

# Operating System report

how to add your system call the Linux OS kernel

# Name Member

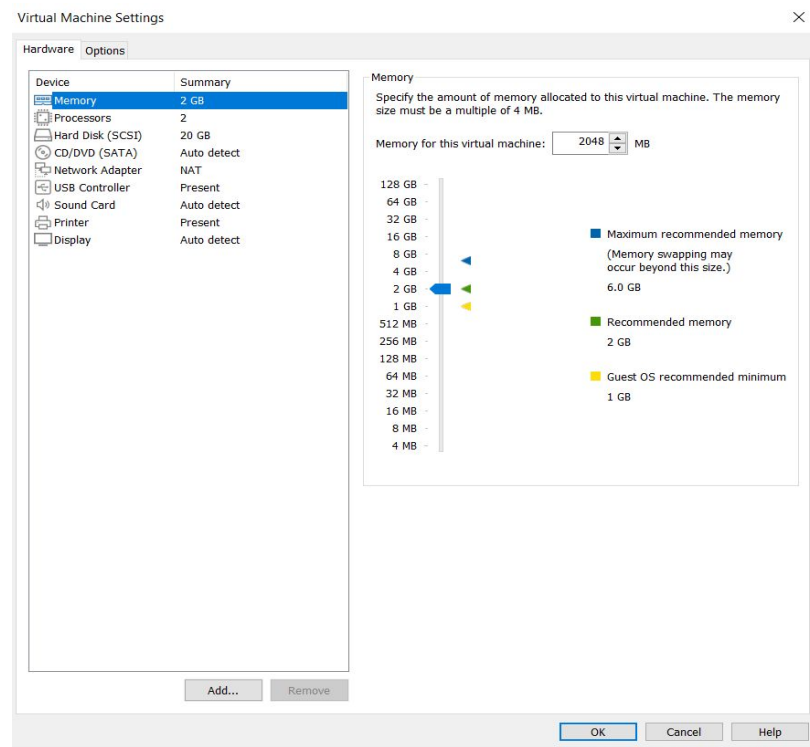
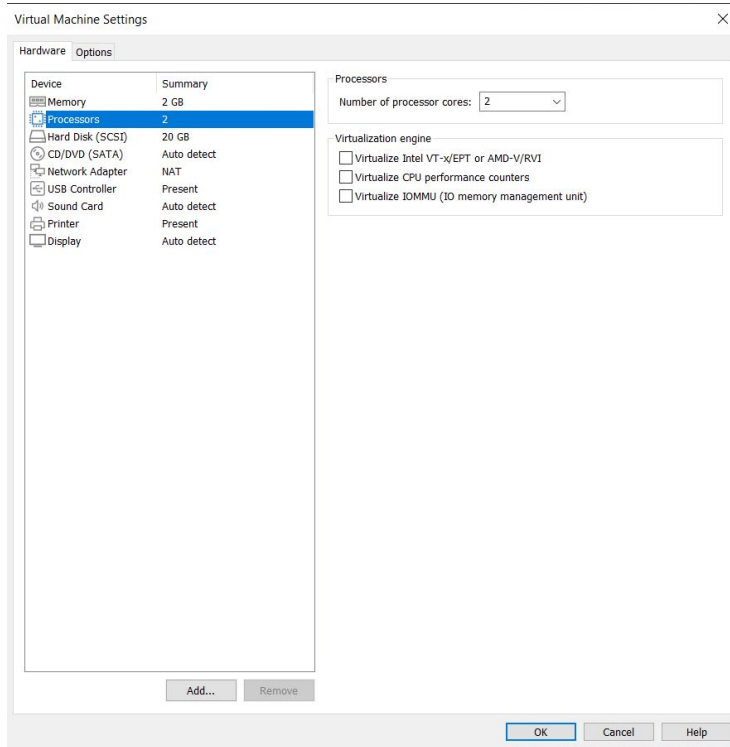
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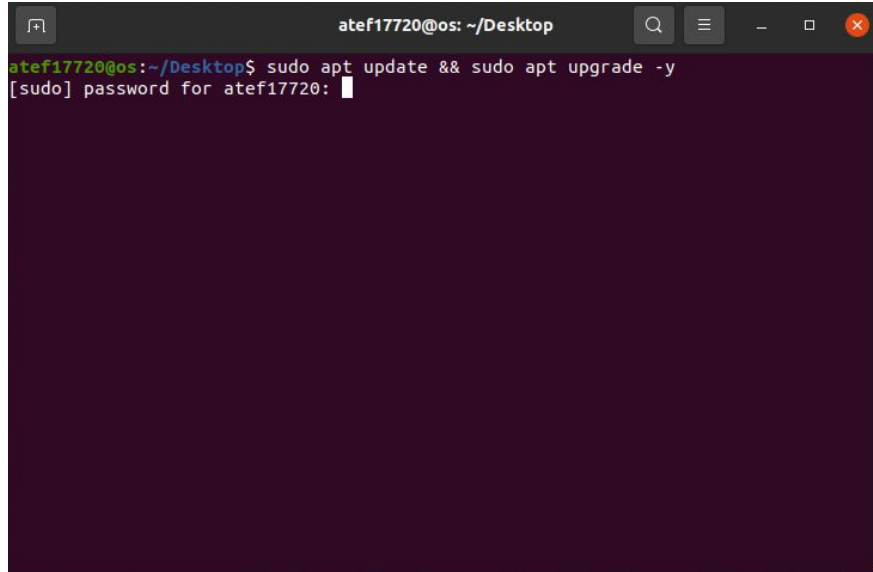
# CPU cores, RAM capacity



