

生態模擬: 以C語言為例

2018/03/01

How to set the environments:

- For Mac OSX
- For Windows 10
- For Windows 7 & 8

Takeshi Miki

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課程名稱	課程目標	先修科目 與 課程涵蓋內容	評分標準	授課教師	難易度
理論生態學導論	1. 學習族群與群聚生態學中的基本概念與理論 2. 學習應用於生態模式的數學技巧	<ul style="list-style-type: none"> 僅須具備微基分的基礎概念(高中程度即可) 本課程所涵蓋的數學內容：2×2 及 3×3 的矩陣運算與特徵值計算、偏微分計算、微分方程（學生不須先修） 	作業、 期中考與期末考	三木健	普通 (作業量較多)
理論演化生態學導論	學習演化生態學與族群遺傳學中的基本概念與理論	<ul style="list-style-type: none"> 生態學(或經濟學)的基本知識 本課程所涵蓋的數學內容：2×2 及 3×3 的矩陣運算與特徵值計算(學生不須先修) 	期中考與期末考	三木健 陳韋仁	普通
生態模擬: 以C語言為例	學習生態模擬所須的linux指令及C語言語法（學生不需具備linux與程式設計基礎）	<ul style="list-style-type: none"> 僅須具備一些生物學與生態學的基本知識 	作業	三木健	易
生態模式： 理論與實作/ 生命科學模式： 理論與實作	學習如何建立新的模式(學生不需具備數學與程式語言的基礎)	<ul style="list-style-type: none"> 須具備生物學與生態學的基本知識 歡迎來自生命科學之任何領域的學生以及已有研究題目的學生 	作業	三木健	易
生態模擬專題討論	學習科學報告的技巧並參與學術研究議題的討論	<ul style="list-style-type: none"> 須具備生態學的基本知識 須先修過與理論生態學相關的課程 	口頭報告	三木健 謝志豪 王慧瑜	難

First of all,

- With your own notebook **for memo** & PC/Mac
- Just confirm this course starts from 10:20
- I will evaluate scores only based on assignments (12-14 items). No exams.
 - If you complete all → A+
 - If you miss 1-2 item → A or A-
- **Note: For each assignment, it should be completed within 2 weeks; otherwise you cannot keep up with the following lectures.**
- **If you (will) have C language programming skills only, you cannot complete some of assignments; your grade will end up with B at best.**

How to set the environments:

- For Mac OSX
- For Windows 10
- For Windows 7 & 8

Environmental settings (Mac OSX)

The requirements:

- **Terminal** → pre-installed

Or you may prefer Xquartz: <https://www.xquartz.org/>

- **gcc (GNU C compiler) → via X code**

“Xcode Developer Tools” (for OSX 10.6) or “Command Line Tools for X code” (for > OSX 10.7).

These can be downloaded with you Apple ID from

<https://developer.apple.com/download/>

Also check:

<https://stackoverflow.com/questions/9353444/how-to-use-install-gcc-on-mac-os-x-10-8-xcode-4-4>

- **R**

<https://ftp.yzu.edu.tw/CRAN/>

- **R studio desktop (Open Source License)**

<https://www.rstudio.com/products/rstudio/download/>

How to set the environments:

- For Mac OSX
- **For Windows 10**
- For Windows 7 & 8

Check first the updated version of your Windows 10.

Open Settings-> System>About:

Version 1703→Creators Update

Version 1607→Anniversary Update (old)

Environmental settings (Windows 10, Fall Creators Update)

The requirements:

1) Enables “Windows Subsystem for Linux (WSL)”

Start → “Windows PowerShell” → Right Click for “execute as administrator”.

And run:

```
>Enable-WindowsOptionalFeature –Online –FeatureName  
Microsoft-Windows-Subsystem-Linux
```

Then, restart your computer when prompted.

Reference

<https://docs.microsoft.com/en-us/windows/wsl/install-win10>

Environmental settings (Windows 10, Fall Creators Update)

The requirements:

2) Open the Microsoft Store and search for “Ubuntu”
and then install it by clicking “Get”.

3) One the download has completed, select “Launch”.

This will open a console window. Wait for installation to complete then you will be prompted to create your LINUX user account and password.

e.g., tmiki, *****

Environmental settings (Windows 10, Fall Creators Update)

The requirements:

4) Change home directory.

First, install an editor “emacs” via terminal (console windows)

```
>sudo apt-get install emacs
```

Then, open the setting file:

```
>sudo emacs /etc/passwd
```

Edit the following line:

```
tmiki :x:1000:1000:”””,,:/home/tmiki :/bin/bash
```

into:

```
tmiki:x:1000:1000:”””...:/mnt/C:\Users\tksmiki:/bin/bash
```

The requirements:

5) Install gcc (GNU C compiler) via terminal:

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

Or

```
>sudo apt-get install gcc
```

6) Install R and Rstudio

- R

<https://ftp.yzu.edu.tw/CRAN/>

- R studio desktop (Open Source License)

<https://www.rstudio.com/products/rstudio/download/>

Environmental settings (Windows 10, older updates)

The requirements:

1) Enables “Windows Subsystem for Linux (WSL)”

Start → “Windows PowerShell” → Right Click for “execute as administrator”.

And run:

```
>Enable-WindowsOptionalFeature –Online –FeatureName  
Microsoft-Windows-Subsystem-Linux
```

Then, restart your computer when prompted.

Reference

<https://docs.microsoft.com/en-us/windows/wsl/install-win10>

Environmental settings (Windows 10, older)

The requirements:

2) Open Setting → Update and Security → For developers

Select the Developer Mode radio button

3) Open a command prompt, for installing ubuntu

Run:

>bash

...

Type “y” to continue:

The requirements:

4) → Installation successful!

then you will be prompted to create your LINUX user account and password.

e.g., tmiki, *****

Environmental settings (Windows 10, older)

The requirements:

5) Change home directory.

First, install an editor “emacs” via terminal (console windows)

```
>sudo apt-get install emacs
```

Then, open the setting file:

```
>sudo emacs /etc/passwd
```

Edit the following line:

```
tmiki :x:1000:1000:”””,,:/home/tmiki :/bin/bash
```

into:

```
tmiki:x:1000:1000:”””...:/mnt/C:\Users\tksmiki:/bin/bash
```

The requirements:

6) Install gcc (GNU C compiler) via terminal:

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

Or

```
>sudo apt-get install gcc
```

7) Install R and Rstudio

- R

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- R studio desktop (Open Source License)

<https://www.rstudio.com/products/rstudio/download/>

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- **For Windows 7 & 8**

Recommended Specs for your PC

For Windows 7 & 8:


I would recommend you to prepare a linux system (**Ubuntu 16.04 LTS** (or 14.04 LTS) **for desktop**) without modifying your current OS system (Win 7,8, or 10). For this purpose, we use virtual system “**Oracle VM VirtualBox**”, which can install any OS as a **guest OS** to your current OS (= **host OS**).

In order to use ubuntu16/14 as a guest OS on VirtualBox, recommended specs are:

Memory: 1GB for allocating to the guest OS (minimum would be 512 MB, **2GB is recommended**) *you need to leave 2GB for the host OS.
Empty Hard Disk: > 8 GB

Download VirtualBox (1 of 2)

You need to download VirtualBox from:
<http://www.oracle.com/technetwork/server-storage/virtualbox/overview/index.html>




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Oracle Technology Network > Server and Storage Systems > Oracle VM VirtualBox > Overview

All-Flash Storage
Corente Cloud Services Exchange
Developer Studio
Engineered Systems
Ksplice
NAS Storage
Netra Systems
Networking and Data Center Fabric Products
OpenStack
Oracle Linux
Oracle Optimized Solutions
Oracle VM
Oracle VM VirtualBox
Oracle x86 Servers
Private Cloud Appliance
SAN Storage
Secure Global Desktop
Server Management Tools
Software in Silicon
Software in Silicon Cloud
Solaris 10
Solaris 11
Solaris Cluster
SPARC Servers

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Oracle VM VirtualBox

VirtualBox is powerful *Cross-platform Virtualization Software* for x86-based systems.
"Cross-platform" means that it installs on Windows, Linux, Mac OS X and Solaris x86 computers. And "Virtualization Software" means that you can create and run multiple Virtual Machines, running different operating systems, on the same computer at the same time. For example, you can run Windows and Linux on your Mac, run Linux and Solaris on your Windows PC, or run Windows on you Linux systems.

Oracle VM VirtualBox is available as Open Source or pre-built Binaries for Windows, Linux, Mac OS X and Solaris.

What's New

- Oracle VM VirtualBox 5.1.6 was released 12th September, 2016.
- Oracle VM VirtualBox 5.1.4 was released 16th August, 2016.
- Oracle VM VirtualBox 5.1.2 was released 21st July, 2016.
- Oracle VM VirtualBox 5.1 was released 12th July, 2016.
- Oracle VM VirtualBox 5.0.24 was released 28th June, 2016.
- Oracle VM VirtualBox 5.0.22 was released 16th June, 2016.
- Oracle VM VirtualBox 5.0.20 was released 28th April, 2016.
- Oracle VM VirtualBox 5.0.18 was released 18th April, 2016.
- Oracle VM VirtualBox 5.0.16 was released 4th March, 2016.
- Oracle VM VirtualBox 5.0.14 was released 19th January, 2016.
- Oracle VM VirtualBox 5.0.12 was released 18th December, 2015.
- Oracle VM VirtualBox 5.0.10 was released 10th November, 2015.

Download necessary programs to your PC (or Mac)



**You need to download Ubuntu Desktop from:
<http://www.ubuntu.com/download/desktop>**

Download Ubuntu Desktop

Ubuntu 16.04.1 LTS

Download the latest version of Ubuntu, for desktop PCs and laptops. LTS stands for long-term support – which means five years of free security and maintenance updates, guaranteed.

[Ubuntu 16.04 LTS release notes](#)

Recommended system requirements:

- ✓ 2 GHz dual core processor or better
- ✓ 2 GB system memory
- ✓ 25 GB of free hard drive space
- ✓ Either a DVD drive or a USB port for the installer media
- ✓ Internet access is helpful

Download

[Alternative downloads and torrents >](#)

Easy ways to switch to Ubuntu



From an older
version



From Windows




From Mac OS X

We use cookies to improve your experience. By your continued use of this site you accept such use. To change your settings please [see our policy](#).

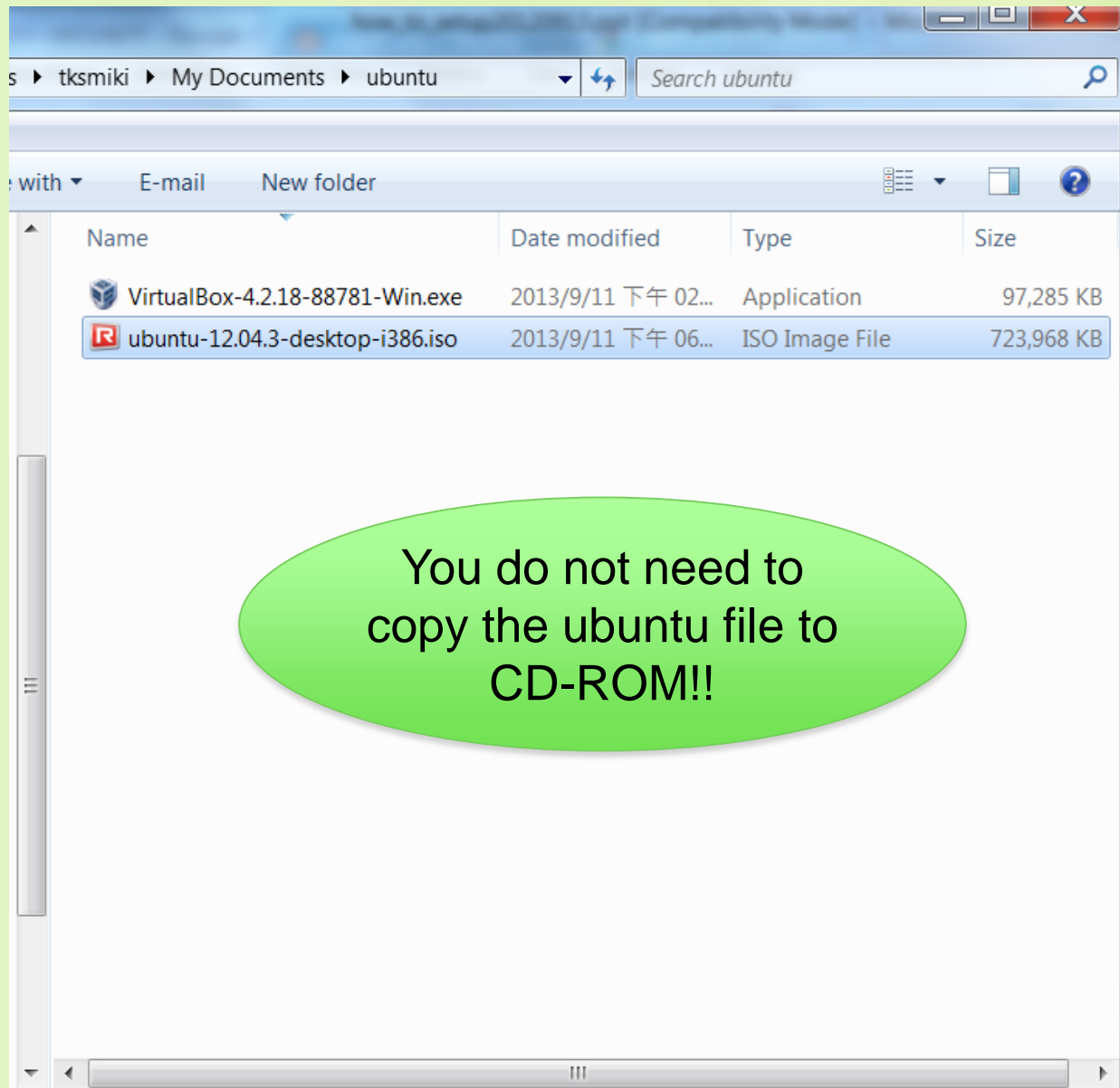


Download necessary programs to your PC (or Mac)

-  In case your PC's spec is low, download “32-bit PC (i386) desktop image” of 14.04.02 LTS.

<http://old-releases.ubuntu.com/releases/14.04.0/>

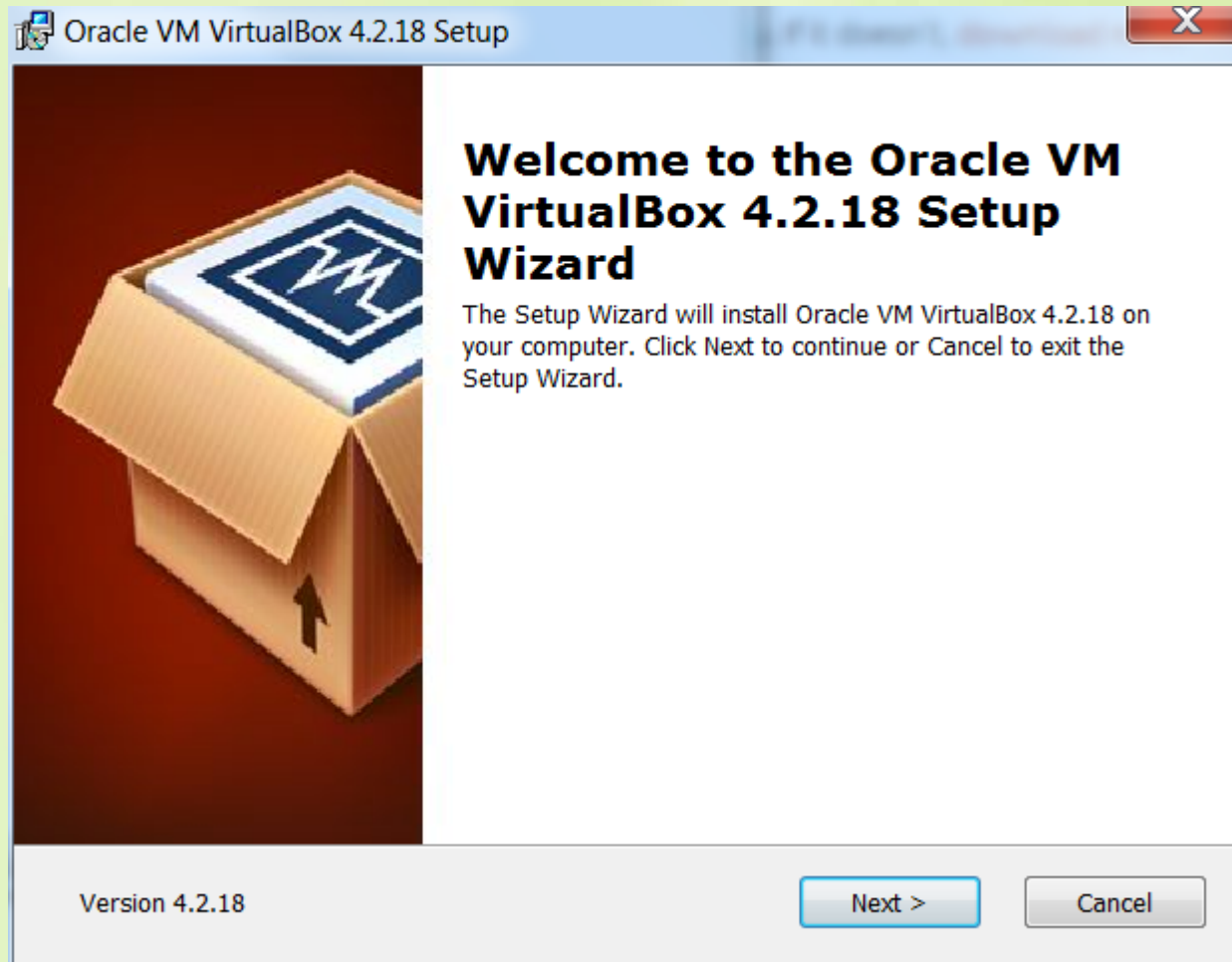
Now you have two programs in your PC/Mac




