

過程：

```
hank@hank-VirtualBox:~$ sudo apt update && sudo apt upgrade -y
[sudo] password for hank:
已有:1 http://tw.archive.ubuntu.com/ubuntu xenial InRelease
已有:1 http://tw.archive.ubuntu.com/ubuntu xenial-updates InRelease
```

全面更新您的操作系統。

```
hank@hank-VirtualBox:~/linux-5.8.1$ sudo apt install vim
```

 使用 vim 或任何其他文本編輯器而不是 nano。

```
hank@hank-VirtualBox:~/linux-5.8.1$ sudo apt clean && sudo apt autoremove
```

清理已安裝的軟件包。

```
hank@hank-VirtualBox:~$ wget -P ~/ https://cdn.kernel.org/pub/linux/kernel/v5.x/linux-5.8.1.tar.xz
```

下載了 5.8.1 版本的 Linux 內核

```
hank@hank-VirtualBox:~$ tar -xvf ~/linux-5.8.1.tar.xz -C ~/
```

將您剛剛下載的 tar 解壓縮到您的主文件夾中。

```
hank@hank-VirtualBox:~$ reboot
```

重開機

```
hank@hank-VirtualBox:~$ cd ~/linux-5.8.1/
hank@hank-VirtualBox:~/linux-5.8.1$ vim hello.c
```

創建系統調用的主目錄。

為您的系統調用創建一個 C 文件。

```
/* hello.c */
#include <linux/kernel.h>
asmlinkage long __x64_sys_hello(void){
    printk("Hello world!\n");
    return 0;
}
```

```
hank@hank-VirtualBox:~/linux-5.8.1$ vim Makefile
```

建立 Makefile (以下是內容)

```
obj-y := hello.o
```

```
hank@hank-VirtualBox:~$ vim Makefile
```

回到上一層修改 Makefile，跟剛剛 Makefile 不同

找到這行 `core-y += kernel/ certs/ mm/ fs/ ipc/ security/ crypto/ block`

修改成 `core-y += kernel/ certs/ mm/ fs/ ipc/ security/ crypto/ block/ hello/`

```
hank@hank-VirtualBox:~/linux-5.8.1/arch/x86/entry/syscalls$ vim syscall_64.tbl
```

請你在最後一行添加上你的 system call 然後請把編號記住, 等一下會用

```
440      common      hello      sys_hello
```

```
hank@hank-VirtualBox:~$ cd linux-5.8.1/include/linux
hank@hank-VirtualBox:~/linux-5.8.1/include/linux$ vim syscalls.h
```

接著編輯 syscalls.h 檔 將我們 syscall 的原型添加進檔案的最後一行 (#endif 之前)

```
Asmlinkage long __x64_sys_hello(void);
```

這邊開始跟上次的編譯一樣

配置內核

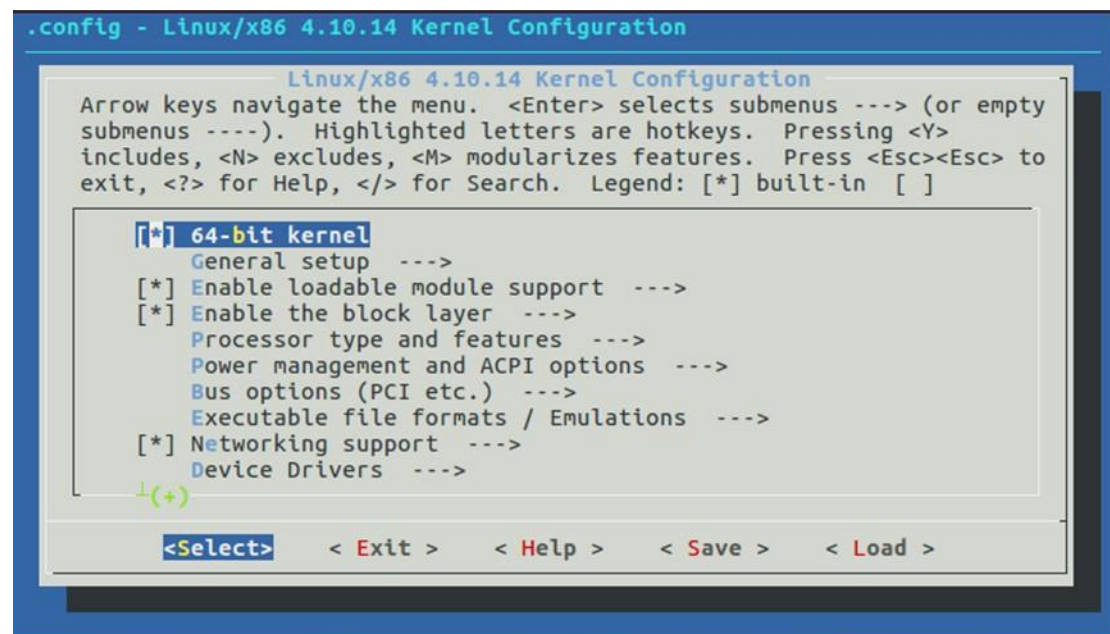
```
hank@hank-VirtualBox:~/linux-5.8.1$ cp -v /boot/config-$(uname -r) .config
```

