

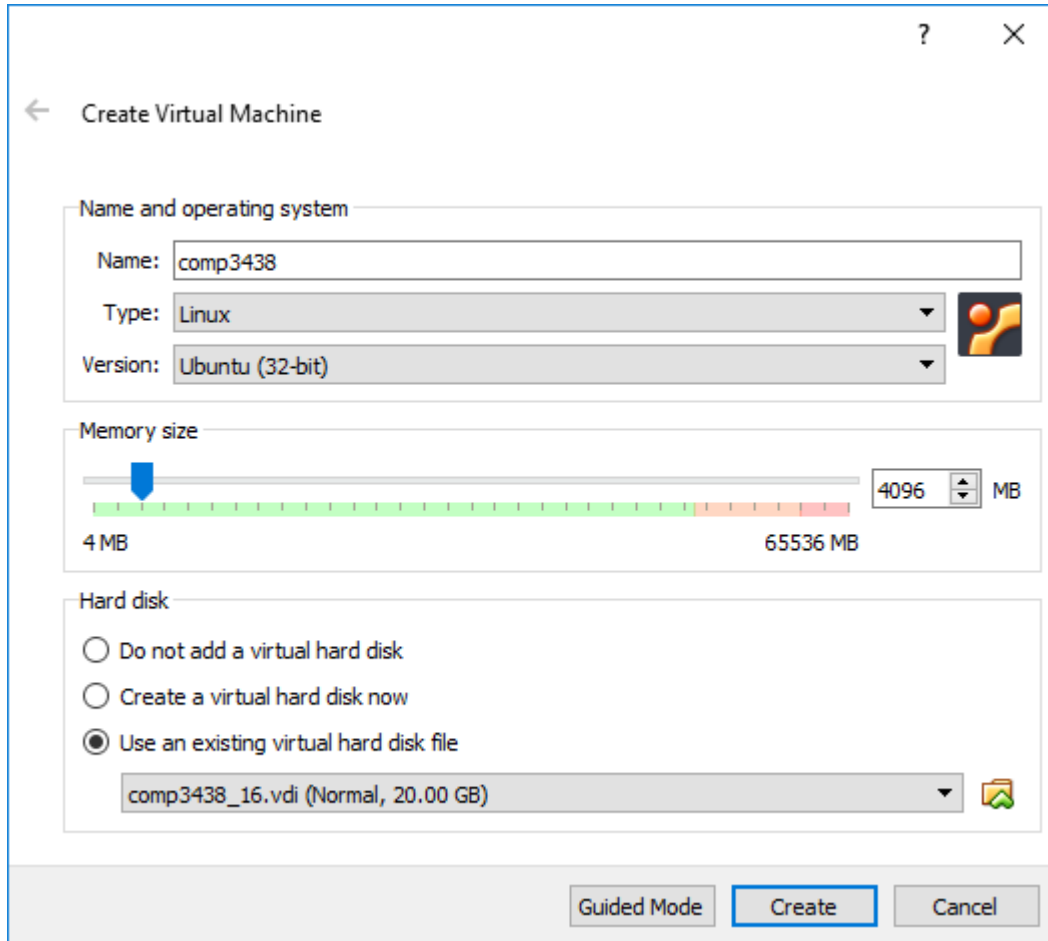
# Lab4 Report

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JAHJA Darwin, 16094501d

## Setup the VM

### 1. Basic settings:

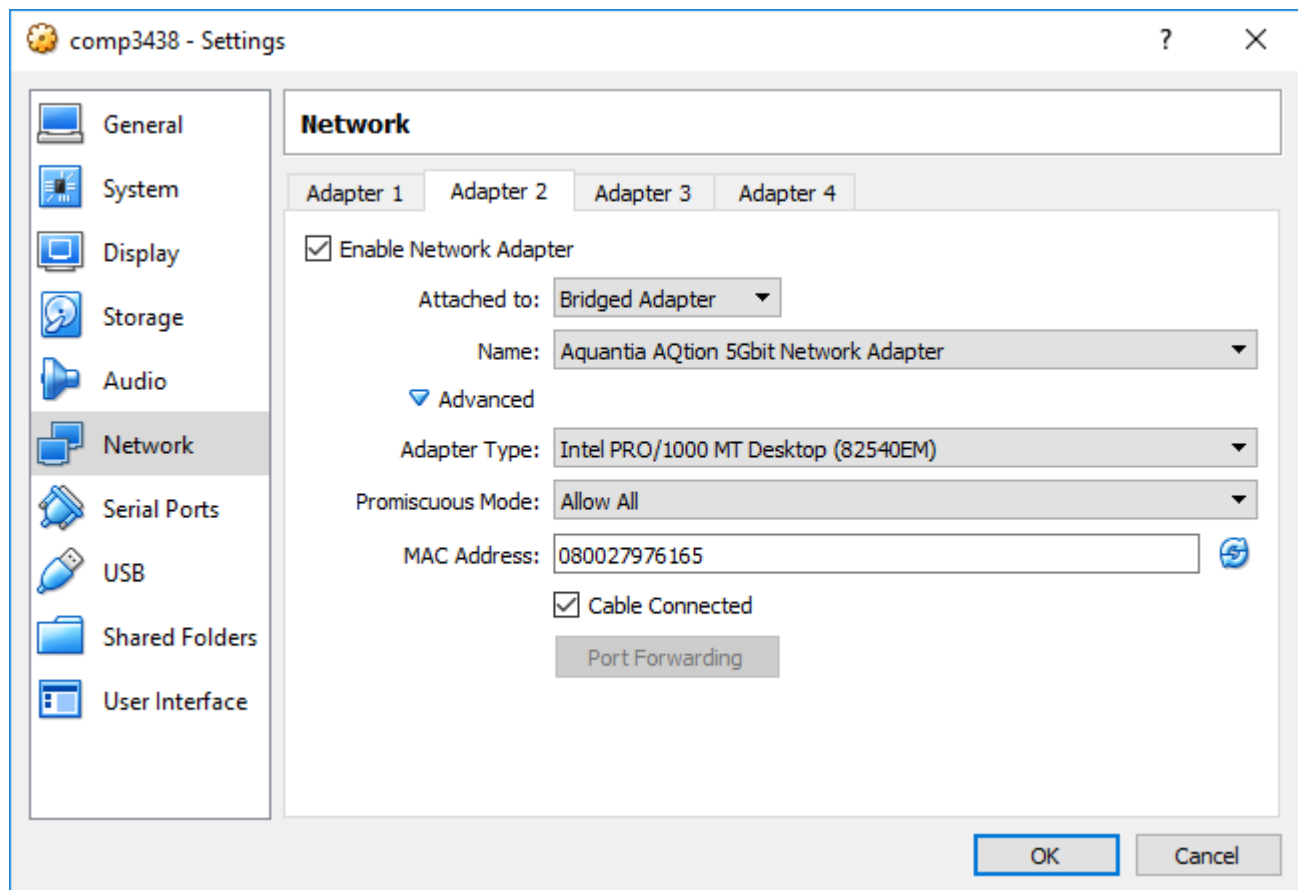


The screenshot shows the 'Create Virtual Machine' window with the following settings:

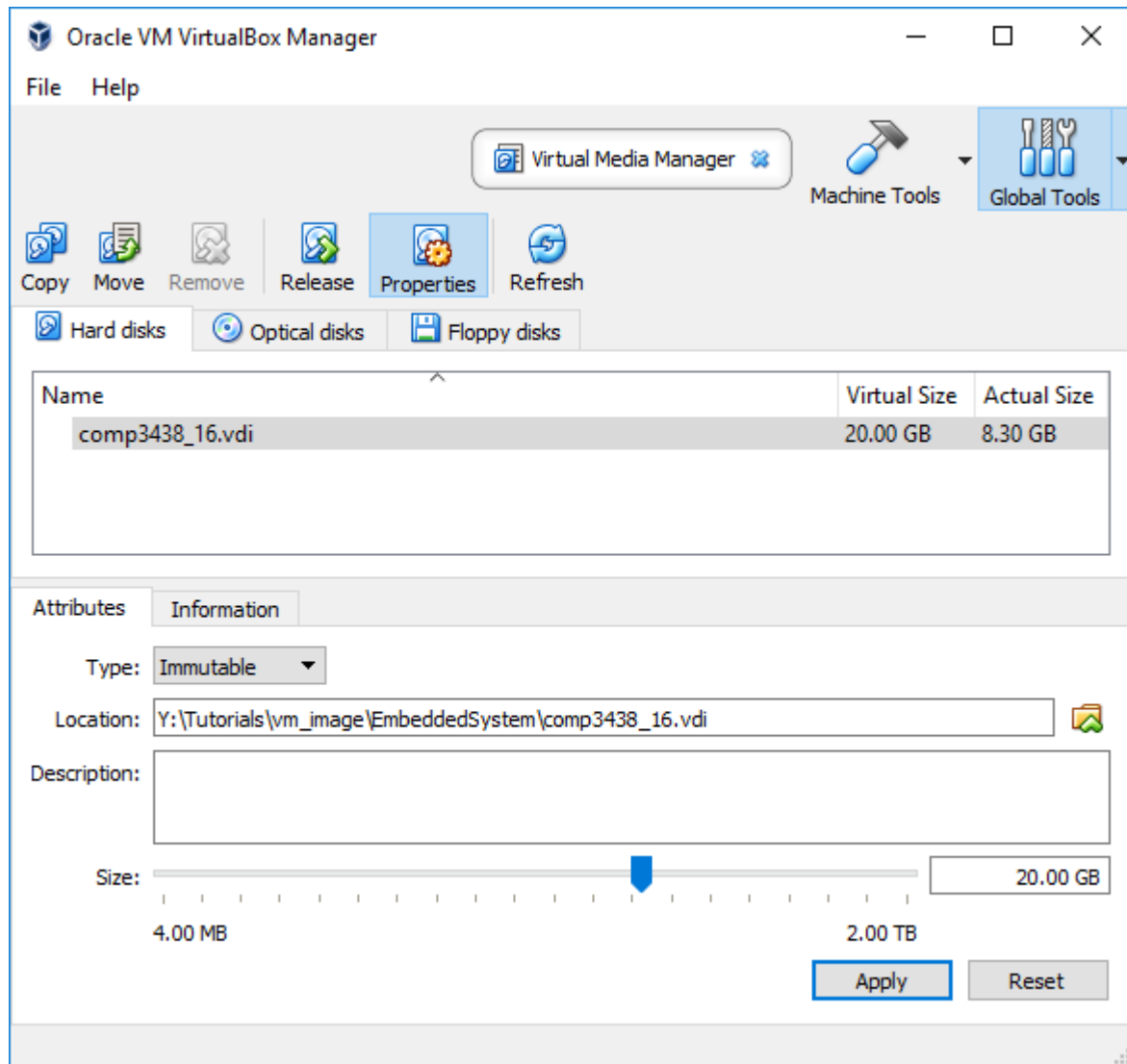
- Name and operating system:**
  - Name: comp3438
  - Type: Linux
  - Version: Ubuntu (32-bit)
- Memory size:**
  - Slider range: 4 MB to 65536 MB
  - Current value: 4096 MB
- Hard disk:**
  - ☐ Do not add a virtual hard disk
  - ☐ Create a virtual hard disk now
  - ☒ Use an existing virtual hard disk file
  - File: comp3438\_16.vdi (Normal, 20.00 GB)

Buttons at the bottom: Guided Mode, Create (highlighted), Cancel.