VirtualBox
Ubuntu14.02

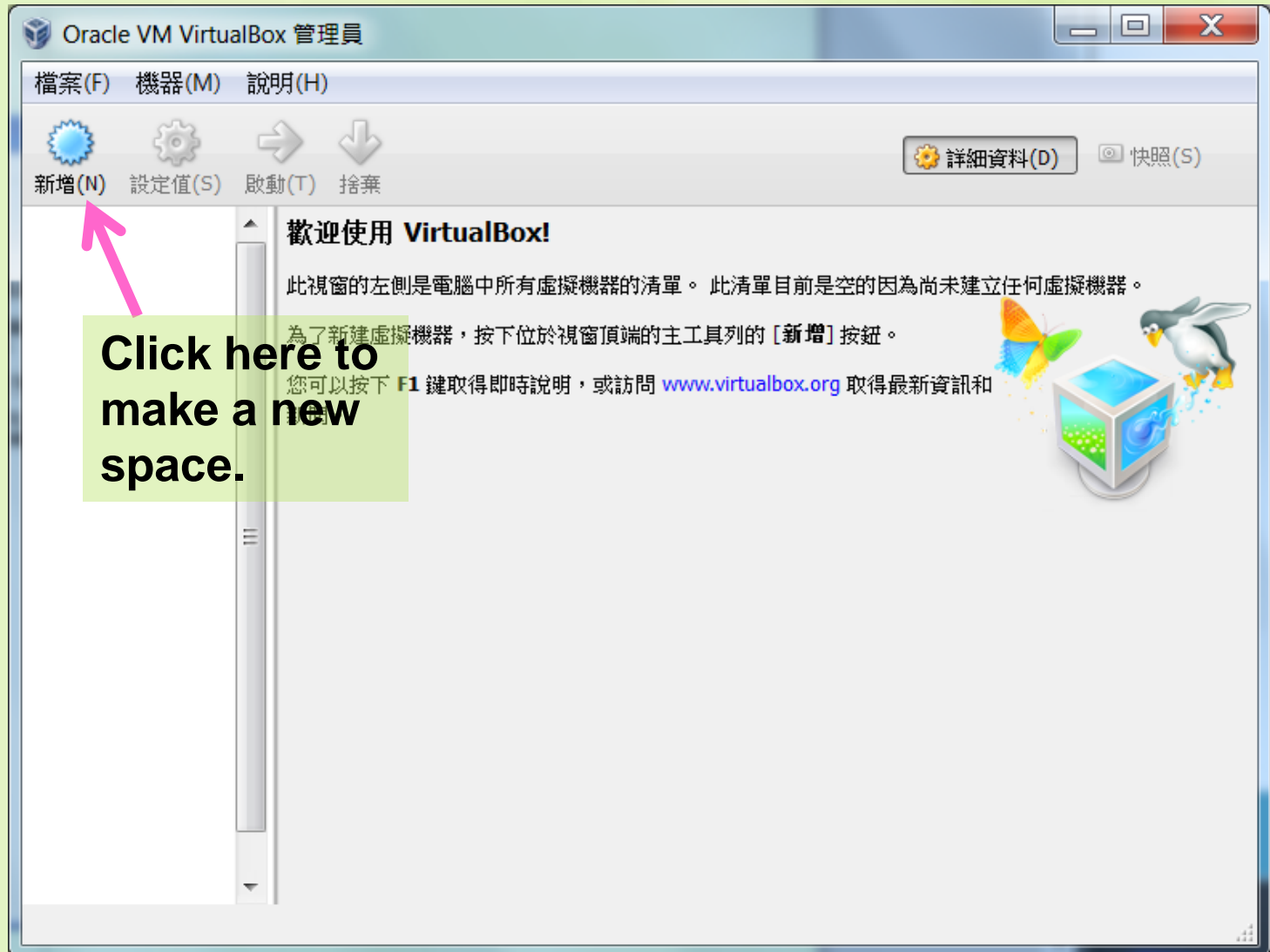
First, you need to install VirtualBox

- Just Double click “VirtualBox....exe” and follow the guidance messages of the installer.



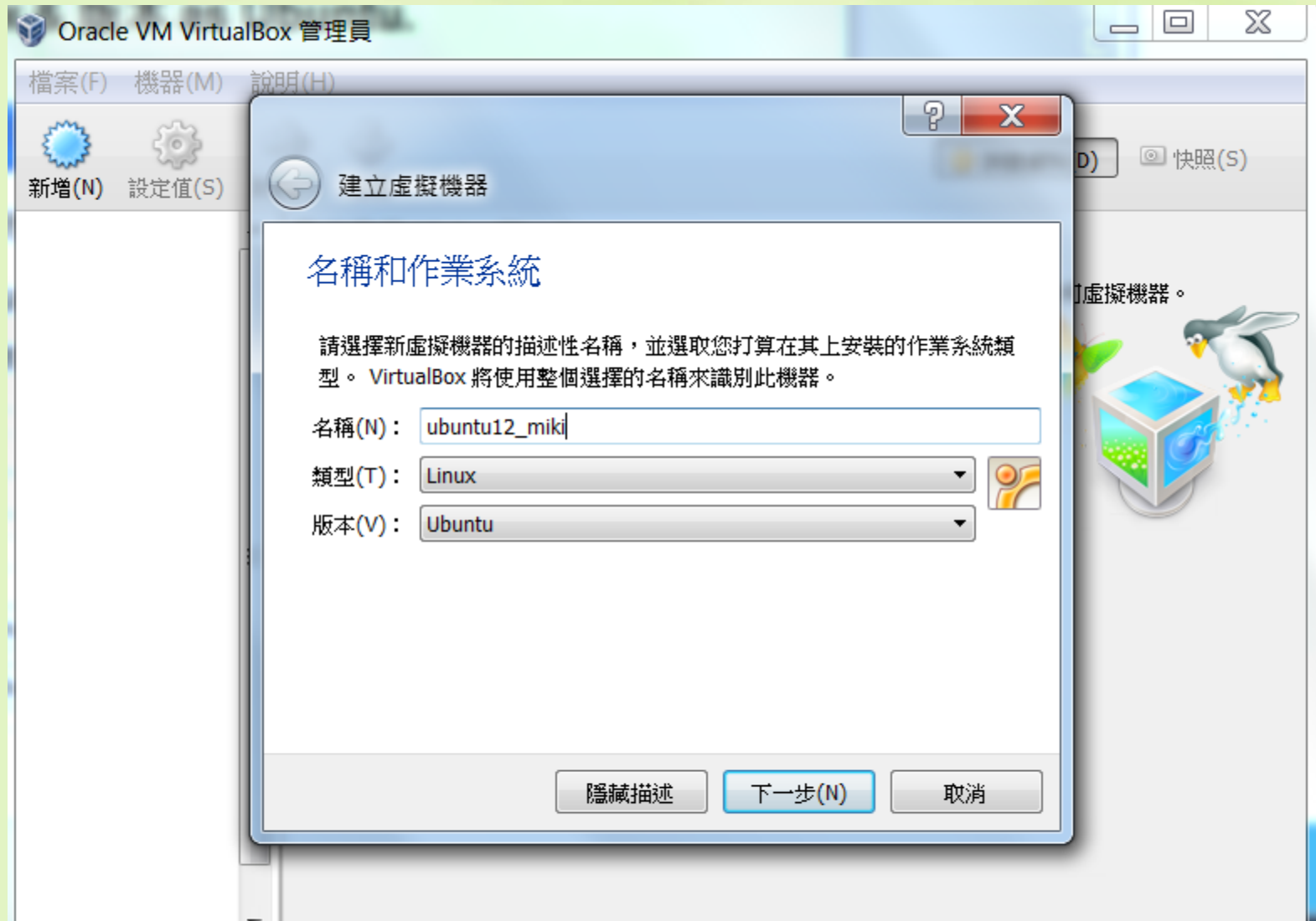
Then, run virtualbox to setup for a guest OS (1 of 9)

 Before installing a guest OS, you need to prepare “virtual space”



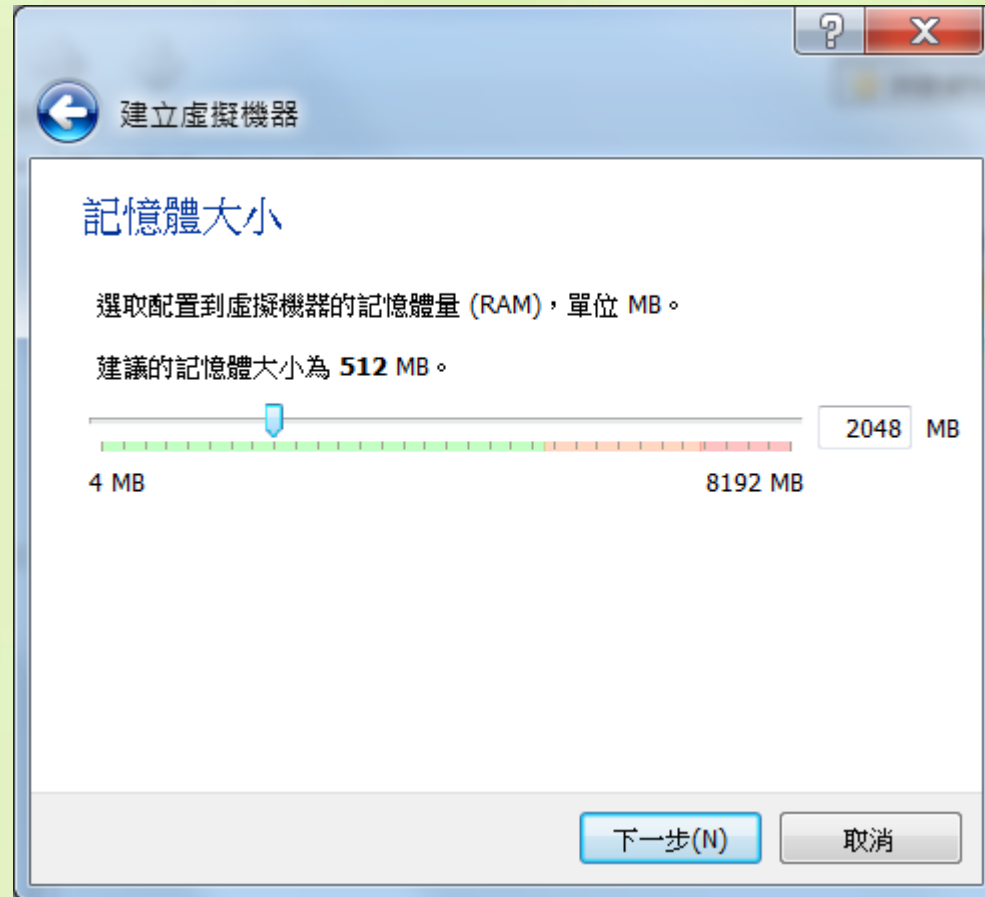
Then, run virtualbox to setup for a guest OS (2 of 9)

- You can give any name (e.g. ubuntu10_miki) and need to choose 作業系統 as Linux & 版本 as Ubuntu.




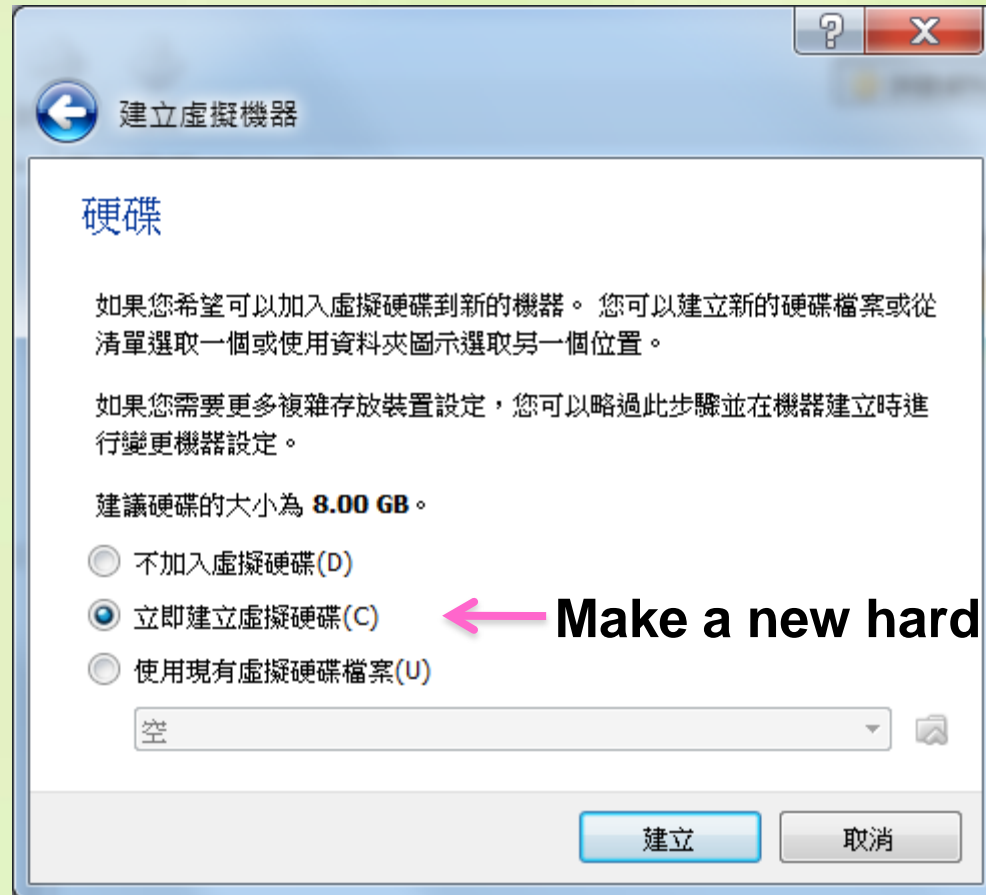
Then, run virtualbox to setup for a guest OS (3 of 9)

- You need to decide how much memory is allocated to a guest OS. At least 1GB would be recommended.




Then, run virtualbox to setup for a guest OS (4 of 9)

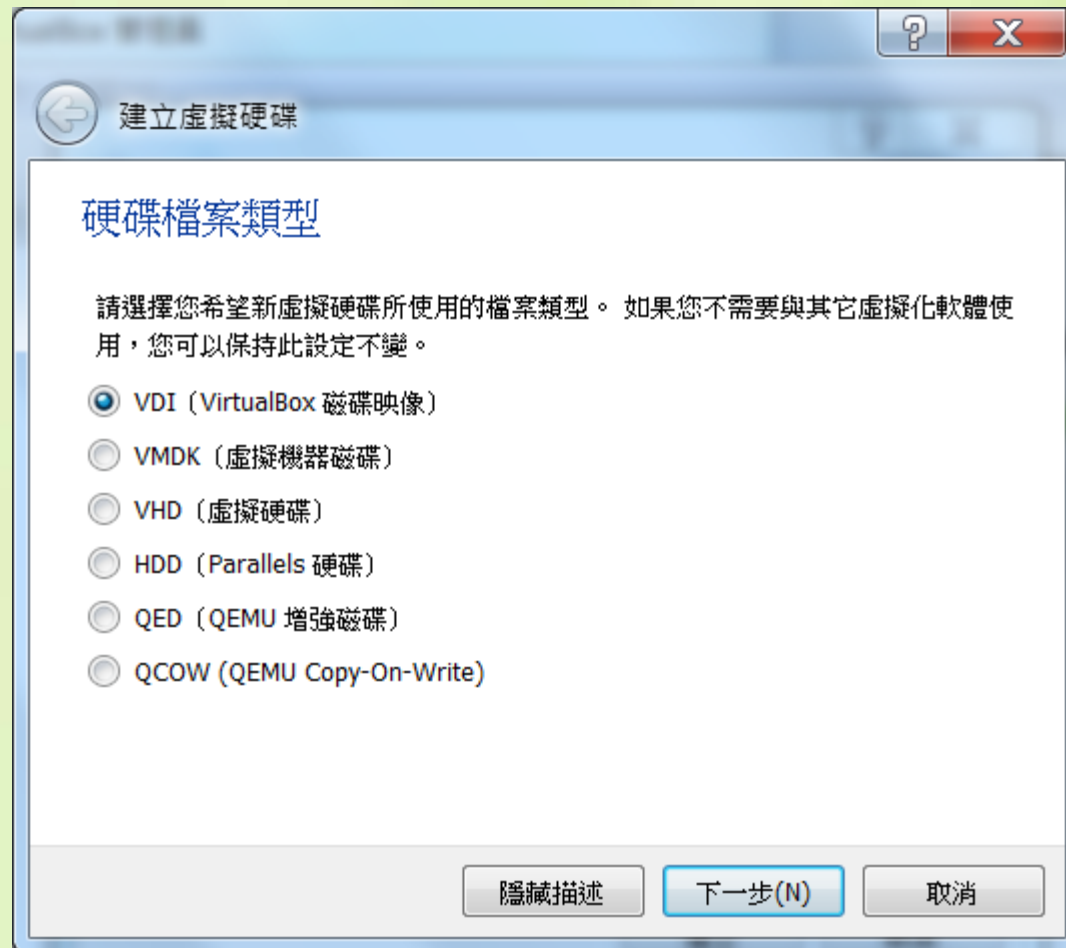
 You need to prepare a virtual hard disk.




