



كلية: الحاسبات والمعلومات
الفرقة: الثالثة



"Operating System "

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How To Add Your System Call The Linux OS Kernel.

- **Description of our system like CPU cores, RAM capacity, Kernel version.**

- CPU cores is 4.

- RAM is 4G.

- Capacity is 60G.


- Kernel version is 5.12.9


- **Steps of how adding the system call.**


- **Step 1 – Preparation**


- In this section, we 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:-


-  Fully update our operating system.

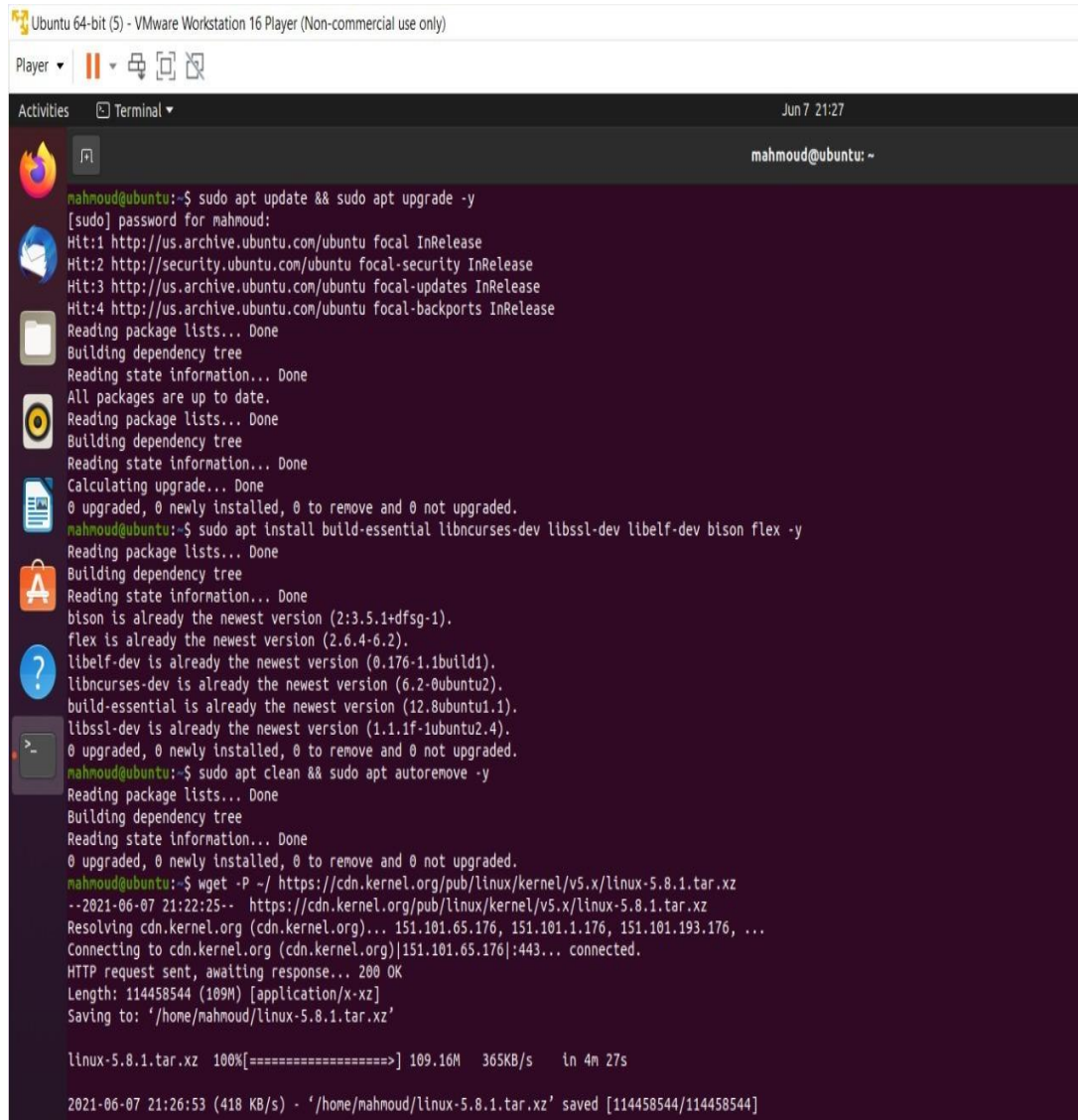
-  Download and install the essential packages to compile kernels.