### 2. Network settings:



3. Make vdi file immutable:

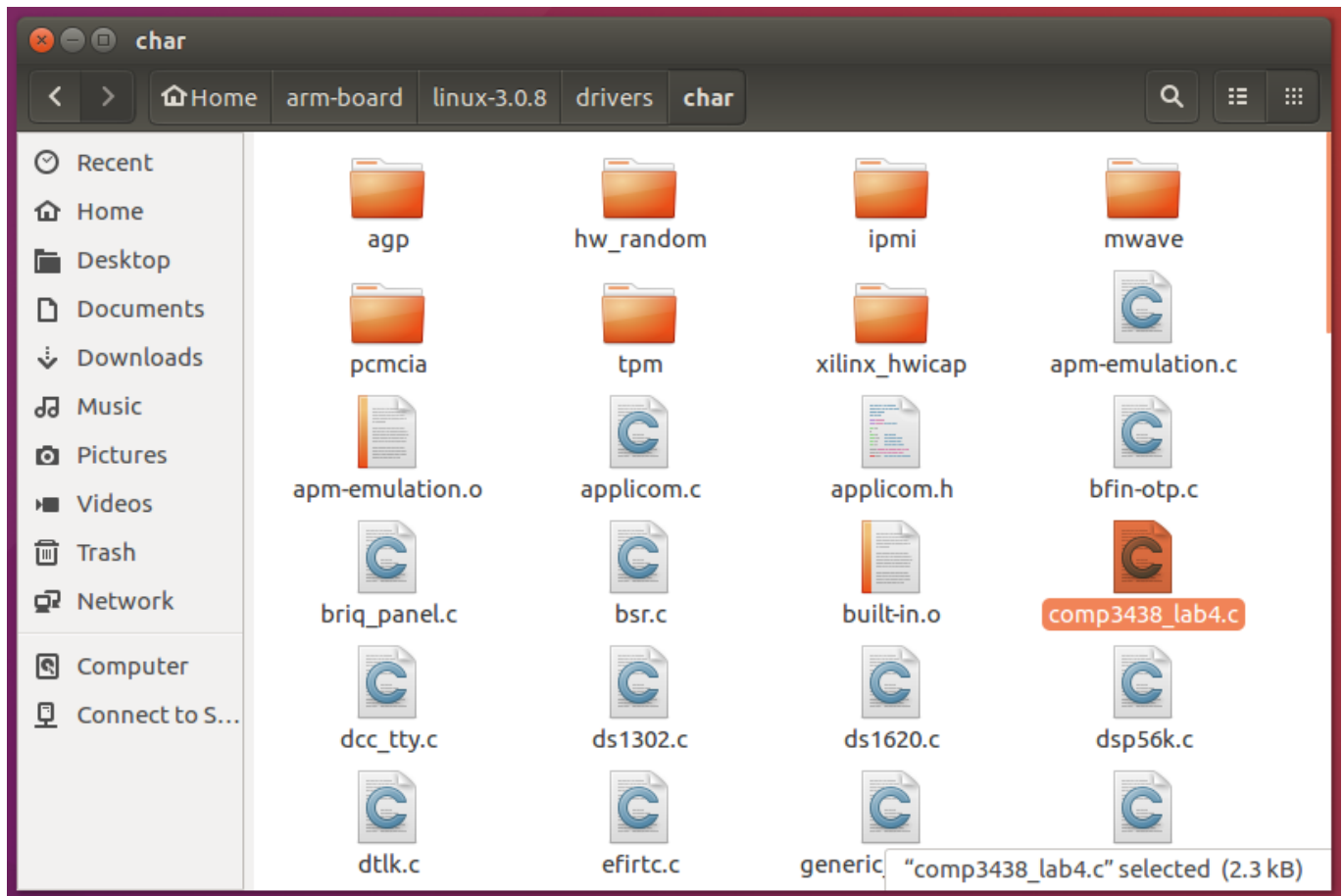


4. Start the VM.

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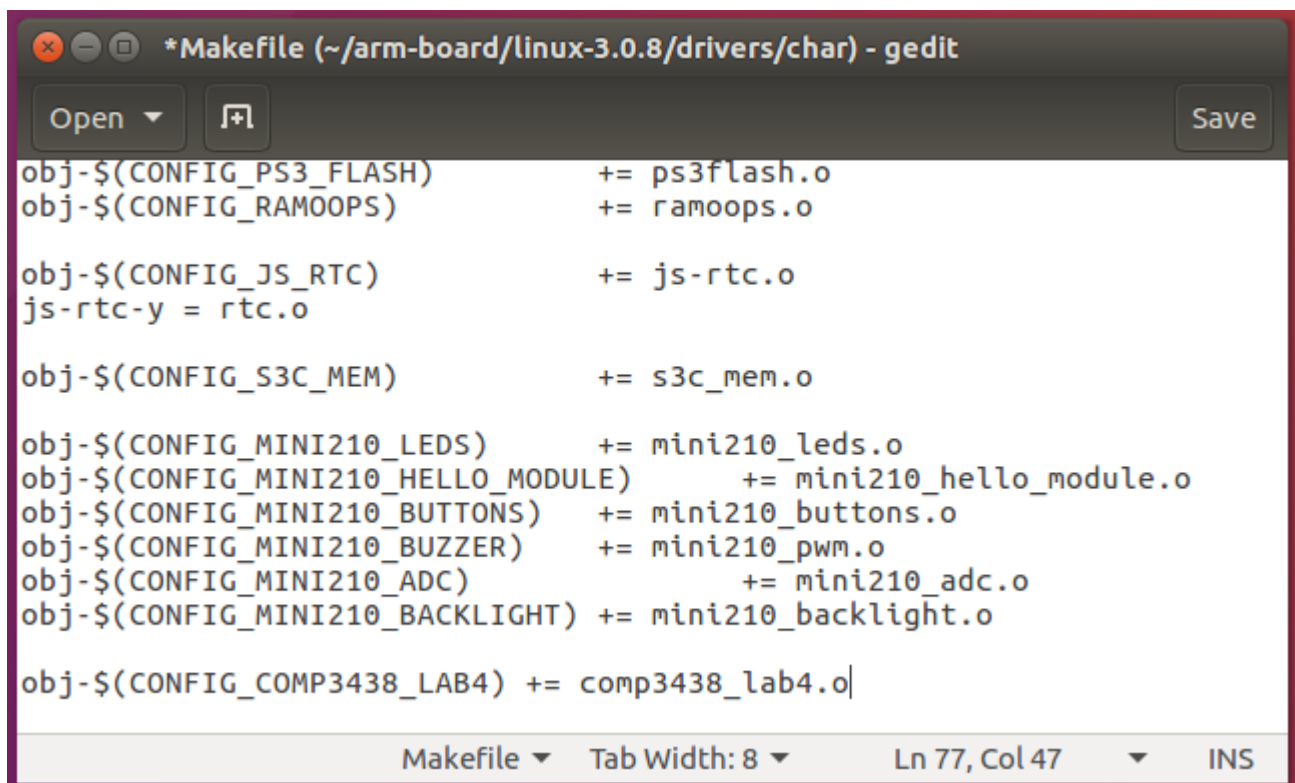
## Create a Character device driver

