

Assignment3 Problem1 Environment Setup

1. Environment Setting

- VirtualBox
- Ubuntu-18.04
- gcc-3.4 & g++3.4
- cpp-3.4.6 & libc++6
- Bochs IA-32 Emulation Platform
- Linux-0.11 source code (oslab code)

2. Install the Ubuntu-18.04 on the VirtualBox

- 1) Download the VirtualBox from the following link:

<https://www.virtualbox.org/wiki/Downloads>

You could choose windows host and mac host according to your os in your computer

- 2) Download the Ubuntu18.04 iso

<https://releases.ubuntu.com/18.04/>

Choose ubuntu-18.04.6-desktop-amd64.iso and download

- 3) Install the VirtualBox on your PC

- 4) Load the Ubuntu18.04 iso into the VirtualBox

First step: Click 'New' button on the top and then load the Ubuntu18.04 iso. The Name is filled with 'Ubuntu18.04'. The Iso Image is selected as where you save Ubuntu18.04 iso.

A reminding is that you need to click 'Skip Unattended Installation'. Or you would find some troubles when you configure the network and find the terminal. (Seen as Figure 1)

Second step: Configure the Memory Capacity, cpu number and hard disk size. (Seen as Figure 2 and Figure 3)

Third step: Then we could finish the loading step of Ubuntu18.04 iso into the Virtual Box.

