Os progect

Team name : phantoms

Members:

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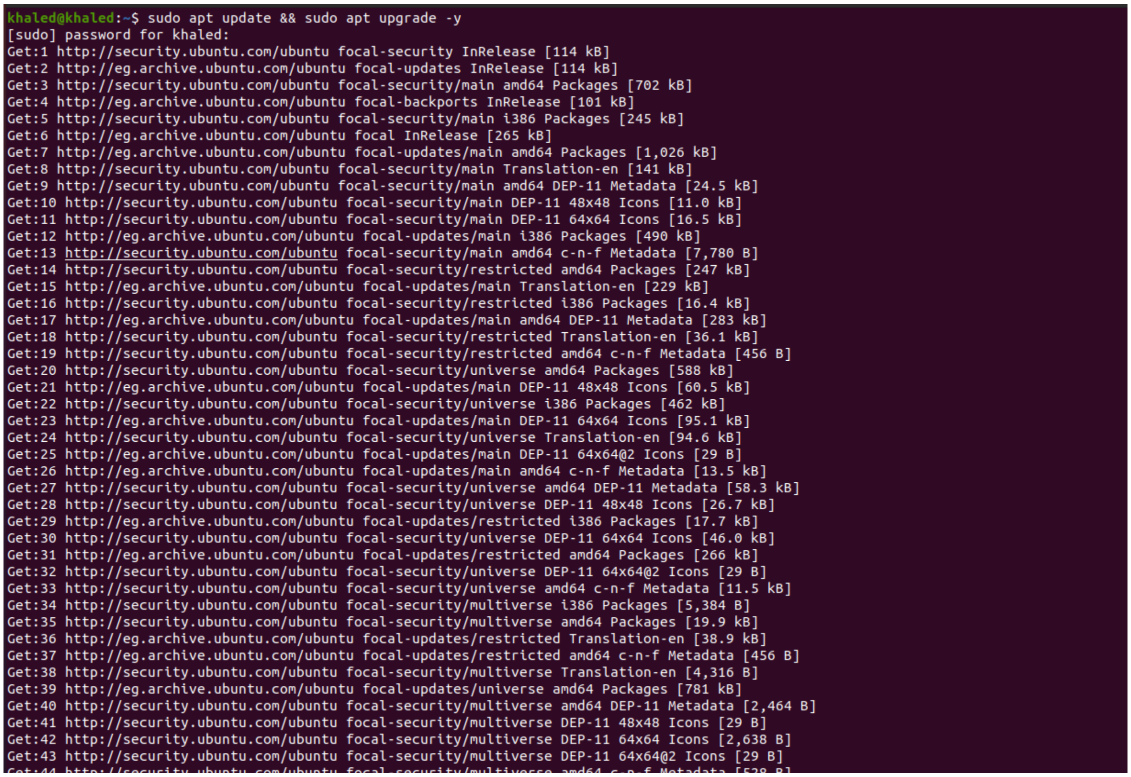
Section 1 – Preparation

In this section, you will download all necessary tools to add a basic system call to the Linux kernel and run it. This is the only part of the entire process where network connectivity is necessary.

1.1 - Fully update your operating system.

