Laboratório 1: Instalar e compilar o núcleo (kernel) Linux
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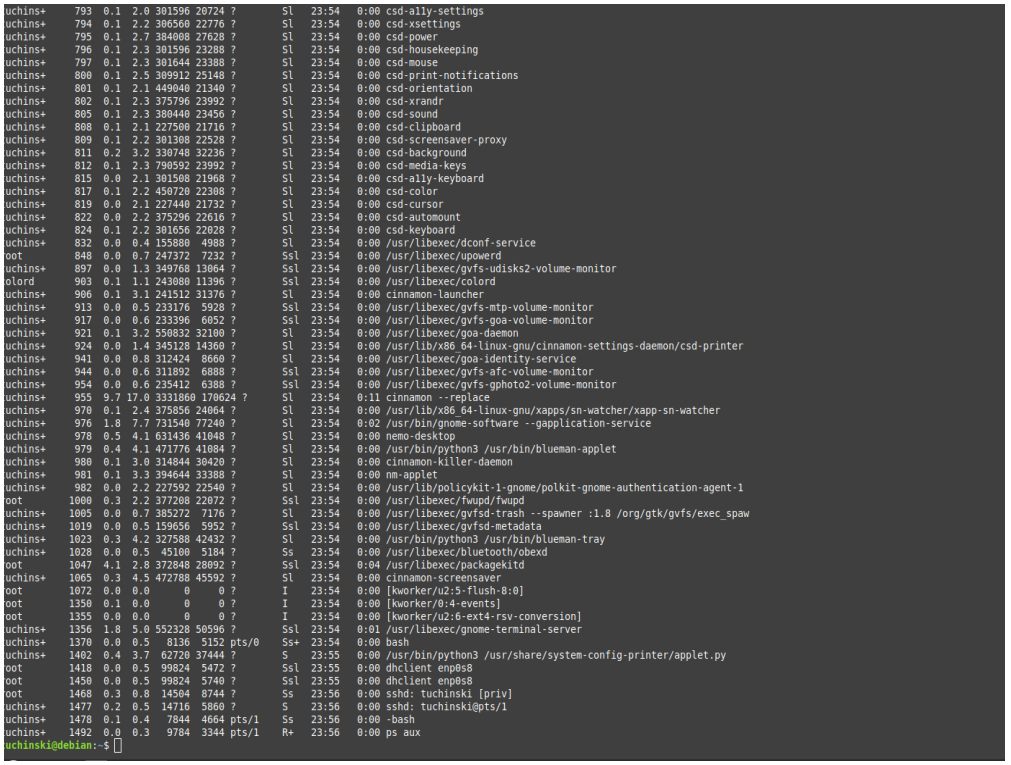
Este relatório tem o objetivo de apresentar os passos realizados em laboratório para a instalação e compilação do núcleo (Kernel) Linux. Para esse procedimento foi utilizado máquina virtual com 1GB ram, 43 GB de armazenamento, Versão do Linux instalado na VM: Debian 11.2.0 e Versão do kernel compilado: 5.16.14.