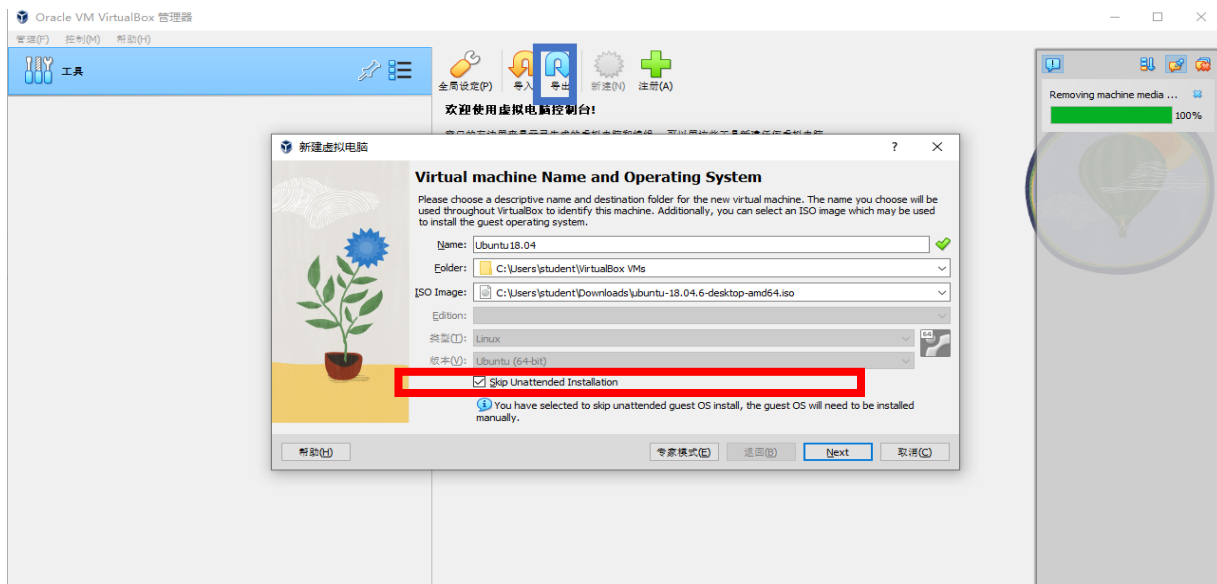


Figure 1

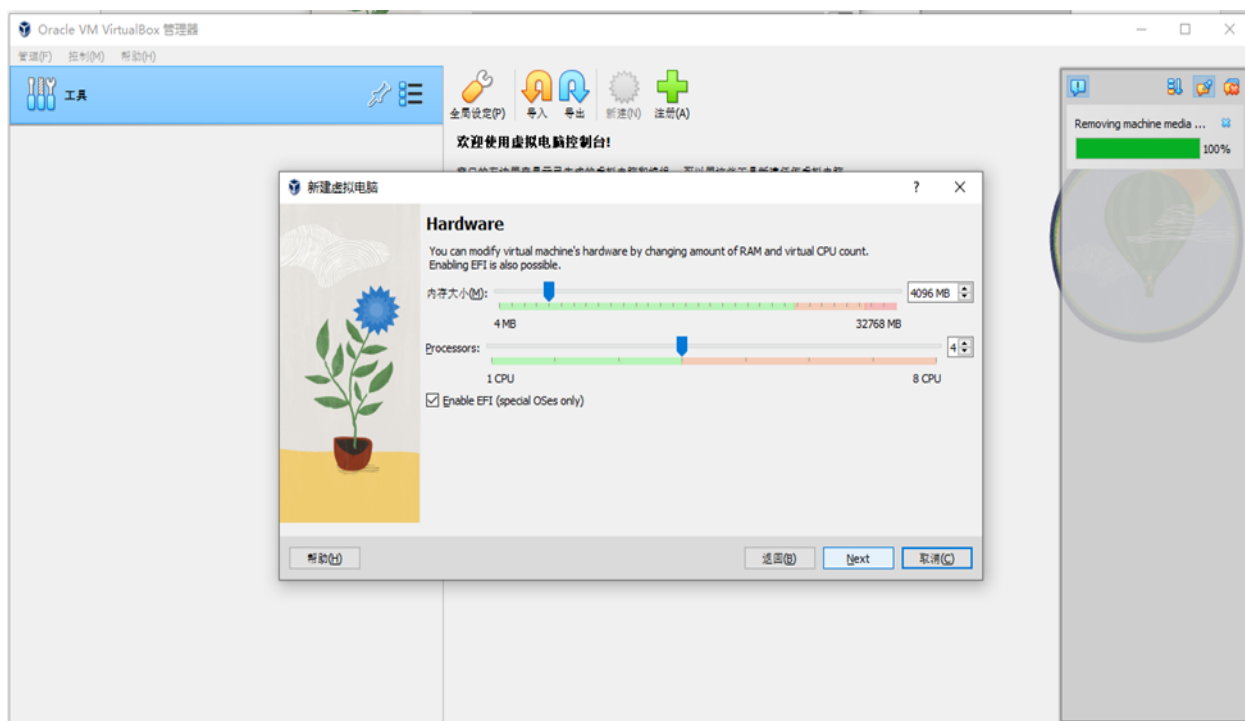


Figure 2

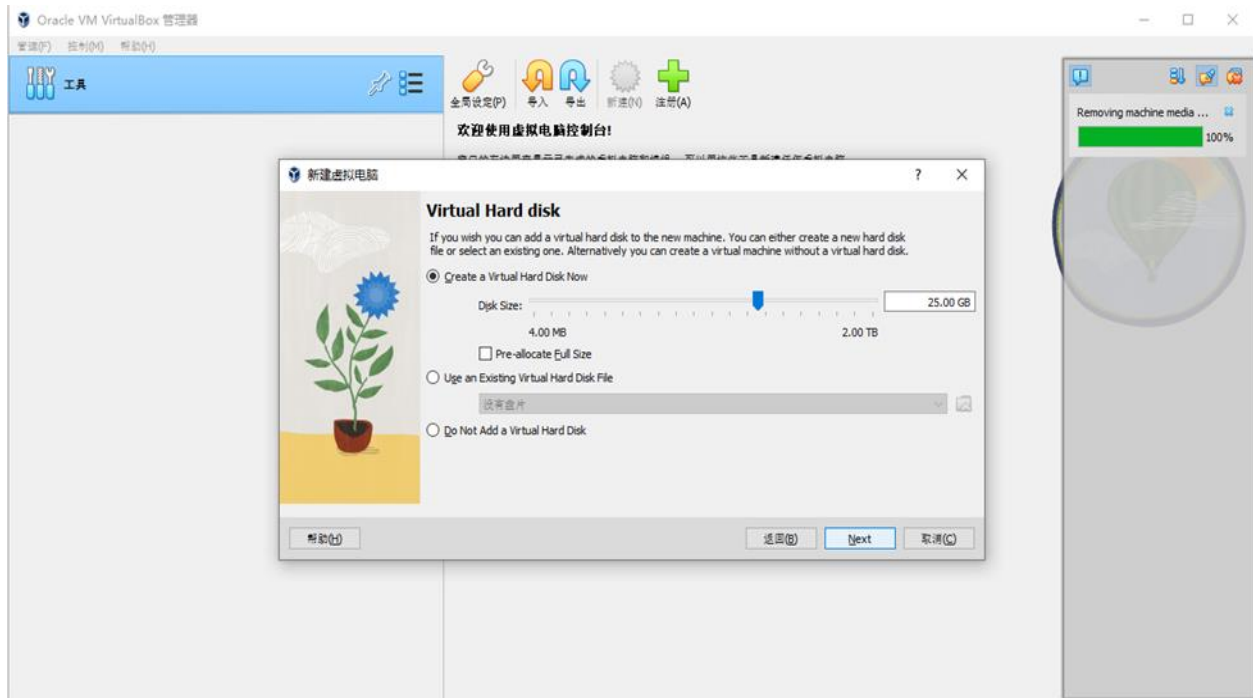


Figure 3

5) Install the Ubuntu18.04

First step: Click 'Start' button on the top, and then the virtual machine would power up. After the system starts up, we would find the 'Install Ubuntu 18.04.6 LTS' on the left up corner of the desktop. Click it. (Seen as Figure 4)

Second step: In the language and Keyboard layout setting, you should choose 'English' and 'English(US)'. (seen as Figure 5&6)

Third step: In the 'Updates and Other software' and 'Installation Type', you should choose 'Normal Installation' and 'Erase Disk and install Ubuntu', and click 'Install now'.

Fourth step: In the 'Who are you', you should enter the username and password in 'Your name' and 'choose a password'. **Please remember it well and you would need to log in with it.** Then continue and installation begins.

Fifth step: After installing and restarting your virtual system, **checking whether you could open your terminal and the connection of your network! (Figure 9)**

Check Terminal: Press 'Activity' and Input 'Terminal', and then click 'Terminal' icon. (Figure 8)

Check network connection: Open 'Firefox' browser and a website.

Sixth step: **Install Upgrade Guest Addition.** Click 'Device' and then 'Upgrade Guest Addition'. Also let the 'shared paste' as 'bidirectional'. This would let you paste things between vm and your pc. (Seen as Figure 10)