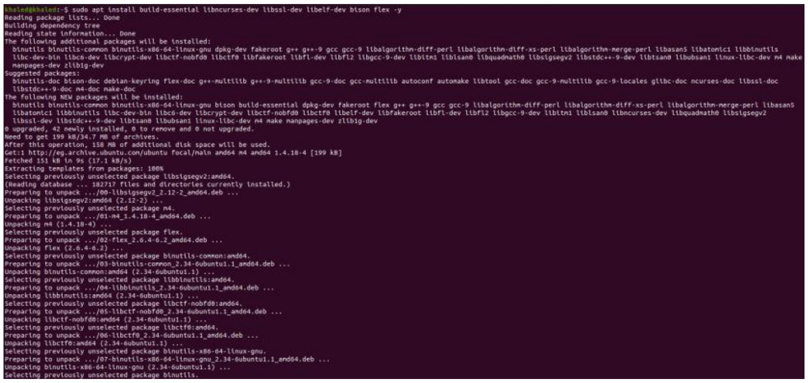
“ sudo apt update && sudo apt upgrade -y ”



```
khaled@khaled:~$ sudo apt update && sudo apt upgrade -y
[sudo] password for khaled:
Get:1 http://security.ubuntu.com/ubuntu focal-security InRelease [114 kB]
Get:2 http://eg.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Get:3 http://security.ubuntu.com/ubuntu focal-security/main amd64 Packages [702 kB]
Get:4 http://eg.archive.ubuntu.com/ubuntu focal-backports InRelease [101 kB]
Get:5 http://security.ubuntu.com/ubuntu focal-security/main i386 Packages [245 kB]
Get:6 http://eg.archive.ubuntu.com/ubuntu focal InRelease [265 kB]
Get:7 http://eg.archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages [1,026 kB]
Get:8 http://security.ubuntu.com/ubuntu focal-security/main Translation-en [141 kB]
Get:9 http://security.ubuntu.com/ubuntu focal-security/main amd64 DEP-11 Metadata [24.5 kB]
Get:10 http://security.ubuntu.com/ubuntu focal-security/main DEP-11 48x48 Icons [11.0 kB]
Get:11 http://security.ubuntu.com/ubuntu focal-security/main DEP-11 64x64 Icons [16.5 kB]
Get:12 http://eg.archive.ubuntu.com/ubuntu focal-updates/main i386 Packages [490 kB]
Get:13 http://security.ubuntu.com/ubuntu focal-security/main amd64 c-n-f Metadata [7,780 B]
Get:14 http://security.ubuntu.com/ubuntu focal-security/restricted amd64 Packages [247 kB]
Get:15 http://eg.archive.ubuntu.com/ubuntu focal-updates/main Translation-en [229 kB]
Get:16 http://security.ubuntu.com/ubuntu focal-security/restricted i386 Packages [16.4 kB]
Get:17 http://eg.archive.ubuntu.com/ubuntu focal-updates/main amd64 DEP-11 Metadata [283 kB]
Get:18 http://security.ubuntu.com/ubuntu focal-security/restricted Translation-en [36.1 kB]
Get:19 http://security.ubuntu.com/ubuntu focal-security/restricted amd64 c-n-f Metadata [456 B]
Get:20 http://security.ubuntu.com/ubuntu focal-security/universe amd64 Packages [588 kB]
Get:21 http://eg.archive.ubuntu.com/ubuntu focal-updates/main DEP-11 48x48 Icons [60.5 kB]
Get:22 http://security.ubuntu.com/ubuntu focal-security/universe i386 Packages [462 kB]
Get:23 http://eg.archive.ubuntu.com/ubuntu focal-updates/main DEP-11 64x64 Icons [95.1 kB]
Get:24 http://security.ubuntu.com/ubuntu focal-security/universe Translation-en [94.6 kB]
Get:25 http://eg.archive.ubuntu.com/ubuntu focal-updates/main DEP-11 64x64@2 Icons [29 B]
Get:26 http://eg.archive.ubuntu.com/ubuntu focal-updates/main amd64 c-n-f Metadata [13.5 kB]
Get:27 http://security.ubuntu.com/ubuntu focal-security/universe amd64 DEP-11 Metadata [58.3 kB]
Get:28 http://security.ubuntu.com/ubuntu focal-security/universe DEP-11 48x48 Icons [26.7 kB]
Get:29 http://eg.archive.ubuntu.com/ubuntu focal-updates/restricted i386 Packages [17.7 kB]
Get:30 http://security.ubuntu.com/ubuntu focal-security/universe DEP-11 64x64 Icons [46.0 kB]
Get:31 http://eg.archive.ubuntu.com/ubuntu focal-updates/restricted amd64 Packages [266 kB]
Get:32 http://security.ubuntu.com/ubuntu focal-security/universe DEP-11 64x64@2 Icons [29 B]
Get:33 http://security.ubuntu.com/ubuntu focal-security/universe amd64 c-n-f Metadata [11.5 kB]
Get:34 http://security.ubuntu.com/ubuntu focal-security/multiverse i386 Packages [5,384 B]
Get:35 http://security.ubuntu.com/ubuntu focal-security/multiverse amd64 Packages [19.9 kB]
Get:36 http://eg.archive.ubuntu.com/ubuntu focal-updates/restricted Translation-en [38.9 kB]
Get:37 http://eg.archive.ubuntu.com/ubuntu focal-updates/restricted amd64 c-n-f Metadata [456 B]
Get:38 http://security.ubuntu.com/ubuntu focal-security/multiverse Translation-en [4,316 B]
Get:39 http://eg.archive.ubuntu.com/ubuntu focal-updates/universe amd64 Packages [781 kB]
Get:40 http://security.ubuntu.com/ubuntu focal-security/multiverse amd64 DEP-11 Metadata [2,464 B]
Get:41 http://security.ubuntu.com/ubuntu focal-security/multiverse DEP-11 48x48 Icons [29 B]
Get:42 http://security.ubuntu.com/ubuntu focal-security/multiverse DEP-11 64x64 Icons [2,638 B]
Get:43 http://security.ubuntu.com/ubuntu focal-security/multiverse DEP-11 64x64@2 Icons [29 B]
Get:44 http://security.ubuntu.com/ubuntu focal-security/multiverse amd64 c-n-f Metadata [528 B]
```

1.2 - Download and install the essential packages to compile kernels.