1. Put the 'comp3438\_lab4.c' file in 'arm-board/linux-3.0.8/drivers/char/'



2. Open the 'arm-board/linux-3.0.8/drivers/char/Makefile' and add the following line at the end.

```
obj-$(CONFIG_COMP3438_LAB4) += comp3438_lab4.o
```

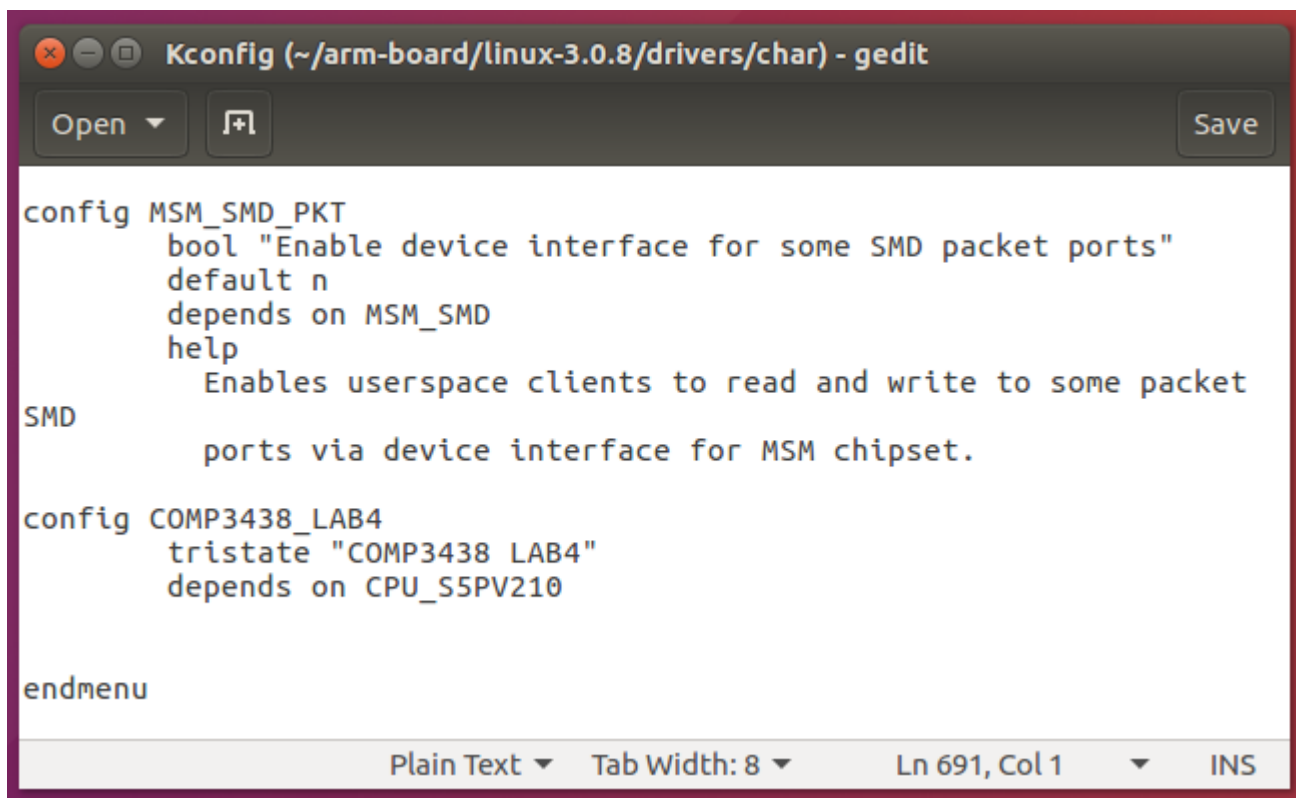


3. Open the "arm-board/linux-3.0.8/drivers/char/Kconfig" and add the following lines at the end before "endmenu".

```
...

config COMP3438_LAB4
    tristate "COMP3438 LAB4"
    depends on CPU_S5PV210

endmenu
```



4. In the terminal, run:

```
cd ~/arm-board/linux-3.0.8" and run
make menuconfig
```

```

comp3438@comp3438-VirtualBox: ~/arm-board/linux-3.0.8
comp3438@comp3438-VirtualBox:~$ cd arm-board/linux-3.0.8/
comp3438@comp3438-VirtualBox:~/arm-board/linux-3.0.8$ make menuconfig