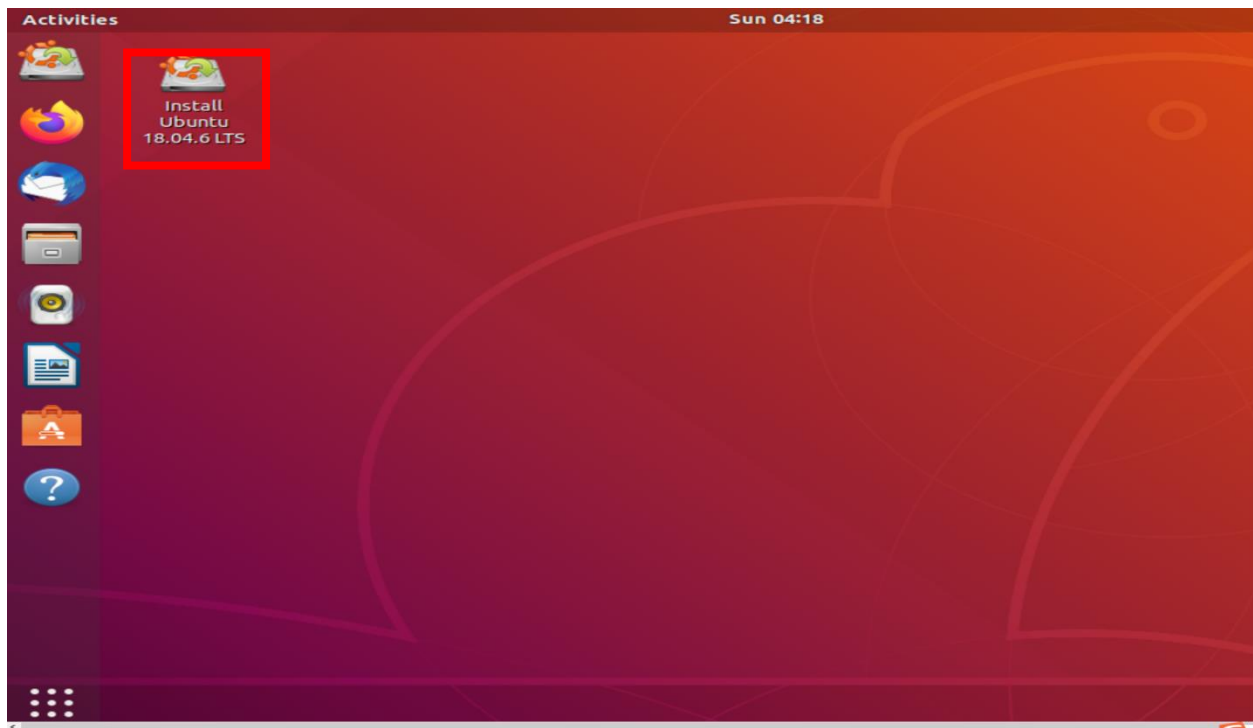


Figure 4

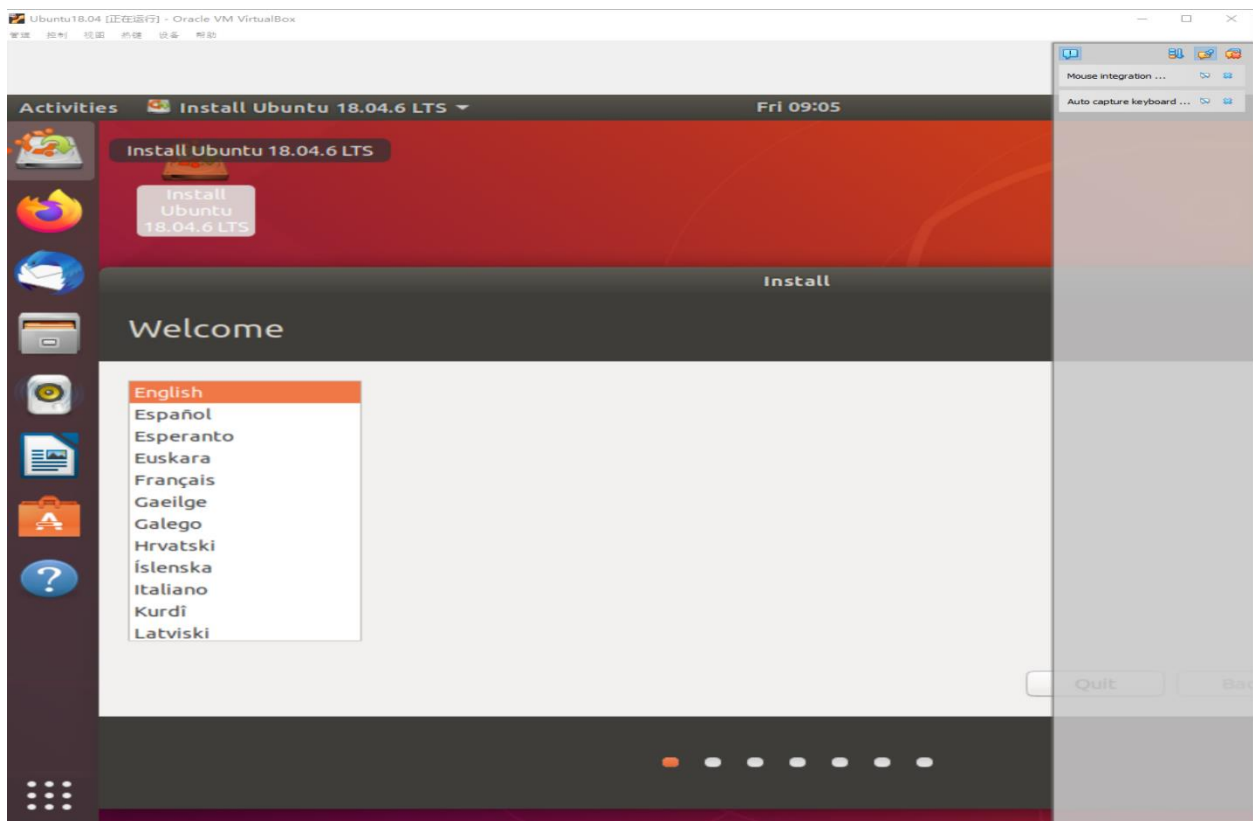


Figure 5

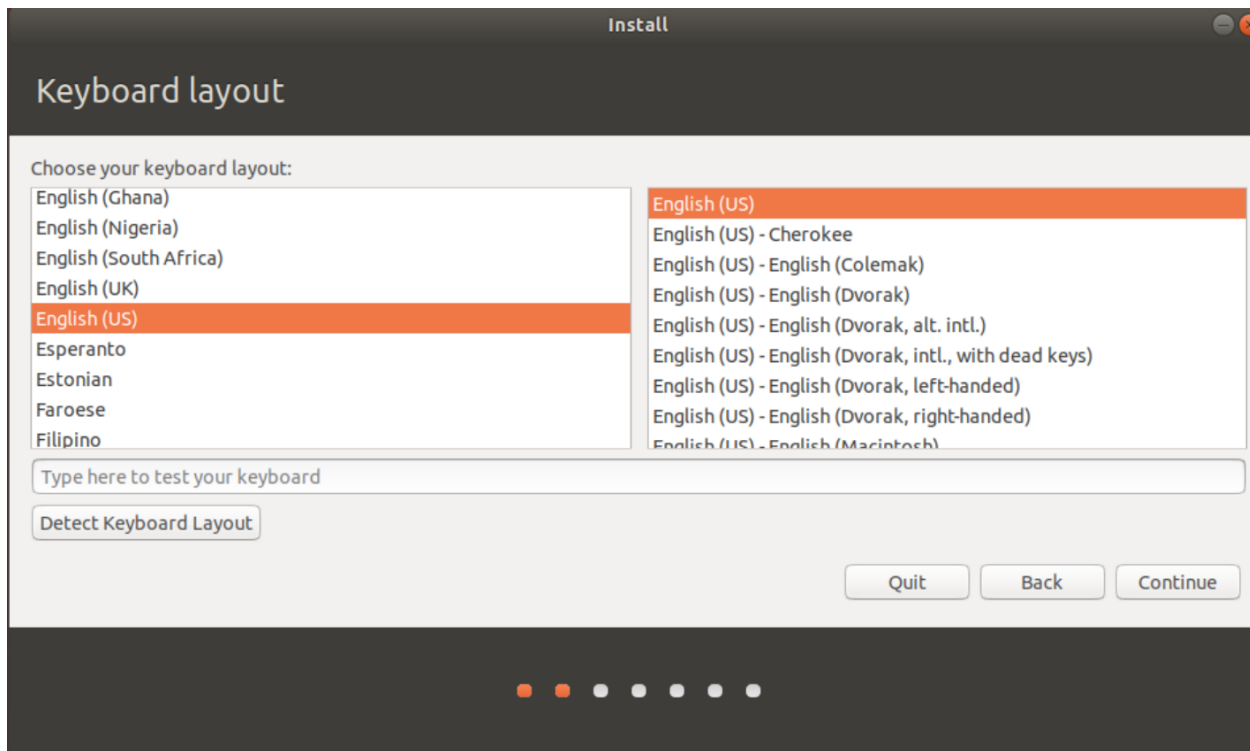


Figure 6

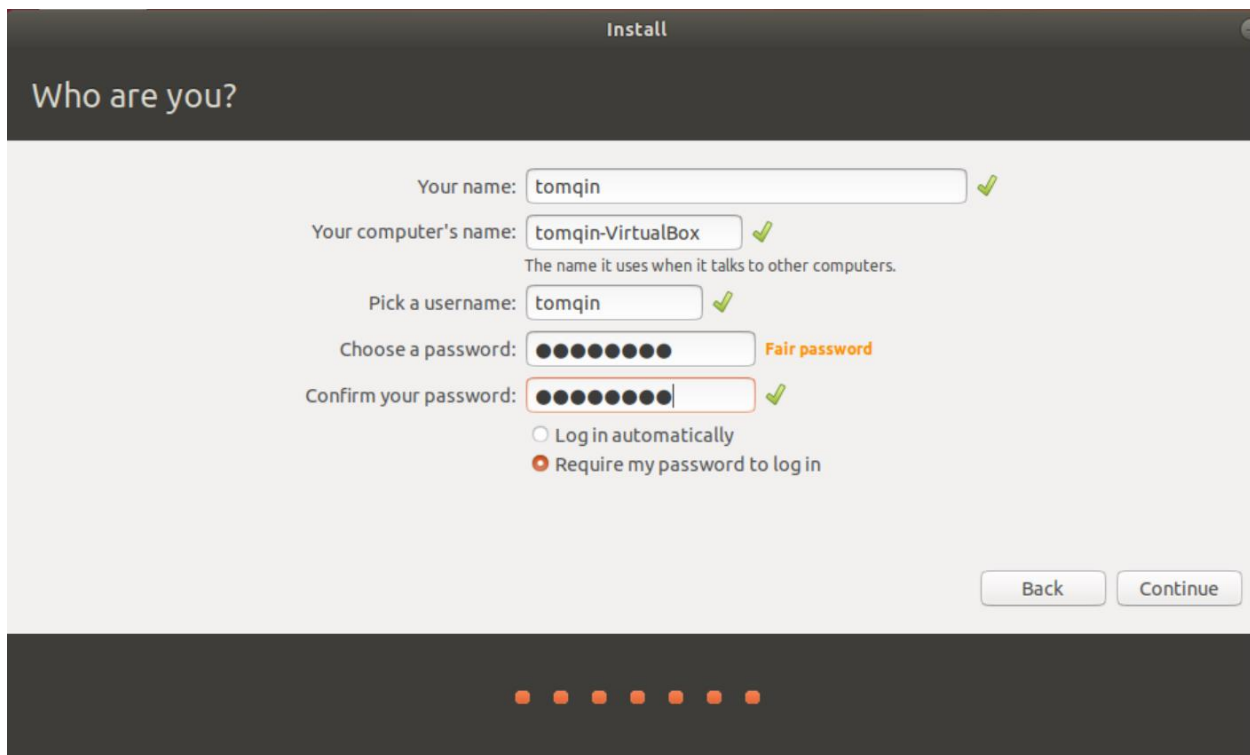


Figure 7



Figure 8

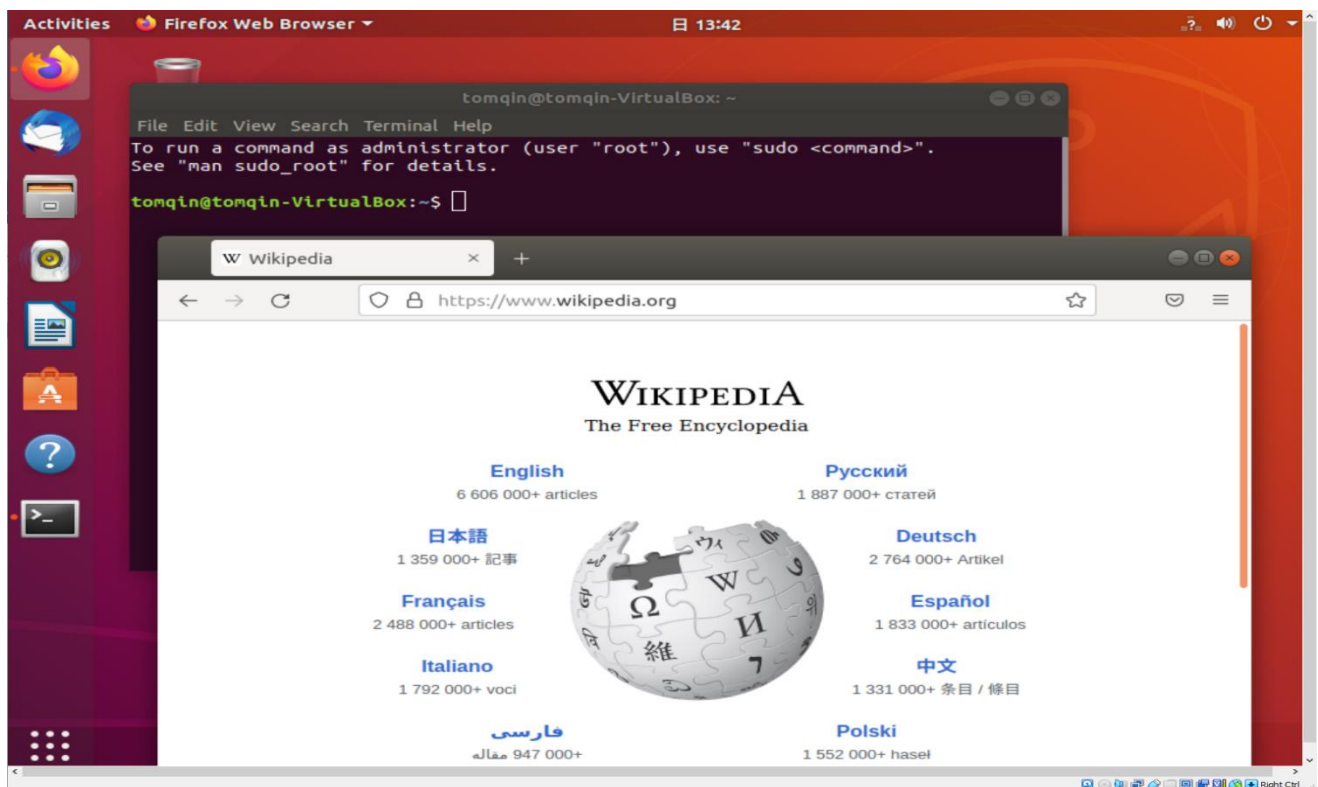


Figure 9

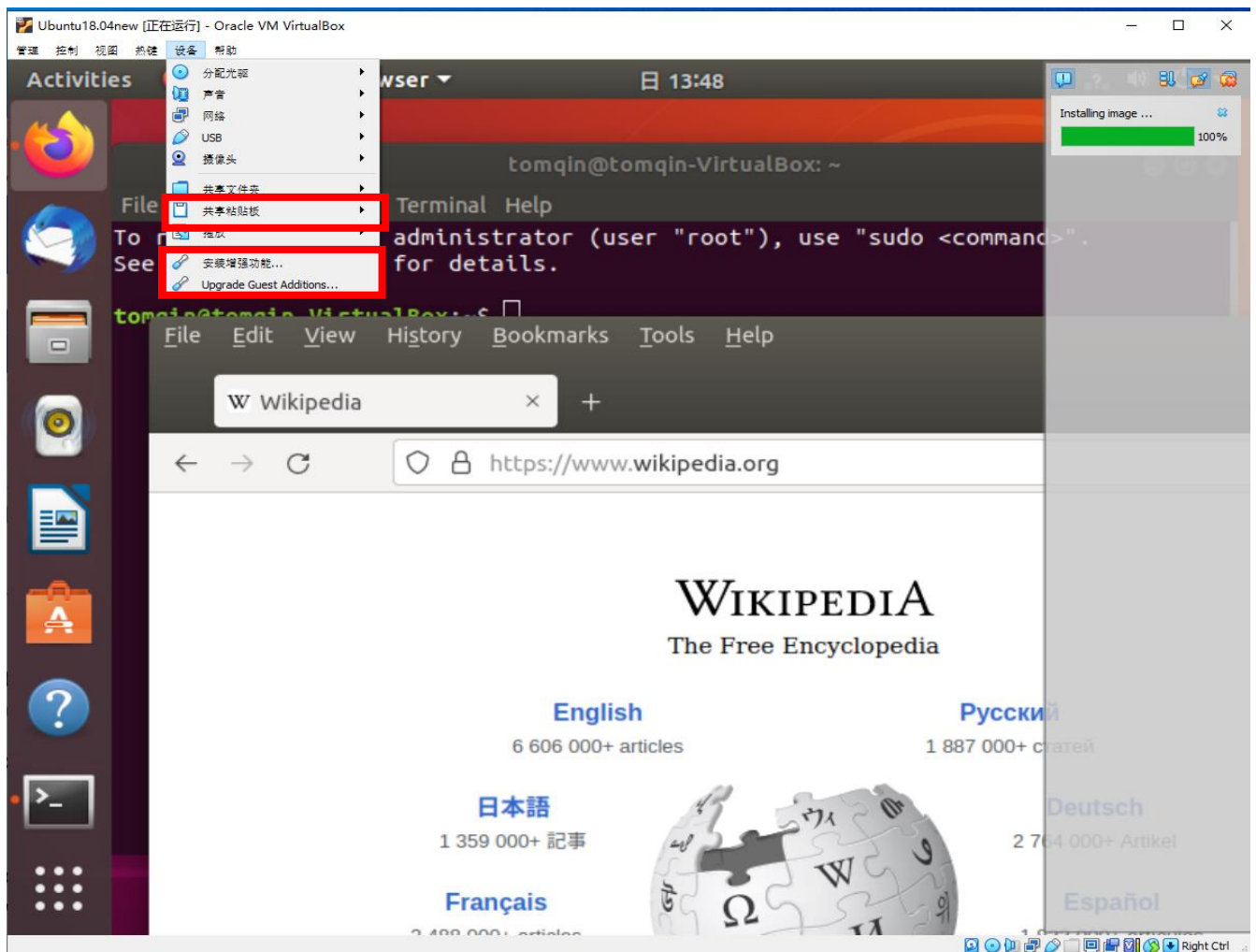


Figure 10

3. Install the gcc-3.4 and g++-3.4 compiler in the system

- 1) Download the compiler package on the PC

Download link:

https://drive.google.com/drive/folders/1C88TWhOxB5UVpD6b7ETvDTLHWj59qjN2?usp=share_link