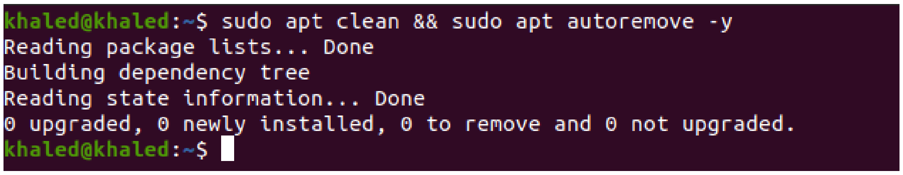
“sudo apt install build-essential libncurses-dev libssl-dev libelf-dev bison flex -y”



```
khaled@khaled:~$ sudo apt install build-essential libncurses-dev libssl-dev libelf-dev bison flex -y
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  binutils binutils-common binutils-x86-64-linux-gnu dpkg-dev fakeroot g++ g++-9 gcc gcc-9 libalgorithm-diff-perl libalgorithm-diff-xs-perl libalgorithm-merge-perl libasan5 libatomic1 libbinutils
  libc-dev-bin libc6-dev libcrypt-dev libctf-nobfd0 libctf0 libfakeroot libfl-dev libfl2 libgcc-9-dev libitm1 liblsan0 libquadmath0 libsigsegv2 libstdc++-9-dev libtsan0 libubsan1 linux-libc-dev m4 make
  manpages-dev zlib1g-dev
Suggested packages:
  binutils-doc bison-doc debian-keyring flex-doc g++-multilib g++-9-multilib gcc-9-doc gcc-multilib autoconf automake libtool gcc-doc gcc-9-multilib gcc-9-locales glibc-doc ncurses-doc libssl-doc
  libstdc++-9-doc m4-doc make-doc
The following NEW packages will be installed:
  binutils binutils-common binutils-x86-64-linux-gnu bison build-essential dpkg-dev fakeroot flex g++ g++-9 gcc gcc-9 libalgorithm-diff-perl libalgorithm-diff-xs-perl libalgorithm-merge-perl libasan5
  libatomic1 libbinutils libc-dev-bin libc6-dev libcrypt-dev libctf-nobfd0 libctf0 libelf-dev libfakeroot libfl-dev libfl2 libgcc-9-dev libitm1 liblsan0 libncurses-dev libquadmath0 libsigsegv2
  libssl-dev libstdc++-9-dev libtsan0 libubsan1 linux-libc-dev m4 make manpages-dev zlib1g-dev
0 upgraded, 42 newly installed, 0 to remove and 0 not upgraded.
Need to get 199 kB/34.7 MB of archives.
After this operation, 158 MB of additional disk space will be used.
Get:1 http://eg.archive.ubuntu.com/ubuntu focal/main amd64 m4 amd64 1.4.18-4 [199 kB]
Fetched 151 kB in 9s (17.1 kB/s)
Extracting templates from packages: 100%
Selecting previously unselected package libsigsegv2:amd64.
(Reading database ... 182717 files and directories currently installed.)
Preparing to unpack .../00-libsigsegv2_2.12-2_amd64.deb ...
Unpacking libsigsegv2:amd64 (2.12-2) ...
Selecting previously unselected package m4.
Preparing to unpack .../01-m4_1.4.18-4_amd64.deb ...
Unpacking m4 (1.4.18-4) ...
Selecting previously unselected package flex.
Preparing to unpack .../02-flex_2.6.4-6.2_amd64.deb ...
Unpacking flex (2.6.4-6.2) ...
Selecting previously unselected package binutils-common:amd64.
Preparing to unpack .../03-binutils-common_2.34-6ubuntu1.1_amd64.deb ...
Unpacking binutils-common:amd64 (2.34-6ubuntu1.1) ...
Selecting previously unselected package libbinutils:amd64.
Preparing to unpack .../04-libbinutils_2.34-6ubuntu1.1_amd64.deb ...
Unpacking libbinutils:amd64 (2.34-6ubuntu1.1) ...
Selecting previously unselected package libctf-nobfd0:amd64.
Preparing to unpack .../05-libctf-nobfd0_2.34-6ubuntu1.1_amd64.deb ...
Unpacking libctf-nobfd0:amd64 (2.34-6ubuntu1.1) ...
Selecting previously unselected package libctf0:amd64.
Preparing to unpack .../06-libctf0_2.34-6ubuntu1.1_amd64.deb ...
Unpacking libctf0:amd64 (2.34-6ubuntu1.1) ...
Selecting previously unselected package binutils-x86-64-linux-gnu.
Preparing to unpack .../07-binutils-x86-64-linux-gnu_2.34-6ubuntu1.1_amd64.deb ...
Unpacking binutils-x86-64-linux-gnu (2.34-6ubuntu1.1) ...
Selecting previously unselected package binutils.
```

1.3 - Clean up your installed packages.

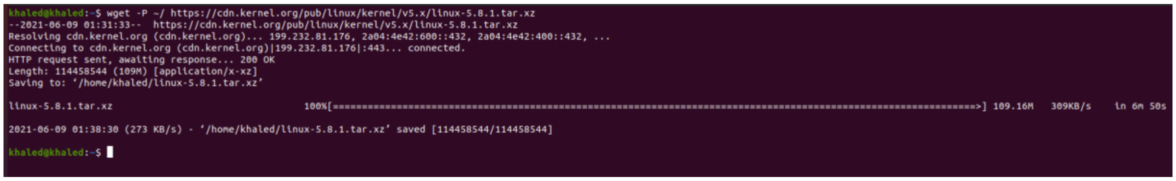
“sudo apt clean && sudo apt autoremove -y “



```
khaled@khaled:~$ sudo apt clean && sudo apt autoremove -y
Reading package lists... Done
Building dependency tree
Reading state information... Done
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
khaled@khaled:~$
```

1.4 - Download the source code of the latest stable version of the Linux kernel (which is 5.8.1 as of 12 August 2020) to your home folder.

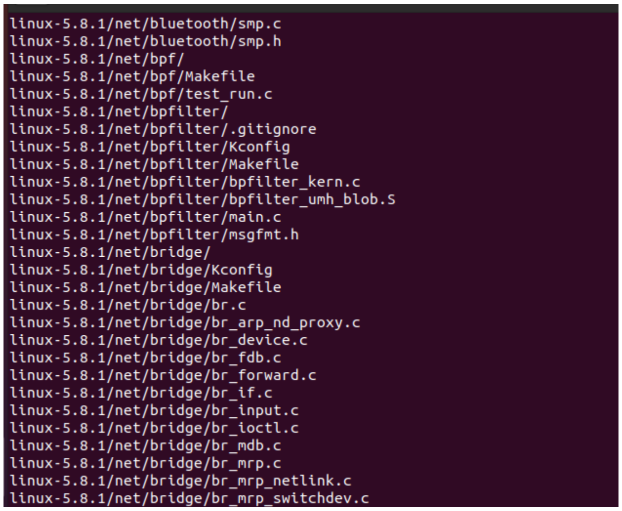
“ wget -P ~/ https://cdn.kernel.org/pub/linux/kernel/v5.x/linux-5.8.1.tar.xz “



```
khaled@khaled:~$ wget -P ~/ https://cdn.kernel.org/pub/linux/kernel/v5.x/linux-5.8.1.tar.xz
--2021-06-09 01:31:33--  https://cdn.kernel.org/pub/linux/kernel/v5.x/linux-5.8.1.tar.xz
Resolving cdn.kernel.org (cdn.kernel.org)... 199.232.81.176, 2a04:4e42:600::432, 2a04:4e42:400::432, ...
Connecting to cdn.kernel.org (cdn.kernel.org)|199.232.81.176|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 114458544 (109M) [application/x-xz]
Saving to: ‘/home/khaled/linux-5.8.1.tar.xz’

linux-5.8.1.tar.xz                100%[===================================================================================================>] 109.16M   309KB/s    in 6m 50s

2021-06-09 01:38:30 (273 KB/s) - ‘/home/khaled/linux-5.8.1.tar.xz’ saved [114458544/114458544]

khaled@khaled:~$
```