← Make a new hard disk

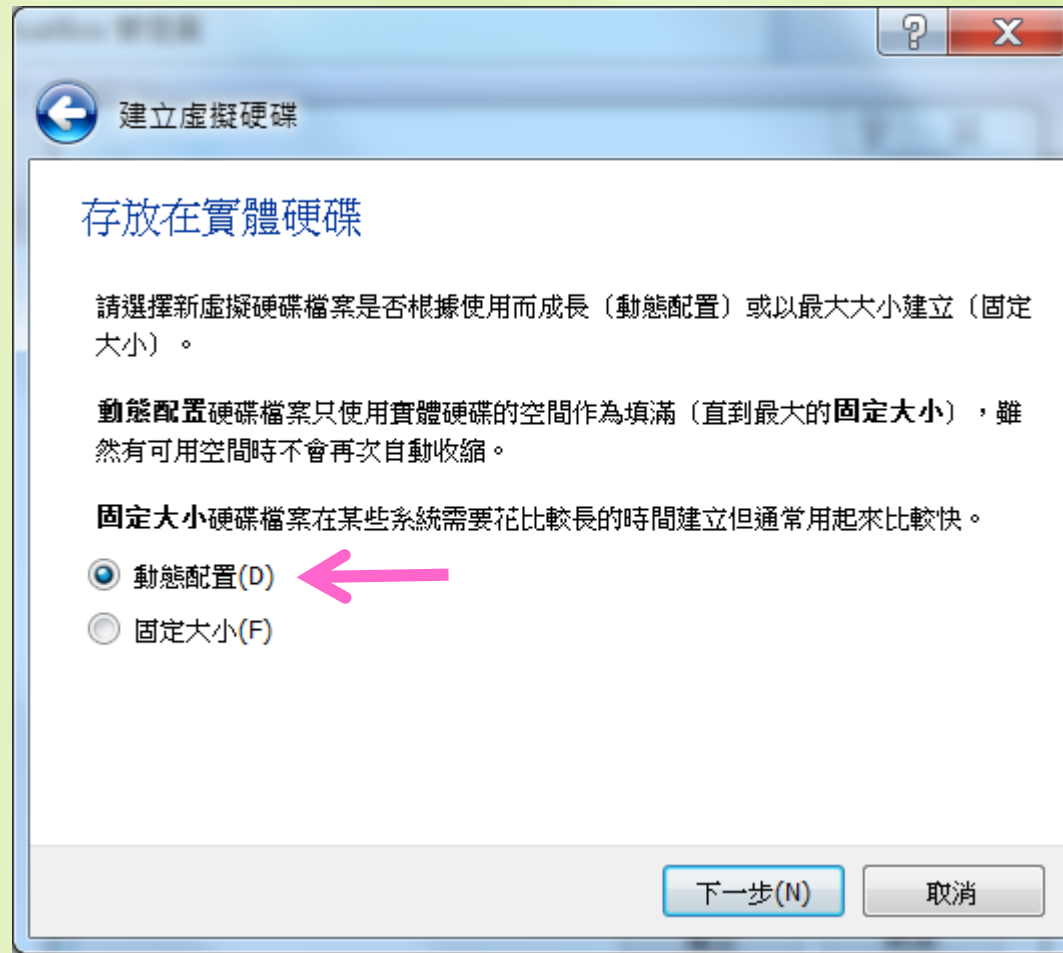
Then, run virtualbox to setup for a guest OS (5 of 9)

 You need to prepare a virtual hard disk.



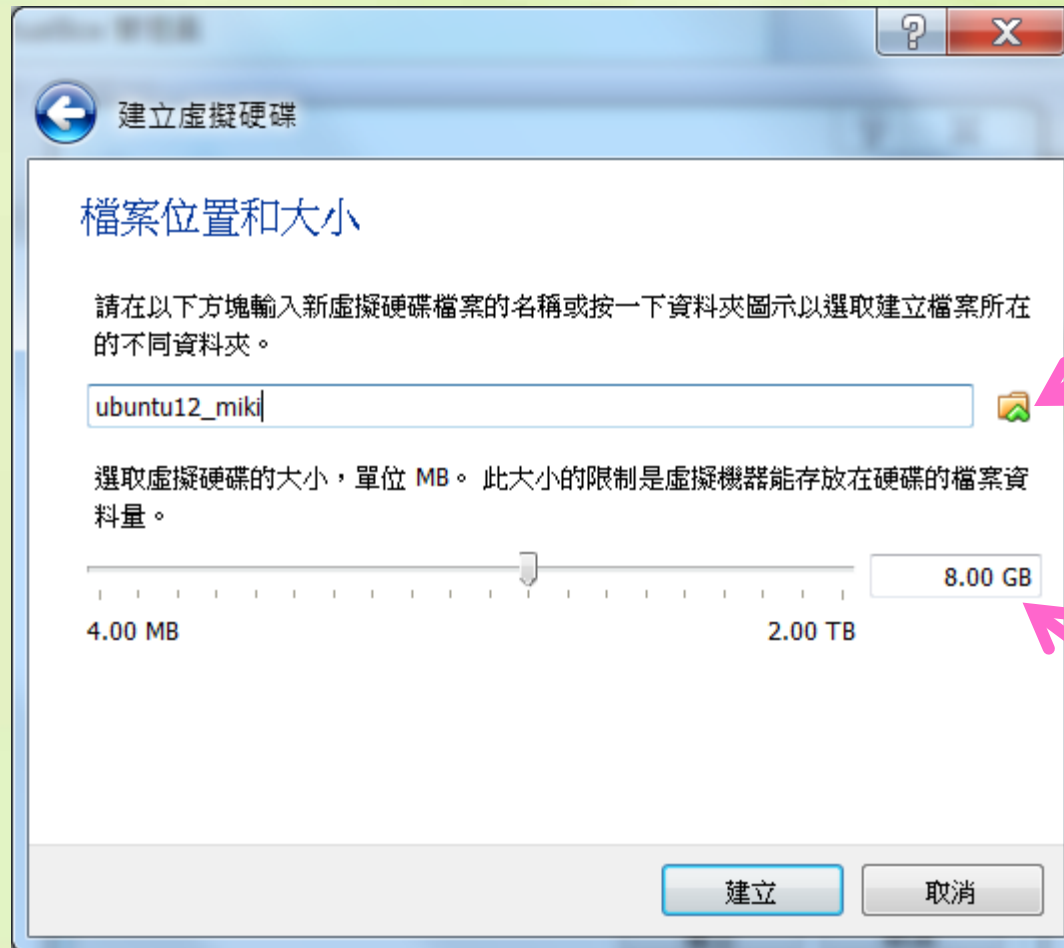
Then, run virtualbox to setup for a guest OS (6 of 9)

 You can choose a virtual hard disk with flexible size (動態. . .).



Then, run virtualbox to setup for a guest OS (8 of 9)

■ For ubuntu, minimum hard disk size is 3GB.

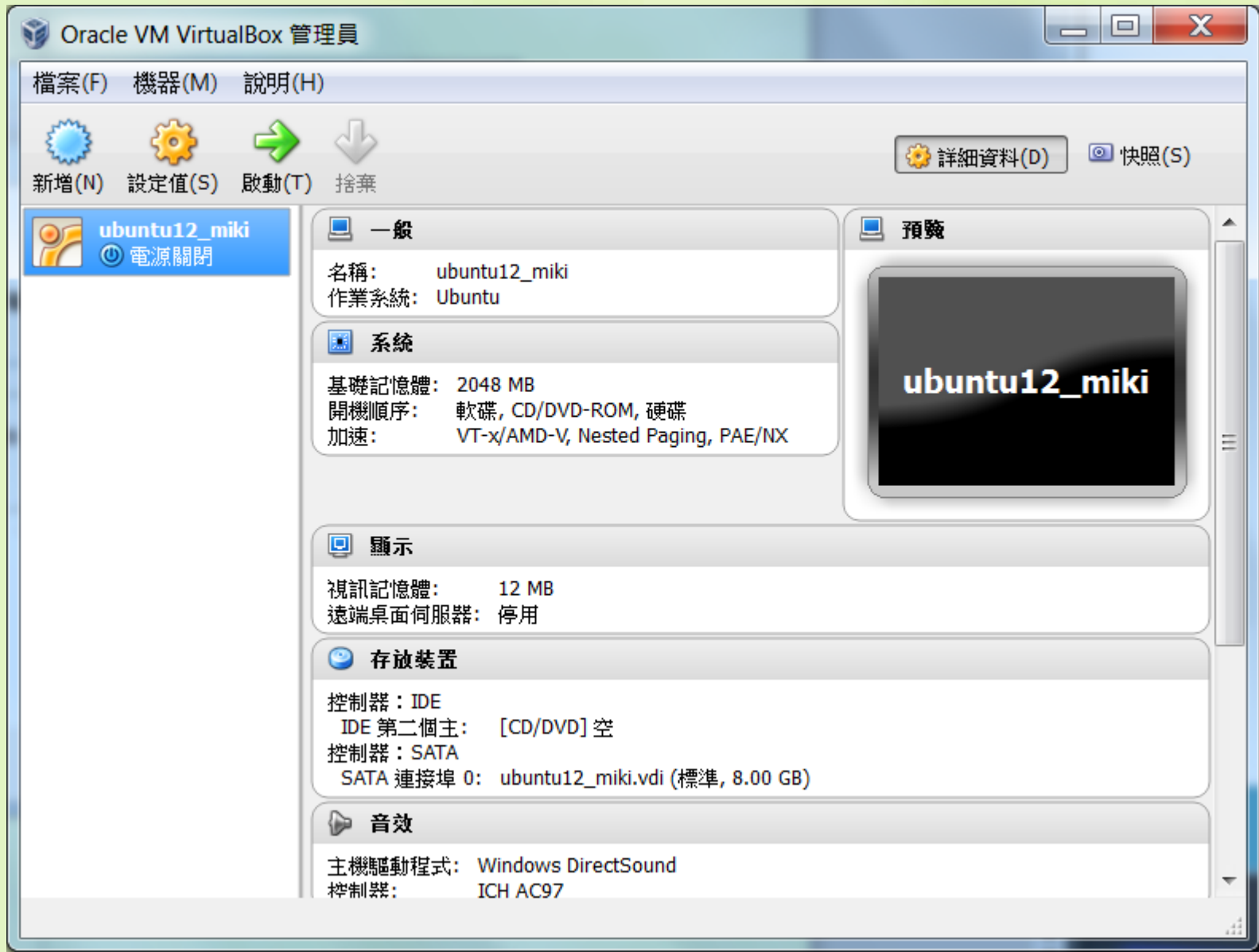


You can change the place of the hard disk.

You can choose the size

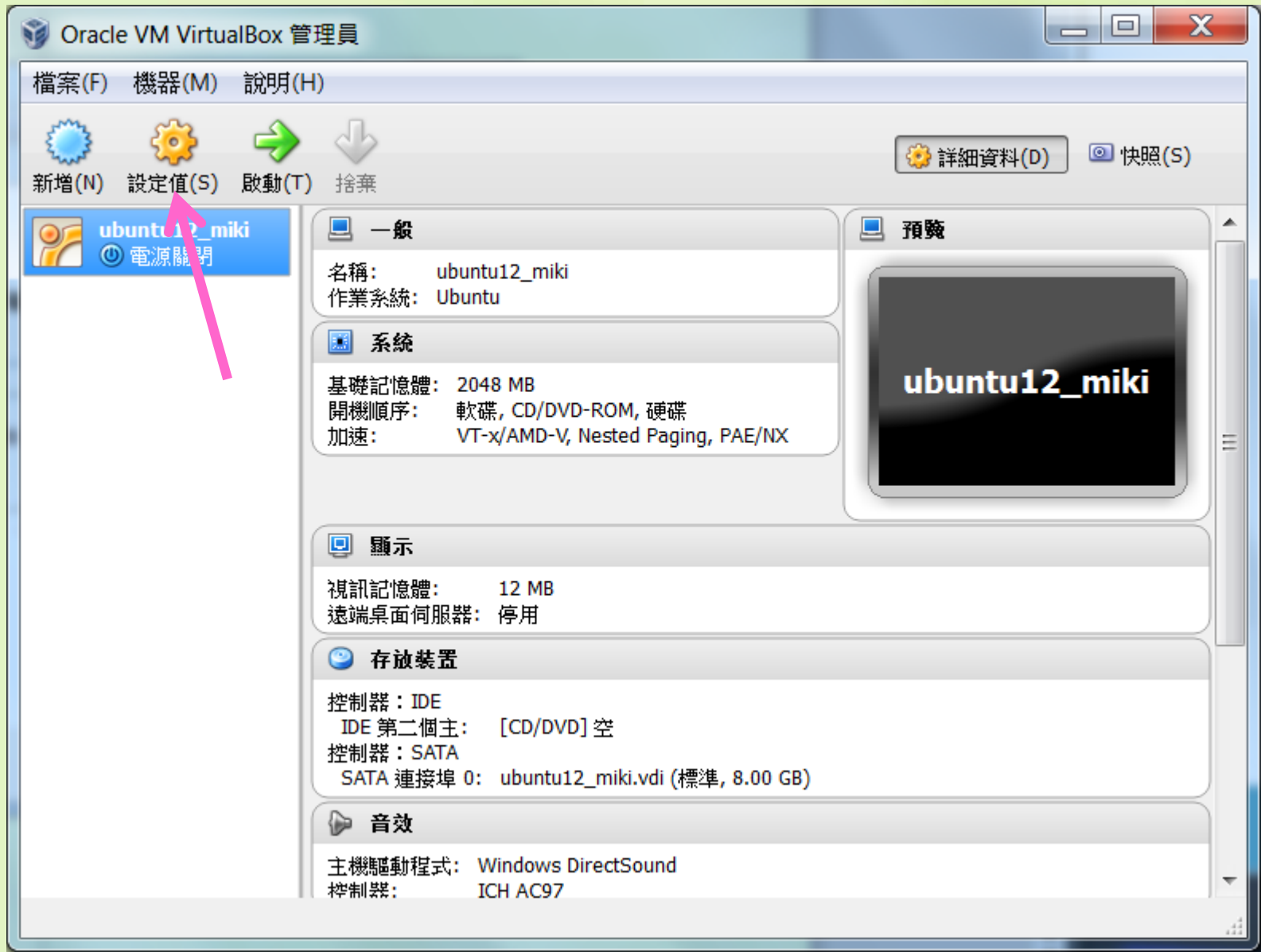
Then, run virtualbox to setup for a guest OS (9 of 9)

 Now, you have a new system for a guest OS.



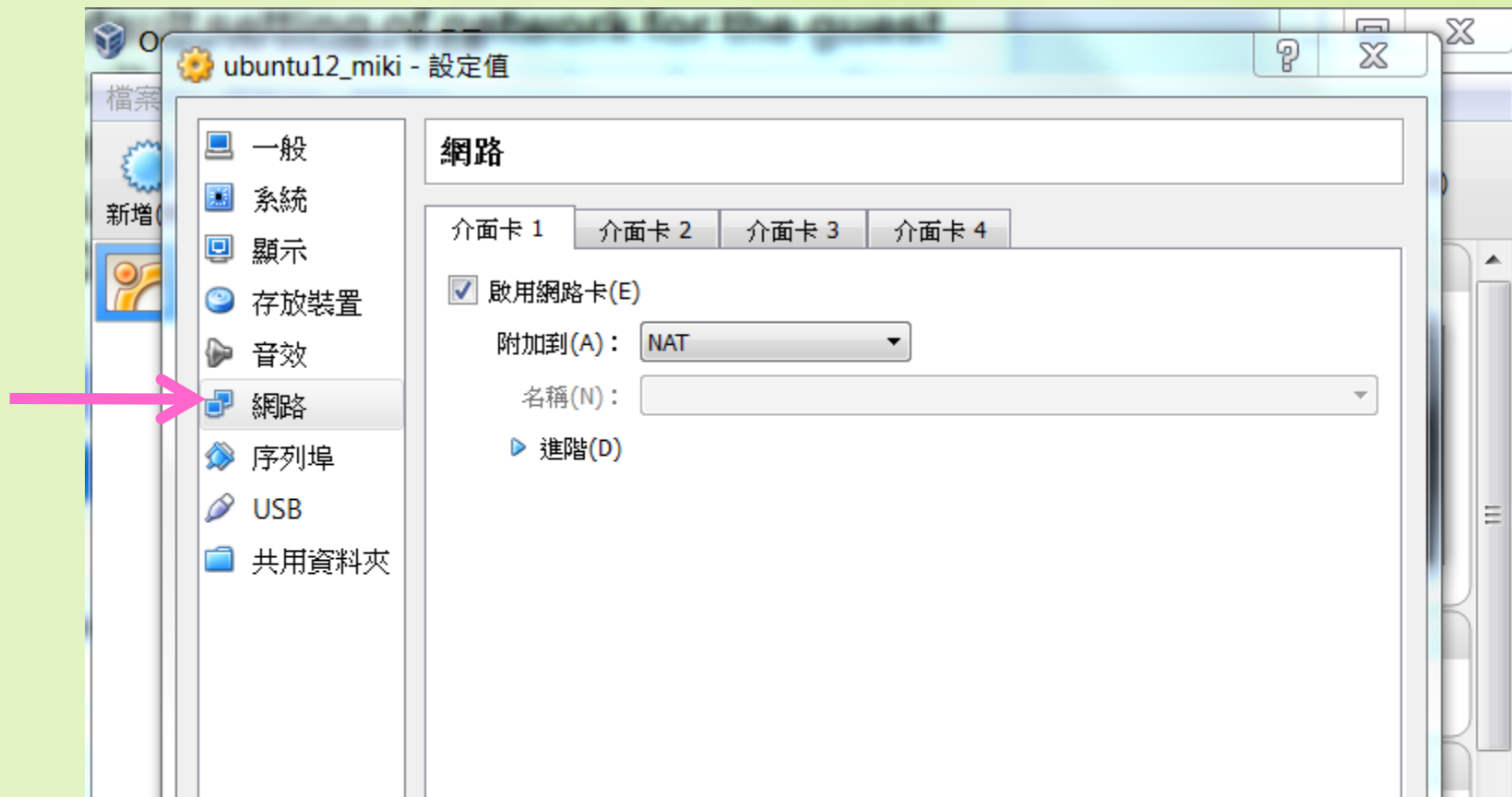
You need to install ubuntu (1 of 21)

Before the installation, you can check the setting for network.



You need to install ubuntu (2 of 21)

- I recommend to install ubuntu with activating internet in your host OS. Although the default setting of network for the guest OS (ubuntu) is automatically prepared, the network sometimes does not work in the guest OS due to the incompatibility problem. In that case, you need to try other settings after installation of the guest OS (you can change them later).