# 1 - Preparation

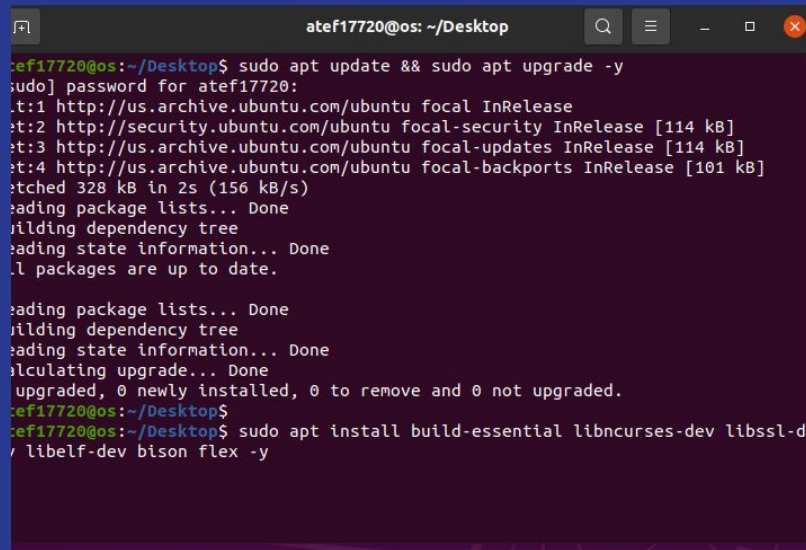
## 1.1 - Fully update your operating system

*We downloaded all necessary tools to add a basic system call to the Linux kernel and run it*

A terminal window with a dark background and light text. The title bar at the top reads 'atef17720@os: ~/Desktop'. The terminal shows a command prompt 'atef17720@os:~/Desktop\$' followed by the command 'sudo apt update && sudo apt upgrade -y'. Below this, a prompt '[sudo] password for atef17720:' is visible with a cursor. The rest of the terminal is empty.

```
atef17720@os: ~/Desktop
atef17720@os:~/Desktop$ sudo apt update && sudo apt upgrade -y
[sudo] password for atef17720: 
```