1.5 - Unpack the tarball you just downloaded to your home folder.

“ tar -xvf ~/linux-5.8.1.tar.xz -C ~/ “



```
linux-5.8.1/net/bluetooth/smp.c
linux-5.8.1/net/bluetooth/smp.h
linux-5.8.1/net/bpf/
linux-5.8.1/net/bpf/Makefile
linux-5.8.1/net/bpf/test_run.c
linux-5.8.1/net/bpfilter/
linux-5.8.1/net/bpfilter/.gitignore
linux-5.8.1/net/bpfilter/Kconfig
linux-5.8.1/net/bpfilter/Makefile
linux-5.8.1/net/bpfilter/bpfilter_kern.c
linux-5.8.1/net/bpfilter/bpfilter_umh_blob.S
linux-5.8.1/net/bpfilter/main.c
linux-5.8.1/net/bpfilter/msgfmt.h
linux-5.8.1/net/bridge/
linux-5.8.1/net/bridge/Kconfig
linux-5.8.1/net/bridge/Makefile
linux-5.8.1/net/bridge/br.c
linux-5.8.1/net/bridge/br_arp_nd_proxy.c
linux-5.8.1/net/bridge/br_device.c
linux-5.8.1/net/bridge/br_fdb.c
linux-5.8.1/net/bridge/br_forward.c
linux-5.8.1/net/bridge/br_if.c
linux-5.8.1/net/bridge/br_input.c
linux-5.8.1/net/bridge/br_ioctl.c
linux-5.8.1/net/bridge/br_mdb.c
linux-5.8.1/net/bridge/br_mrp.c
linux-5.8.1/net/bridge/br_mrp_netlink.c
linux-5.8.1/net/bridge/br_mrp_switchdev.c
```

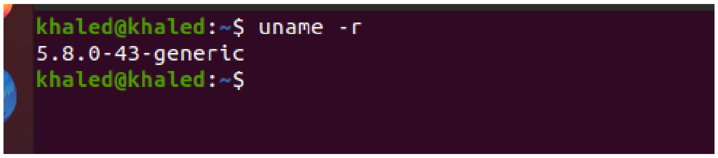
1.6 - Reboot your computer. **“ sudo reboot “**

Section 2 – Creation

In this section, you will write a basic system call in C and integrate it into the new kernel.

2.1 - Check the version of your current kernel.

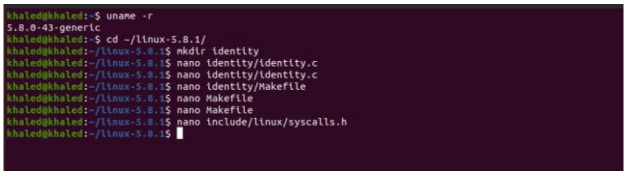
“ uname -r “



```
khaled@khaled:~$ uname -r
5.8.0-43-generic
khaled@khaled:~$
```

2.2 - Change your working directory to the root directory of the recently unpacked source code.

“ cd ~/linux-5.8.1/ “



```
khaled@khaled:~$ uname -r
5.8.0-43-generic
khaled@khaled:~$ cd ~/linux-5.8.1/
khaled@khaled:~/linux-5.8.1$ mkdir identity
khaled@khaled:~/linux-5.8.1$ nano identity/identity.c
khaled@khaled:~/linux-5.8.1$ nano identity/identity.c
khaled@khaled:~/linux-5.8.1$ nano identity/Makefile
khaled@khaled:~/linux-5.8.1$ nano Makefile
khaled@khaled:~/linux-5.8.1$ nano Makefile
khaled@khaled:~/linux-5.8.1$ nano include/linux/syscalls.h
khaled@khaled:~/linux-5.8.1$
```

2.3 - Create the home directory of your system call.

Decide a name for your system call, and keep it consistent from this point onwards. I have chosen identity.

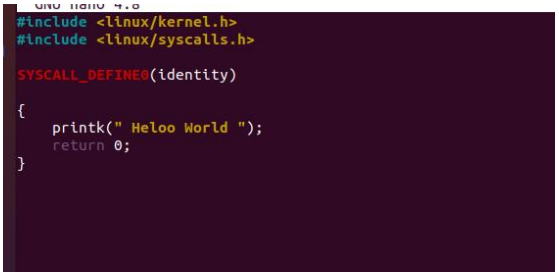
“ mkdir identity “

2.4 - Create a C file for your system call.

Create the C file with the following command.

“ nano identity/identity.c “

Write the following code in it.



```
  GNU nano 4.8
#include <linux/kernel.h>
#include <linux/syscalls.h>

SYSCALL_DEFINE0(identity)

{
    printk(" Heloo World ");
    return 0;
}
```

2.5 - Create a Makefile for your system call.