-  Clean up our installed packages.

-  Download the source code of the latest stable version of the Linux kernel to our home folder.

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

-  Reboot your computer.



```
Ubuntu 64-bit (5) - VMware Workstation 16 Player (Non-commercial use only)
Player
Activities Terminal Jun 7 21:27
mahmoud@ubuntu: ~
mahmoud@ubuntu:~$ sudo apt update && sudo apt upgrade -y
[sudo] password for mahmoud:
Hit:1 http://us.archive.ubuntu.com/ubuntu focal InRelease
Hit:2 http://security.ubuntu.com/ubuntu focal-security InRelease
Hit:3 http://us.archive.ubuntu.com/ubuntu focal-updates InRelease
Hit:4 http://us.archive.ubuntu.com/ubuntu focal-backports InRelease
Reading package lists... Done
Building dependency tree
Reading state information... Done
All packages are up to date.
Reading package lists... Done
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
mahmoud@ubuntu:~$ 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
bison is already the newest version (2:3.5.1+dfsg-1).
flex is already the newest version (2.6.4-6.2).
libelf-dev is already the newest version (0.176-1.1build1).
libncurses-dev is already the newest version (6.2-0ubuntu2).
build-essential is already the newest version (12.8ubuntu1.1).
libssl-dev is already the newest version (1.1.1f-1ubuntu2.4).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
mahmoud@ubuntu:~$ 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.
mahmoud@ubuntu:~$ wget -P ~/ https://cdn.kernel.org/pub/linux/kernel/v5.x/linux-5.8.1.tar.xz
--2021-06-07 21:22:25-- https://cdn.kernel.org/pub/linux/kernel/v5.x/linux-5.8.1.tar.xz
Resolving cdn.kernel.org (cdn.kernel.org)... 151.101.65.176, 151.101.1.176, 151.101.193.176, ...
Connecting to cdn.kernel.org (cdn.kernel.org)|151.101.65.176|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 114458544 (109M) [application/x-xz]
Saving to: '/home/mahmoud/linux-5.8.1.tar.xz'

linux-5.8.1.tar.xz 100%[=====] 109.16M 365KB/s in 4m 27s

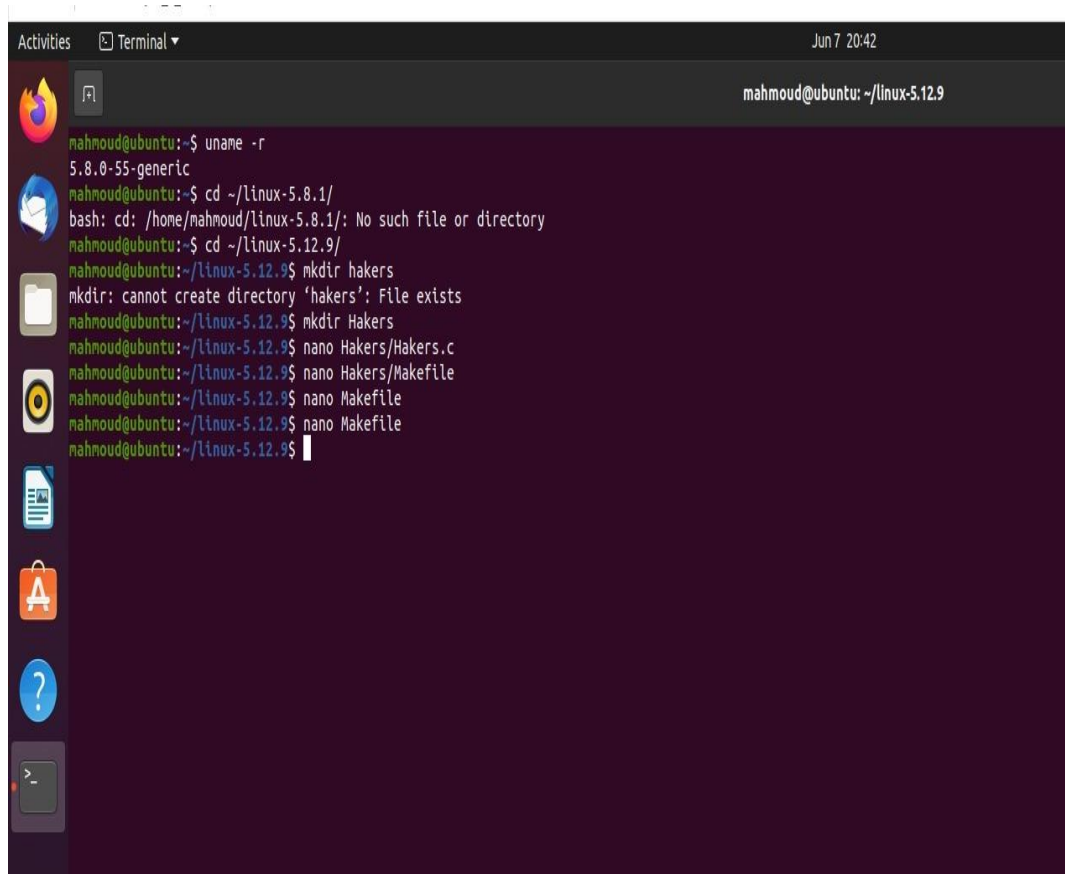
2021-06-07 21:26:53 (418 KB/s) - '/home/mahmoud/linux-5.8.1.tar.xz' saved [114458544/114458544]
```

