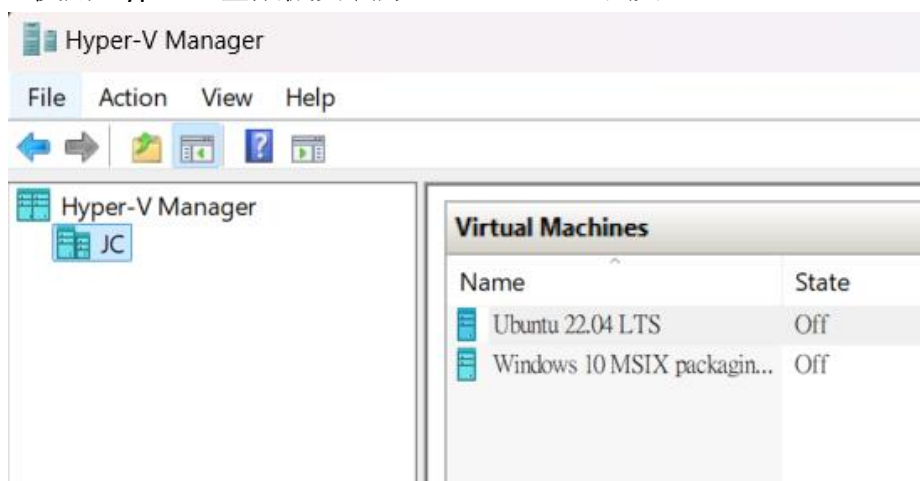
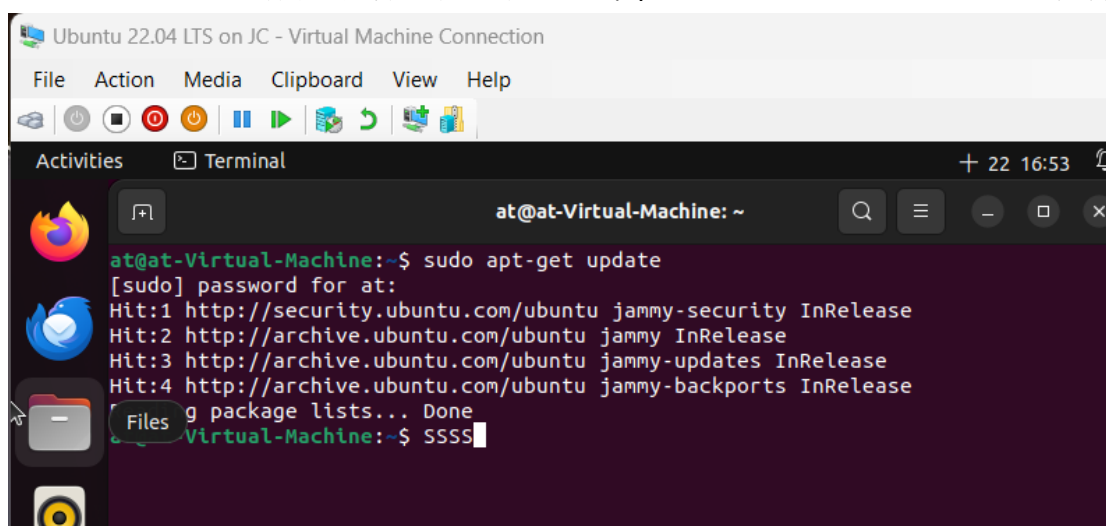