## 1.2 – Download and install the essential packages to compile kernels



```
atef17720@os: ~/Desktop
atef17720@os:~/Desktop$ sudo apt update && sudo apt upgrade -y
[sudo] password for atef17720:
Hit:1 http://us.archive.ubuntu.com/ubuntu focal InRelease
Hit:2 http://security.ubuntu.com/ubuntu focal-security InRelease [114 kB]
Hit:3 http://us.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Hit:4 http://us.archive.ubuntu.com/ubuntu focal-backports InRelease [101 kB]
Fetched 328 kB in 2s (156 kB/s)
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.
atef17720@os:~/Desktop$
atef17720@os:~/Desktop$ sudo apt install build-essential libncurses-dev libssl-dev libelf-dev bison flex -y
```

```
atef17720@os: ~/Desktop
Reading state information... Done
Calculating upgrade... Done
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
atef17720@os:~/Desktop$
atef17720@os:~/Desktop$ 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.
atef17720@os:~/Desktop$ sudo apt install vim -y
Reading package lists... Done
Building dependency tree
Reading state information... Done
vim is already the newest version (2:8.1.2269-1ubuntu5).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
atef17720@os:~/Desktop$ sudo apt clean && sudo apt autoremove -y
```

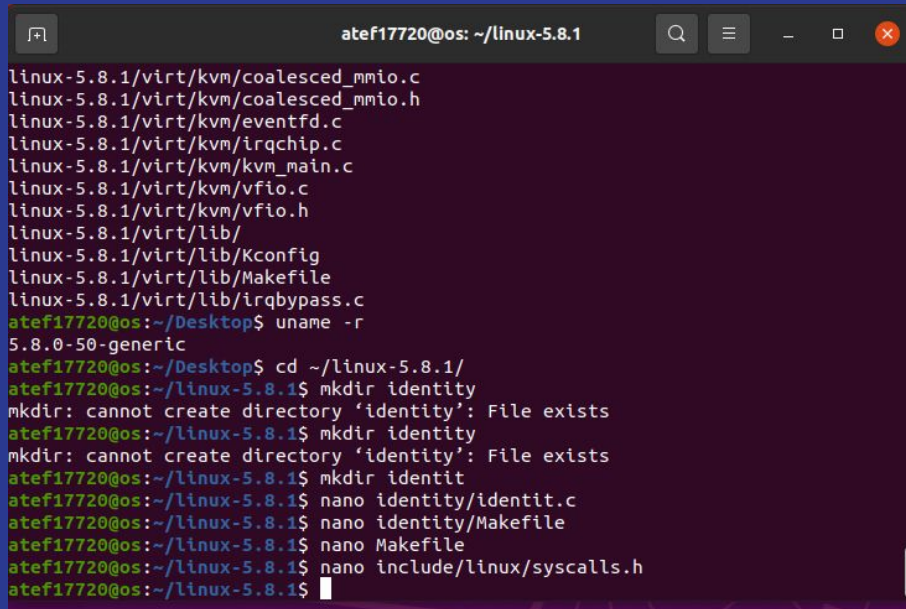
```
atef17720@os: ~/Desktop
libssl-dev is already the newest version (1.1.1f-1ubuntu2.4).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
atef17720@os:~/Desktop$ sudo apt install vim -y
Reading package lists... Done
Building dependency tree
Reading state information... Done
vim is already the newest version (2:8.1.2269-1ubuntu5).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
atef17720@os:~/Desktop$ 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.
atef17720@os:~/Desktop$ wget -P ~/ https://cdn.kernel.org/pub/linux/kernel/v5.x/
linux-5.8.1.tar.xz
--2021-06-06 16:14:15-- 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, 2a04:4e42:54::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/atef17720/linux-5.8.1.tar.xz.1'

linux-5.8.1.tar.xz.  9%[>] 10.29M  1.66MB/s  eta 55s
```

# 2-Creation

we write a basic system call in C and integrate it into the new kernel.

- 2.1 - Check the version of your current kernel.
- 2.2 - Change your working directory to the root directory of the recently unpacked source code
- 2.3 - Create the home directory of your system call.
- 2.4 - Create a C file for your system call
- 2.5 - Create a Makefile for your system call.
- 2.7 - Add a corresponding function prototype for your system call to the
- 2.8 - Add your system call to the kernel's system call table.