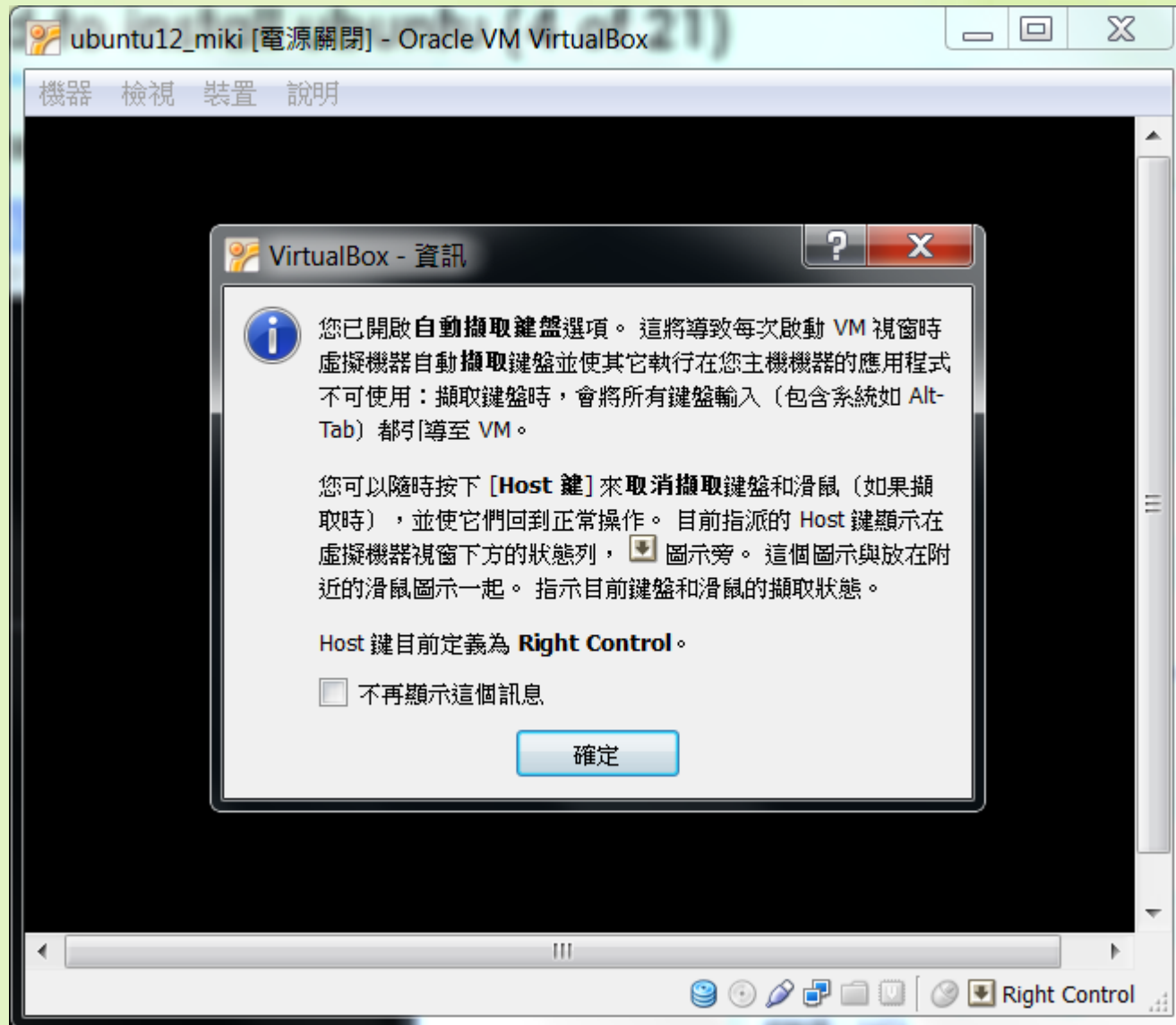
You need to install ubuntu (3 of 21)

- There are no special icons for the installation. **Only in the first time of booting** (啟動), the installer of OS is activated. If you fail in completing the installation processes and again boot the OS, error message “no OS” will appear. In that case, you can delete the system (here, ubuntu12_miki) and again make another virtual system.




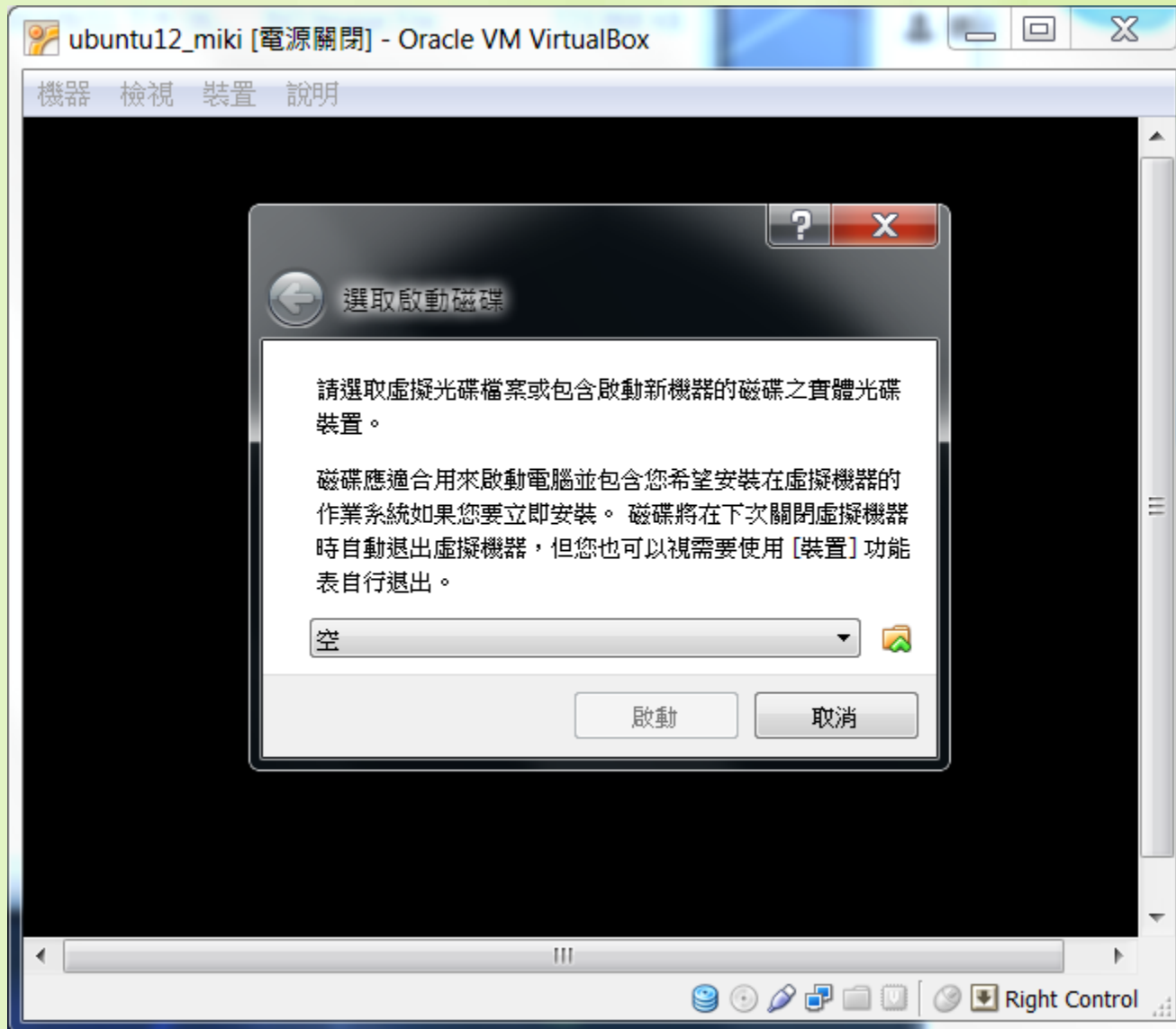
You need to install ubuntu (4 of 21)

 Read the message and just Click OK (確定).



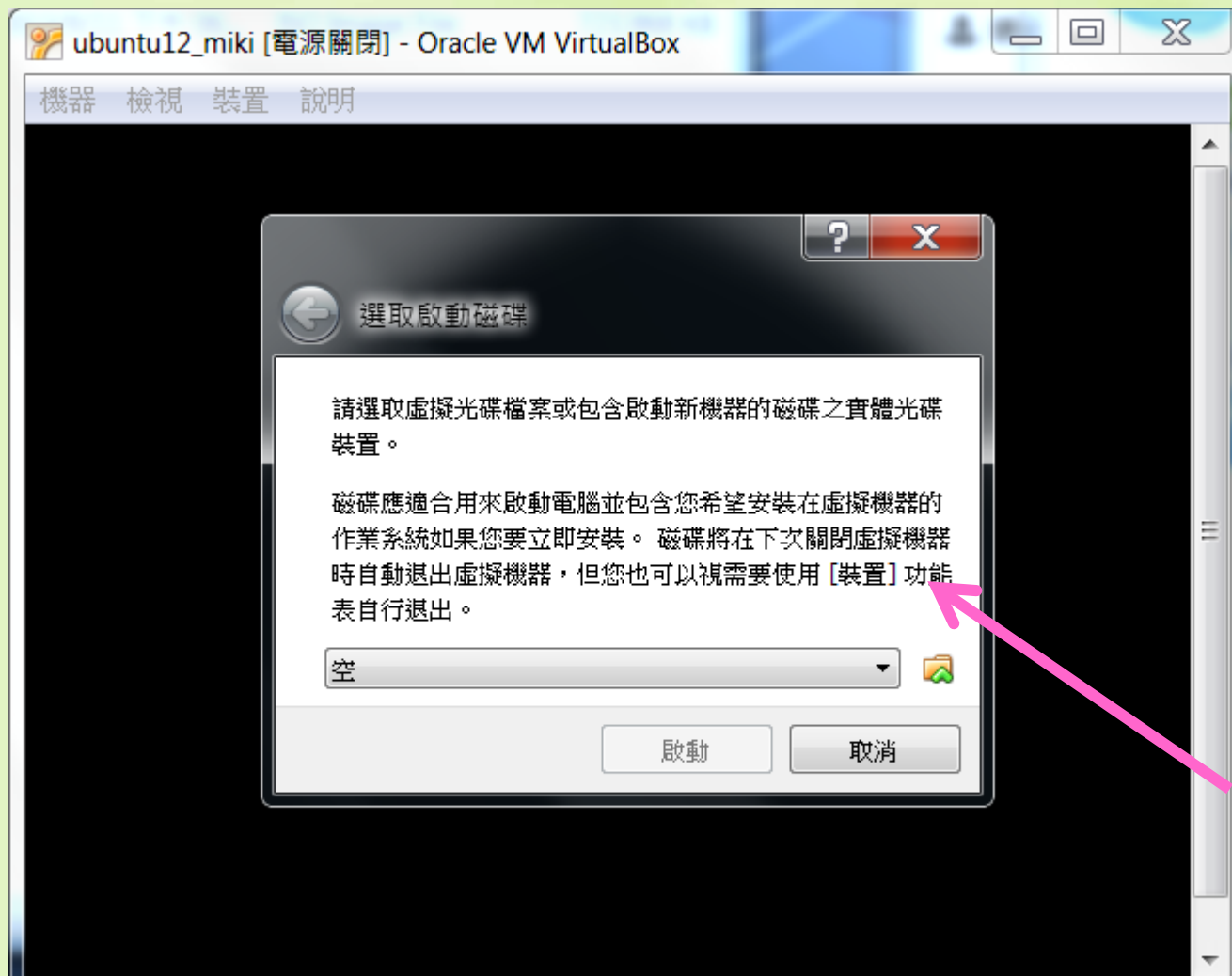
You need to install ubuntu (5 of 21)

 This is an initial process of the installation.



You need to install ubuntu (6 of 21)

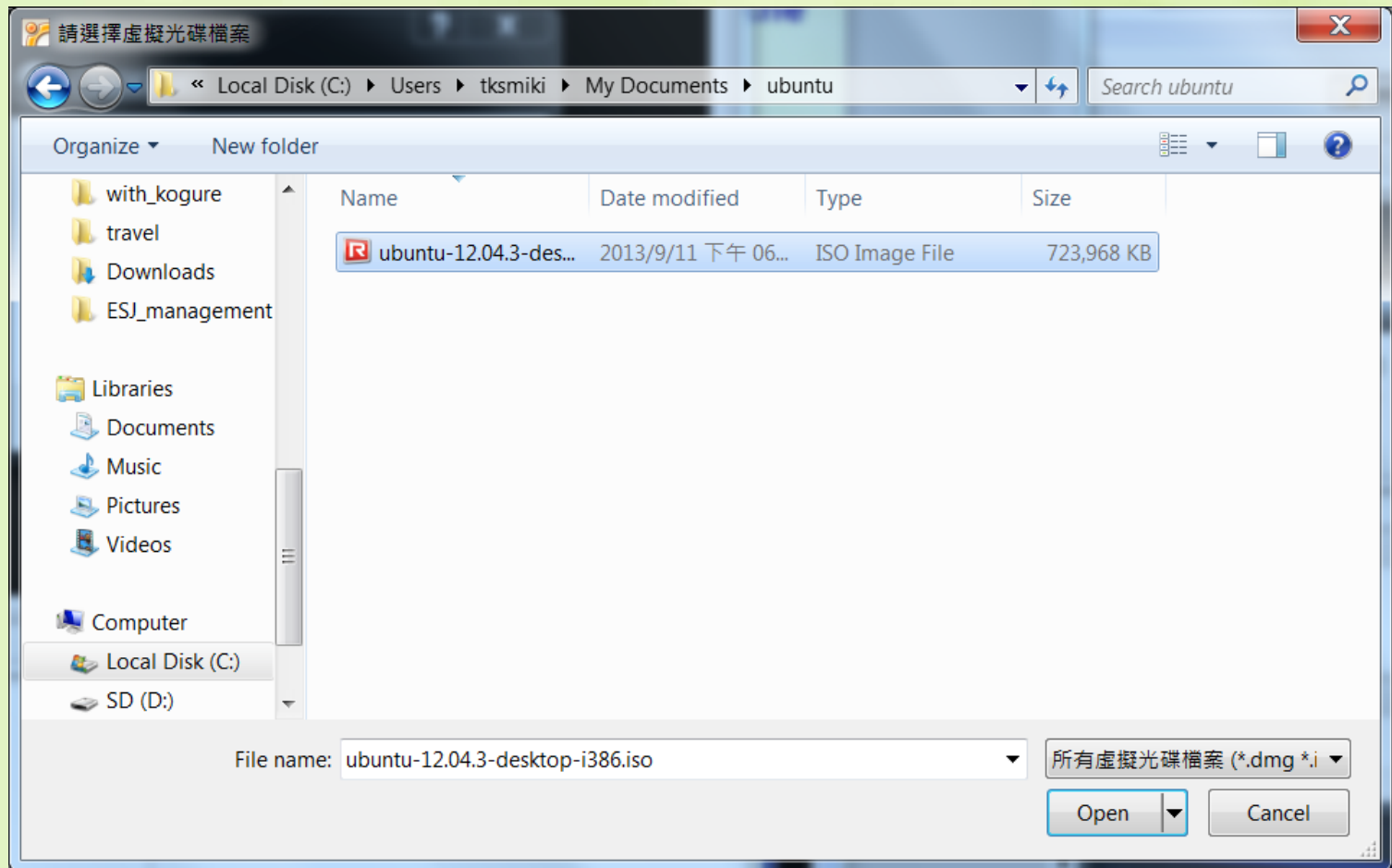
- VirtualBox intends to install a guest OS from CD-R driver as a default setting, but you do not need it. **You need to change the place for the media to the downloaded image file of ubuntu.**



Click Here

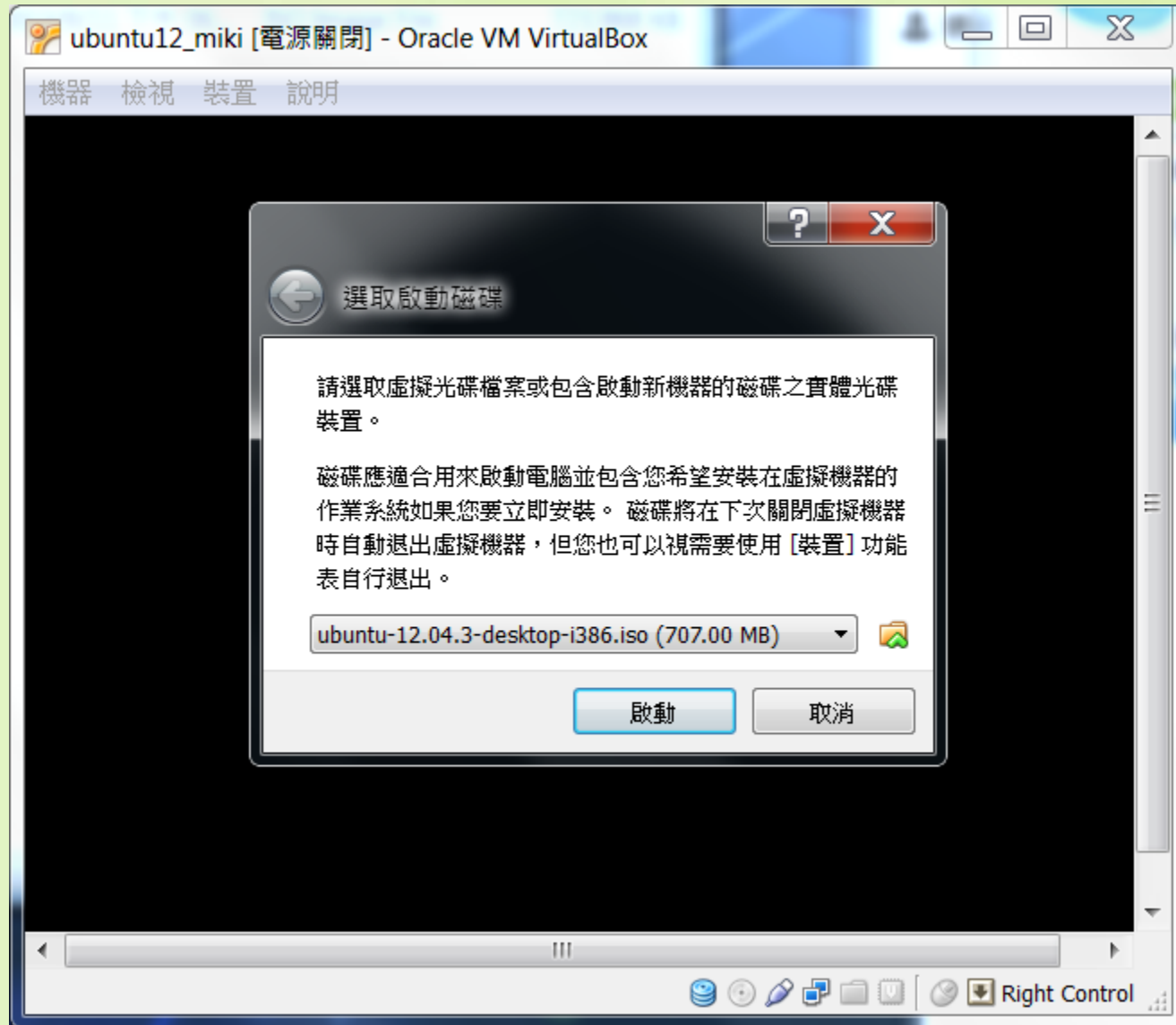
You need to install ubuntu (7 of 21)