Create the Makefile with the following command.

“ nano identity/Makefile ”

Write the following code in it. **“ obj-y := identity.o ”**

2.6 - Add the home directory of your system call to the main Makefile of the kernel.

Open the Makefile with the following command **“ nano Makefile “**

Search for core-y. In the second result, you will see a series of directories.

kernel/ certs/ mm/ fs/ ipc/ security/ crypto/ block/\

In the fresh source code of Linux 5.8.1 kernel, it should be in line 1073.

Add the home directory of your system call at the end like the following

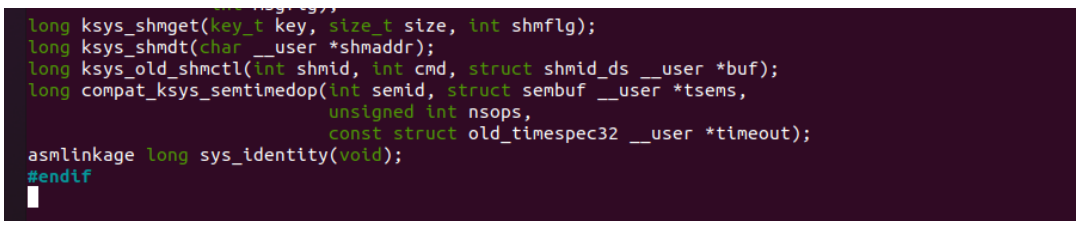
2.7 - Add a corresponding function prototype for your system call to the header file of system calls.

Open the header file with the following command.

“nano include/linux/syscalls.h“

Navigate to the bottom of it and write the following code just above #endif.

“ asmlinkage long sys_identity(void); “

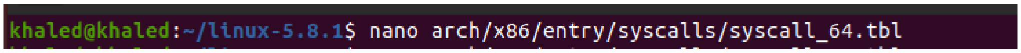


```
                 int msgflg);
long ksys_shmget(key_t key, size_t size, int shmflg);
long ksys_shmdt(char __user *shmaddr);
long ksys_old_shmctl(int shmid, int cmd, struct shmid_ds __user *buf);
long compat_ksys_semtimedop(int semid, struct sembuf __user *tsems,
                            unsigned int nsops,
                            const struct old_timespec32 __user *timeout);
asmlinkage long sys_identity(void);
#endif
```

2.8 - Add your system call to the kernel's system call table.

Open the table with the following command.

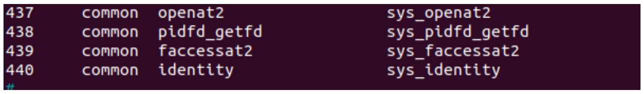
“ nano arch/x86/entry/syscalls/syscall_64.tbl “



```
khaled@khaled:~/linux-5.8.1$ nano arch/x86/entry/syscalls/syscall_64.tbl
```

Navigate to the bottom of it. You will find a series of x32 system calls. Scroll to the section above it. This is the section of your interest. Add the following code at the end of this section respecting the chronology of the row as well as the format of the column. Use Tab for space.

“ 440 common identity sys_identity “



```
437     common  openat2                 sys_openat2
438     common  pidfd_getfd             sys_pidfd_getfd
439     common  faccessat2              sys_faccessat2
440     common  identity                sys_identity
```

Section 3 – Installation

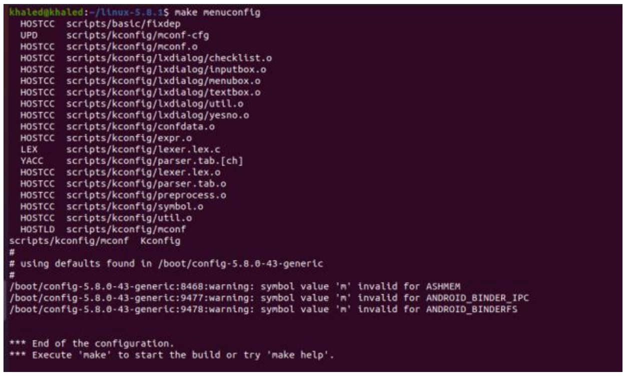
In this section, you will install the new kernel and prepare your operating system to boot into it.

3.1 - Configure the kernel.

Make sure the window of your terminal is maximized.

Open the configuration window with the following command.

“ make menuconfig “



```
khaled@khaled:~/linux-5.8.1$ make menuconfig
  HOSTCC  scripts/basic/fixdep
  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
  HOSTCC  scripts/kconfig/confdata.o
  HOSTCC  scripts/kconfig/expr.o
  LEX     scripts/kconfig/lexer.lex.c
  YACC    scripts/kconfig/parser.tab.[ch]
  HOSTCC  scripts/kconfig/lexer.lex.o
  HOSTCC  scripts/kconfig/parser.tab.o
  HOSTCC  scripts/kconfig/preprocess.o
  HOSTCC  scripts/kconfig/symbol.o
  HOSTCC  scripts/kconfig/util.o
  HOSTLD  scripts/kconfig/mconf
scripts/kconfig/mconf  Kconfig
#
# using defaults found in /boot/config-5.8.0-43-generic
#
/boot/config-5.8.0-43-generic:8468:warning: symbol value 'm' invalid for ASHMEM
/boot/config-5.8.0-43-generic:9477:warning: symbol value 'm' invalid for ANDROID_BINDER_IPC
/boot/config-5.8.0-43-generic:9478:warning: symbol value 'm' invalid for ANDROID_BINDERFS


*** End of the configuration.
*** Execute 'make' to start the build or try 'make help'.
```

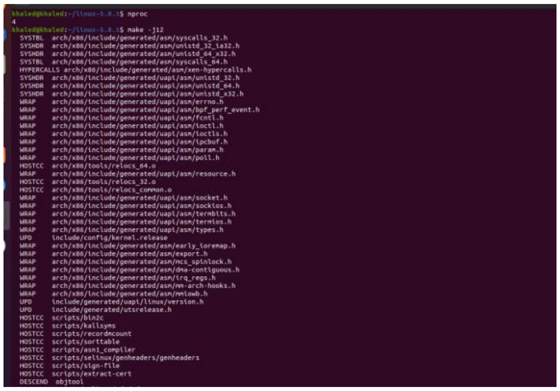
Use **Tab** to move between options. Make no changes to keep it in default settings.