- 2) Extract the files and open the terminals. Use 'cd' to arrive at the download place. We could see 5 files in the package. (Figure 11)

Then we input the following commands in the terminal step by step (Figure 12)

```
sudo dpkg --force-depends -i gcc-3.4-base_3.4.6-6ubuntu3_amd64.deb
```

```
sudo dpkg --force-depends -i gcc-3.4_3.4.6-6ubuntu3_amd64.deb
```



```
sudo dpkg --force-depends -i cpp-3.4_3.4.6-6ubuntu3_amd64.deb
```

```
sudo dpkg --force-depends -i g++-3.4_3.4.6-6ubuntu3_amd64.deb
```

```
sudo dpkg --force-depends -i libstdc++6-dev_3.4.6-6ubuntu3_amd64.deb
```

- 3) After entering these command, we would find a call says '**libstdc++6-dev: dependency problems**' (Figure 13). Then we could solve it by entering these commands:

```
sudo -i
```

```
apt --fix-broken install
```

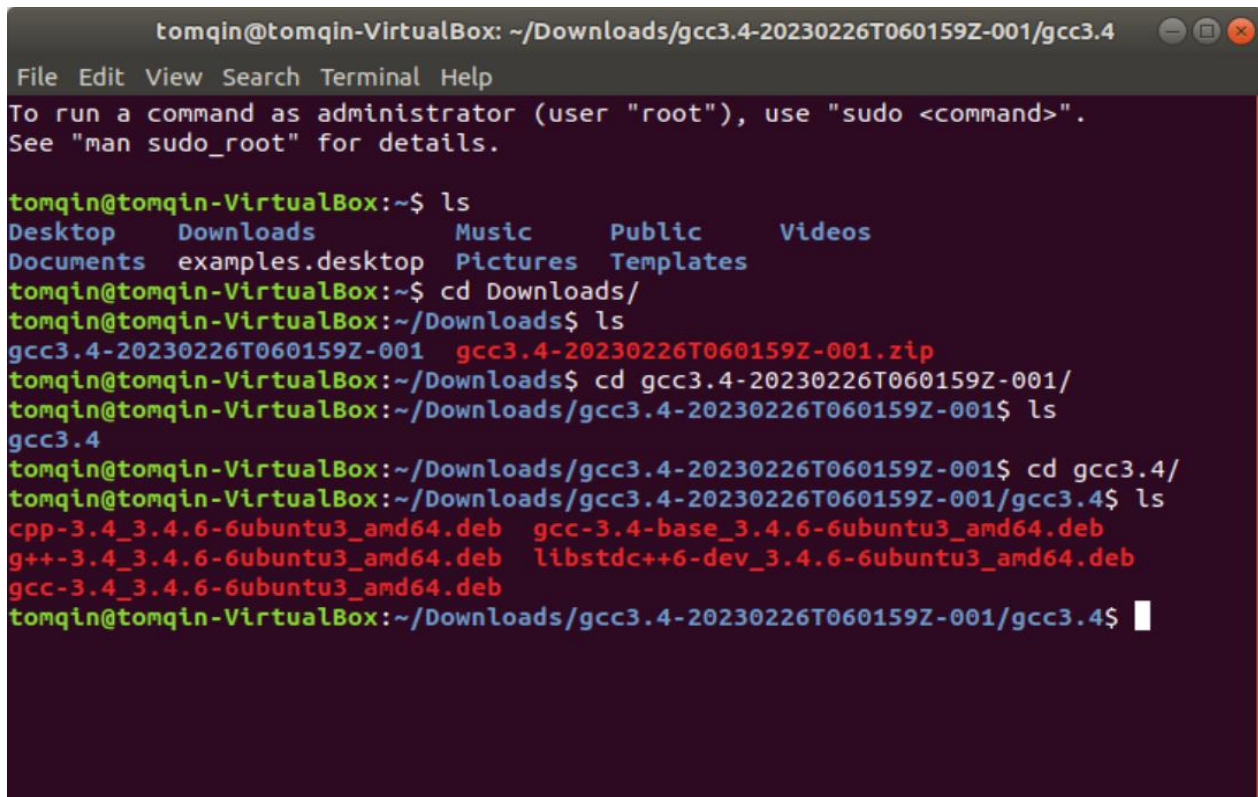
```
exit
```

- 4) We could use the following commands to check the installation status of gcc-3.4 and g++3.4 (Figure 14)

```
ls /usr/bin/gcc* -ll
```

```
ls /usr/bin/g++* -ll
```