- VirtualBox intends to install a guest OS from CD-R driver as a default setting, but you do not need it. **You need to change the place for the media to the place where you save ubuntu.**



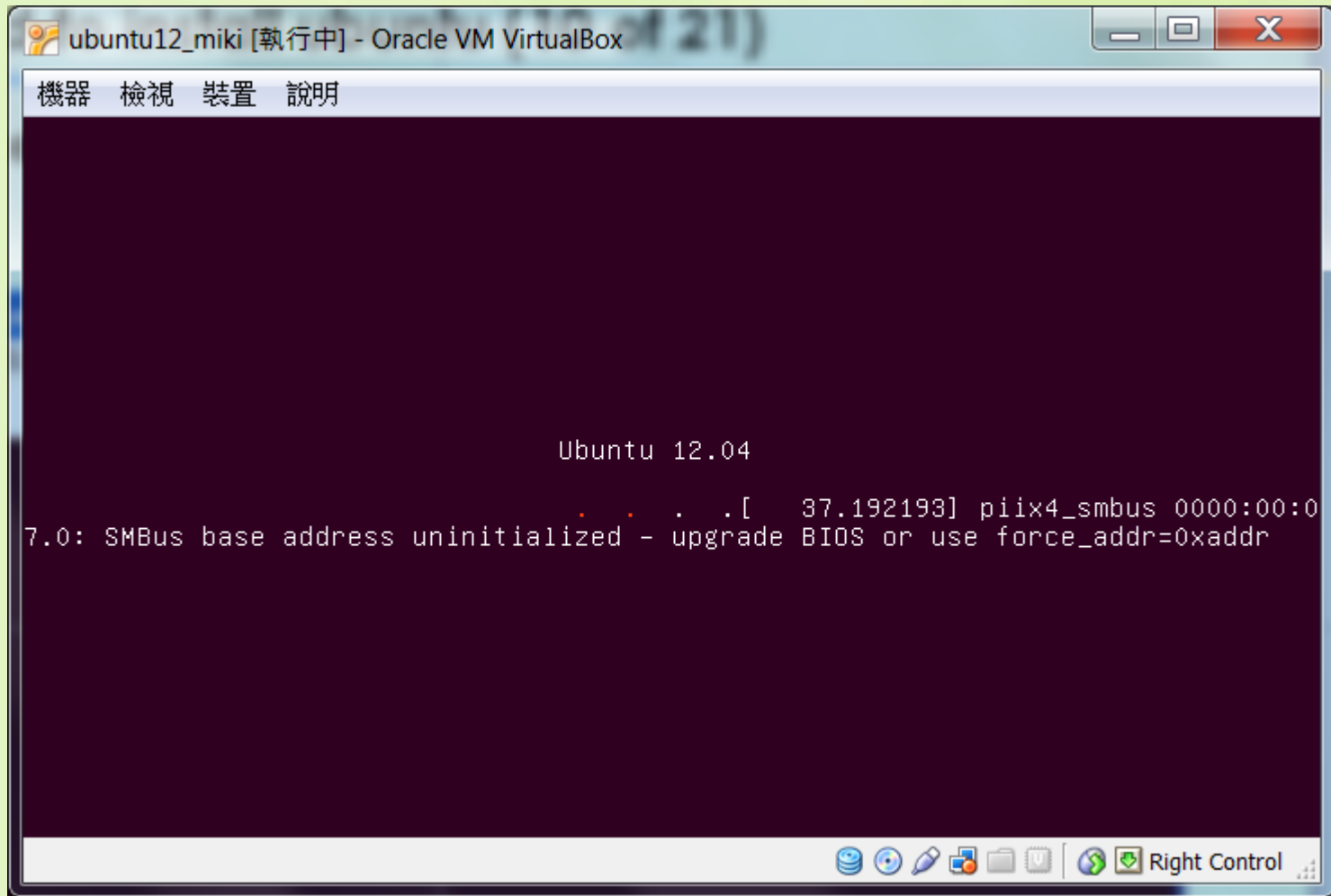
You need to install ubuntu (8 of 21)

Now, you have decided the source of OS file.



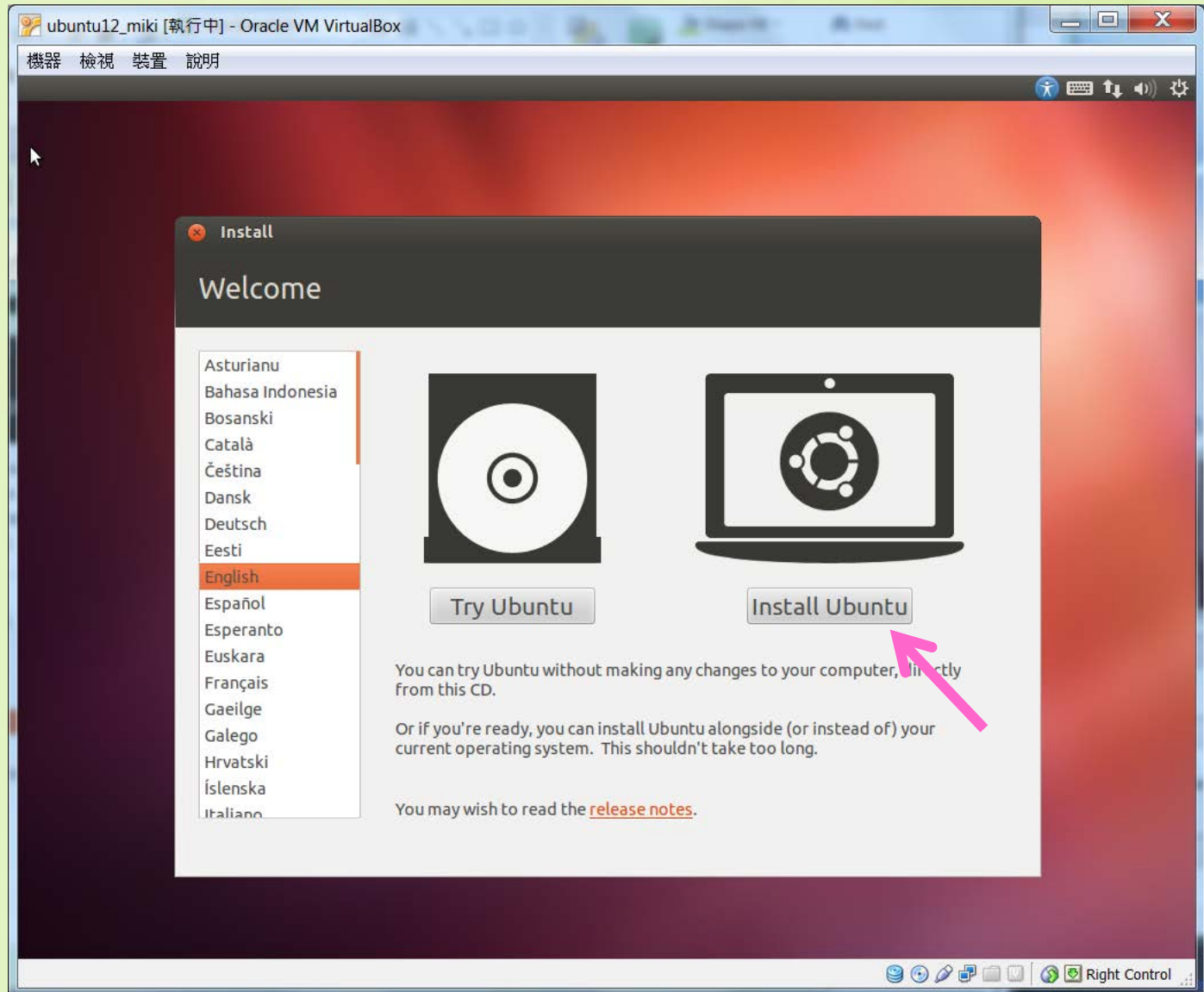
You need to install ubuntu (9 of 21)

■ Now, the file of ubuntu 'virtual' CD is read. It takes time.



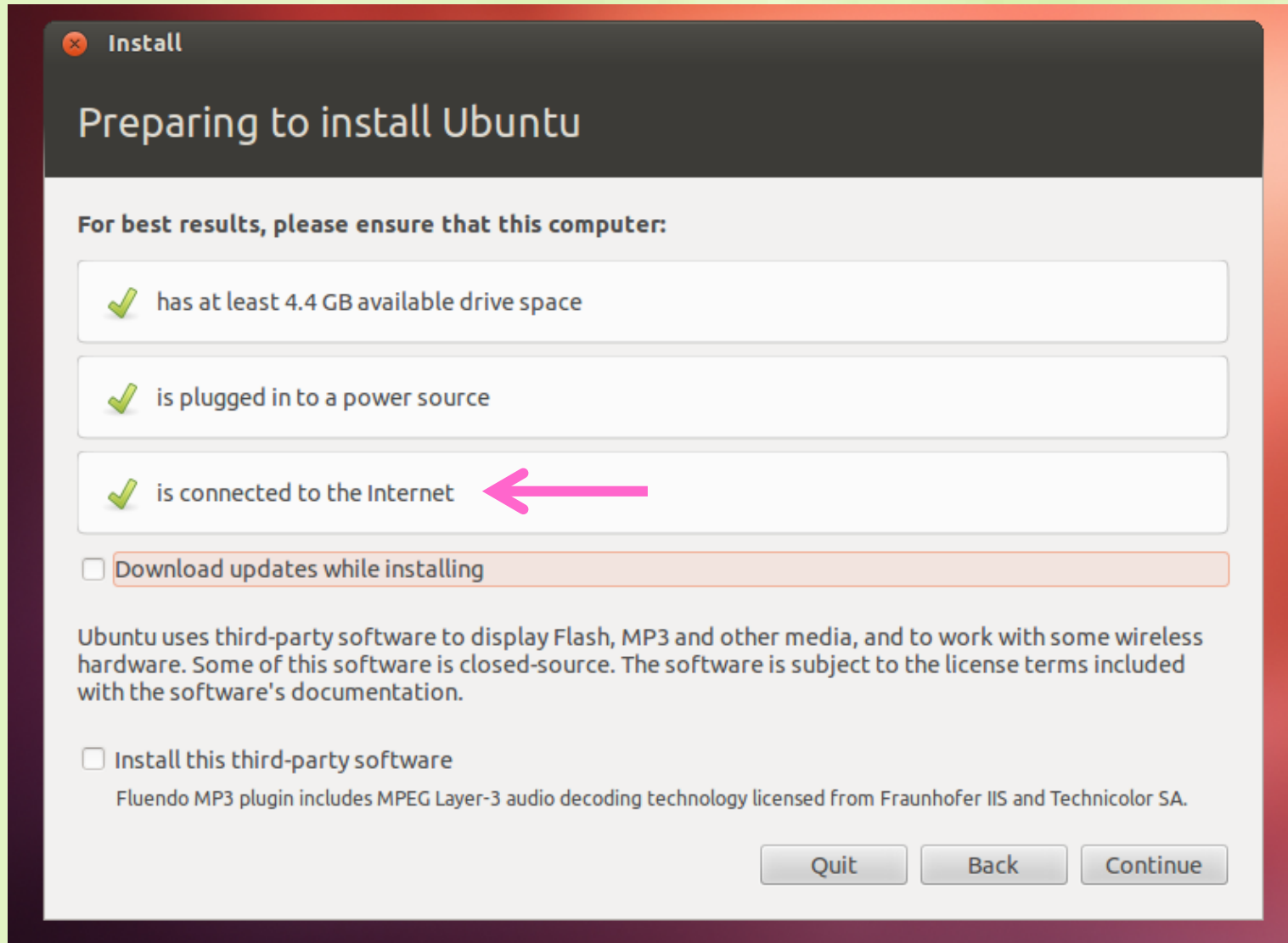
You need to install ubuntu (10 of 21)

- You need to choose “install Ubuntu”. You can also choose any language but recommend to use English.



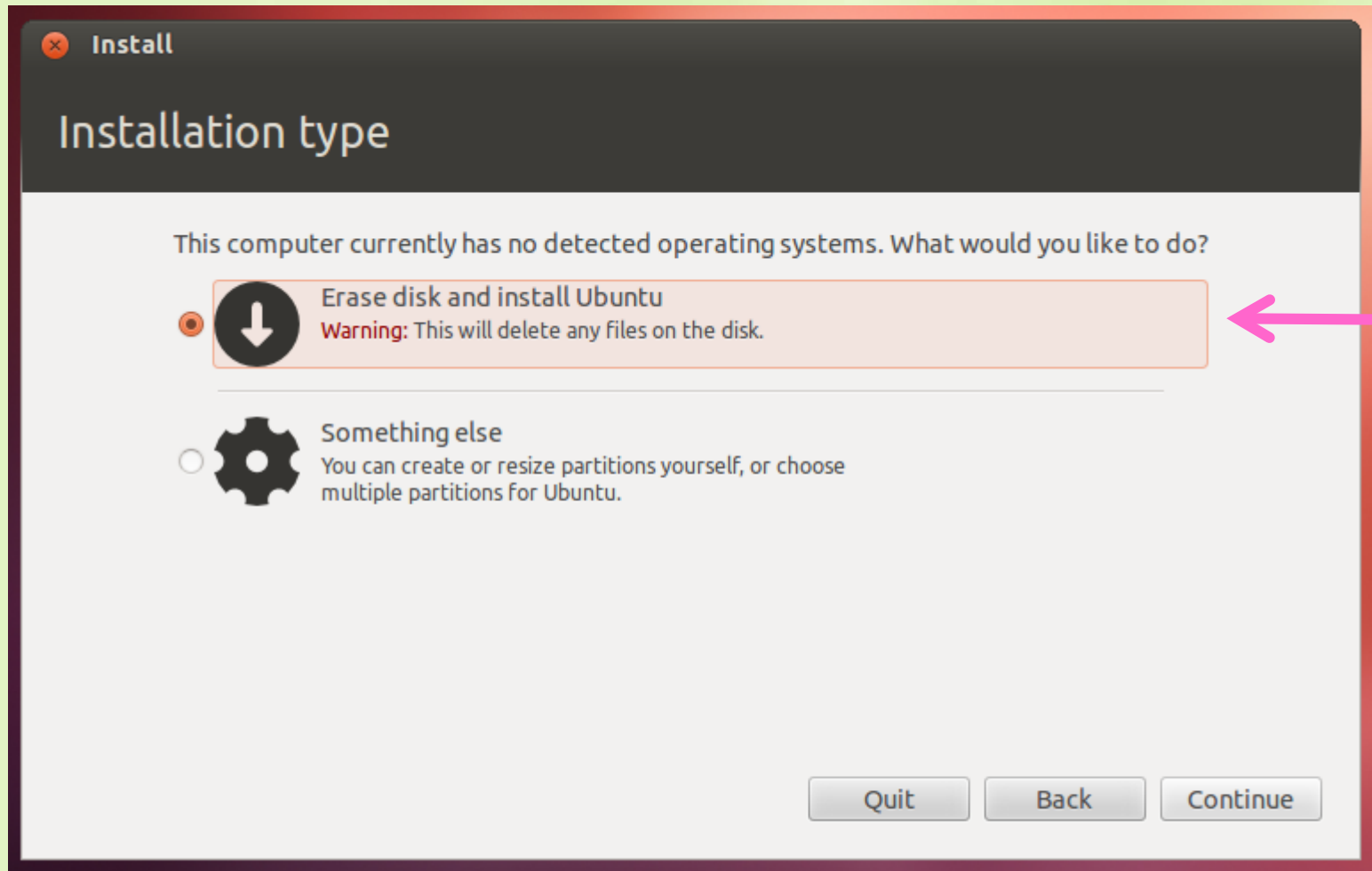
You need to install ubuntu (11 of 21)

- If ubuntu recognizes the internet, it is the best. However, even if not, you can install ubuntu.