3.2 - Find out how many logical cores you have.

“ nproc “

3.3 - Compile the kernel's source code.

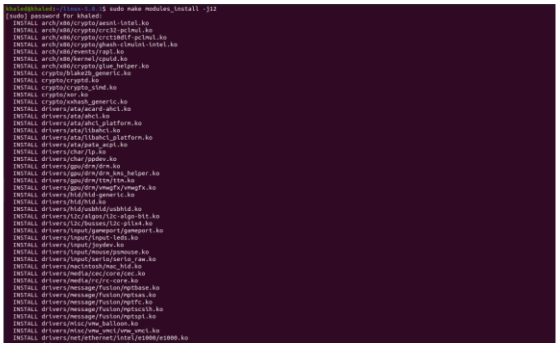
“ make -j12 ”



```
khaled@khaled:~/linux-5.8.1$ nproc
4
khaled@khaled:~/linux-5.8.1$ make -j12
  SYSTBL  arch/x86/include/generated/asm/syscalls_32.h
  SYSHDR  arch/x86/include/generated/asm/unistd_32_ia32.h
  SYSHDR  arch/x86/include/generated/asm/unistd_64_x32.h
  SYSTBL  arch/x86/include/generated/asm/syscalls_64.h
  HYPERCALLS arch/x86/include/generated/asm/xen-hypercalls.h
  SYSHDR  arch/x86/include/generated/uapi/asm/unistd_32.h
  SYSHDR  arch/x86/include/generated/uapi/asm/unistd_64.h
  SYSHDR  arch/x86/include/generated/uapi/asm/unistd_x32.h
  WRAP    arch/x86/include/generated/uapi/asm/errno.h
  WRAP    arch/x86/include/generated/uapi/asm/bpf_perf_event.h
  WRAP    arch/x86/include/generated/uapi/asm/fcntl.h
  WRAP    arch/x86/include/generated/uapi/asm/ioctl.h
  WRAP    arch/x86/include/generated/uapi/asm/ioctls.h
  WRAP    arch/x86/include/generated/uapi/asm/ipcbuf.h
  WRAP    arch/x86/include/generated/uapi/asm/param.h
  WRAP    arch/x86/include/generated/uapi/asm/poll.h
  HOSTCC  arch/x86/tools/relocs_64.o
  WRAP    arch/x86/include/generated/uapi/asm/resource.h
  HOSTCC  arch/x86/tools/relocs_32.o
  HOSTCC  arch/x86/tools/relocs_common.o
  WRAP    arch/x86/include/generated/uapi/asm/socket.h
  WRAP    arch/x86/include/generated/uapi/asm/sockios.h
  WRAP    arch/x86/include/generated/uapi/asm/termbits.h
  WRAP    arch/x86/include/generated/uapi/asm/termios.h
  WRAP    arch/x86/include/generated/uapi/asm/types.h
  UPD     include/config/kernel.release
  WRAP    arch/x86/include/generated/asm/early_ioremap.h
  WRAP    arch/x86/include/generated/asm/export.h
  WRAP    arch/x86/include/generated/asm/mcs_spinlock.h
  WRAP    arch/x86/include/generated/asm/dma-contiguous.h
  WRAP    arch/x86/include/generated/asm/irq_regs.h
  WRAP    arch/x86/include/generated/asm/mm-arch-hooks.h
  WRAP    arch/x86/include/generated/asm/mmiowb.h
  UPD     include/generated/uapi/linux/version.h
  UPD     include/generated/utsrelease.h
  HOSTCC  scripts/bin2c
  HOSTCC  scripts/kallsyms
  HOSTCC  scripts/recordmcount
  HOSTCC  scripts/sorttable
  HOSTCC  scripts/asn1_compiler
  HOSTCC  scripts/selinux/genheaders/genheaders
  HOSTCC  scripts/sign-file
  HOSTCC  scripts/extract-cert
  DESCEND  objtool
```

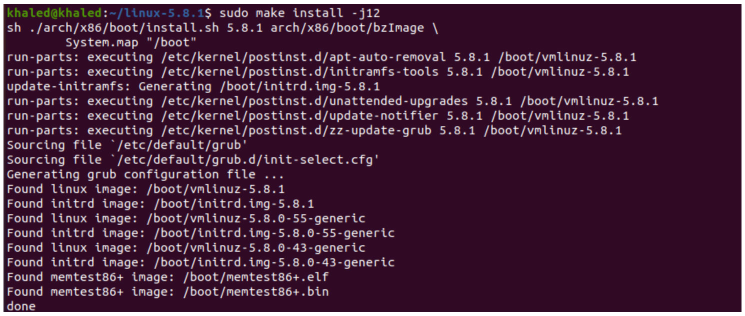
3.4 - Prepare the installer of the kernel.