一、實作過程：

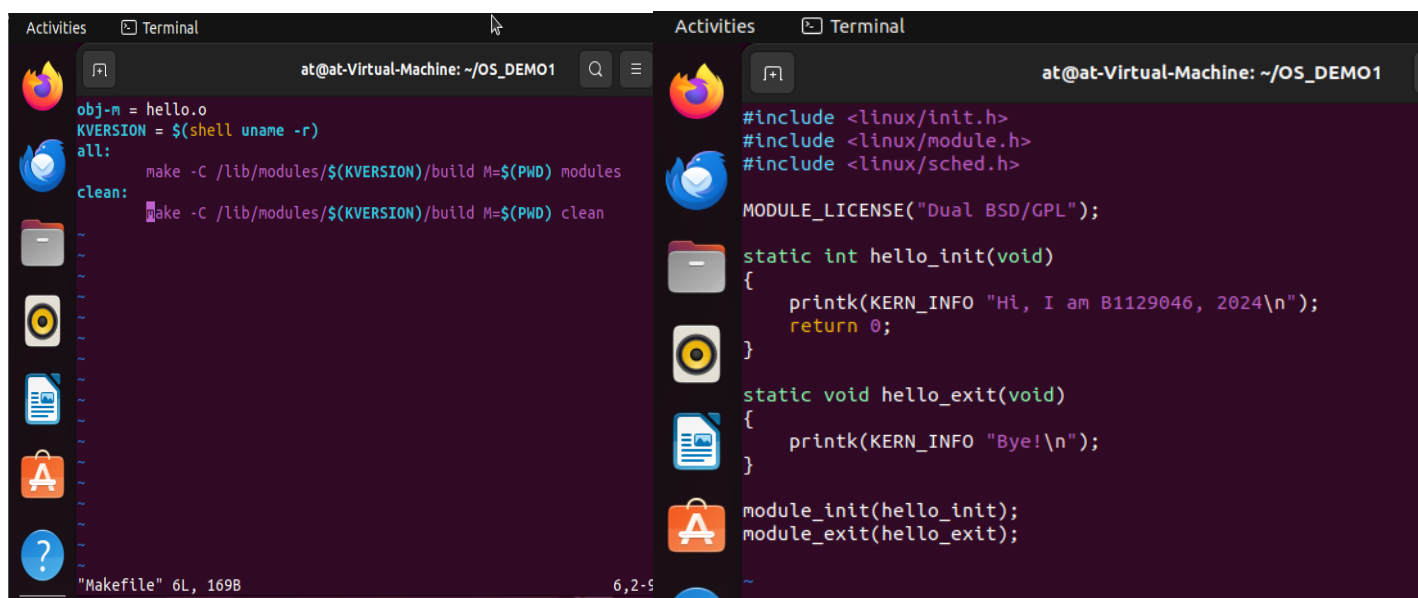
1.使用 Hyper-V 虛擬機安裝好 Ubuntu22.04 以及 Windows 10



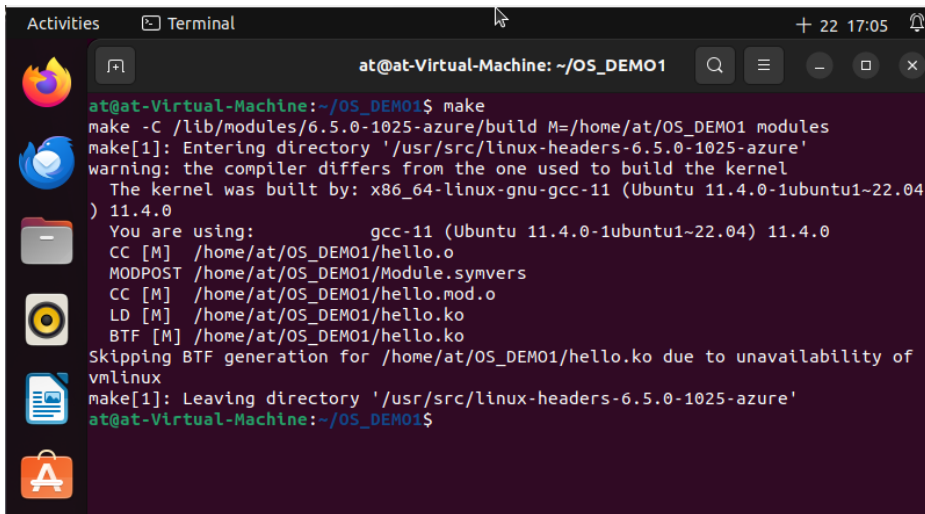
2.在 Ubuntu 中將所需的套件進行安裝更新 (update、make、linux-essential 等等)