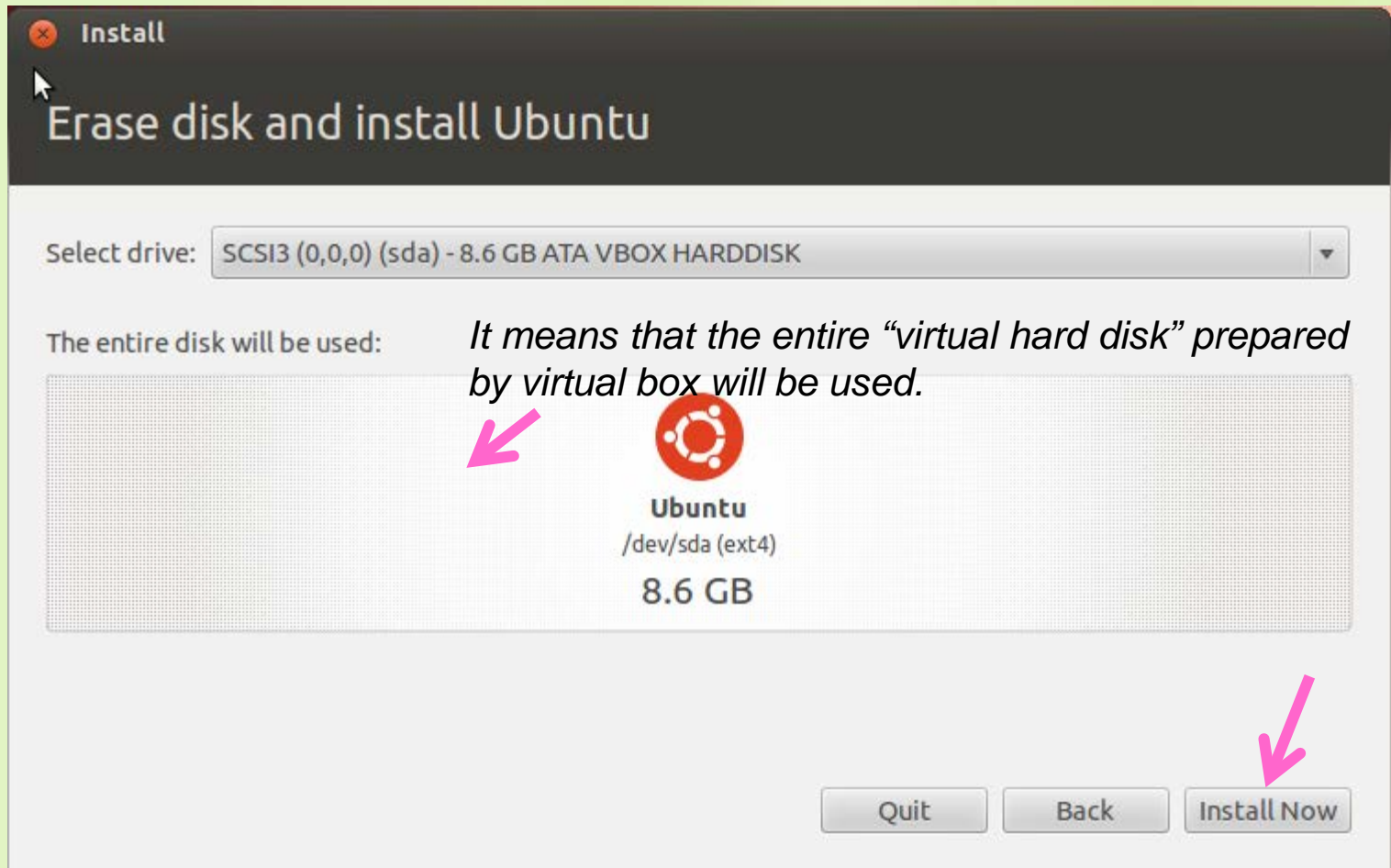
You need to install ubuntu (12 of 21)

- It is OK to use “Erase...”. Ubuntu tries to erase ‘virtual’ hard disk, not the whole real hard disk in your host OS.



You need to install ubuntu (13 of 21)

 You can just follow the default setting.




You need to install ubuntu (14 of 21)

- If the internet is active, where you are is automatically recognized.



You need to install ubuntu (15 of 21)

 You can choose your keyboard layout.

Install

Keyboard layout

Choose your keyboard layout:

Spanish (Latin American)

Swahili (Kenya)

Swahili (Tanzania)

Swedish

Taiwanese

Tajik

Thai

Tswana

Turkish


Taiwanese

Taiwanese - Saisiyat (Taiwan)

Taiwanese - Taiwanese (indigenous)

▶ Copying files...

You need to install ubuntu (16 of 21)

 You need to set your information here.

Install

Who are you?

Your name:

Your computer's name:
The name it uses when it talks to other computers.

Pick a username:

Choose a password:

Confirm your password:

☐ Log in automatically

☒ Require my password to log in

☐ Encrypt my home folder

► Copying files...

You need to install ubuntu (17 of 21)

I request you to choose “Require my password to log in”.

Install

Who are you?

Your name: ✓

Your computer's name: ✓
The name it uses when it talks to other computers.

Pick a username: ✓

Choose a password: Fair password

Confirm your password: ✓

☐ Log in automatically

☒ Require my password to log in

☐ Encrypt my home folder

Back Continue

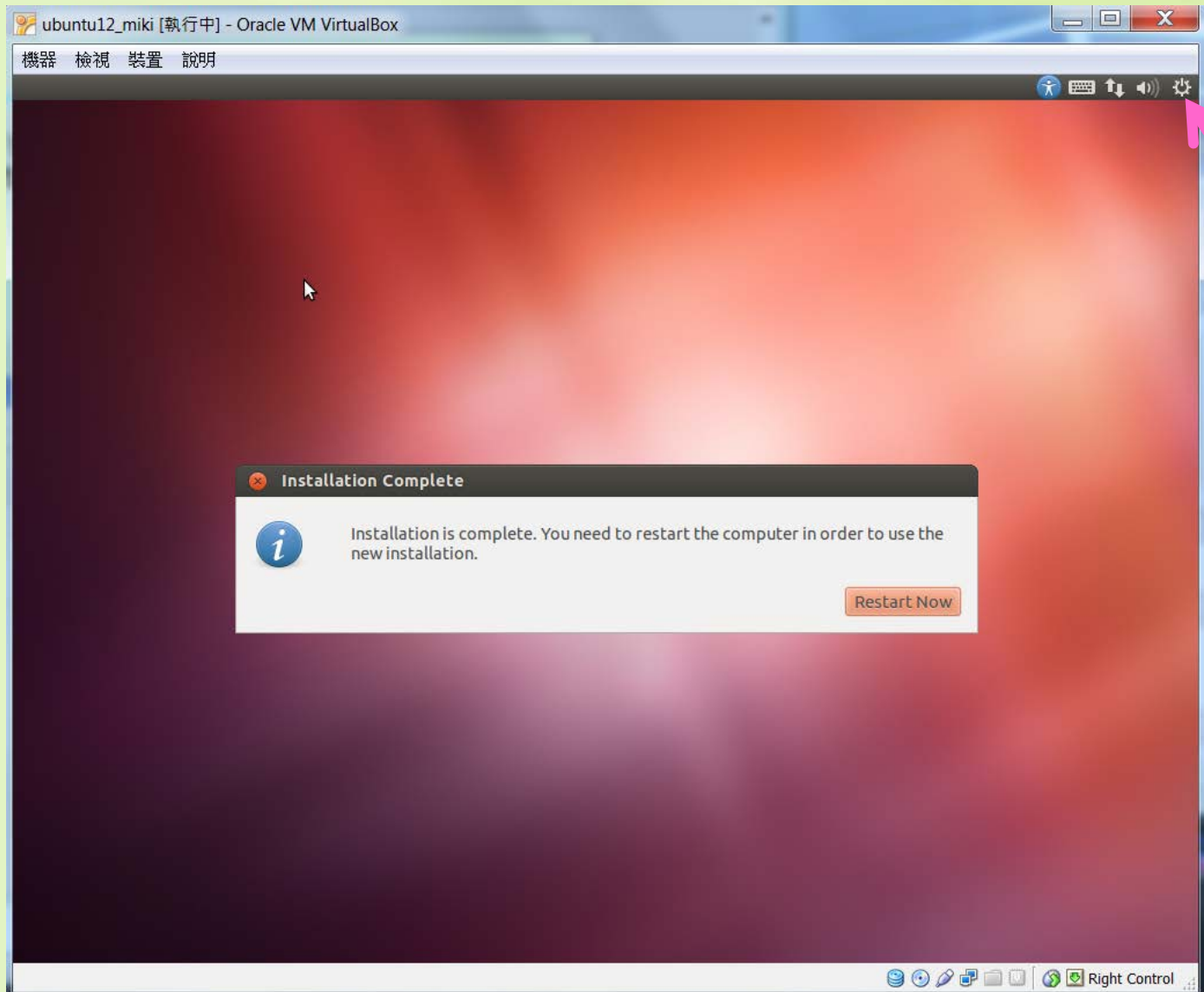
You need to install ubuntu (18 of 21)

 Then, you just have to wait for the completion of installation.




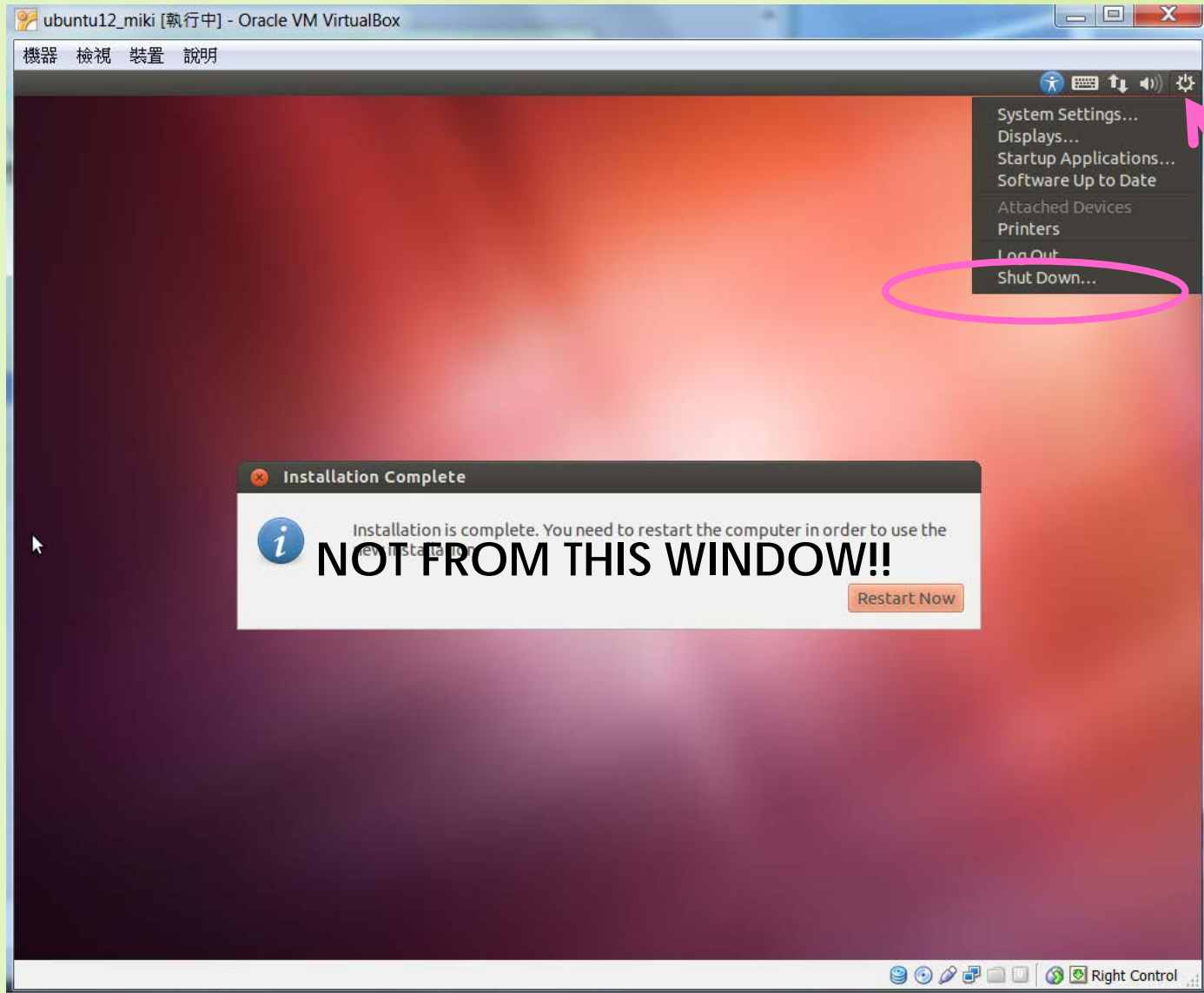
When the installation is completed

 You are requested to 'restart', BUT...




When the installation is completed

-  You are requested to 'restart', BUT... **SIMPLY SHUT DOWN!**
You will find another window to shut down.




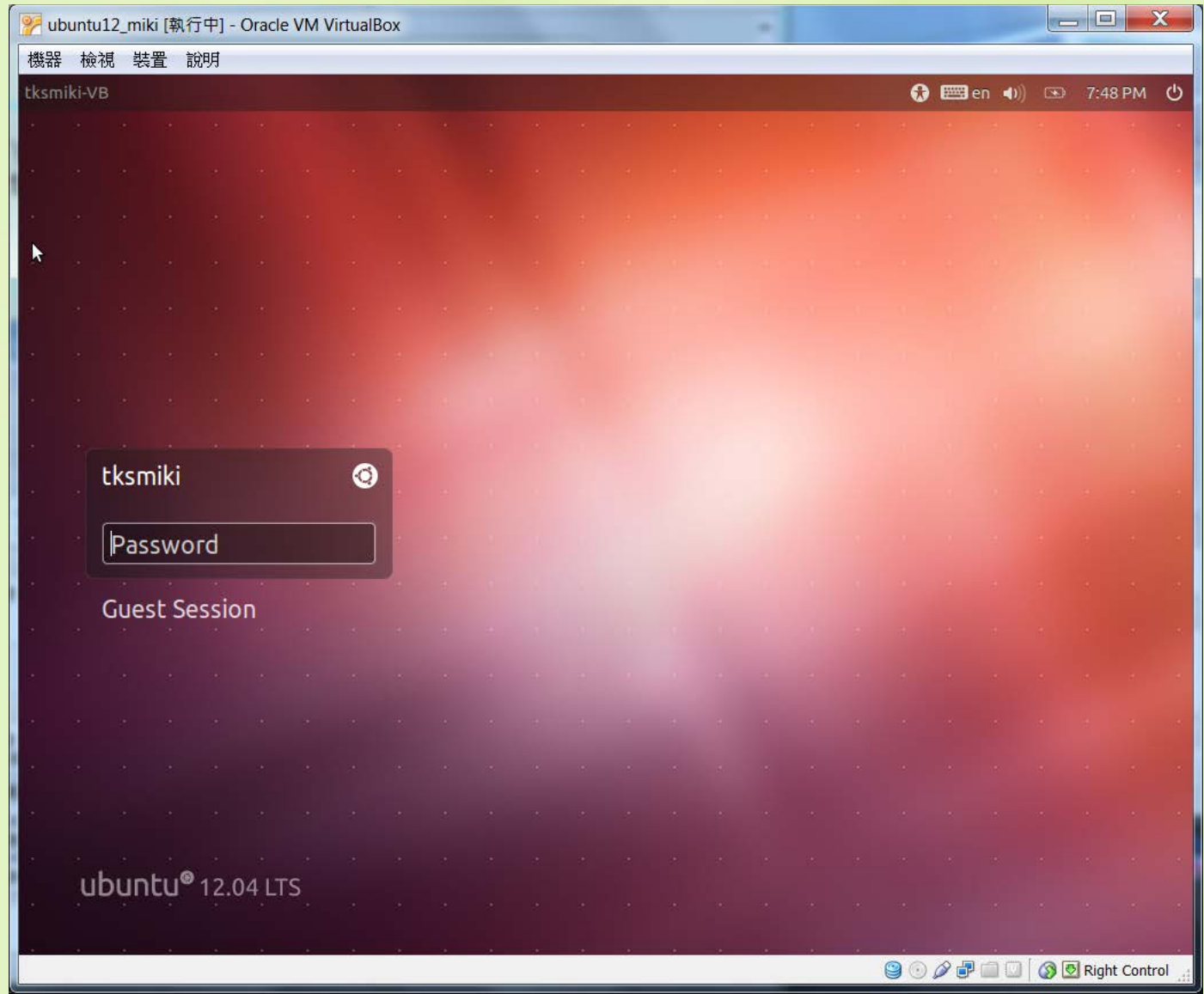
After installation

 You need to reboot your guest OS (ubuntu).



After installation

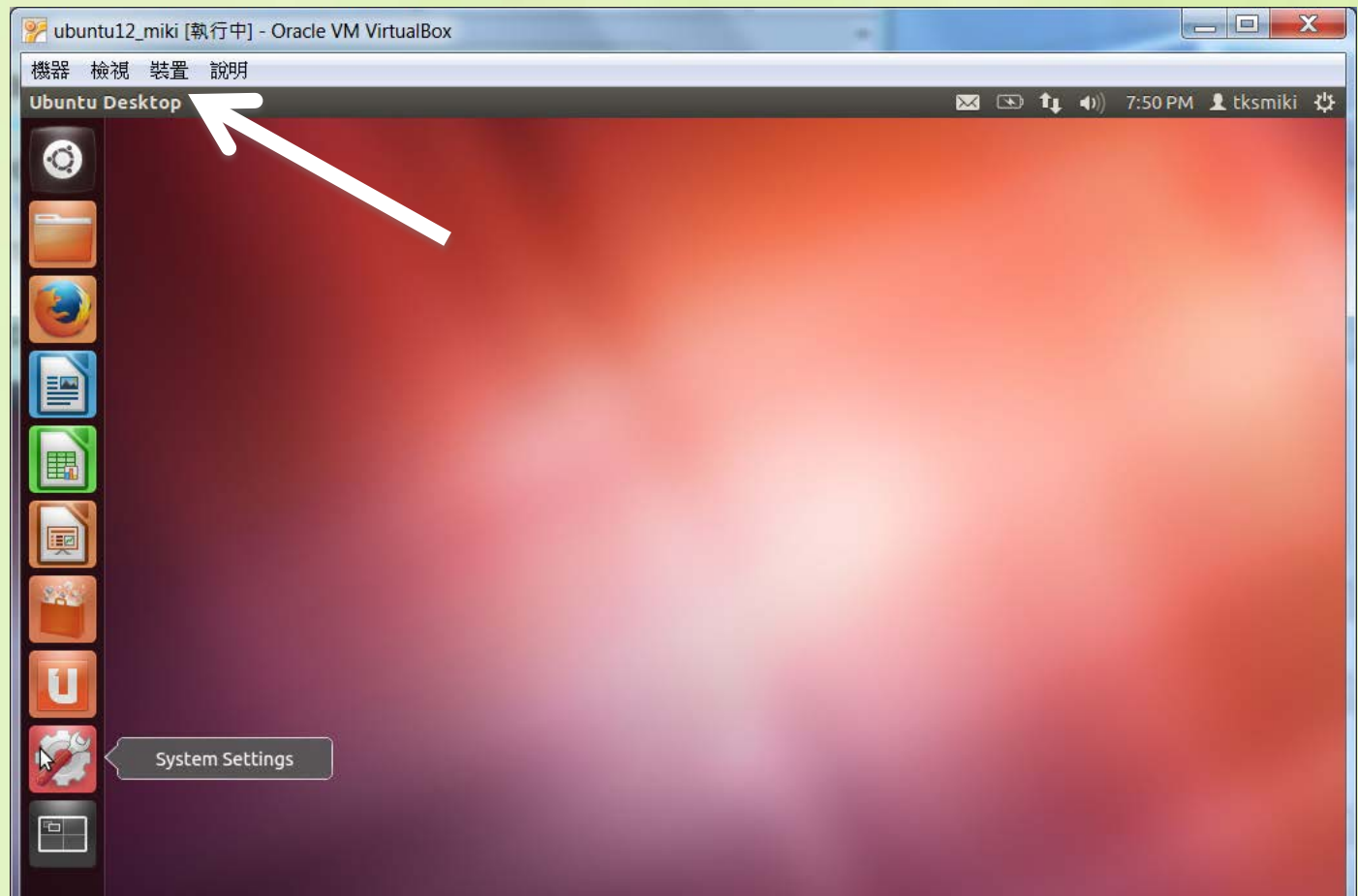
-  You need to reboot your guest OS (ubuntu).