```

5. In the menu, Go to *Device Drivers* > *character devices* > *COMP3438 LAB4*. Press 'M', save and exit.

```

comp3438@comp3438-VirtualBox: ~/arm-board/linux-3.0.8
.config - Linux/arm 3.0.8 Kernel Configuration

Character devices
Arrow keys navigate the menu. <Enter> selects 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 [ ] excluded <M> module < >

^(-)
< > IPMI top-level message handler --->
[*] Hardware Random Number Generator Core support
< > Timer IOMEM HW Random Number Generator support
< > Siemens R3964 line discipline
< > RAW driver (/dev/raw/rawN)
< > TPM Hardware Support --->
< > DCC tty driver
< > Log panic/oops to a RAM buffer
[*] Support for /dev/s3c-mem
<M> COMP3438 LAB4

<Select>  < Exit >  < Help >

```

6. Run `make` to compile the driver. It will create the driver files in "arm-board/linux-3.0.8/drivers/char"

```

comp3438@comp3438-VirtualBox: ~/arm-board/linux-3.0.8

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

comp3438@comp3438-VirtualBox:~/arm-board/linux-3.0.8$ make
scripts/kconfig/conf --silentoldconfig Kconfig
CHK      include/linux/version.h
CHK      include/generated/utsrelease.h
make[1]: 'include/generated/mach-types.h' is up to date.
CALL     scripts/checksyscalls.sh
CHK      include/generated/compile.h
CC [M]   drivers/char/comp3438_lab4.o
Kernel: arch/arm/boot/Image is ready
SHIPPED  arch/arm/boot/compressed/lib1funcs.S
AS       arch/arm/boot/compressed/lib1funcs.o
LD       arch/arm/boot/compressed/vmlinux
OBJCOPY  arch/arm/boot/zImage
Kernel: arch/arm/boot/zImage is ready
Building modules, stage 2.
MODPOST 5 modules
CC       drivers/char/comp3438_lab4.mod.o
LD [M]   drivers/char/comp3438_lab4.ko
comp3438@comp3438-VirtualBox:~/arm-board/linux-3.0.8$

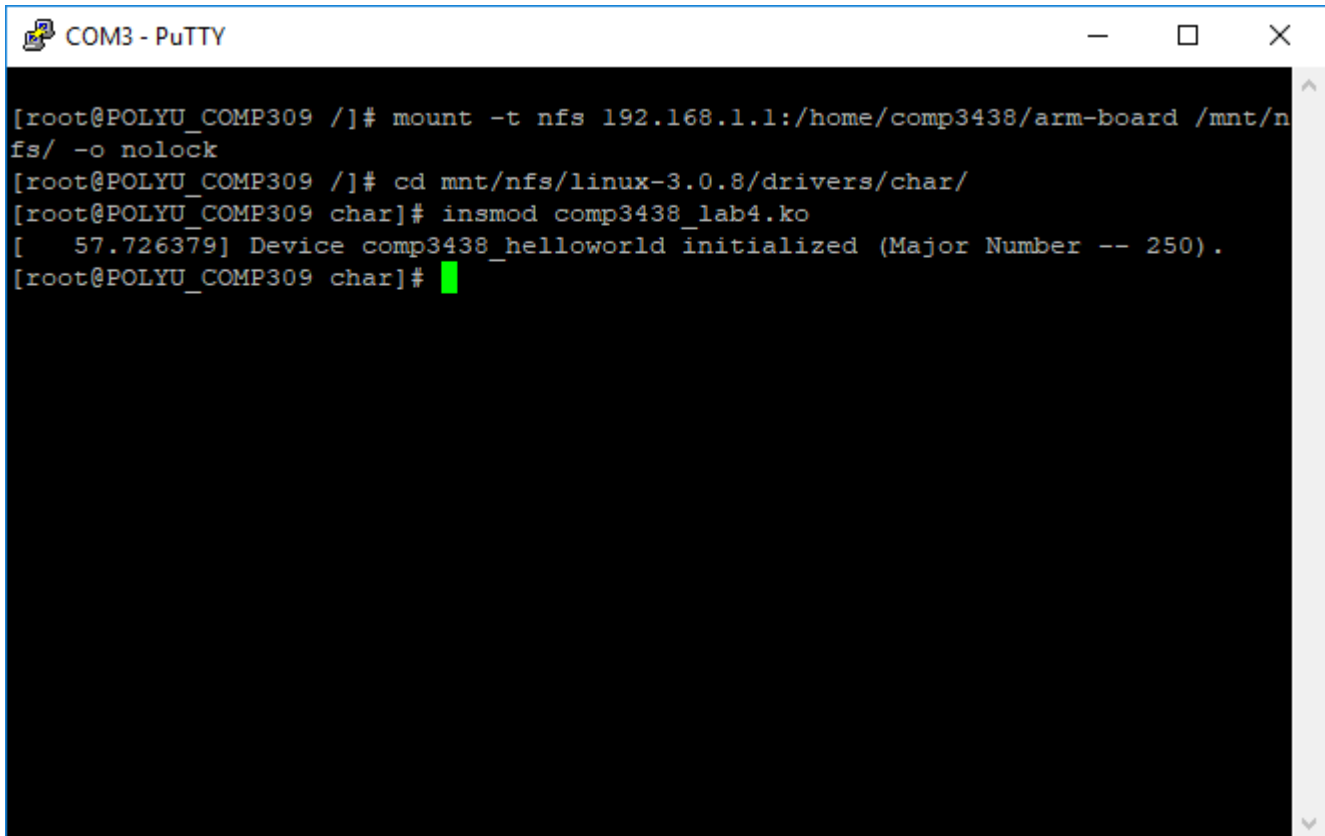
```

Name	Size	Type	Modified
applicom.c	24.5 kB	Text	Oct 1
applicom.h	2.6 kB	Text	Oct 1
bfin-otp.c	6.1 kB	Text	Oct 1
briq_panel.c	5.3 kB	Text	Oct 1
bsr.c	9.0 kB	Text	Oct 1
built-in.o	976.3 kB	Document	Oct 1
comp3438_lab4.c	2.3 kB	Text	Oct 1
comp3438_lab4.ko	65.7 kB	Document	17:33
comp3438_lab4.mod.c	444 bytes	Text	17:33
comp3438_lab4.mod.o	16.1 kB	Document	17:33
comp3438_lab4.o	50.7 kB	Document	17:32
dcc_tty.c	8.1 kB	Text	Oct 1
ds1302.c	7.7 kB	Text	Oct 1
ds1620.c	8.1 kB	Text	Oct 1

