30:00 UTC 2014 x86_64
x86_64 x86_64 GNU/Linux
parth@ubuntu:~$ 
parth@ubuntu:~$ 
parth@ubuntu:~$ wget "https://cdn.kernel.org/pub/linux/kernel/v3.x/linux-3.16.71
.tar.xz"
--2019-08-08 23:36:38-- https://cdn.kernel.org/pub/linux/kernel/v3.x/linux-3.16
.71.tar.xz
Resolving cdn.kernel.org (cdn.kernel.org)... 151.101.65.176, 151.101.193.176, 15
1.101.129.176, ...
Connecting to cdn.kernel.org (cdn.kernel.org)|151.101.65.176|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 81128780 (77M) [application/x-xz]
Saving to: 'linux-3.16.71.tar.xz'

100%[=====>] 81,128,780 116KB/s in 11m 32s

2019-08-08 23:48:12 (114 KB/s) - 'linux-3.16.71.tar.xz' saved [81128780/81128780]

parth@ubuntu:~$ ls
linux-3.16.71.tar.xz
parth@ubuntu:~$ tar xf linux-3.16.71.tar.xz
parth@ubuntu:~$ ls
linux-3.16.71 linux-3.16.71.tar.xz
parth@ubuntu:~$ 

```

- We are copying the .config file.

- cp - copies file and directories

```
parth@ubuntu:~$ uname -r
3.13.0-24-generic
parth@ubuntu:~$ cd /usr/src/linux-headers-3.13.0-24-generic/
parth@ubuntu:/usr/src/linux-headers-3.13.0-24-generic$ ls -a
.          crypto      init      Makefile  scripts    usr
..         Documentation ipc       .missing-syscalls.d security    virt
arch       drivers      Kbuild    mm         sound
block      firmware    Kconfig   Module.symvers .tmp_versions
.config    fs          kernel    net        tools
.config.old include      lib       samples    ubuntu
parth@ubuntu:/usr/src/linux-headers-3.13.0-24-generic$ cp .config ~/linux-3.16.71
parth@ubuntu:/usr/src/linux-headers-3.13.0-24-generic$ cp .config ~/linux-3.16.71/
```

- After copying now our task is to name our kernel, I named it Parth-Kernel.

nano .config

nano- an enhanced free Pico clone

After this we need to name our kernel by changing name in CONFIG_LOCALVARIABLE.

```
GNU nano 2.2.6          File: .config          Modified
CONFIG_X86_HT=y
CONFIG_ARCH_HWEIGHT_CFLAGS="-fcall-saved-rdi -fcall-saved-rsi -fcall-saved-rdx $"
CONFIG_ARCH_SUPPORTS_UPROBES=y
CONFIG_DEFCONFIG_LIST="/lib/modules/$UNAME_RELEASE/.config"
CONFIG_IRQ_WORK=y
CONFIG_BUILDTIME_EXTABLE_SORT=y

#
# General setup
#
CONFIG_INIT_ENV_ARG_LIMIT=32
CONFIG_CROSS_COMPILE=""
# CONFIG_COMPILE_TEST is not set
CONFIG_LOCALVERSION="-parth-kernel"
# CONFIG_LOCALVERSION_AUTO is not set
CONFIG_HAVE_KERNEL_GZIP=y
CONFIG_HAVE_KERNEL_BZIP2=y
CONFIG_HAVE_KERNEL_LZMA=y
CONFIG_HAVE_KERNEL_XZ=y
CONFIG_HAVE_KERNEL_LZO=y
CONFIG_HAVE_KERNEL_LZ4=y
CONFIG_KERNEL_GZIP=y
# CONFIG_KERNEL_BZIP2 is not set
# CONFIG_KERNEL_LZMA is not set
# CONFIG_KERNEL_XZ is not set

^G Get Help  ^O WriteOut  ^R Read File ^Y Prev Page ^K Cut Text  ^C Cur Pos
^X Exit      ^J Justify   ^W Where Is  ^V Next Page ^U UnCut Text ^T To Spell
```

- Making oldconfig.

This is made to configure the system within the shell.

make- make utility to maintain groups of programs

```
parth@ubuntu:~/linux-3.16.71$ make oldconfig
```

Ubuntu 14.04 Server [Running] - Oracle VM VirtualBox
Machine View Devices Help