使用命令複製現有的配置文件 `cp` :

```
hank@hank-VirtualBox:~/linux-5.8.1$ sudo apt-get install git fakeroot build-essential ncurses-dev xz-utils libssl-dev bc flex libelf-dev bison
```

安裝需要的套件

```
hank@hank-VirtualBox:~/linux-5.8.1$ make menuconfig
```



該命令啟動幾個打開配置菜單的腳本

```
hank@hank-VirtualBox:~/linux-5.8.1$ make -j8
```

構建和編譯 Linux 內核的過程需要一些時間才能完成。

終端列出了所有 Linux 內核組件：內存管理、硬件設備驅動程序、文件系統驅動程序、網絡驅動程序和進程管理。-j8 假如你使用多核心 這樣打可以加速

```
hank@hank-VirtualBox:~/linux-5.8.1$ sudo make modules_install
```

使用此命令安裝所需的模塊

```
hank@hank-VirtualBox:~/linux-5.8.1$ sudo make install
```

輸入命令安裝內核

```
hank@hank-VirtualBox:~/linux-5.8.1$ reboot
```

重開機

```
hank@hank-VirtualBox:~$ uname -rms
Linux 5.8.1 x86_64
hank@hank-VirtualBox:~$ vim hello.c
hank@hank-VirtualBox:~$ gcc -g -Wall hello.c -o hello
hank@hank-VirtualBox:~$ ./hello
sys_hello returned 0
hank@hank-VirtualBox:~$ dmesg
[  0.000000] Linux version 5.8.1 (hank@hank-VirtualBox) (gcc (Ubuntu 5.4.0-6ub
```

測試 system call

Hello.c 內容

```
#include <linux/kernel.h>
```

```
#include <unistd.h>
```

```
#include <sys/syscall.h>
```

```
#include <stdio.h>
```

```
int main(){
```

```
    /* 使用我們剛剛新增的 system call */
```

```
    long int sys = syscall(332);
```

```
    /* print 出 syscall 的回傳值, 若為 0 則代表成功 */
```

```
    printf("sys_hello returned %ld\\n", sys);
```

```
    return 0;
```

```
}
```

#編譯 hello.c

```
gcc -g -Wall hello.c -o hello
```

# 執行

```
./hello
```

```
[ 17.404762] random: crng init done
[ 17.404762] random: 7 urandom warning(s) missed due to ratelimiting
[ 190.395064] I am B0928012 at 05 2022!
hank@hank-VirtualBox:~$
```

遇到的問題：一開始 `make` 都會失敗，但是上次作業 `make` 都正常，以為是版本有問題，因此換 `kernel` 版本，但還是錯誤。後來在網路上找，發現要把 `sys_hello` 改成 `__x64_sys_hello`，除此之外，解壓縮 `tar` 後也要記得 `reboot`，不然有機率會失敗。

參考資料：

<https://wenyuangg.github.io/posts/linux/linux-add-system-call.html>

<https://phoenixnap.com/kb/build-linux-kernel>

<https://blog.kaibro.tw/2016/11/07/Linux-Kernel%E7%B7%A8%E8%AD%AF-Ubuntu/>

<https://hackmd.io/@combo-tw/Linux->

[https://hackmd.io/@combo-tw/Linux-](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)

[tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80](https://hackmd.io/@combo-tw/Linux-%E8%AE%80%E6%9B%B8%E6%9C%83/%2F%40combo-tw%2FBJPoAcqQS#%E5%A6%82%E4%BD%95%E6%96%B0%E5%A2%9E%E4%B8%80%E5%80%8B-System-Call)