## Load the driver on the embedded board

1. Open putty and mount "/home/comp3438/arm-board" to the embedded board. And dynamically load the driver in kernel.

```
# Run in putty terminal
mount -t nfs 192.168.1.1:/home/comp3438/arm-board /mnt/nfs -o nolock
cd /mnt/nfs/linux-3.0.8/drivers/char
insmod comp3438_lab4.ko
```



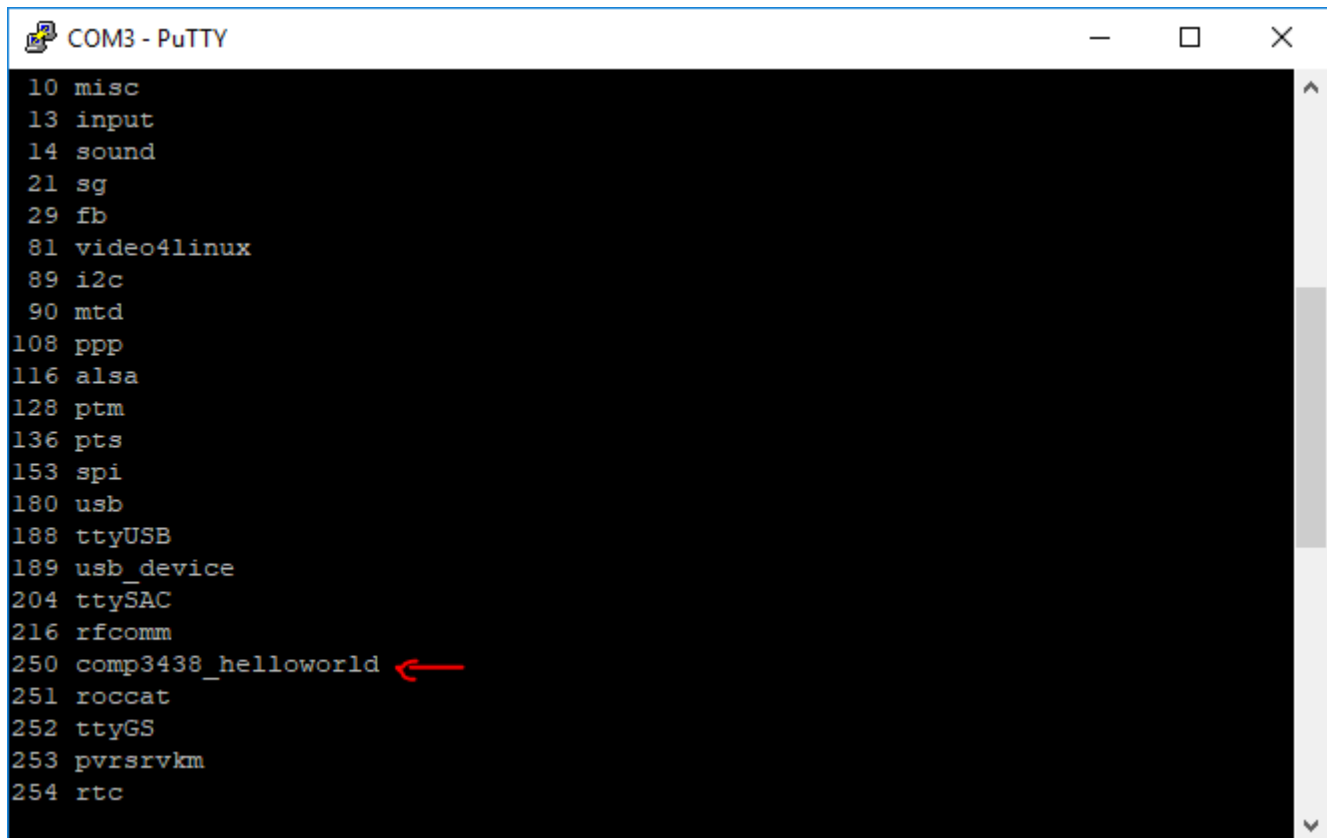
```
COM3 - PuTTY

[root@POLYU_COMP309 /]# mount -t nfs 192.168.1.1:/home/comp3438/arm-board /mnt/nfs/ -o nolock
[root@POLYU_COMP309 /]# cd mnt/nfs/linux-3.0.8/drivers/char/
[root@POLYU_COMP309 char]# insmod comp3438_lab4.ko
[ 57.726379] Device comp3438_helloworld initialized (Major Number -- 250).
[root@POLYU_COMP309 char]#
```