“ sudo make modules_install -j12 ”



```
khaled@khaled:~/linux-5.8.1$ sudo make modules_install -j12
[sudo] password for khaled:
  INSTALL arch/x86/crypto/aesni-intel.ko
  INSTALL arch/x86/crypto/crc32-pclmul.ko
  INSTALL arch/x86/crypto/crct10dif-pclmul.ko
  INSTALL arch/x86/crypto/ghash-clmulni-intel.ko
  INSTALL arch/x86/events/rapl.ko
  INSTALL arch/x86/kernel/cpuid.ko
  INSTALL arch/x86/crypto/glue_helper.ko
  INSTALL crypto/blake2b_generic.ko
  INSTALL crypto/cryptd.ko
  INSTALL crypto/crypto_simd.ko
  INSTALL crypto/xor.ko
  INSTALL crypto/xxhash_generic.ko
  INSTALL drivers/ata/acard-ahci.ko
  INSTALL drivers/ata/ahci.ko
  INSTALL drivers/ata/ahci_platform.ko
  INSTALL drivers/ata/libahci.ko
  INSTALL drivers/ata/libahci_platform.ko
  INSTALL drivers/ata/pata_acpi.ko
  INSTALL drivers/char/lp.ko
  INSTALL drivers/char/ppdev.ko
  INSTALL drivers/gpu/drm/drm.ko
  INSTALL drivers/gpu/drm/drm_kms_helper.ko
  INSTALL drivers/gpu/drm/ttm/ttm.ko
  INSTALL drivers/gpu/drm/vmwgfx/vmwgfx.ko
  INSTALL drivers/hid/hid-generic.ko
  INSTALL drivers/hid/hid.ko
  INSTALL drivers/hid/usbhid/usbhid.ko
  INSTALL drivers/i2c/algos/i2c-algo-bit.ko
  INSTALL drivers/i2c/busses/i2c-piix4.ko
  INSTALL drivers/input/gameport/gameport.ko
  INSTALL drivers/input/input-leds.ko
  INSTALL drivers/input/joydev.ko
  INSTALL drivers/input/mouse/psmouse.ko
  INSTALL drivers/input/serio/serio_raw.ko
  INSTALL drivers/macintosh/mac_hid.ko
  INSTALL drivers/media/cec/core/cec.ko
  INSTALL drivers/media/rc/rc-core.ko
  INSTALL drivers/message/fusion/mptbase.ko
  INSTALL drivers/message/fusion/mptsas.ko
  INSTALL drivers/message/fusion/mptfc.ko
  INSTALL drivers/message/fusion/mptscsih.ko
  INSTALL drivers/message/fusion/mptspi.ko
  INSTALL drivers/misc/vmw_balloon.ko
  INSTALL drivers/misc/vmw_vmci/vmw_vmci.ko
  INSTALL drivers/net/ethernet/intel/e1000/e1000.ko
```

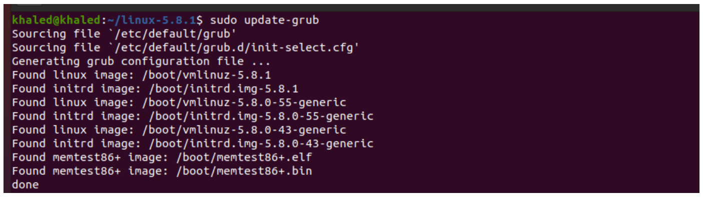
3.5 - Install the



```
khaled@khaled:~/linux-5.8.1$ sudo make install -j12
sh ./arch/x86/boot/install.sh 5.8.1 arch/x86/boot/bzImage \
        System.map "/boot"
run-parts: executing /etc/kernel/postinst.d/apt-auto-removal 5.8.1 /boot/vmlinuz-5.8.1
run-parts: executing /etc/kernel/postinst.d/initramfs-tools 5.8.1 /boot/vmlinuz-5.8.1
update-initramfs: Generating /boot/initrd.img-5.8.1
run-parts: executing /etc/kernel/postinst.d/unattended-upgrades 5.8.1 /boot/vmlinuz-5.8.1
run-parts: executing /etc/kernel/postinst.d/update-notifier 5.8.1 /boot/vmlinuz-5.8.1
run-parts: executing /etc/kernel/postinst.d/zz-update-grub 5.8.1 /boot/vmlinuz-5.8.1
Sourcing file `/etc/default/grub'
Sourcing file `/etc/default/grub.d/init-select.cfg'
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-5.8.1
Found initrd image: /boot/initrd.img-5.8.1
Found linux image: /boot/vmlinuz-5.8.0-55-generic
Found initrd image: /boot/initrd.img-5.8.0-55-generic
Found linux image: /boot/vmlinuz-5.8.0-43-generic
Found initrd image: /boot/initrd.img-5.8.0-43-generic
Found memtest86+ image: /boot/memtest86+.elf
Found memtest86+ image: /boot/memtest86+.bin
done
```

3.6 - Update the bootloader of the operating system with the new kernel.

“ sudo update-grub “



```
khaled@khaled:~/linux-5.8.1$ 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-5.8.1
Found initrd image: /boot/initrd.img-5.8.1
Found linux image: /boot/vmlinuz-5.8.0-55-generic
Found initrd image: /boot/initrd.img-5.8.0-55-generic
Found linux image: /boot/vmlinuz-5.8.0-43-generic
Found initrd image: /boot/initrd.img-5.8.0-43-generic
Found memtest86+ image: /boot/memtest86+.elf
Found memtest86+ image: /boot/memtest86+.bin
done
```

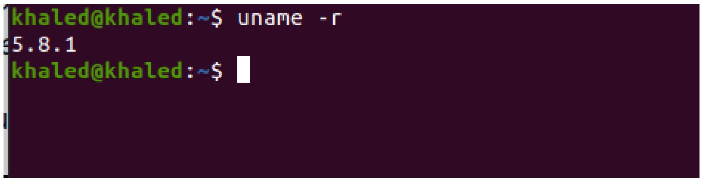
3.7 - Reboot your computer. **“ sudo reboot “**

Section 4 – Result

In this section, you will write a C program to check whether your system call works or not. After that, you will see your system call in action

4.1 - Check the version of your current kernel.