- ➔ Instalação da máquina virtual:
  - ◆ Particionamento do disco

  - ◆ Configuração do endereço do repositório

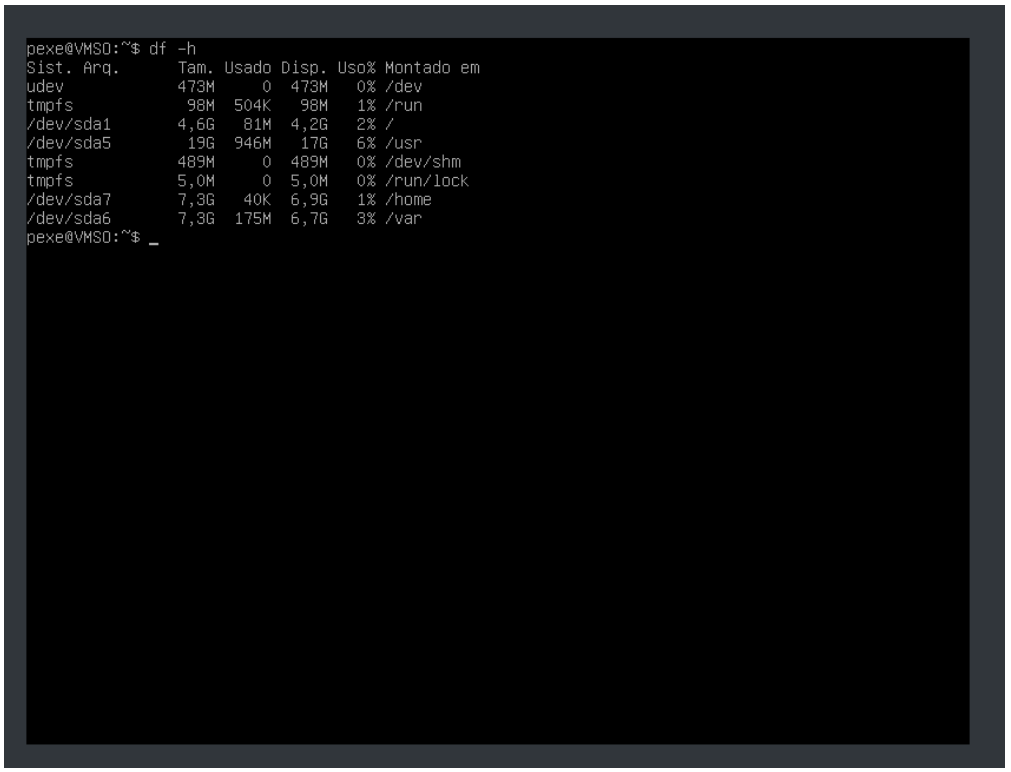
➔ Verificando a listagem de processos em execução:

◆ *ps aux*:



➔ Verificando o espaço em disco:

◆ *df -h*



➔ Escolha do tamanho das partições:

- ◆ Diretório "/" -> 5GB
  - alocado espaço conforme recomendações na documentação;
- ◆ Diretório "/usr" -> 20GB
  - deixado com o maior espaço por conta da necessidade de armazenamento para a compilação do kernel;
- ◆ Diretório "/home" -> 8GB;
  - alocado espaço suficiente para armazenar os arquivos do usuário;
- ◆ Área de troca(swap) -> 2GB
  - espaço alocado por ser duas vezes o tamanho da memória RAM, conforme recomendação.

➔ Verificando a memória disponível:

- ◆ *free -b*

```
tuchinski@debian:~$ free -b
               total        used        free      shared  buff/cache   available
Mem.:     1023885312   437014528   297889792    11362304   288980992   431144960
Swap:     1999630336   447426560  1552203776
tuchinski@debian:~$
```

- ◆ *cat /proc/meminfo*

```
tuchinski@debian:~$ cat /proc/meminfo
MemTotal:         999888 kB
MemFree:          183992 kB
MemAvailable:     253424 kB
Buffers:           11756 kB
Cached:           182992 kB
SwapCached:        41564 kB
Active:           199040 kB
Inactive:         495680 kB
Active(anon):     103856 kB
Inactive(anon):   407204 kB
Active(file):      95184 kB
Inactive(file):    88476 kB
Unevictable:          32 kB
Mlocked:              32 kB
SwapTotal:       1952764 kB
SwapFree:        1511184 kB
Dirty:              5096 kB
Writeback:             0 kB
AnonPages:        460864 kB
Mapped:            68016 kB
Shmem:             11088 kB
KReclaimable:      26640 kB
Slab:              62972 kB
SReclaimable:      26640 kB
SUnreclaim:        36332 kB
KernelStack:        5904 kB
PageTables:        13816 kB
NFS_Unstable:          0 kB
Bounce:                0 kB
WritebackTmp:          0 kB
CommitLimit:     2452708 kB
Committed_AS:    3016064 kB
VmallocTotal:   34359738367 kB
VmallocUsed:       36552 kB
VmallocChunk:          0 kB
Percpu:              624 kB
HardwareCorrupted:     0 kB
AnonHugePages:     96256 kB
ShmemHugePages:        0 kB
ShmemPmdMapped:        0 kB
FileHugePages:         0 kB
FilePmdMapped:         0 kB
HugePages_Total:       0
HugePages_Free:        0
HugePages_Rsvd:        0
HugePages_Surp:        0
Hugepagesize:       2048 kB
Hugetlb:               0 kB
DirectMap4k:      106432 kB
DirectMap2M:      942080 kB
```

➔ Comandos de rede:

- *ip address show*

```
tuchinski@debian:~$ ip address show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 08:00:27:f8:ee:d2 brd ff:ff:ff:ff:ff:ff
    inet 10.0.2.15/24 brd 10.0.2.255 scope global dynamic noprefixroute enp0s3
       valid_lft 83336sec preferred_lft 83336sec
    inet6 fe80::a00:27ff:fef8:eed2/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
3: enp0s8: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 08:00:27:a7:bb:d2 brd ff:ff:ff:ff:ff:ff
    inet 192.168.56.101/24 brd 192.168.56.255 scope global dynamic enp0s8
       valid_lft 528sec preferred_lft 528sec
    inet6 fe80::a00:27ff:fea7:bbd2/64 scope link
       valid_lft forever preferred_lft forever
```

- *ip route*

```
tuchinski@debian:~$ ip route
default via 10.0.2.2 dev enp0s3 proto dhcp metric 100
10.0.2.0/24 dev enp0s3 proto kernel scope link src 10.0.2.15 metric 100
169.254.0.0/16 dev enp0s3 scope link metric 1000
192.168.56.0/24 dev enp0s8 proto kernel scope link src 192.168.56.101
```

- *cat /etc/resolv.conf*

```
tuchinski@debian:~$ cat /etc/resolv.conf
# Generated by NetworkManager
nameserver 10.0.2.3
```

- *cat /etc/network/interfaces*

```
tuchinski@debian:~$ cat /etc/network/interfaces
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

source /etc/network/interfaces.d/*

# The loopback network interface
auto lo
iface lo inet loopback
```

- *ping google.com*

```
tuchinski@debian:~$ ping google.com
PING google.com (142.250.218.206) 56(84) bytes of data.
64 bytes from gru14s25-in-f14.1e100.net (142.250.218.206): icmp_seq=1 ttl=63 time=14.9 ms
64 bytes from gru14s25-in-f14.1e100.net (142.250.218.206): icmp_seq=2 ttl=63 time=15.5 ms
64 bytes from gru14s25-in-f14.1e100.net (142.250.218.206): icmp_seq=3 ttl=63 time=15.4 ms
64 bytes from gru14s25-in-f14.1e100.net (142.250.218.206): icmp_seq=4 ttl=63 time=15.3 ms
^C
--- google.com ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3021ms
rtt min/avg/max/mdev = 14.886/15.251/15.467/0.221 ms
```

➔ Configuração dos repositórios do apt-get:

- */etc/apt*

```
GNU nano 5.4                                                    sources.list
# deb cdrom:[Debian GNU/Linux 11.2.0 _Bullseye_ - Official amd64 NETINST 20211218-11:12]/ bullseye main

#deb cdrom:[Debian GNU/Linux 11.2.0 _Bullseye_ - Official amd64 NETINST 20211218-11:12]/ bullseye main

deb http://deb.debian.org/debian/ bullseye main
deb-src http://deb.debian.org/debian/ bullseye main

deb http://security.debian.org/debian-security bullseye-security main
deb-src http://security.debian.org/debian-security bullseye-security main

# bullseye-updates, to get updates before a point release is made;
# see https://www.debian.org/doc/manuals/debian-reference/ch02.en.html#_updates_and_backports
deb http://deb.debian.org/debian/ bullseye-updates main
deb-src http://deb.debian.org/debian/ bullseye-updates main

# This system was installed using small removable media
# (e.g. netinst, live or single CD). The matching "deb cdrom"
# entries were disabled at the end of the installation process.
# For information about how to configure apt package sources,
# see the sources.list(5) manual.
```

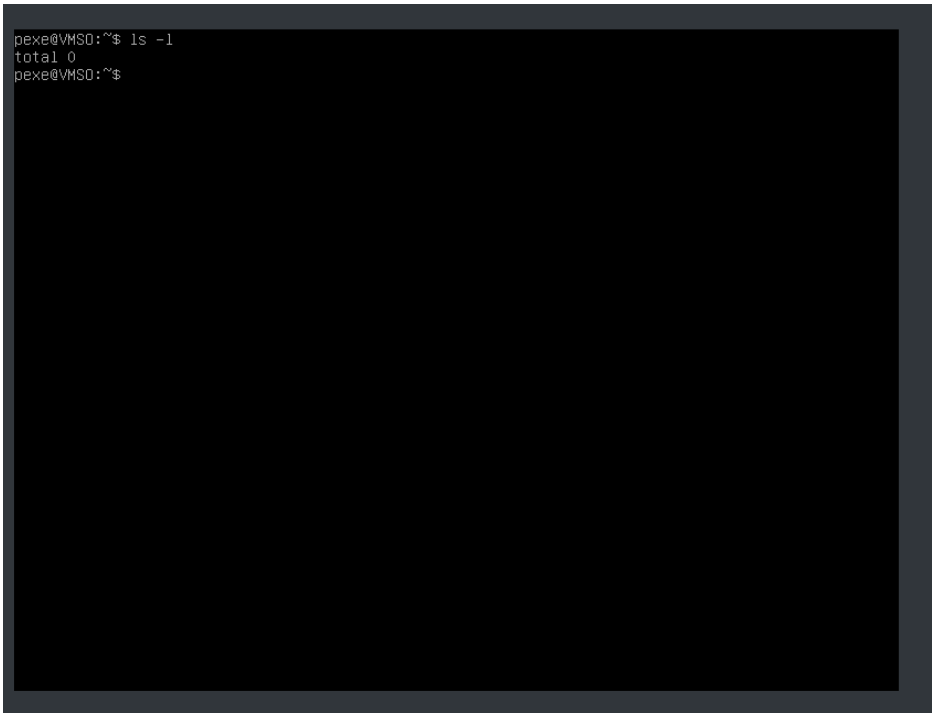
➔ Verificando o kernel atual:

- *uname -a*

```
tuchinski@debian:/etc/apt$ uname -a
Linux debian 5.10.0-12-amd64 #1 SMP Debian 5.10.103-1 (2022-03-07) x86_64 GNU/Linux
```

➔ Teste dos comandos

- *ls -l*

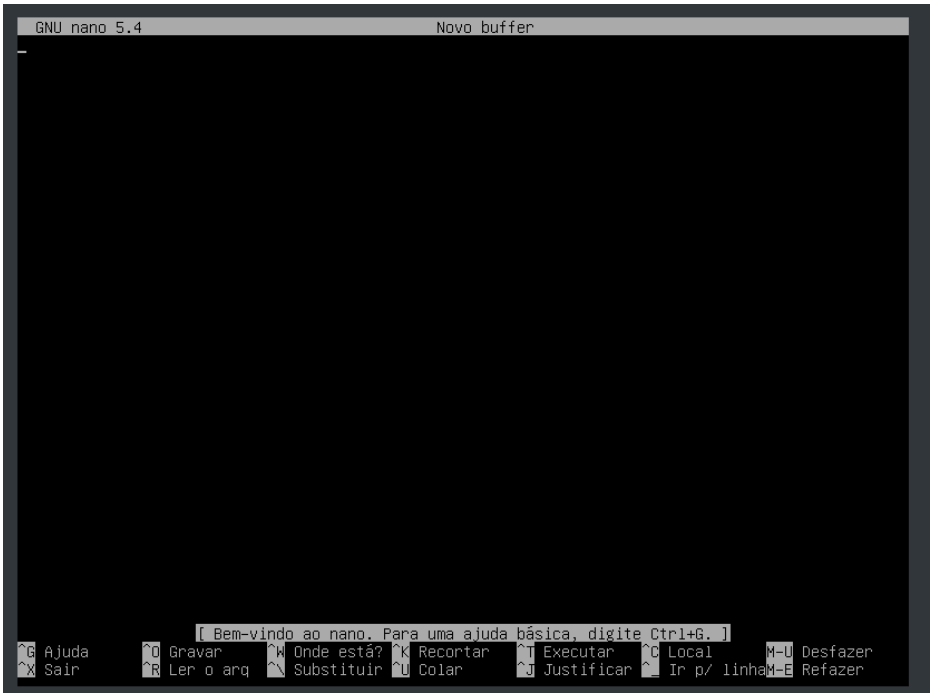


◆ *cd diretório*

◆ *cat nome_do_arquivo*

◆ *rm nome_do_arquivo*

◆ *pico ou nano*



◆ *cp nome_de_origem nome_de_destino*

◆ *grep nome_do_arquivo*

◆ *head nome_do_arquivo*

```
root@debian:/home/tuchinski/Documentos# head teste.txt
testando comandos na VM

meio do arquivo


fim do arquivo
```

◆ *tail nome_do_arquivo*

```
pexe@VMSO:~$ tail teste.txt
arquivo de teste
pexe@VMSO:~$ _
```