2. Check if device driver is added to the system.

```
cat /proc/devices
```

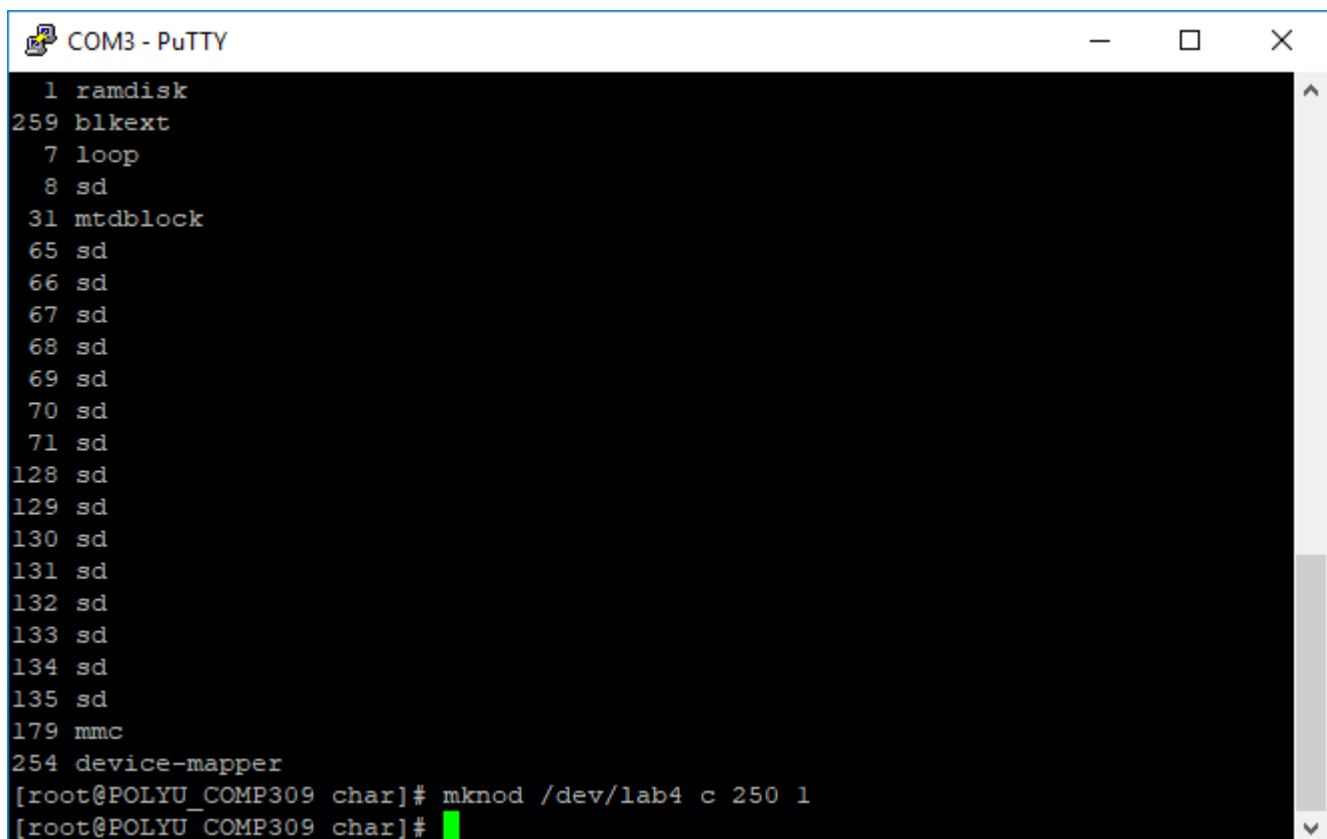




```
COM3 - PuTTY
10 misc
13 input
14 sound
21 sg
29 fb
81 video4linux
89 i2c
90 mtd
108 ppp
116 alsa
128 ptm
136 pts
153 spi
180 usb
188 ttyUSB
189 usb_device
204 ttySAC
216 rfcomm
250 comp3438_helloworld
251 roccat
252 ttyGS
253 pvrsrvkm
254 rtc
```

3. Link the driver to a device file.

```
mknod /dev/lab4 c 250 1
```



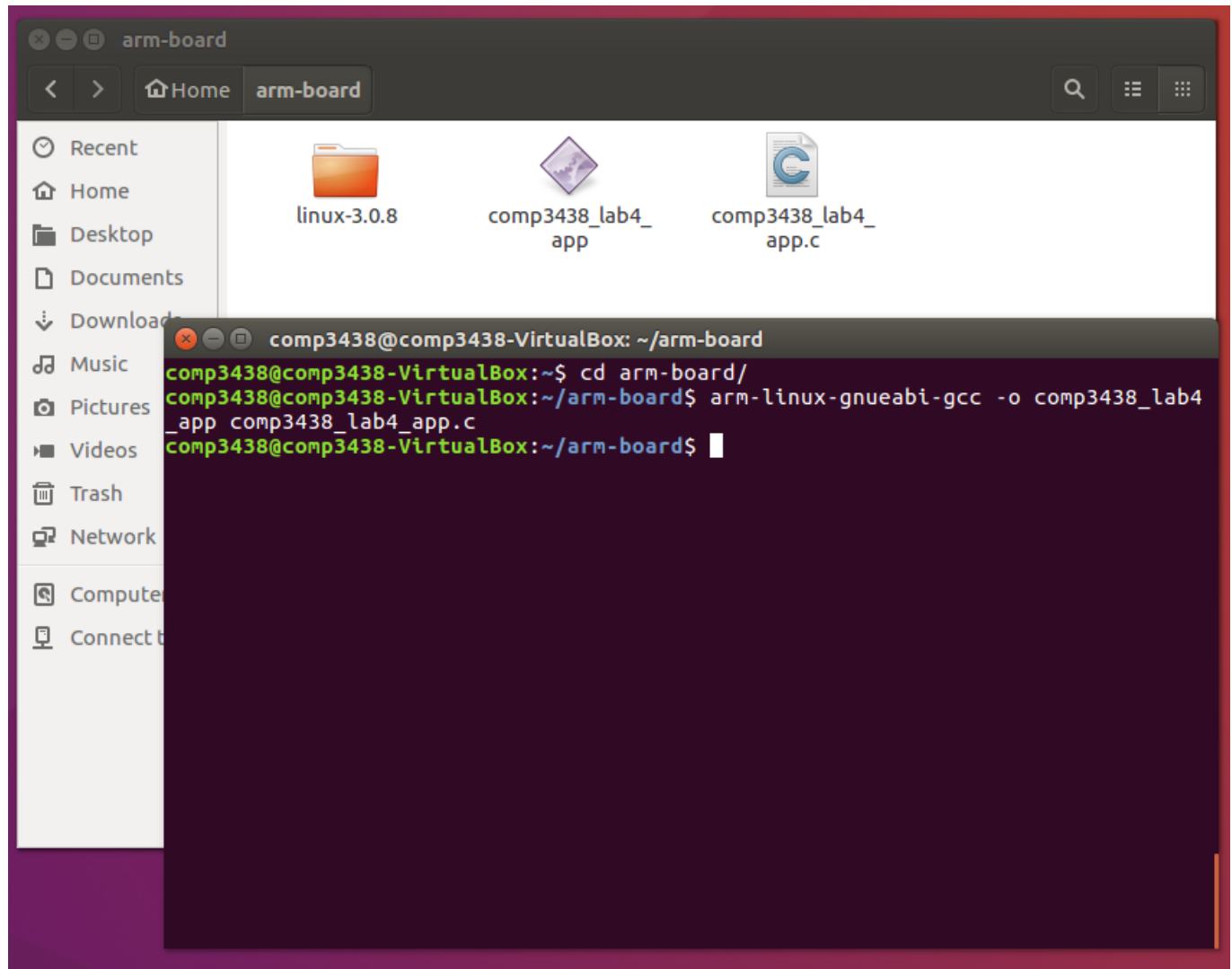
```
COM3 - PuTTY
1 ramdisk
259 blkext
7 loop
8 sd
31 mtdblock
65 sd
66 sd
67 sd
68 sd
69 sd
70 sd
71 sd
128 sd
129 sd
130 sd
131 sd
132 sd
133 sd
134 sd
135 sd
179 mmc
254 device-mapper
[root@POLYU_COMP309 char]# mknod /dev/lab4 c 250 1
[root@POLYU_COMP309 char]#
```