3.將 hello.c 與 Makefile 利用 vim 新增至虛擬機中

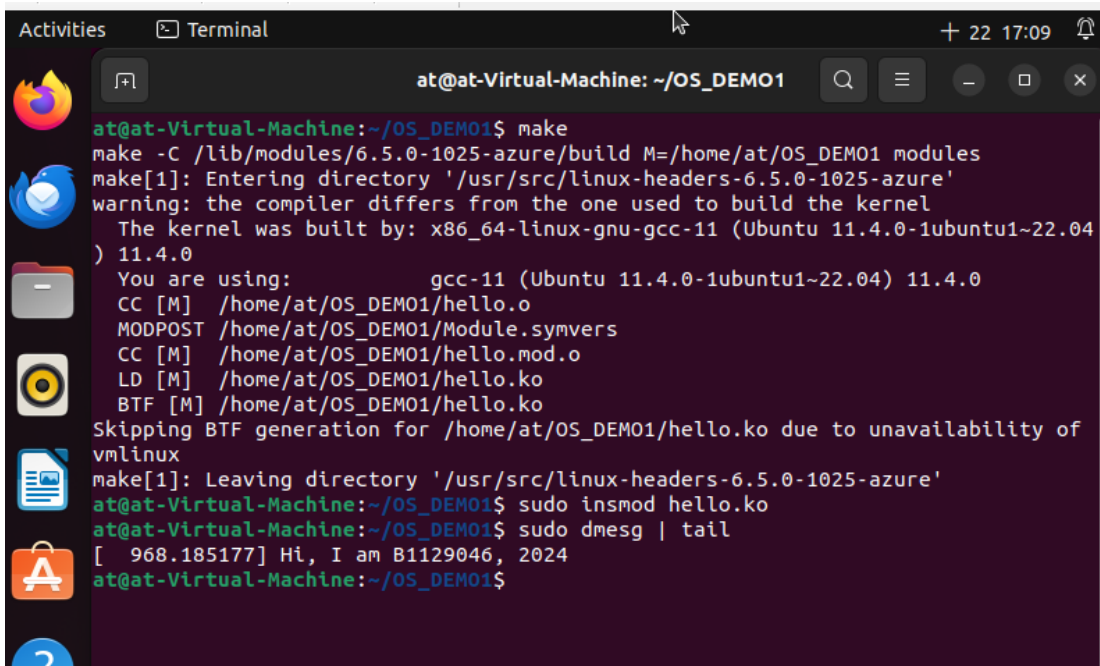


4.使用 make 指令編譯檔案



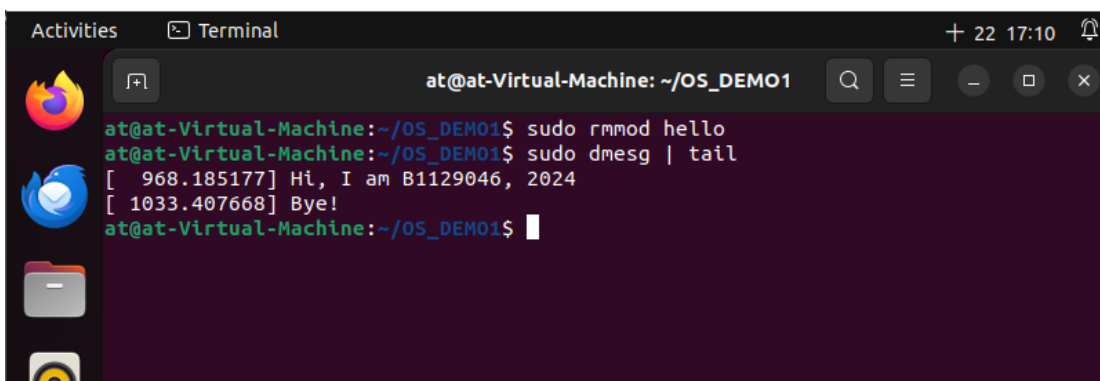
```
at@at-Virtual-Machine: ~/OS_DEMO1
at@at-Virtual-Machine:~/OS_DEMO1$ make
make -C /lib/modules/6.5.0-1025-azure/build M=/home/at/OS_DEMO1 modules
make[1]: Entering directory '/usr/src/linux-headers-6.5.0-1025-azure'
warning: the compiler differs from the one used to build the kernel
The kernel was built by: x86_64-linux-gnu-gcc-11 (Ubuntu 11.4.0-1ubuntu1~22.04) 11.4.0
You are using: gcc-11 (Ubuntu 11.4.0-1ubuntu1~22.04) 11.4.0
CC [M] /home/at/OS_DEMO1/hello.o
MODPOST /home/at/OS_DEMO1/Module.symvers
CC [M] /home/at/OS_DEMO1/hello.mod.o
LD [M] /home/at/OS_DEMO1/hello.ko
BTF [M] /home/at/OS_DEMO1/hello.ko
Skipping BTF generation for /home/at/OS_DEMO1/hello.ko due to unavailability of vmlinux
make[1]: Leaving directory '/usr/src/linux-headers-6.5.0-1025-azure'
at@at-Virtual-Machine:~/OS_DEMO1$
```