If there is no gcc-3.4 and g++-3.4, then you should return to step 2) to install the corresponding package again.



```
tomqin@tomqin-VirtualBox: ~/Downloads/gcc3.4-20230226T060159Z-001/gcc3.4
File Edit View Search Terminal Help
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

tomqin@tomqin-VirtualBox:~$ ls
Desktop  Downloads  Music  Public  Videos
Documents  examples.desktop  Pictures  Templates
tomqin@tomqin-VirtualBox:~$ cd Downloads/
tomqin@tomqin-VirtualBox:~/Downloads$ ls
gcc3.4-20230226T060159Z-001  gcc3.4-20230226T060159Z-001.zip
tomqin@tomqin-VirtualBox:~/Downloads$ cd gcc3.4-20230226T060159Z-001/
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T060159Z-001$ ls
gcc3.4
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T060159Z-001$ cd gcc3.4/
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T060159Z-001/gcc3.4$ ls
cpp-3.4_3.4.6-6ubuntu3_amd64.deb  gcc-3.4-base_3.4.6-6ubuntu3_amd64.deb
g++-3.4_3.4.6-6ubuntu3_amd64.deb  libstdc++6-dev_3.4.6-6ubuntu3_amd64.deb
gcc-3.4_3.4.6-6ubuntu3_amd64.deb
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T060159Z-001/gcc3.4$
```

Figure 11


```
tomqin@tomqin-VirtualBox: ~/Downloads/gcc3.4-20230226T060159Z-001/gcc3.4
File Edit View Search Terminal Help
gcc-3.4_3.4.6-6ubuntu3_amd64.deb
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T060159Z-001/gcc3.4$
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T060159Z-001/gcc3.4$ sudo dp
kg --force-depends -i gcc-3.4-base_3.4.6-6ubuntu3_amd64.deb
[sudo] password for tomqin:
Selecting previously unselected package gcc-3.4-base.
(Reading database ... 127740 files and directories currently installed.)
Preparing to unpack gcc-3.4-base_3.4.6-6ubuntu3_amd64.deb ...
Unpacking gcc-3.4-base (3.4.6-6ubuntu3) ...
Setting up gcc-3.4-base (3.4.6-6ubuntu3) ...
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T060159Z-001/gcc3.4$
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T060159Z-001/gcc3.4$ sudo dp
kg --force-depends -i gcc-3.4_3.4.6-6ubuntu3_amd64.deb
Selecting previously unselected package gcc-3.4.
(Reading database ... 127747 files and directories currently installed.)
Preparing to unpack gcc-3.4_3.4.6-6ubuntu3_amd64.deb ...
Unpacking gcc-3.4 (3.4.6-6ubuntu3) ...
dpkg: gcc-3.4: dependency problems, but configuring anyway as you requested:
gcc-3.4 depends on cpp-3.4 (= 3.4.6-6ubuntu3); however:
  Package cpp-3.4 is not installed.

Setting up gcc-3.4 (3.4.6-6ubuntu3) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T060159Z-001/gcc3.4$
```

Figure 12

```
tomqin@tomqin-VirtualBox: ~/Downloads/gcc3.4-20230224T111445Z-001/gcc3.4
File Edit View Search Terminal Help
Package libc6-dev is not installed.

Setting up libstdc++6-dev (3.4.6-6ubuntu3) ...
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230224T111445Z-001/gcc3.4
$ sudo -i
root@tomqin-VirtualBox:~# apt --fix-broken install
Reading package lists... Done
Building dependency tree
Reading state information... Done
Correcting dependencies... Done
The following packages will be REMOVED:
  g++-3.4 libstdc++6-dev
0 upgraded, 0 newly installed, 2 to remove and 0 not upgraded.
After this operation, 13.0 MB disk space will be freed.
Do you want to continue? [Y/n] y
(Reading database ... 128071 files and directories currently installed.
)
Removing libstdc++6-dev (3.4.6-6ubuntu3) ...
Removing g++-3.4 (3.4.6-6ubuntu3) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
root@tomqin-VirtualBox:~# exit
logout
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230224T111445Z-001/gcc3.4
$
```

Figure 13

```
tomqin@tomqin-VirtualBox: ~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4
File Edit View Search Terminal Help
Preparing to unpack .../libc6-dev_2.27-3ubuntu1.6_amd64.deb ...
Unpacking libc6-dev:amd64 (2.27-3ubuntu1.6) ...
Selecting previously unselected package manpages-dev.
Preparing to unpack .../manpages-dev_4.15-1_all.deb ...
Unpacking manpages-dev (4.15-1) ...
Setting up libc6-dbg:amd64 (2.27-3ubuntu1.6) ...
Setting up linux-libc-dev:amd64 (4.15.0-204.215) ...
Setting up libc-dev-bin (2.27-3ubuntu1.6) ...
Setting up manpages-dev (4.15-1) ...
Setting up libc6-dev:amd64 (2.27-3ubuntu1.6) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
Processing triggers for libc-bin (2.27-3ubuntu1.4) ...
root@tomqin-VirtualBox:~# exit
logout
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$ ls /usr
/bin/gcc* -ll
-rwxr-xr-x 1 root root 94160 Jan  4  2008 /usr/bin/gcc-3.4
-rwxr-xr-x 1 root root 16077 Jan  4  2008 /usr/bin/gccbug-3.4
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$ ls /usr
/bin/g++* -ll
-rwxr-xr-x 1 root root 95920 Jan  4  2008 /usr/bin/g++-3.4
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$
```

Figure 14

4. Install Bochs and Switch compiler version

1) Install some dependent packages firstly using the following commands (Figure 15):

```
sudo apt-get install bin86
```

```
sudo apt-get install gcc-multilib
```

```
sudo apt-get install build-essential
```

2) Install the Bochs (Figure 16)

```
sudo apt-get install bochs bochs-x bochs-sdl
```

3) Set the priority of different version of gcc and g++ using the command belows (Figure 17):

```
sudo update-alternatives --install /usr/bin/gcc gcc /usr/bin/gcc-3.4 30
```

```
sudo update-alternatives --install /usr/bin/gcc gcc /usr/bin/gcc-7 70
```

```
sudo update-alternatives --install /usr/bin/g++ g++ /usr/bin/g++-3.4 30
```