Installation of additional files to Ubuntu (very important!)

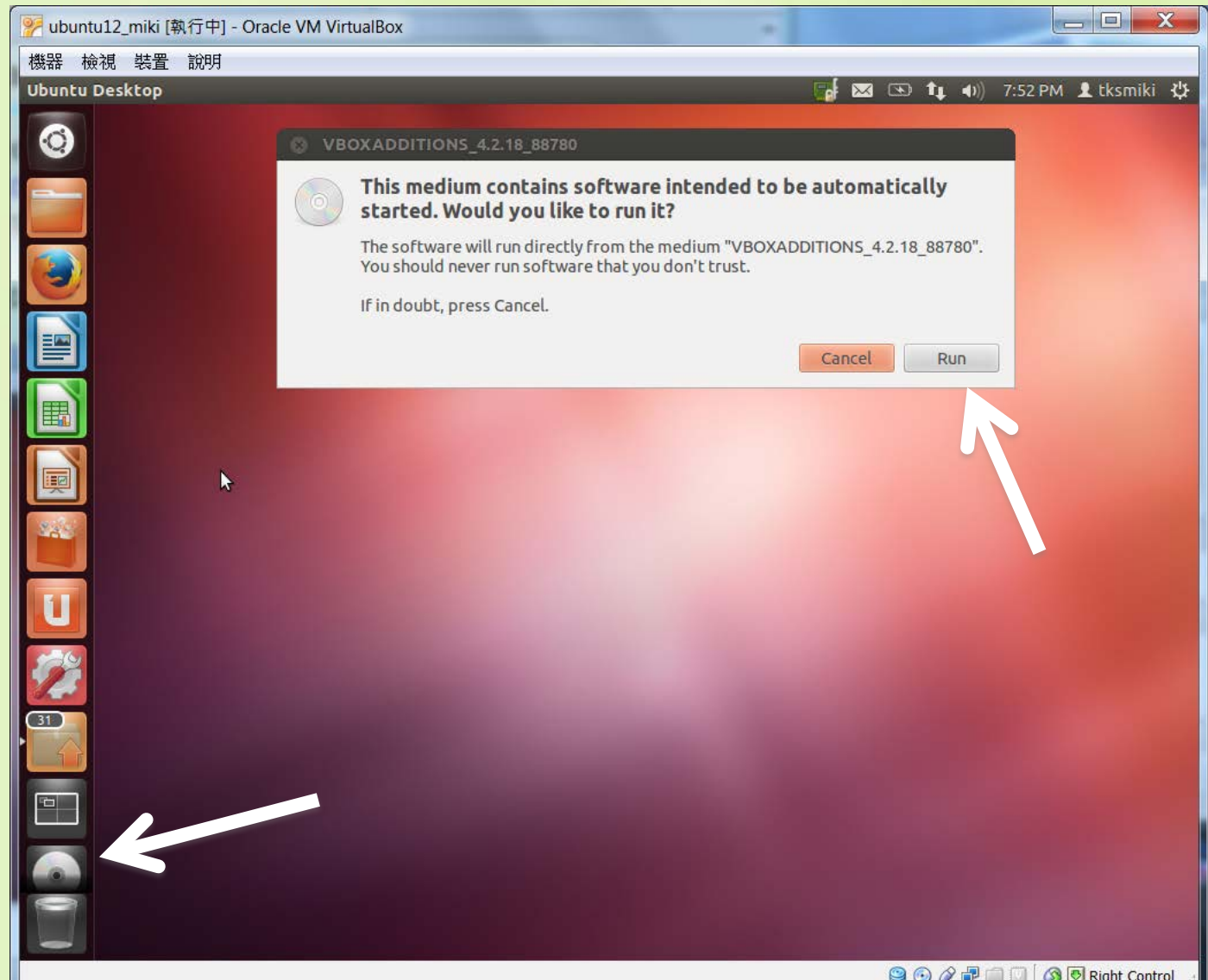
After booting ubuntu, you need to choose “裝置”>“安裝(guest additions of)” [from the tool bar of VirtualBox](#). This is necessary for link tightly the guest OS (ubuntu) and your host OS.

Then, a virtual CD-ROM is recognized and appears at Desktop.



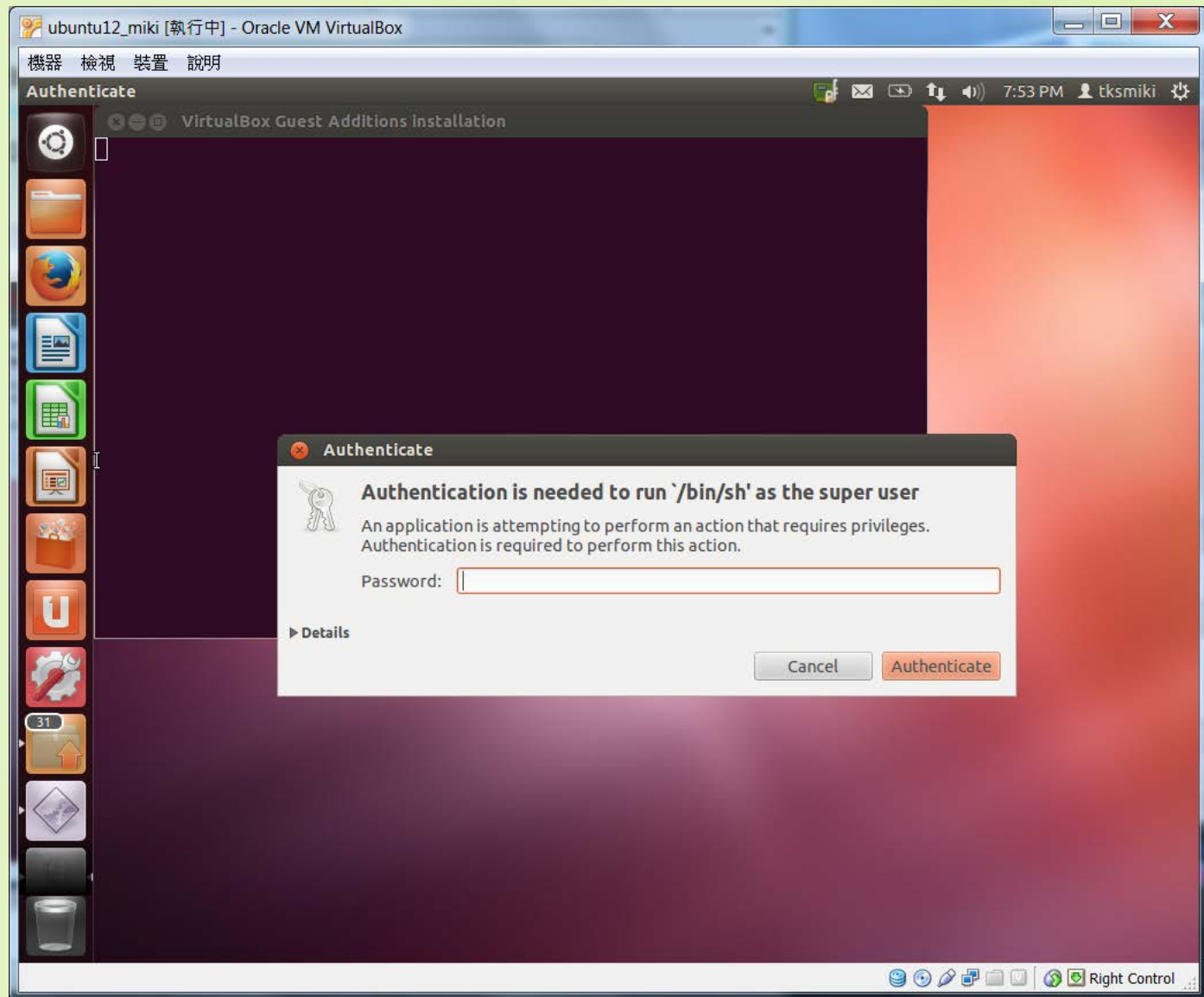
Installation of additional files to ubuntu

Then, a virtual CD-ROM is recognized and appears at Desktop.



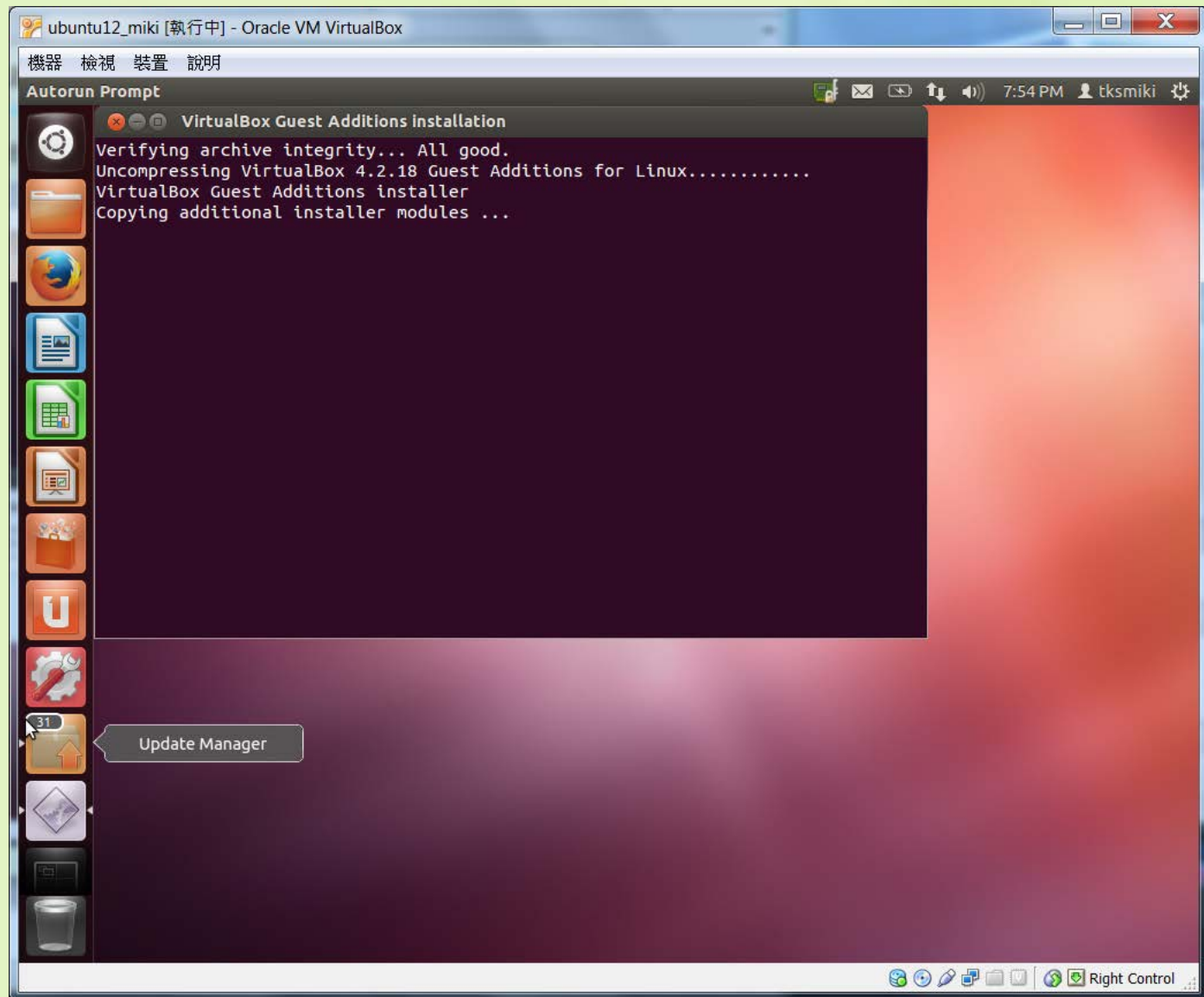
Installation of additional files to ubuntu

You need to input PASSWORD.



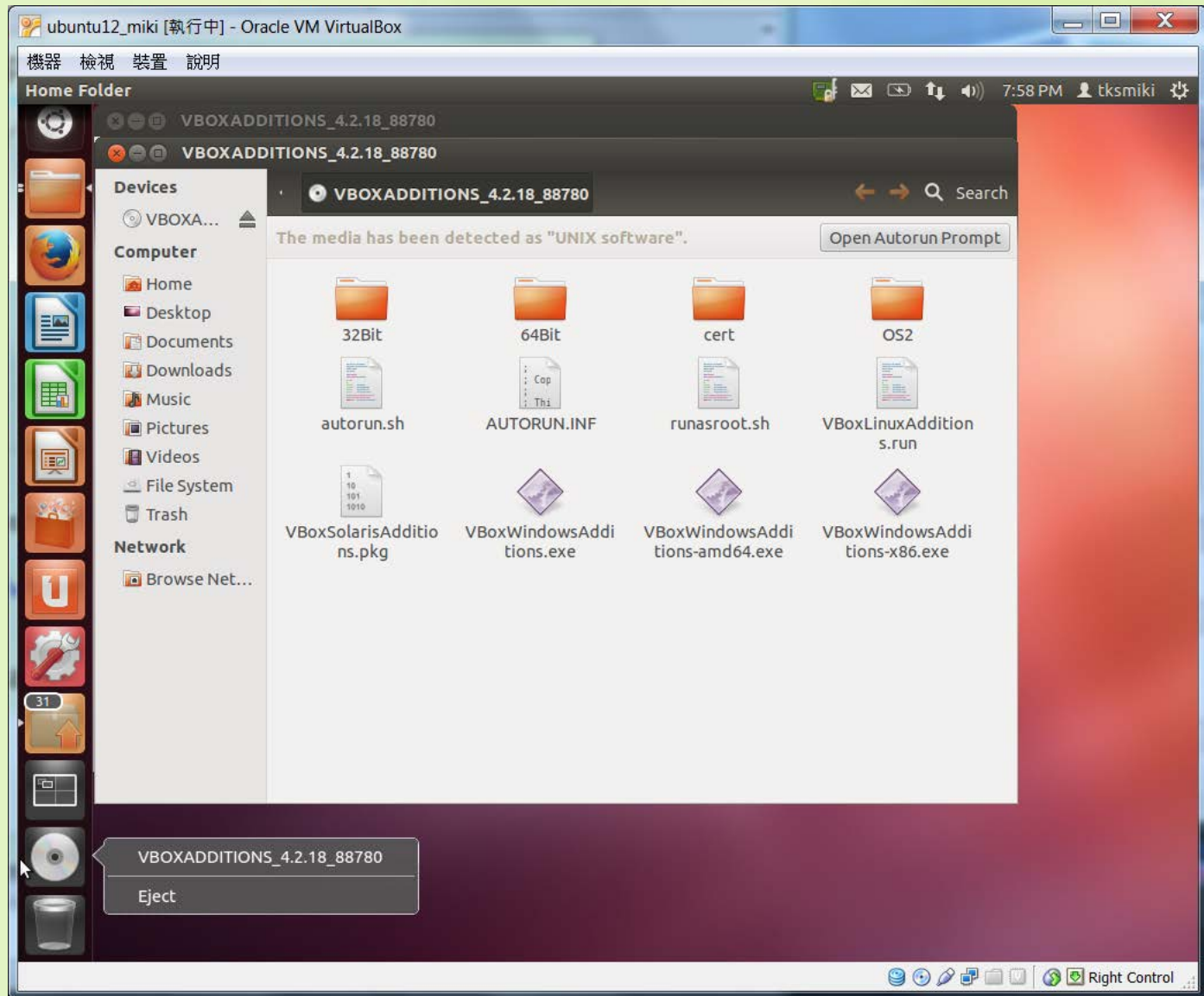
Installation of additional files to ubuntu

You can follow the guidance of the installation.



Installation of additional files to ubuntu

You should eject this 'virtual' CD.