- *mv nome_de_origem nome_de_destino*

➔ *compilando kernel:*

- *instalação das bibliotecas*

◆ *baixando kernel*

◆ *make modules_install*

```
root@debian:/usr/src/linux-5.16.14# make modules_install
arch/x86/Makefile:142: CONFIG_X86_X32 enabled but no binutils support
  INSTALL /lib/modules/5.16.14/kernel/arch/x86/crypto/aesni-intel.ko
  INSTALL /lib/modules/5.16.14/kernel/arch/x86/crypto/crc32-pclmul.ko
  INSTALL /lib/modules/5.16.14/kernel/arch/x86/crypto/crc32c-intel.ko
  INSTALL /lib/modules/5.16.14/kernel/arch/x86/crypto/crct10dif-pclmul.ko
  INSTALL /lib/modules/5.16.14/kernel/arch/x86/crypto/ghash-clmulni-intel.ko
  INSTALL /lib/modules/5.16.14/kernel/arch/x86/events/rapl.ko
  INSTALL /lib/modules/5.16.14/kernel/arch/x86/kernel/msr.ko
  INSTALL /lib/modules/5.16.14/kernel/block/t10-pi.ko
  INSTALL /lib/modules/5.16.14/kernel/crypto/crc32c_generic.ko
  INSTALL /lib/modules/5.16.14/kernel/crypto/crct10dif_common.ko
  INSTALL /lib/modules/5.16.14/kernel/crypto/crct10dif_generic.ko
  INSTALL /lib/modules/5.16.14/kernel/crypto/cryptd.ko
  INSTALL /lib/modules/5.16.14/kernel/crypto/crypto_simd.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/acpi/ac.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/acpi/battery.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/acpi/button.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/acpi/video.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/ata/acard-ahci.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/ata/ahci.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/ata/ata_generic.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/ata/ata_piix.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/ata/libahci.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/ata/libata.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/cdrom/cdrom.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/char/lp.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/char/ppdev.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/gpu/drm/drm.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/gpu/drm/drm_kms_helper.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/gpu/drm/ttm/ttm.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/gpu/drm/vmwgfx/vmwgfx.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/hid/hid-generic.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/hid/hid.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/hid/usbhid/usbhid.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/i2c/algos/i2c-algo-bit.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/i2c/busses/i2c-piix4.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/input/evdev.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/input/joydev.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/input/misc/pcspkr.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/input/mouse/psmouse.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/input/serio/serio_raw.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/media/cec/core/cec.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/net/ethernet/intel/e1000/e1000.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/parport/parport.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/parport/parport_pc.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/powercap/intel_rapl_common.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/powercap/intel_rapl_msr.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/scsi/scsi_common.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/scsi/scsi_mod.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/scsi/sd_mod.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/scsi/sg.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/scsi/sr_mod.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/thermal/intel/intel_powerclamp.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/usb/common/usb-common.ko
  INSTALL /lib/modules/5.16.14/kernel/drivers/usb/core/usbcore.ko
```

```
INSTALL /lib/modules/5.16.14/kernel/drivers/scsi/sr_mod.ko
INSTALL /lib/modules/5.16.14/kernel/drivers/thermal/intel/intel_powerclamp.ko
INSTALL /lib/modules/5.16.14/kernel/drivers/usb/common/usb-common.ko
INSTALL /lib/modules/5.16.14/kernel/drivers/usb/core/usbcore.ko
INSTALL /lib/modules/5.16.14/kernel/drivers/usb/host/ehci-hcd.ko
INSTALL /lib/modules/5.16.14/kernel/drivers/usb/host/ehci-pci.ko
INSTALL /lib/modules/5.16.14/kernel/drivers/usb/host/ohci-hcd.ko
INSTALL /lib/modules/5.16.14/kernel/drivers/usb/host/ohci-pci.ko
INSTALL /lib/modules/5.16.14/kernel/drivers/virt/vboxguest/vboxguest.ko
INSTALL /lib/modules/5.16.14/kernel/fs/autofs/autofs4.ko
INSTALL /lib/modules/5.16.14/kernel/fs/configfs/configfs.ko
INSTALL /lib/modules/5.16.14/kernel/fs/ext4/ext4.ko
INSTALL /lib/modules/5.16.14/kernel/fs/fuse/fuse.ko
INSTALL /lib/modules/5.16.14/kernel/fs/jbd2/jbd2.ko
INSTALL /lib/modules/5.16.14/kernel/fs/mbcache.ko
INSTALL /lib/modules/5.16.14/kernel/kernel/configs.ko
INSTALL /lib/modules/5.16.14/kernel/lib/crc-t10dif.ko
INSTALL /lib/modules/5.16.14/kernel/lib/crc16.ko
INSTALL /lib/modules/5.16.14/kernel/lib/crypto/libaes.ko
INSTALL /lib/modules/5.16.14/kernel/net/ipv4/netfilter/ip_tables.ko
INSTALL /lib/modules/5.16.14/kernel/net/netfilter/x_tables.ko
INSTALL /lib/modules/5.16.14/kernel/net/netfilter/xt_tcpudp.ko
INSTALL /lib/modules/5.16.14/kernel/net/rfkill/rfkill.ko
INSTALL /lib/modules/5.16.14/kernel/sound/ac97_bus.ko
INSTALL /lib/modules/5.16.14/kernel/sound/core/snd-pcm.ko
INSTALL /lib/modules/5.16.14/kernel/sound/core/snd-timer.ko
INSTALL /lib/modules/5.16.14/kernel/sound/core/snd.ko
INSTALL /lib/modules/5.16.14/kernel/sound/pci/ac97/snd-ac97-codec.ko
INSTALL /lib/modules/5.16.14/kernel/sound/pci/snd-intel8x0.ko
INSTALL /lib/modules/5.16.14/kernel/sound/soundcore.ko
DEPMOD  /lib/modules/5.16.14
```