5.將 module 安裝上 kernel, 叫出 log 檢查輸出



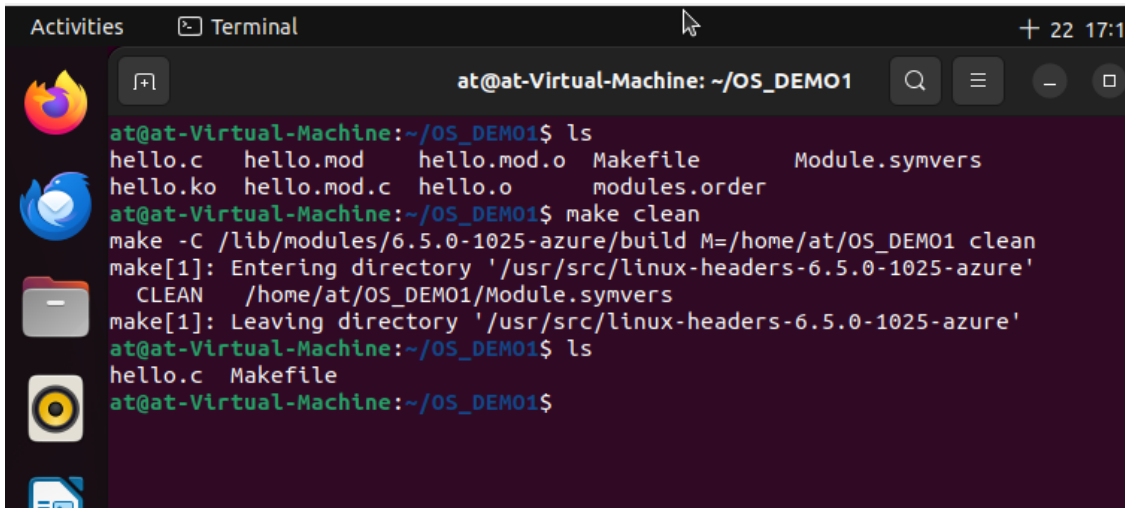
```
at@at-Virtual-Machine:~/OS_DEMO1$ make
make -C /lib/modules/6.5.0-1025-azure/build M=/home/at/OS_DEMO1 modules
make[1]: Entering directory '/usr/src/linux-headers-6.5.0-1025-azure'
warning: the compiler differs from the one used to build the kernel
The kernel was built by: x86_64-linux-gnu-gcc-11 (Ubuntu 11.4.0-1ubuntu1~22.04) 11.4.0
You are using: gcc-11 (Ubuntu 11.4.0-1ubuntu1~22.04) 11.4.0
CC [M] /home/at/OS_DEMO1/hello.o
MODPOST /home/at/OS_DEMO1/Module.symvers
CC [M] /home/at/OS_DEMO1/hello.mod.o
LD [M] /home/at/OS_DEMO1/hello.ko
BTF [M] /home/at/OS_DEMO1/hello.ko
Skipping BTF generation for /home/at/OS_DEMO1/hello.ko due to unavailability of vmlinux
make[1]: Leaving directory '/usr/src/linux-headers-6.5.0-1025-azure'
at@at-Virtual-Machine:~/OS_DEMO1$ sudo insmod hello.ko
at@at-Virtual-Machine:~/OS_DEMO1$ sudo dmesg | tail
[ 968.185177] Hi, I am B1129046, 2024
at@at-Virtual-Machine:~/OS_DEMO1$
```

6.解除 module 並再次檢查 log 輸出



```
at@at-Virtual-Machine:~/OS_DEMO1$ sudo rmmod hello
at@at-Virtual-Machine:~/OS_DEMO1$ sudo dmesg | tail
[ 968.185177] Hi, I am B1129046, 2024
[ 1033.407668] Bye!
at@at-Virtual-Machine:~/OS_DEMO1$
```

7.最後用 make clean 清理檔案

A terminal window titled 'at@at-Virtual-Machine: ~/OS_DEMO1' with a search bar and window controls. The terminal shows the following commands and output:

```
at@at-Virtual-Machine:~/OS_DEMO1$ ls
hello.c  hello.mod  hello.mod.o  Makefile      Module.symvers
hello.ko  hello.mod.c  hello.o      modules.order
at@at-Virtual-Machine:~/OS_DEMO1$ make clean
make -C /lib/modules/6.5.0-1025-azure/build M=/home/at/OS_DEMO1 clean
make[1]: Entering directory '/usr/src/linux-headers-6.5.0-1025-azure'
CLEAN /home/at/OS_DEMO1/Module.symvers
make[1]: Leaving directory '/usr/src/linux-headers-6.5.0-1025-azure'
at@at-Virtual-Machine:~/OS_DEMO1$ ls
hello.c  Makefile
at@at-Virtual-Machine:~/OS_DEMO1$
```

二、遇到的問題：

- 1.實作的過程中有遇到編譯器 GCC 的版本不同的問題，再使用更新指令後就可以成功 make 了
- 2.執行到要書出道 kernel log 時如果使用等級太高的方式輸出會出現警告，之後從 Alert 改成 Info 就不會發生了。