Important Remark

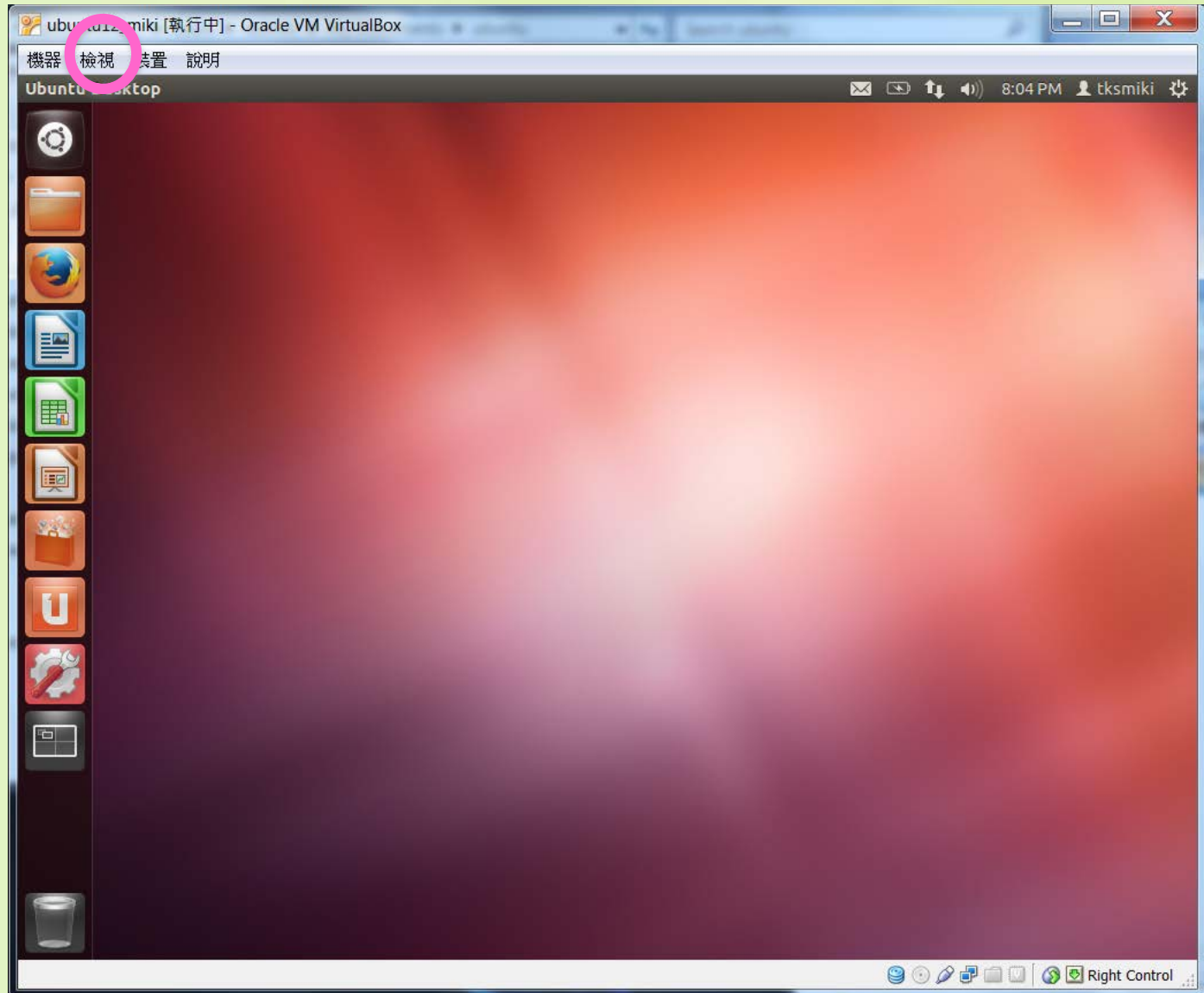
As the same as Windows and Mac OS, Ubuntu frequently ask if you would like to update applications or files.

I strongly recommend NOT to update any!!

The update is not well organized and often causes incompatibility to other applications.

Additional setting

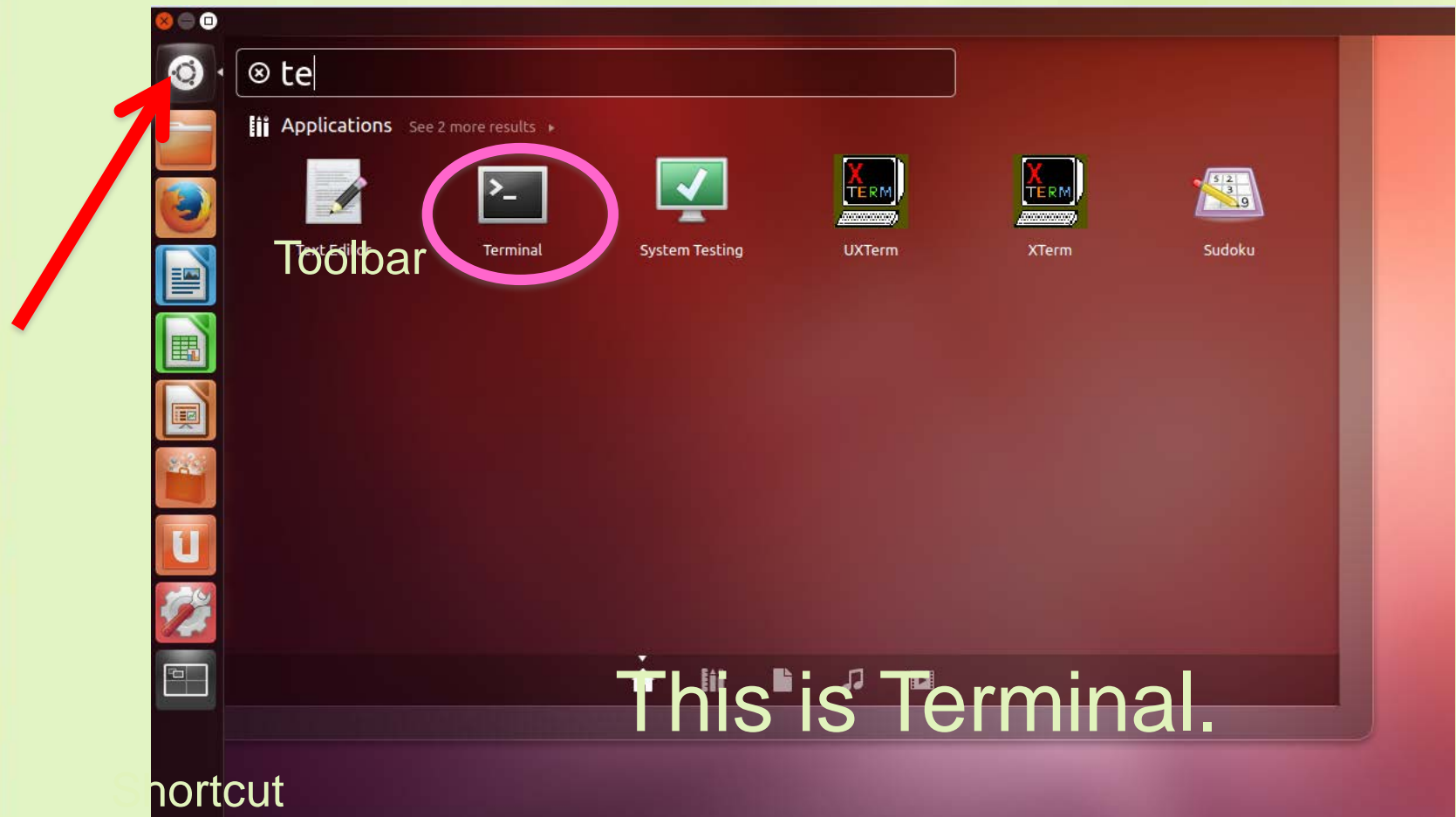
You can also adjust the screen size from the tool bar of virtualbox.



Additional setting

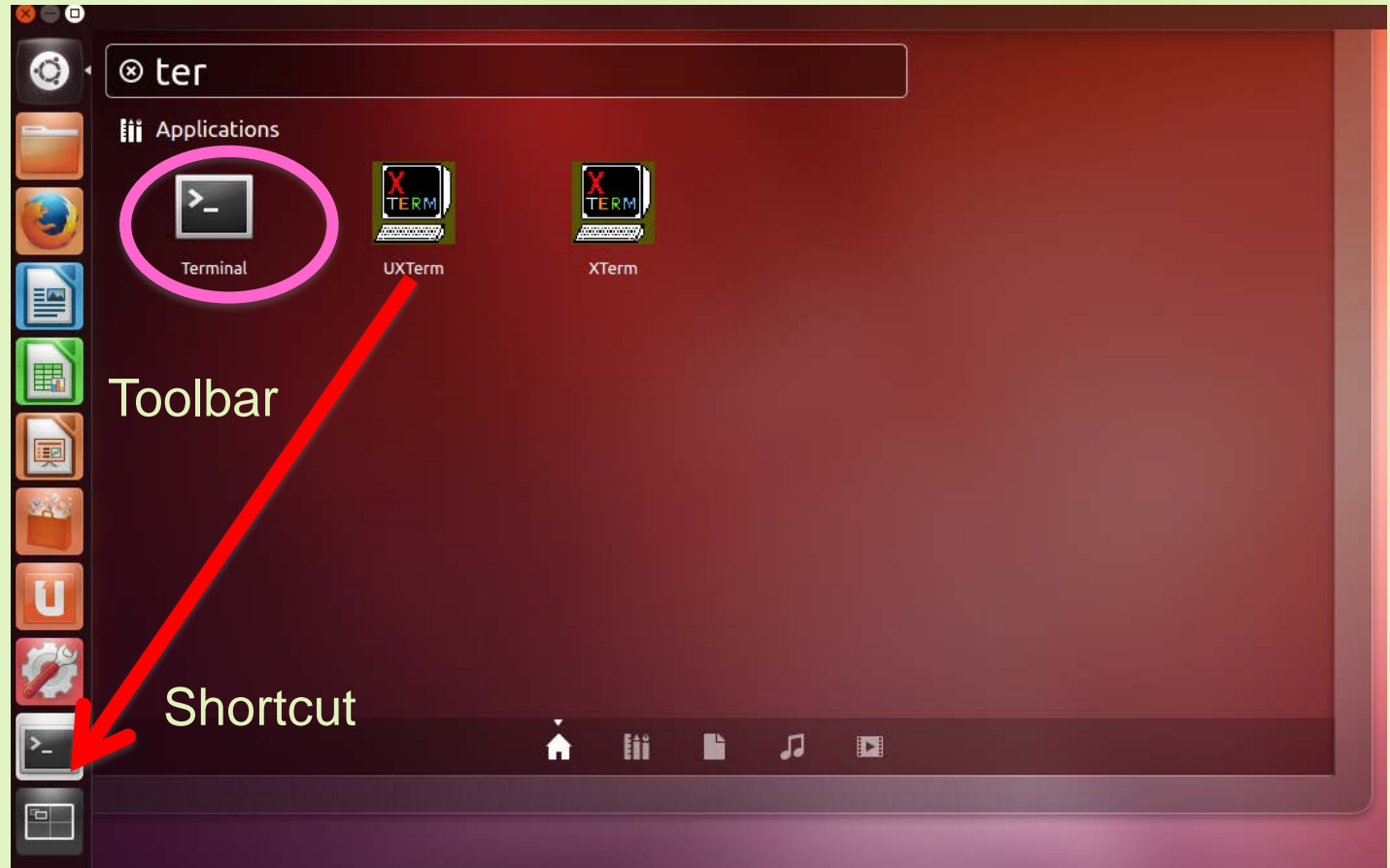
Next, you can access to application from “Dash home”

Search ‘te” and choose “Terminal”



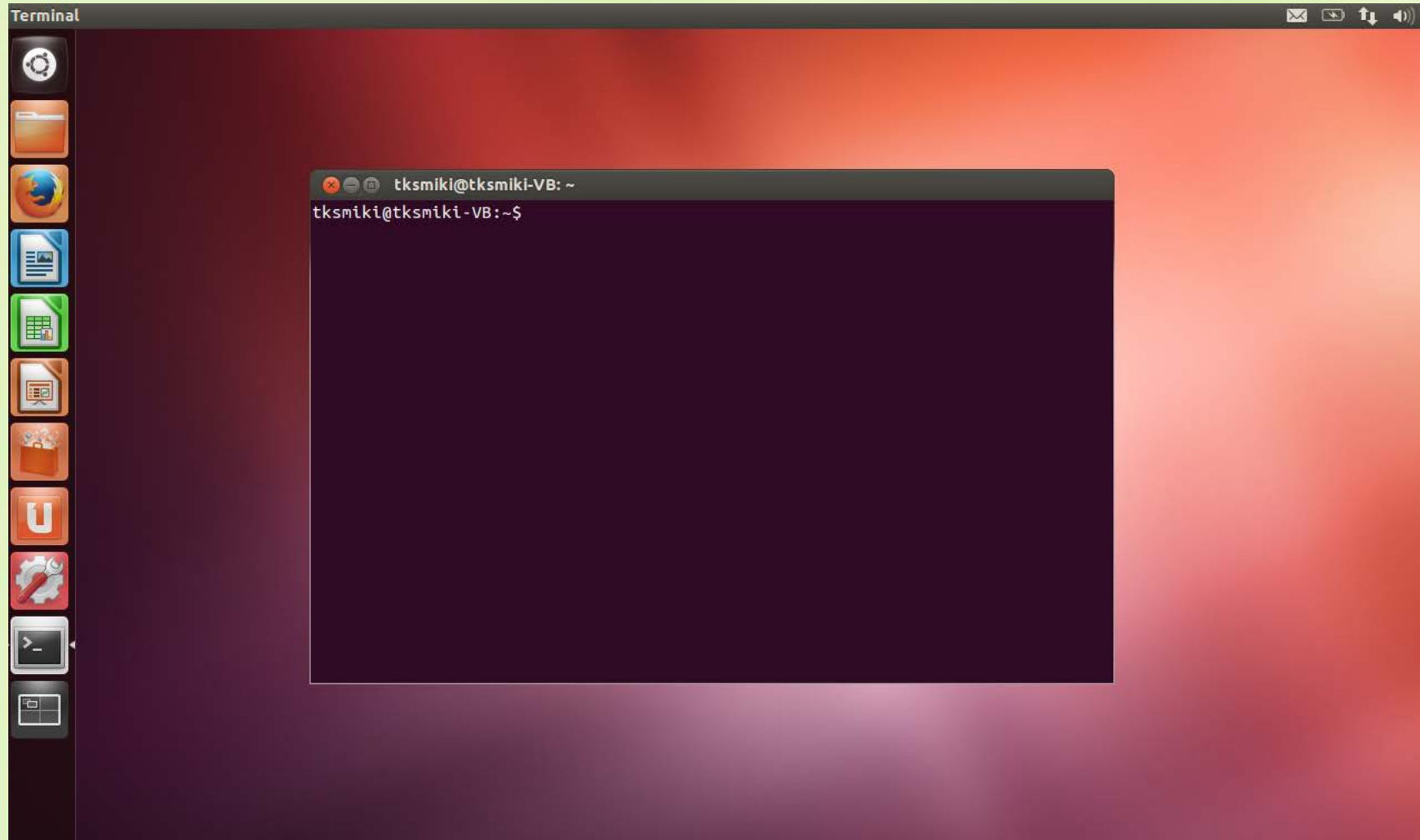
Additional setting

If you'd like to make shortcut, you can drag the icon from Dash home to the toolbar.



Additional setting

This is 'Terminal', which is command-line user interface.



Additional setting

We need to install three tools:

1) A tool to convert programing codes to applications (GNU C compiler)→which is a part of ubuntu, or need to be manually installed for OSX users

2) An editor of programing codes. Here, I recommend to use **R** and “**Rstudio**”. You can find the installer of “**Rstudio Desktop**” for each OS from:

<https://ftp.yzu.edu.tw/CRAN/>

<https://www.rstudio.com/products/rstudio/download/#download>

3) A tool for graphic outputs. Here, I recommend to use the graphic functions of R through Rstudio.

COMMON INFO: GUI of Rstudio Desktop

List of objects used in scripts (for R)

You can write codes/scripts here (for C and R).

```
96 long sp_pool; //number of species
97
98 int *richness_cons, *richness_prod;
99 double *cost_cons, *cost_prod;
100 double *bge;
101 double alfa, beta, x, y;
102
103 //parameters for carbon resource
104 double *supply_C;
105 double loss;
106
107
108
109 int main (int argc, char *argv[])
110 {
111     long i, j, k, m, n;
112     long n_variable;
113     double t;
114     double deltat = DELTAZERO;
115     double tzero = 0.0;
116     double end_time = 365.0*100.0;
117     double extinct_time = 365.0*5.0;
118     long write_index;
119
120     //Setting for invasibility and assembly analysis
121     //matrix for invasibility
122     int **invasibility;
123     int *com_state, *com_state_init;
124
125     //for 2 substrate cases
126     double **eq_state;
127     double **eq_flux;
128
129     //for >2 substrate cases
130     double **eq_state_long;
131     double **eq_flux_long;
132
133     long com_state_decimal, com_state_max;
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```

Write commands/see messages

```
> #test03<-read.table("/base03t")
> test04<-read.table("/base04t")
> #test05<-read.table("/base05t")
> test06<-read.table("/base06t")
> plot(test01$V1, test01$V2, type="l", xlim=c(start_plot, end_plot), ylim=c(0, max(test01$V4)), main="algae", xlab="day", col=1)
> par(new=T)
> #One storms with competition, constant
> plot((test02$V1-start_plot), test02$V4, type="l", xlim=c(100, 250), ylim=c(0, max(test01$V4)), main="algae", xlab="day", col=1)
> par(new=T)
> plot((test04$V1-start_plot), test04$V4, type="p", lty=2, xlim=c(100, 250), ylim=c(0, max(test01$V4)), main="algae", xlab="day", col=1)
> par(new=T)
> plot((test06$V1-start_plot), test06$V4, type="l", lty=3, xlim=c(100, 250), ylim=c(0, max(test01$V4)), main="algae", xlab="day", col=1)
> par(new=T)
> plot((test02$V1-start_plot), test02$V2, type="l", lty=3, xlim=c(100, 250), ylim=c(0, max(test01$V4)), main="algae", xlab="day", col=1)
```

Environment

Object	Obs.	Vars.
test01	7300 obs.	8 variables
test02	7300 obs.	8 variables
test04	7300 obs.	8 variables
test06	7300 obs.	8 variables
test2	7299 obs.	8 variables
test3	7300 obs.	8 variables
test4	7299 obs.	8 variables

algae

Graphics and file information

Any problems?

- If you have any problems during installation, please let me know by e-mail (tksmiki@ntu.edu.tw).
- Also visit CEIBA website for checking the schedule and download materials