Step 2 - Creation

In this section, we will write a basic system call in C and integrate it into the new kernel:-

- ✚ Check the version of our current kernel.
- ✚ Change our working directory to the root directory of the recently unpacked source code.
- ✚ Create the home directory of our system call.
- ✚ Create a C file for our system call.
- ✚ Create a Make file for our system call.

- ✚ Add the home directory of your system call to the main Make file of the kernel.
- ✚ Add a corresponding function prototype for our system call to the header file of system calls.
- ✚ Add our system call to the kernel's system call table.

A terminal window titled 'Terminal' with a dark background. The user 'mahmoud@ubuntu' is in the directory '~/linux-5.12.9'. The terminal shows the following commands and output:

```
mahmoud@ubuntu:~$ uname -r
5.8.0-55-generic
mahmoud@ubuntu:~$ cd ~/linux-5.8.1/
bash: cd: /home/mahmoud/linux-5.8.1/: No such file or directory
mahmoud@ubuntu:~$ cd ~/linux-5.12.9/
mahmoud@ubuntu:~/linux-5.12.9$ mkdir hackers
mkdir: cannot create directory 'hackers': File exists
mahmoud@ubuntu:~/linux-5.12.9$ mkdir Hakers
mahmoud@ubuntu:~/linux-5.12.9$ nano Hakers/Hakers.c
mahmoud@ubuntu:~/linux-5.12.9$ nano Hakers/Makefile
mahmoud@ubuntu:~/linux-5.12.9$ nano Makefile
mahmoud@ubuntu:~/linux-5.12.9$ nano Makefile
mahmoud@ubuntu:~/linux-5.12.9$
```

Step 3 - Installation

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

- ✚ Configure the kernel.
- ✚ Find out how many logical cores you have.
- ✚ Compile the kernel's source code.
- ✚ Prepare the installer of the kernel.
- ✚ Install the kernel.
- ✚ Update the bootloader of the operating system with the new kernel.
- ✚ Reboot your computer.