sudo update-alternatives --install /usr/bin/g++ g++ /usr/bin/g++-7 70

4) Switch the gcc and g++ version (Figure 18) Firstly, input this command,

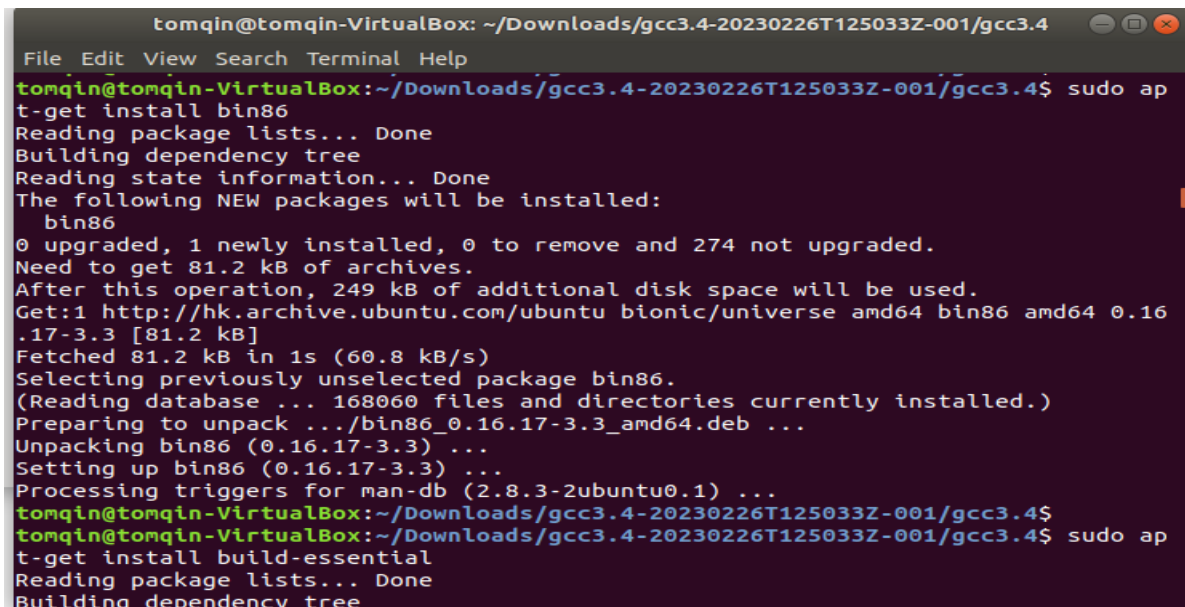
sudo update-alternatives --config gcc

and then type the selection number 1.

The same is for the g++, input this command,

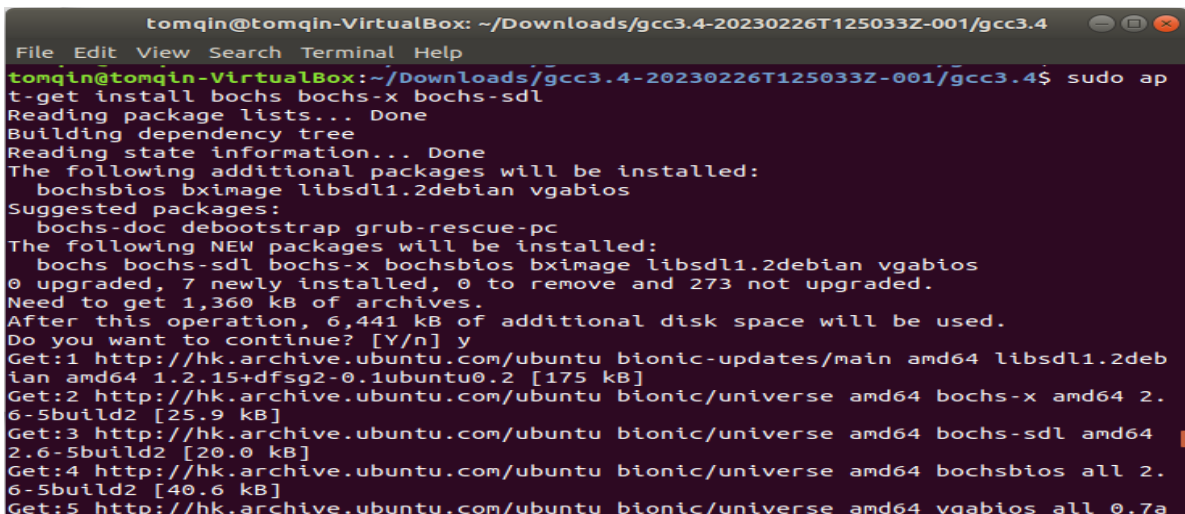
sudo update-alternatives --config g++

and then type the selection number 1.



```
tomqin@tomqin-VirtualBox: ~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4
File Edit View Search Terminal Help
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$ sudo ap
t-get install bin86
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following NEW packages will be installed:
  bin86
0 upgraded, 1 newly installed, 0 to remove and 274 not upgraded.
Need to get 81.2 kB of archives.
After this operation, 249 kB of additional disk space will be used.
Get:1 http://hk.archive.ubuntu.com/ubuntu bionic/universe amd64 bin86 amd64 0.16
.17-3.3 [81.2 kB]
Fetched 81.2 kB in 1s (60.8 kB/s)
Selecting previously unselected package bin86.
(Reading database ... 168060 files and directories currently installed.)
Preparing to unpack .../bin86_0.16.17-3.3_amd64.deb ...
Unpacking bin86 (0.16.17-3.3) ...
Setting up bin86 (0.16.17-3.3) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$ sudo ap
t-get install build-essential
Reading package lists... Done
Building dependency tree
```

Figure 15



```
tomqin@tomqin-VirtualBox: ~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4
File Edit View Search Terminal Help
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$ sudo ap
t-get install bochs bochs-x bochs-sdl
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  bochsbios bximage libsd1.2debian vgabios
Suggested packages:
  bochs-doc debootstrap grub-rescue-pc
The following NEW packages will be installed:
  bochs bochs-sdl bochs-x bochsbios bximage libsd1.2debian vgabios
0 upgraded, 7 newly installed, 0 to remove and 273 not upgraded.
Need to get 1,360 kB of archives.
After this operation, 6,441 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://hk.archive.ubuntu.com/ubuntu bionic-updates/main amd64 libsd1.2deb
ian amd64 1.2.15+dfsg2-0.1ubuntu0.2 [175 kB]
Get:2 http://hk.archive.ubuntu.com/ubuntu bionic/universe amd64 bochs-x amd64 2.
6-5build2 [25.9 kB]
Get:3 http://hk.archive.ubuntu.com/ubuntu bionic/universe amd64 bochs-sdl amd64
2.6-5build2 [20.0 kB]
Get:4 http://hk.archive.ubuntu.com/ubuntu bionic/universe amd64 bochsbios all 2.
6-5build2 [40.6 kB]
Get:5 http://hk.archive.ubuntu.com/ubuntu bionic/universe amd64 vgabios all 0.7a
```

Figure 16


```
tomqin@tomqin-VirtualBox: ~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4
File Edit View Search Terminal Help
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$ sudo update-alternatives --install /usr/bin/gcc gcc /usr/bin/gcc-3.4 30
update-alternatives: using /usr/bin/gcc-3.4 to provide /usr/bin/gcc (gcc) in auto mode
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$ sudo update-alternatives --install /usr/bin/gcc gcc /usr/bin/gcc-7 70
update-alternatives: using /usr/bin/gcc-7 to provide /usr/bin/gcc (gcc) in auto mode
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$ sudo update-alternatives --install /usr/bin/g++ g++ /usr/bin/g++-3.4 30
update-alternatives: using /usr/bin/g++-3.4 to provide /usr/bin/g++ (g++) in auto mode
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$ sudo update-alternatives --install /usr/bin/g++ g++ /usr/bin/g++-7 70
update-alternatives: using /usr/bin/g++-7 to provide /usr/bin/g++ (g++) in auto mode
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$ sudo update-alternatives --config gcc
There are 2 choices for the alternative gcc (providing /usr/bin/gcc).

  Selection    Path                                Priority  Status
-----
0             /usr/bin/gcc-7                      70       auto mode
* 1            /usr/bin/gcc-3.4                    30       manual mode
2             /usr/bin/gcc-7                      70       manual mode
```