```
"SECMARK" target support (NETFILTER_XT_TARGET_SECMARK) [M/n/?] n
"TCPMSS" target support (NETFILTER_XT_TARGET_TCPMSS) [M/n/?] n
"TCPOPTSTRIP" target support (NETFILTER_XT_TARGET_TCPOPTSTRIP) [M/n/?] n
*
* Xtables matches
*
"addrtype" address type match support (NETFILTER_XT_MATCH_ADDRTYPE) [M/n/?] n
"bpf" match support (NETFILTER_XT_MATCH_BPF) [M/n/?] n
"control group" match support (NETFILTER_XT_MATCH_CGROUP) [M/n/?] (NEW)
"cluster" match support (NETFILTER_XT_MATCH_CLUSTER) [M/n/?] n
"comment" match support (NETFILTER_XT_MATCH_COMMENT) [M/n/?] n
"connbytes" per-connection counter match support (NETFILTER_XT_MATCH_CONNBYTES) [M/n/?] n
"connlabel" match support (NETFILTER_XT_MATCH_CONNLABEL) [M/n/?] n
"connlimit" match support (NETFILTER_XT_MATCH_CONNLIMIT) [M/n/?] n
"connmark" connection mark match support (NETFILTER_XT_MATCH_CONNMARK) [M/n/?] n
"conntrack" connection tracking match support (NETFILTER_XT_MATCH_CONNTRACK) [M/n/?] n
"cpu" match support (NETFILTER_XT_MATCH_CPU) [M/n/?] n
"dccp" protocol match support (NETFILTER_XT_MATCH_DCCP) [M/n/?] n
"devgroup" match support (NETFILTER_XT_MATCH_DEVGROUP) [M/n/?] n
"dsccp" and "tsc" match support (NETFILTER_XT_MATCH_DSCCP) [M/n/?] n
"esp" match support (NETFILTER_XT_MATCH_ESP) [M/n/?] n
"hashlimit" match support (NETFILTER_XT_MATCH_HASHLIMIT) [M/n/?] n
"helper" match support (NETFILTER_XT_MATCH_HELPER) [M/n/?] n
"hl" hoplimit/TTL match support (NETFILTER_XT_MATCH_HL) [M/?] n
"ipcomp" match support (NETFILTER_XT_MATCH_IPCOMP) [M/n/?] (NEW)
```

- Compiling the code

- make -j 5 → j Specifies the number of jobs (commands) to run simultaneously. If there is more than one -j option, the last one is effective.

```

parth@ubuntu:~/linux-3.16.71$ ls
arch      Documentation  init      lib        README      sound
block     drivers        ipc       MAINTAINERS  REPORTING-BUGS  tools
COPYING   firmware      Kbuild    Makefile    samples      usr
CREDITS   fs             Kconfig   mm          scripts      virt
crypto    include        kernel    net         security
parth@ubuntu:~/linux-3.16.71$ make -j 5

```

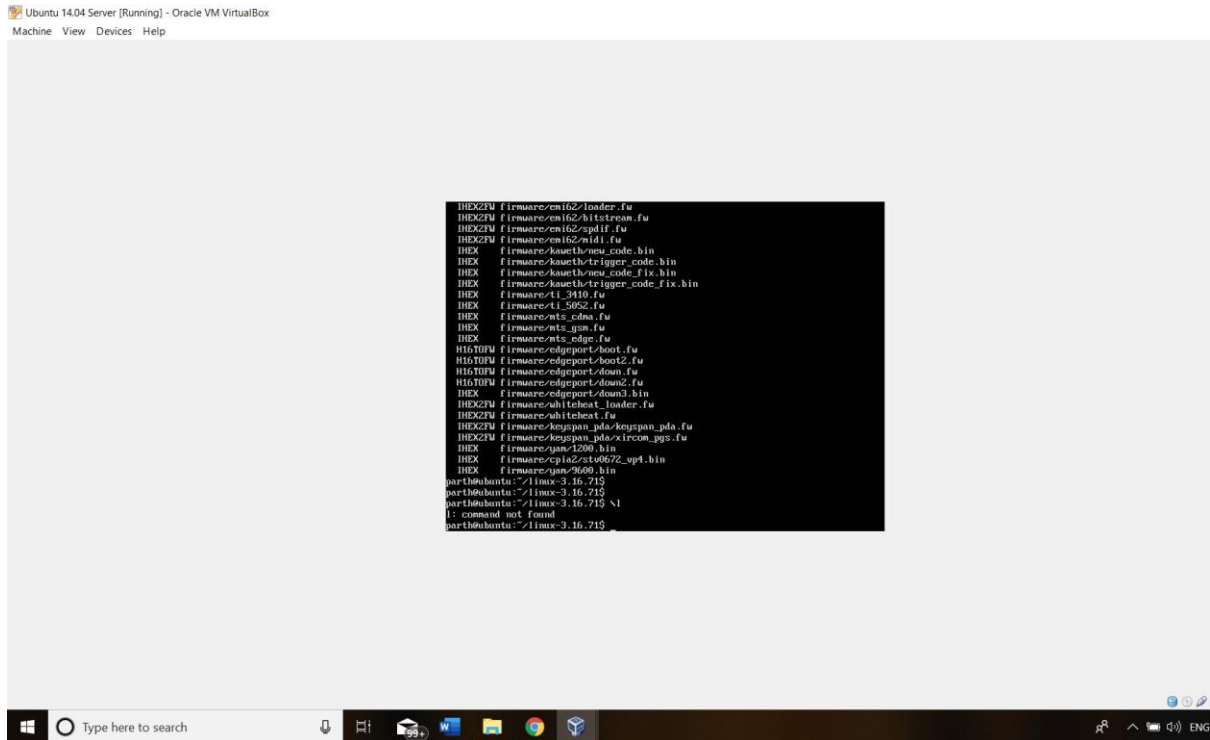
Ubuntu 14.04 Server [Running] - Oracle VM VirtualBox
Machine View Devices Help