Ubuntu 64-bit (5) - VMware Workstation 16 Player (Non-commercial use only)

Player ▾ || ▾

```

Activities  Terminal Jun 7 20:50
mahmoud@ubuntu: ~/linux-5.12.9

*** End of the configuration.
*** Execute 'make' to start the build or try 'make help'.
mahmoud@ubuntu:~/linux-5.12.9$ nproc
4
mahmoud@ubuntu:~/linux-5.12.9$ make clean
CLEAN arch/x86/crypto
CLEAN arch/x86/entry/vdso
CLEAN arch/x86/kernel/cpu
CLEAN arch/x86/kernel
CLEAN arch/x86/purgatory
CLEAN arch/x86/realmode/rm
CLEAN kernel/debug/kdb
CLEAN kernel
CLEAN usr
CLEAN arch/x86/tools
mahmoud@ubuntu:~/linux-5.12.9$ make mrproper
CLEAN scripts/basic
CLEAN scripts/genksyms
CLEAN scripts/kconfig
CLEAN scripts/mod
CLEAN scripts/selinux/genheaders
CLEAN scripts/selinux/mdp
CLEAN scripts
CLEAN include/config include/generated arch/x86/include/generated .config
mahmoud@ubuntu:~/linux-5.12.9$ 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
#
# using defaults found in /boot/config-5.8.0-55-generic
#