Figure 17

```
tomqin@tomqin-VirtualBox: ~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4
File Edit View Search Terminal Help
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$ sudo update-alternatives --config gcc
There are 2 choices for the alternative gcc (providing /usr/bin/gcc).

  Selection    Path                                Priority  Status
-----
0             /usr/bin/gcc-7                      70       auto mode
* 1            /usr/bin/gcc-3.4                    30       manual mode
2             /usr/bin/gcc-7                      70       manual mode

Press <enter> to keep the current choice[*], or type selection number: 1
tomqin@tomqin-VirtualBox:~/Downloads/gcc3.4-20230226T125033Z-001/gcc3.4$ sudo update-alternatives --config g++
There are 2 choices for the alternative g++ (providing /usr/bin/g++).

  Selection    Path                                Priority  Status
-----
* 0            /usr/bin/g++-7                      70       auto mode
1             /usr/bin/g++-3.4                    30       manual mode
2             /usr/bin/g++-7                      70       manual mode

Press <enter> to keep the current choice[*], or type selection number: 1
```

Figure 18

5. Download oslab source code and run it

- 1) Download oslab source code from this link:

https://drive.google.com/file/d/16jBb8X5MgZCp0VbAY3bA8PV_BkgbVpb2/view?usp=share_link

- 2) Then we use 'cd' to the oslab directory, and input the command:

```
./dbg-asm
```

A report from the terminal says that **'./bochs/bochs-dbg: error while loading shared libraries: libSM.so.6: cannot open shared object file: No such file or directory'**. That means we should install some package. Then we use these commands to install the needed packages (Figure 19):

```
sudo apt-get install libsm6:i386
```

```
sudo apt-get install libx11-6:i386
```

```
sudo apt-get install libxpm4:i386
```

- 3) We input the command ./dbg-asm again. Then the bochs x86 Emulator starts. In the bochs x86 Emulator,

Ctrl+c means pausing the program and it would show what it executes before pausing.

c means continuing running the program

Then we input 'c' here, then we would see the initialize page in the shell. Then we input 'ls', we could see that the example in the tutorial is 'test.c' file. And the homework problem 1 is the 'homework.c' file.

Then we use the following command to compile the 'test.c' file:

```
gcc -o test test.c
```

Then use './test' to run the executable file, we could see that the program starts running.

You could see the Figure 20 to have a better understanding of this step 3).

```
tomqin@tomqin-VirtualBox: ~/Downloads/oslab
File Edit View Search Terminal Help

tomqin@tomqin-VirtualBox:~/Downloads$ cd oslab
tomqin@tomqin-VirtualBox:~/Downloads/oslab$ ./dbg-asm
./bochs/bochs-dbg: error while loading shared libraries: libSM.so.6: cannot open
shared object file: No such file or directory
tomqin@tomqin-VirtualBox:~/Downloads/oslab$ dpkg-query -W -f='${Package} ${Version} ${Architecture} ${Source} ${Version} ${Architecture}\n' libSM.so.6
libsm6:amd64: /usr/lib/x86_64-linux-gnu/libSM.so.6
libsm6:amd64: /usr/lib/x86_64-linux-gnu/libSM.so.6.0.1
tomqin@tomqin-VirtualBox:~/Downloads/oslab$ sudo apt-get install libsm6:i386
[sudo] password for tomqin:
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  gcc-8-base:i386 libbsd0:i386 libc6:i386 libgcc1:i386 libice6 libice6:i386
  libuuid1:i386
Suggested packages:
  glibc-doc:i386 locales:i386
The following NEW packages will be installed:
  gcc-8-base:i386 libbsd0:i386 libc6:i386 libgcc1:i386 libice6:i386
  libsm6:i386 libuuid1:i386
The following packages will be upgraded:
  libice6
1 upgraded, 7 newly installed, 0 to remove and 272 not upgraded.
```

Figure 19

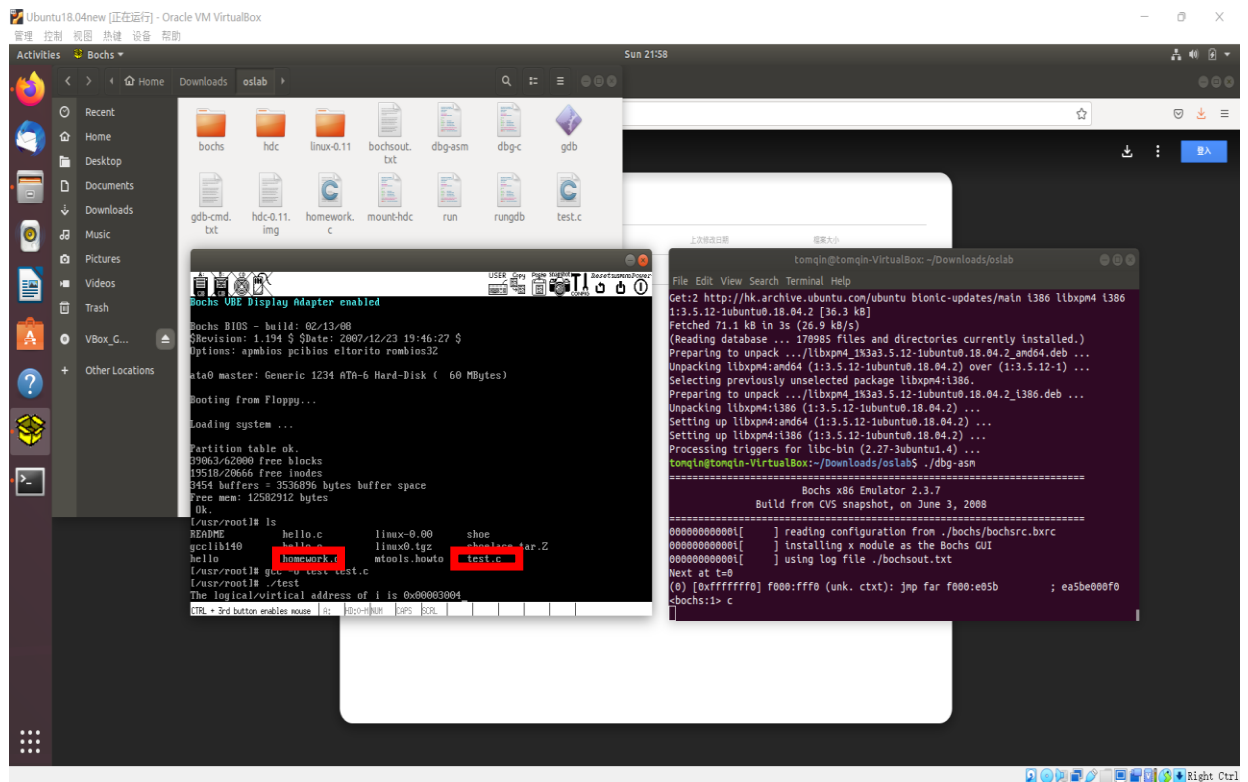


Figure 20