A terminal window with a dark background and light text. The window title is 'atef17720@os: ~/linux-5.8.1'. The terminal shows a series of commands and their outputs. The first part lists the contents of the 'linux-5.8.1' directory, showing various C and H files related to KVM and VFIO. Then, the user runs 'uname -r' and gets '5.8.0-50-generic'. Next, they run 'cd ~/linux-5.8.1/'. Then, they attempt to run 'mkdir identity' and get an error 'mkdir: cannot create directory 'identity': File exists'. They then run 'mkdir identity' again and get the same error. Then, they run 'mkdir identity' a third time and get the same error. Then, they run 'nano identity/identit.c'. Then, they run 'nano identity/Makefile'. Then, they run 'nano Makefile'. Finally, they run 'nano include/linux/syscalls.h' and the cursor is visible at the end of the line.

```
linux-5.8.1/virt/kvm/coalesced_mmio.c
linux-5.8.1/virt/kvm/coalesced_mmio.h
linux-5.8.1/virt/kvm/eventfd.c
linux-5.8.1/virt/kvm/irqchip.c
linux-5.8.1/virt/kvm/kvm_main.c
linux-5.8.1/virt/kvm/vfio.c
linux-5.8.1/virt/kvm/vfio.h
linux-5.8.1/virt/lib/
linux-5.8.1/virt/lib/Kconfig
linux-5.8.1/virt/lib/Makefile
linux-5.8.1/virt/lib/irqbypass.c
atef17720@os: ~/Desktop$ uname -r
5.8.0-50-generic
atef17720@os: ~/Desktop$ cd ~/linux-5.8.1/
atef17720@os: ~/linux-5.8.1$ mkdir identity
mkdir: cannot create directory 'identity': File exists
atef17720@os: ~/linux-5.8.1$ mkdir identity
mkdir: cannot create directory 'identity': File exists
atef17720@os: ~/linux-5.8.1$ mkdir identit
atef17720@os: ~/linux-5.8.1$ nano identity/identit.c
atef17720@os: ~/linux-5.8.1$ nano identity/Makefile
atef17720@os: ~/linux-5.8.1$ nano Makefile
atef17720@os: ~/linux-5.8.1$ nano include/linux/syscalls.h
atef17720@os: ~/linux-5.8.1$
```

```
atef17720@os: ~/linux-5.8.1
.config - Linux/x86 5.8.1 Kernel Configuration

Linux/x86 5.8.1 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 [ ]

[*] 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 --->
v(+)

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

```
atef17720@os: ~/linux-5.8.1

linux-5.8.1/virt/lib/Kconfig
linux-5.8.1/virt/lib/Makefile
linux-5.8.1/virt/lib/irqbypass.c
atef17720@os: ~/Desktop$ uname -r
5.8.0-50-generic
atef17720@os: ~/Desktop$ cd ~/linux-5.8.1/
atef17720@os: ~/linux-5.8.1$ mkdir identity
mkdir: cannot create directory 'identity': File exists
atef17720@os: ~/linux-5.8.1$ mkdir identity
mkdir: cannot create directory 'identity': File exists
atef17720@os: ~/linux-5.8.1$ mkdir identit
atef17720@os: ~/linux-5.8.1$ nano identity/identit.c
atef17720@os: ~/linux-5.8.1$ nano identity/Makefile
atef17720@os: ~/linux-5.8.1$ nano Makefile
atef17720@os: ~/linux-5.8.1$ nano include/linux/syscalls.h
atef17720@os: ~/linux-5.8.1$ nano arch/x86/entry/syscalls/syscall_64.tbl
atef17720@os: ~/linux-5.8.1$ make menuconfig
scripts/kconfig/mconf Kconfig