```

```
Activities Terminal Jun 7 21:12
mahmoud@ubuntu: ~/linux-5.12.9

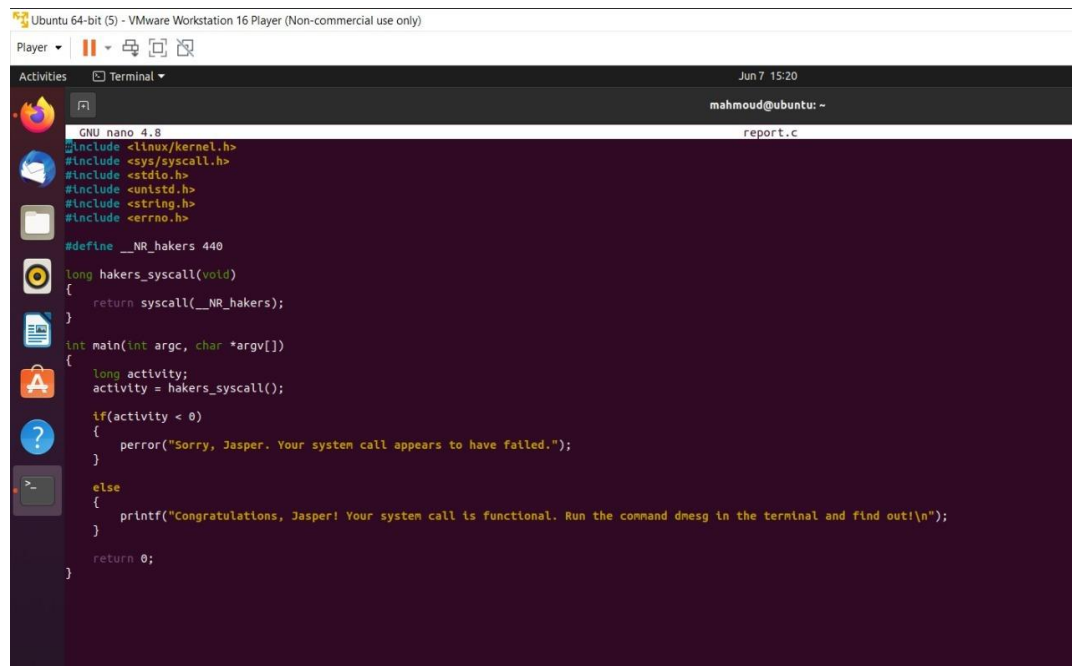
INSTALL drivers/video/fbdev/core/sysimgblt.ko
INSTALL drivers/xen/xen-privcmd.ko
INSTALL fs/autofs/autofs4.ko
INSTALL fs/nls/nls_iso8859-1.ko
INSTALL kernel/configs.ko
INSTALL net/ipv4/netfilter/ip_tables.ko
INSTALL net/netfilter/x_tables.ko
INSTALL net/netfilter/xt_tcpudp.ko
INSTALL net/sched/sch_fq_codel.ko
INSTALL net/vmw_vsock/vmw_vsock_virtio_transport_common.ko
INSTALL net/vmw_vsock/vmw_vsock_vmci_transport.ko
INSTALL net/vmw_vsock/vsock_loopback.ko
INSTALL net/vmw_vsock/vsock.ko
INSTALL sound/ac97_bus.ko
INSTALL sound/core/seq/snd-seq-midi-event.ko
INSTALL sound/core/seq/snd-seq-midi.ko
INSTALL sound/core/seq/snd-seq.ko
INSTALL sound/core/snd-pcm.ko
INSTALL sound/core/snd-rawmidi.ko
INSTALL sound/core/snd-seq-device.ko
INSTALL sound/core/snd-timer.ko
INSTALL sound/core/snd.ko
INSTALL sound/pci/ac97/snd-ac97-codec.ko
INSTALL sound/pci/snd-ens1371.ko
INSTALL sound/soundcore.ko
DEPMOD 5.12.9
mahmoud@ubuntu:~/linux-5.12.9$ sudo make install -j4
sh ./arch/x86/boot/install.sh 5.12.9 arch/x86/boot/bzImage \
    System.map "/boot"
run-parts: executing /etc/kernel/postinst.d/apt-auto-removal 5.12.9 /boot/vmlinuz-5.12.9
run-parts: executing /etc/kernel/postinst.d/initramfs-tools 5.12.9 /boot/vmlinuz-5.12.9
update-initramfs: Generating /boot/initrd.img-5.12.9
run-parts: executing /etc/kernel/postinst.d/unattended-upgrades 5.12.9 /boot/vmlinuz-5.12.9
run-parts: executing /etc/kernel/postinst.d/update-notifier 5.12.9 /boot/vmlinuz-5.12.9
run-parts: executing /etc/kernel/postinst.d/zz-update-grub 5.12.9 /boot/vmlinuz-5.12.9
Sourcing file '/etc/default/grub'
Sourcing file '/etc/default/grub.d/init-select.cfg'
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-5.12.9
Found initrd image: /boot/initrd.img-5.12.9
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 mentest86+ image: /boot/mentest86+.elf
Found mentest86+ image: /boot/mentest86+.bin
done
```

Step 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:-

🔧 Check the version of your current kernel.

- ✚ Change your working directory to your home directory.
- ✚ Create a C file to generate a report of the success or failure of your system call.
- ✚ Compile the C file you just created.
- ✚ Run the C file you just compiled.
- ✚ Check the last line of the output.



```
GNU nano 4.8
#include <linux/kernel.h>
#include <sys/syscall.h>
#include <stdio.h>
#include <unistd.h>
#include <string.h>
#include <errno.h>

#define __NR_hackers 440

long hackers_syscall(void)
{
    return syscall(__NR_hackers);
}

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

    if(activity < 0)
    {
        perror("Sorry, Jasper. Your system call appears to have failed.");
    }
    else
    {
        printf("Congratulations, Jasper! Your system call is functional. Run the command dmesg in the terminal and find out!\n");
    }

    return 0;
}
```

-References that help you.

- [DEV Community](#)

- <https://www.tutorialspoint.com/>