```

CC [M] net/sched/cn_cqp.o
CC [M] net/smpc/auth_gss/gss_krb5_urap.o
CC [M] drivers/input/misc/dock120.o
CC [M] net/sched/cn_ahyle.o
CC [M] net/smpc/auth_gss/gss_krb5_crypto.o
CC [M] drivers/input/misc/cn091.o
CC [M] drivers/infiniband/hw/cxgb4/provider.o
CC [M] net/netfilter/ipset/ip_set_getport.o
CC [M] net/smpc/auth_gss/gss_krb5_keys.o
CC [M] net/sched/cn_u32.o
CC [M] drivers/input/misc/cn3000_dbx.o
CC [M] drivers/infiniband/hw/cxgb4/mem.o
LD [M] net/smpc/auth_gss/auth_rpcgss.o
LD [M] net/smpc/auth_gss/rpcsec_gss_krb5.o
CC [M] net/sched/cn_meta.o
LD [M] net/smpc/xprtno/au1111n.o
LD [M] net/smpc/xprtno/zuc_rdma.o
CC [M] drivers/input/misc/cn3000_dbx_12c.o
CC [M] net/netfilter/ipset/ip_set.o
CC [M] drivers/input/misc/ds90C03_onkey.o
CC [M] drivers/infiniband/hw/cxgb4/cq.o
CC [M] net/smpc/xprtno/zuc_rdma_transport.o
CC [M] net/sched/cn_text.o
CC [M] drivers/input/misc/ds90C03_onkey.o
CC [M] net/netfilter/ipset/ip_set_bitmap_ip.o
CC [M] net/sched/cn_canid.o
CC [M] drivers/input/misc/gp2ap002a00f.o
CC [M] drivers/infiniband/hw/cxgb4/qp.o
CC [M] net/smpc/xprtno/zuc_rdma_marshall.o

```

Done with compiling



- Installing the modules by using make command and this installs all the modules.

make modules install

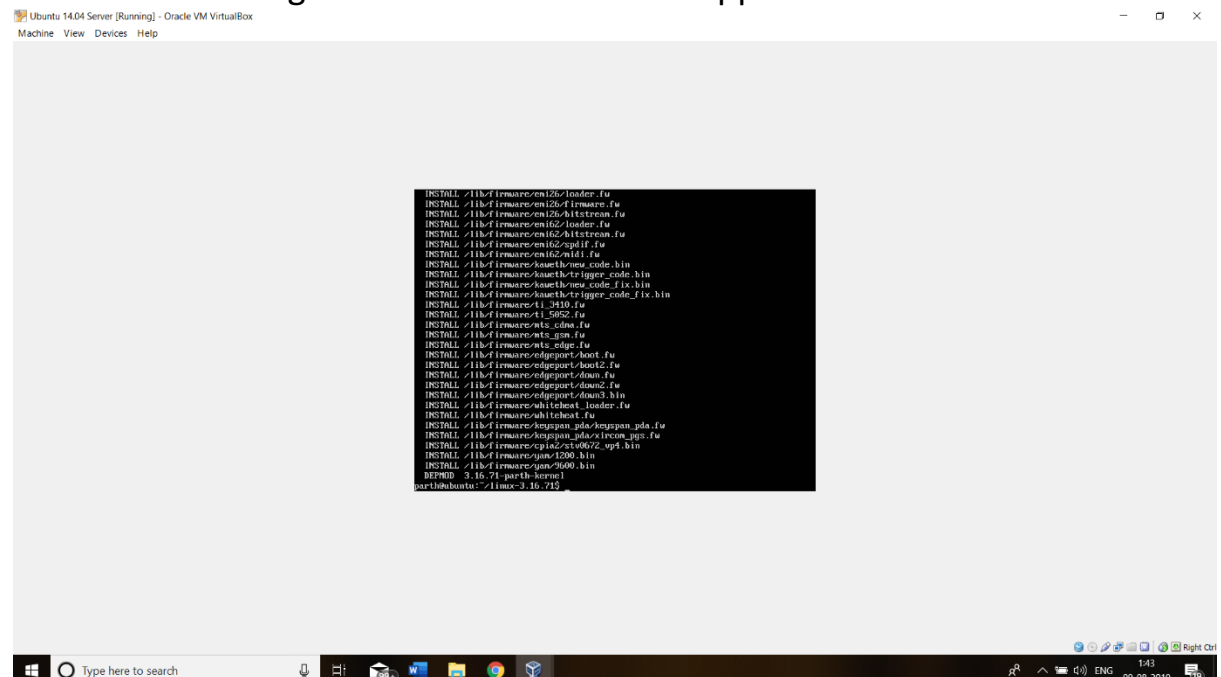
- make- make utility to maintain groups of programs