- *make install*

```
root@debian:/usr/src/linux-5.16.14# make install
arch/x86/Makefile:142: CONFIG_X86_X32 enabled but no binutils support
sh ./arch/x86/boot/install.sh 5.16.14 \
        arch/x86/boot/bzImage System.map "/boot"
run-parts: executing /etc/kernel/postinst.d/apt-auto-removal 5.16.14 /boot/vmlinuz-5.16.14
run-parts: executing /etc/kernel/postinst.d/dkms 5.16.14 /boot/vmlinuz-5.16.14
dkms: running auto installation service for kernel 5.16.14:.
run-parts: executing /etc/kernel/postinst.d/initramfs-tools 5.16.14 /boot/vmlinuz-5.16.14
update-initramfs: Generating /boot/initrd.img-5.16.14
run-parts: executing /etc/kernel/postinst.d/unattended-upgrades 5.16.14 /boot/vmlinuz-5.16.14
run-parts: executing /etc/kernel/postinst.d/zz-update-grub 5.16.14 /boot/vmlinuz-5.16.14
Generating grub configuration file ...
Found background image: /usr/share/images/desktop-base/desktop-grub.png
Found linux image: /boot/vmlinuz-5.16.14
Found initrd image: /boot/initrd.img-5.16.14
Found linux image: /boot/vmlinuz-5.10.0-12-amd64
Found initrd image: /boot/initrd.img-5.10.0-12-amd64
Found linux image: /boot/vmlinuz-5.10.0-10-amd64
Found initrd image: /boot/initrd.img-5.10.0-10-amd64
done
```

➔ Tamanho dos arquivos no diretório /boot:

- *ls -lh* no diretório /boot após compilação do kernel

```
root@debian:/boot# ls -lh
total 147M
-rw-r--r-- 1 root root 231K dez  8 13:21 config-5.10.0-10-amd64
-rw-r--r-- 1 root root 231K mar  7 18:06 config-5.10.0-12-amd64
-rw-r--r-- 1 root root 143K mar 16 21:26 config-5.16.14
drwxr-xr-x 5 root root 1,0K mar 16 21:26 grub
-rw-r--r-- 1 root root  40M mar 14 23:24 initrd.img-5.10.0-10-amd64
-rw-r--r-- 1 root root  40M mar 14 23:24 initrd.img-5.10.0-12-amd64
-rw-r--r-- 1 root root  43M mar 16 21:26 initrd.img-5.16.14
drwx------ 2 root root  12K mar 14 22:52 lost+found
-rw-r--r-- 1 root root   83 dez  8 13:21 System.map-5.10.0-10-amd64
-rw-r--r-- 1 root root   83 mar  7 18:06 System.map-5.10.0-12-amd64
-rw-r--r-- 1 root root 4,3M mar 16 21:26 System.map-5.16.14
-rw-r--r-- 1 root root 6,6M dez  8 13:21 vmlinuz-5.10.0-10-amd64
-rw-r--r-- 1 root root 6,6M mar  7 18:06 vmlinuz-5.10.0-12-amd64
-rw-r--r-- 1 root root 6,6M mar 16 21:26 vmlinuz-5.16.14
```

➔ Tamanho da pasta com os módulos compilados:

- *du -sh 5.16.14*

```
root@debian:/lib/modules# du -sh 5.16.14/
141M    5.16.14/
```

Referências utilizadas

- https://www.debian.org/releases/stable/amd64/apc.pt.html
- https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/6/html/installation_guide/s2-diskpartrecommend-x86
- https://kernel.org
- https://www.debian.org