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

atef17720@os: ~/linux-5.8.1$
```

# 3 - Installation

3.1 - Configure the kernel.

3.2 - Find out how many logical cores you have.

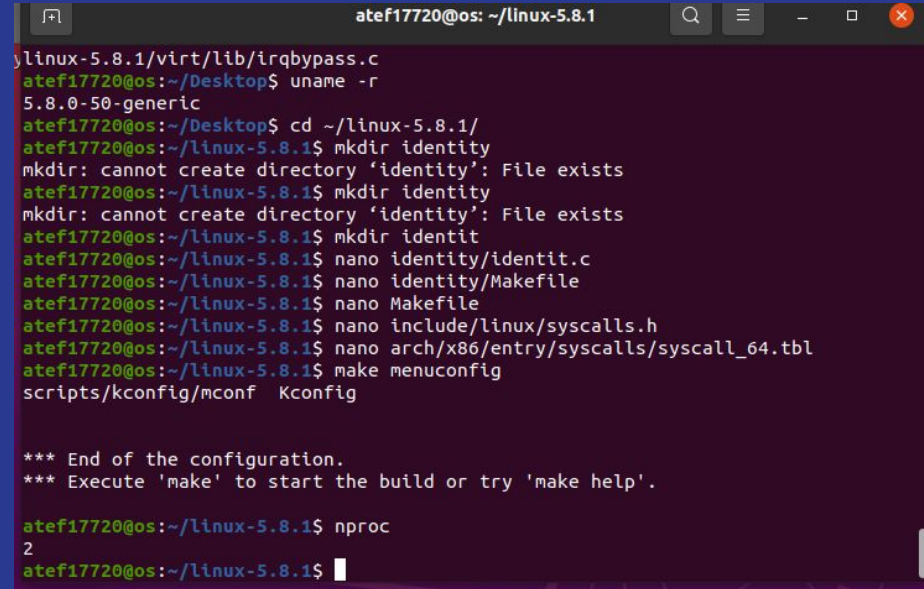
3.3 - Compile the kernel's source code.

3.4 - Prepare the installer of the kernel.

3.5 - Install the kernel.

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

3.7 - Reboot your computer.

A terminal window titled 'atef17720@os: ~/linux-5.8.1' with standard window controls. The terminal shows a series of commands and their outputs for configuring the Linux 5.8.1 kernel. The user runs 'uname -r' to check the current kernel version (5.8.0-50-generic), then navigates to the source directory and creates a new configuration named 'identity'. They use 'nano' to edit 'identity/identit.c', 'identity/Makefile', 'include/linux/syscalls.h', and 'arch/x86/entry/syscalls/syscall\_64.tbl'. Finally, they run 'make menuconfig' which displays a configuration menu (partially visible at the bottom) and ends with instructions to execute 'make' to build the kernel. The user then runs 'nproc' to check the number of processors (2).

```
linux-5.8.1/virt/lib/irqbypass.c
atef17720@os:~/Desktop$ uname -r
5.8.0-50-generic
atef17720@os:~/Desktop$ cd ~/linux-5.8.1/
atef17720@os:~/linux-5.8.1$ mkdir identity
mkdir: cannot create directory 'identity': File exists
atef17720@os:~/linux-5.8.1$ mkdir identity
mkdir: cannot create directory 'identity': File exists
atef17720@os:~/linux-5.8.1$ mkdir identit
atef17720@os:~/linux-5.8.1$ nano identity/identit.c
atef17720@os:~/linux-5.8.1$ nano identity/Makefile
atef17720@os:~/linux-5.8.1$ nano Makefile
atef17720@os:~/linux-5.8.1$ nano include/linux/syscalls.h
atef17720@os:~/linux-5.8.1$ nano arch/x86/entry/syscalls/syscall_64.tbl
atef17720@os:~/linux-5.8.1$ make menuconfig
scripts/kconfig/mconf Kconfig

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

atef17720@os:~/linux-5.8.1$ nproc
2
atef17720@os:~/linux-5.8.1$
```

51070-50-generic

```
atef17720@os:~/linux-5.8.1$ cd
```

```
atef17720@os:~$ nano report.c
```

```
atef17720@os:~$ gcc -o report report.c
```

```
atef17720@os:~$ ./report
```

Congratulations, mohamed atef! Your system call is functional. Run the command dmesg in the terminal and find out!

```
atef17720@os:~$
```

# 4 - References

<https://www.kernel.org/doc/html/latest/process/adding-syscalls.html>

<https://dev.to/jasper/adding-a-system-call-to-the-linux-kernel-5-8-1-in-ubuntu-20-04-lts-2ga8>

<https://medium.com/anubhav-shrimal/adding-a-hello-world-system-call-to-linux-kernel-da32875872>