```

INSTALL crypto/ctr.ko
INSTALL crypto/cts.ko
INSTALL crypto/deflate.ko
INSTALL crypto/des_generic.ko
INSTALL crypto/fcrypt.ko
INSTALL crypto/gcm.ko
INSTALL crypto/gf128mul.ko
INSTALL crypto/ghash-generic.ko
INSTALL crypto/khazad.ko
INSTALL crypto/lrw.ko
INSTALL crypto/lz4.ko
INSTALL crypto/lz4hc.ko
INSTALL crypto/md4.ko
INSTALL crypto/michael_mic.ko
INSTALL crypto/pcbc.ko
INSTALL crypto/pcrypt.ko
INSTALL crypto/rmd128.ko
INSTALL crypto/rmd160.ko
INSTALL crypto/rmd256.ko
INSTALL crypto/rmd320.ko
INSTALL crypto/salsa20_generic.ko
INSTALL crypto/seed.ko
INSTALL crypto/seqiv.ko
INSTALL crypto/serpent_generic.ko
INSTALL crypto/tcrypt.ko
INSTALL crypto/tea.ko
INSTALL crypto/tgr192.ko
INSTALL crypto/twofish_common.ko
INSTALL crypto/twofish_generic.ko

```

After downloading the modules this screen appears.



sudo make install

```

INSTALL /lib/firmware/kaweth/trigger_code.bin
INSTALL /lib/firmware/kaweth/new_code_fix.bin
INSTALL /lib/firmware/kaweth/trigger_code_fix.bin
INSTALL /lib/firmware/ti_3410.fw
INSTALL /lib/firmware/ti_5052.fw
INSTALL /lib/firmware/mts_cdma.fw
INSTALL /lib/firmware/mts_gsm.fw
INSTALL /lib/firmware/mts_edge.fw
INSTALL /lib/firmware/edgeport/boot.fw
INSTALL /lib/firmware/edgeport/boot2.fw
INSTALL /lib/firmware/edgeport/down.fw
INSTALL /lib/firmware/edgeport/down2.fw
INSTALL /lib/firmware/edgeport/down3.bin
INSTALL /lib/firmware/whiteheat_loader.fw
INSTALL /lib/firmware/whiteheat.fw
INSTALL /lib/firmware/keyspan_pda/keyspan_pda.fw
INSTALL /lib/firmware/keyspan_pda/xircom_pgs.fw
INSTALL /lib/firmware/cpia2/stv0672_vp4.bin
INSTALL /lib/firmware/yam/1200.bin
INSTALL /lib/firmware/yam/9600.bin
DEPMOD 3.16.71-parth-kernel
parth@ubuntu:~/linux-3.16.71$ sudo make install
sh ./arch/x86/boot/install.sh 3.16.71-parth-kernel arch/x86/boot/bzImage \
    System.map "/boot"
run-parts: executing /etc/kernel/postinst.d/apt-auto-removal 3.16.71-parth-kernel
l /boot/vmlinuz-3.16.71-parth-kernel
run-parts: executing /etc/kernel/postinst.d/initramfs-tools 3.16.71-parth-kernel
/boot/vmlinuz-3.16.71-parth-kernel
update-initramfs: Generating /boot/initrd.img-3.16.71-parth-kernel

```

After its installed.