Now, the device is attached to the file. we can read from the file using unix system calls.

## Read from the driver by writing C code

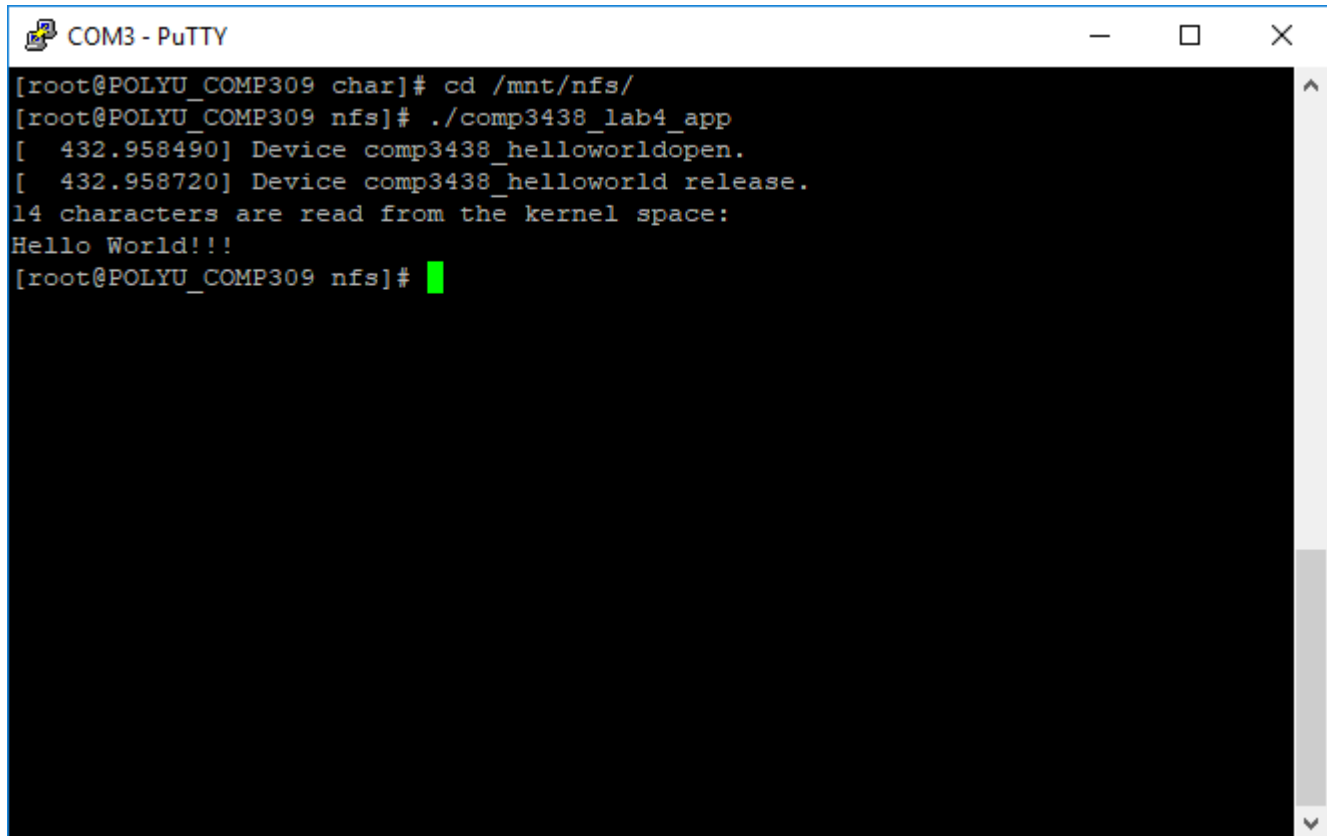
1. Put "comp3438\_lab4\_app.c" in 'arm-board/' and compile the code.

```
cd arm-board/  
arm-linux-gnueabi-gcc -o comp3438_lab4_app comp3438_lab4_app.c
```



3. In putty terminal, go to "/mnt/nfs" and run the compiled file.

```
cd /mnt/nfs/  
./comp3438_lab4_app
```



```
COM3 - PuTTY
[ root@POLYU_COMP309 char]# cd /mnt/nfs/
[ root@POLYU_COMP309 nfs]# ./comp3438_lab4_app
[  432.958490] Device comp3438_helloworldopen.
[  432.958720] Device comp3438_helloworld release.
14 characters are read from the kernel space:
Hello World!!!
[ root@POLYU_COMP309 nfs]#
```