“ uname -r “

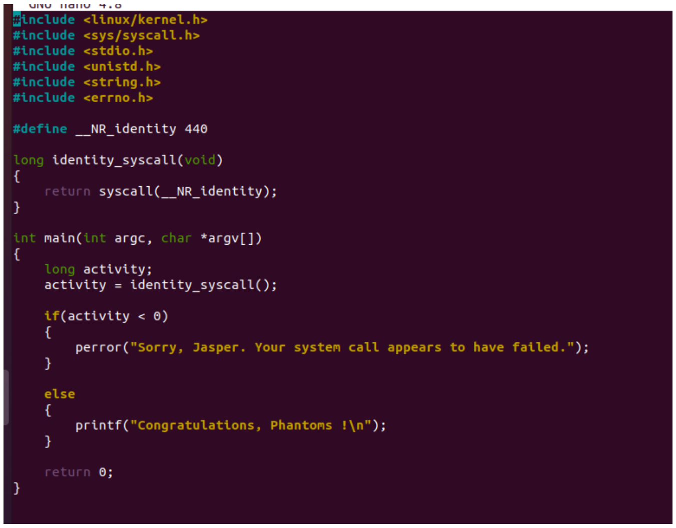


```
khaled@khaled:~$ uname -r
5.8.1
khaled@khaled:~$ 
```

4.2 - Change your working directory to your home directory.

“ cd ~ ”

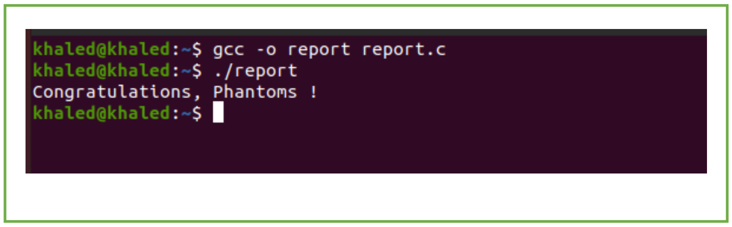
4.3 - Create a C file to generate a report of the success or failure of your system call. **“ nano report.c “** Write the following code in it.



```
#include <linux/kernel.h>
#include <sys/syscall.h>
#include <stdio.h>
#include <unistd.h>
#include <string.h>
#include <errno.h>

#define __NR_identity 440

long identity_syscall(void)
{
    return syscall(__NR_identity);
}

int main(int argc, char *argv[])
{
    long activity;
    activity = identity_syscall();

    if(activity < 0)
    {
        perror("Sorry, Jasper. Your system call appears to have failed.");
    }

    else
    {
        printf("Congratulations, Phantoms !\n");
    }

    return 0;
}
```

4.4 - Compile the C file you just created.

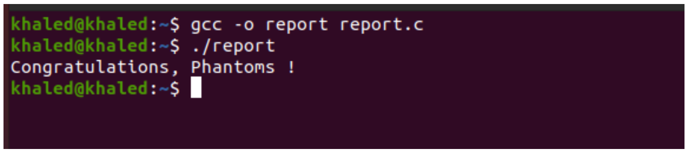
“ gcc -o report report.c ”



```
khaled@khaled:~$ gcc -o report report.c
khaled@khaled:~$ ./report
Congratulations, Phantoms !
khaled@khaled:~$ 
```

4.5 - Run the C file you just compiled.

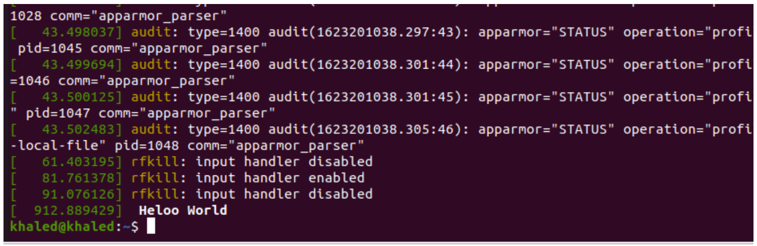
“ ./report ”



```
khaled@khaled:~$ gcc -o report report.c
khaled@khaled:~$ ./report
Congratulations, Phantoms !
khaled@khaled:~$ 
```

4.6 - Check the last line of the dmesg output.

“ dmesg ”



```
1028 comm="apparmor_parser"
[   43.498037] audit: type=1400 audit(1623201038.297:43): apparmor="STATUS" operation="profi
 pid=1045 comm="apparmor_parser"
[   43.499694] audit: type=1400 audit(1623201038.301:44): apparmor="STATUS" operation="profi
=1046 comm="apparmor_parser"
[   43.500125] audit: type=1400 audit(1623201038.301:45): apparmor="STATUS" operation="profi
" pid=1047 comm="apparmor_parser"
[   43.502483] audit: type=1400 audit(1623201038.305:46): apparmor="STATUS" operation="profi
-local-file" pid=1048 comm="apparmor_parser"
[   61.403195] rfkill: input handler disabled
[   81.761378] rfkill: input handler enabled
[   91.076126] rfkill: input handler disabled
[  912.889429]  Heloo World
khaled@khaled:~$ 
```