```

INSTALL /lib/firmware/whiteheat_loader.fw
INSTALL /lib/firmware/whiteheat.fw
INSTALL /lib/firmware/keyspan_pda/keyspan_pda.fw
INSTALL /lib/firmware/keyspan_pda/xircom_pgs.fw
INSTALL /lib/firmware/cpia2/stv0672_vp4.bin
INSTALL /lib/firmware/yam/1200.bin
INSTALL /lib/firmware/yam/9600.bin
DEPMOD 3.16.71-parth-kernel
parth@ubuntu:~/linux-3.16.71$ sudo make install
sh ./arch/x86/boot/install.sh 3.16.71-parth-kernel arch/x86/boot/bzImage \
    System.map "/boot"
run-parts: executing /etc/kernel/postinst.d/apt-auto-removal 3.16.71-parth-kernel
l /boot/vmlinuz-3.16.71-parth-kernel
run-parts: executing /etc/kernel/postinst.d/initramfs-tools 3.16.71-parth-kernel
/boot/vmlinuz-3.16.71-parth-kernel
update-initramfs: Generating /boot/initrd.img-3.16.71-parth-kernel
run-parts: executing /etc/kernel/postinst.d/update-notifier 3.16.71-parth-kernel
/boot/vmlinuz-3.16.71-parth-kernel
run-parts: executing /etc/kernel/postinst.d/zz-update-grub 3.16.71-parth-kernel
/boot/vmlinuz-3.16.71-parth-kernel
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-3.16.71-parth-kernel
Found initrd image: /boot/initrd.img-3.16.71-parth-kernel
Found linux image: /boot/vmlinuz-3.13.0-24-generic
Found initrd image: /boot/initrd.img-3.13.0-24-generic
Found memtest86+ image: /boot/memtest86+.elf
Found memtest86+ image: /boot/memtest86+.bin
done
parth@ubuntu:~/linux-3.16.71$
parth@ubuntu:~/linux-3.16.71$

```

- Now come the grub entry, this opens the grub shell.

- grub- the grub shell

```
GNU nano 2.2.6      File: 40_custom      Modified
#!/bin/sh
exec tail -n +3 $0
# This file provides an easy way to add custom menu entries.  Simply type the
# menu entries you want to add after this comment.  Be careful not to change
# the 'exec tail' line above.

menuentry 'Ubuntu 14 parth-kernel' {
    set root='hd0,1'
    linux /boot/vmlinuz-3.16.71-parth-kernel root=/dev/sda1
}
```

File Name to Write: 40_custom

^G Get Help	^M-D DOS Format	^M-A Append	^M-B Backup File
^C Cancel	^M-M Mac Format	^M-P Prepend	

- Updating the grub entry.

. sudo- execute a command as another user

```
parth@ubuntu:/etc/grub.d$ sudo update-grub
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-3.16.71-parth-kernel
Found initrd image: /boot/initrd.img-3.16.71-parth-kernel
Found linux image: /boot/vmlinuz-3.13.0-24-generic
Found initrd image: /boot/initrd.img-3.13.0-24-generic
Found memtest86+ image: /boot/memtest86+.elf
Found memtest86+ image: /boot/memtest86+.bin
done
parth@ubuntu:/etc/grub.d$ _
```

- Now opening grub menu.



Here at the last we can see UBUNTU 14 PARTH-KERNEL.

- Now reboot and then see the kernel release.

- Uname -r → print the kernel release

```
parth@ubuntu:~$ uname -r
3.16.71-parth-kernel
parth@ubuntu:~$ _
```

////////Done for this part////////
////////Parth Singh////////
//2018356//