

Operating Systems, Virtual Machine and Cloud computing

Dumrong Mairiang, PhD

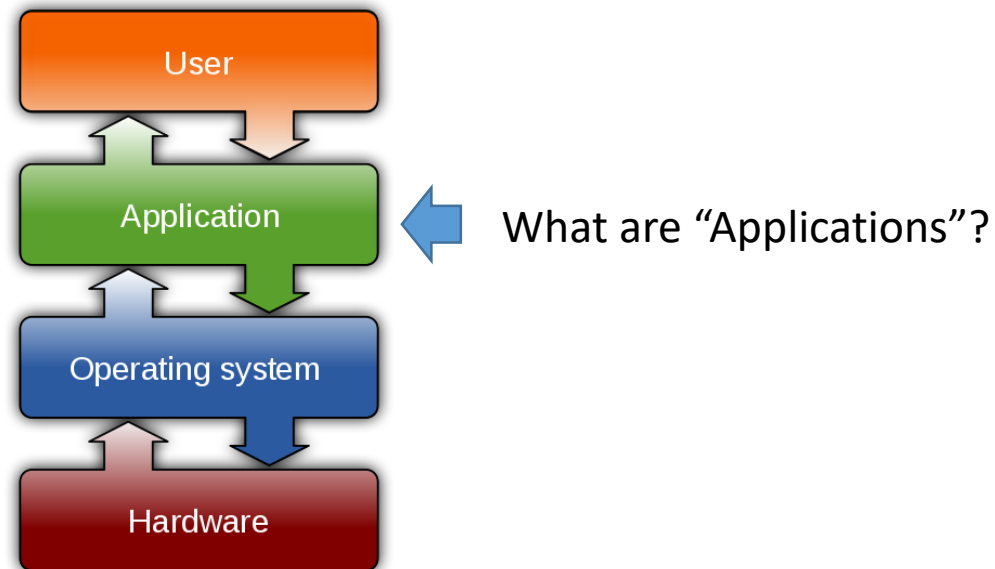
SIRE507: FUNDAMENTAL COMPUTER SCIENCE FOR BIOLOGIST

Operating system (OS)

- What is it?
- Why is it important?

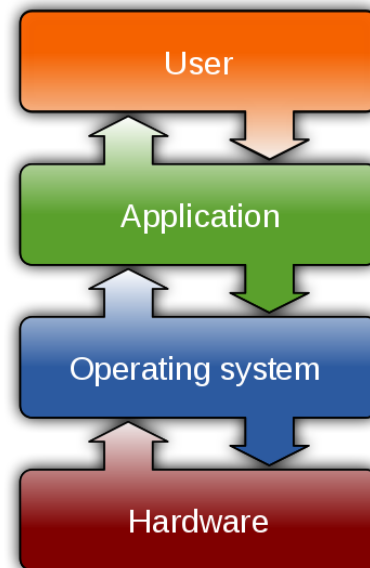
Operating system (OS)

- What is it?
 - The basic software that manages a computer
- Why is it important?



Operating system (OS)

- What is it?
 - The basic software that manages a computer
- Why is it important?



[Golftheman](#)



What are “Applications”?

Self-contained programs that perform a specific function



Operating system (OS)

- Do you know any OS?

Operating system (OS)

- Do you know any OS?



macOS High Sierra

ubuntu 

The Ubuntu logo, which is an orange circle containing a white stylized gear or flower-like shape.

Operating system (OS)

- Do you know any OS?



macOS High Sierra

ubuntu 

The Ubuntu logo, which is a red circle containing a white gear-like shape with eight dots around its perimeter.

Mobile OS

iOS



Operating system (OS)

- Do you know any OS?

Microsoft Windows family



Other



Unix/Unix-like family



FreeBSD

ORACLE
SOLARIS



Macintosh/Darwin

iOS
macOS

Linux



CentOS

ubuntu



fedora



debian

Why do you need to know about OSes?

Why do you need to know about OSes?

- Many (if not majority) of bioinformatic applications were developed for Unix-like or Linux OS
- If you want to develop a web application, web servers usually run with Linux
- Many free and open-source applications must be run on Unix-like or Linux OS

Operating system (OS)

- Old machine, legacy application and IoT:
 - 32-bit vs 64-bit (32-bit apps on Windows?)
 - Lite version/distribution of OS (e.g. Alpine, Lubuntu)
- Users of your application
 - Windows
 - General users with probably no or little bioinformatic background
 - Graphical user interface is likely to be expected
 - Unix-like/Linux
 - Bioinformaticians
 - Command lines are acceptable

Distinct features of each OS

- OS-specific file extensions
 - Microsoft Windows
 - File.exe
 - File.msi
 - Mac OS
 - File.dmg
 - Linux
 - File.deb

Distinct features of each OS

- File naming rules
 - Microsoft Windows
 - Reserved characters: \, /, :, ?, *, >, <, |, “
 - Linux and Mac OS
 - Reserved characters: /, >, <, |, &, (,), “, ‘
 - Reserved characters but will be “automatically escaped”: \, *, :, space
- As bioinformatician: Please AVOID using “space” in the file name
 - FileName.txt
 - File_Name.txt

Distinct features of each OS

- File paths to YourFile.txt in your “home” directory
 - Microsoft Windows
 - C:\Users\YourName\YourFile.txt
 - Mac OS
 - /Users/YourName/YourFile.txt
 - Linux
 - /home/YourName/YourFile.txt
 - Linux (root access)
 - /root/YourFile.txt

Distinct features of each OS

- Application for accessing command line
 - Microsoft Windows
 - Command Prompt
 - Mac OS
 - Terminal
 - Linux
 - Terminal

Distinct features of each OS

- Application for Back-up
 - Microsoft Windows
 - System Restore and Restore Point
 - Mac OS
 - Time Machine
 - Linux
 - Ubuntu backups
 - Backups application

Distinct features of each OS

- Application for Hardware Management/List
 - Microsoft Windows
 - Device Manager
 - Mac OS
 - System Reports (“About this Mac”)
 - Linux (Ubuntu)
 - hardinfo, lspci, lsusb

Distinct features of each OS

- Checking or interrupting programs
 - Microsoft Windows
 - Task Manager
 - Mac OS
 - top (basic) and htop (to be installed)
 - Linux (Ubuntu)
 - top (basic) and htop (to be installed)

Distinct features of each OS

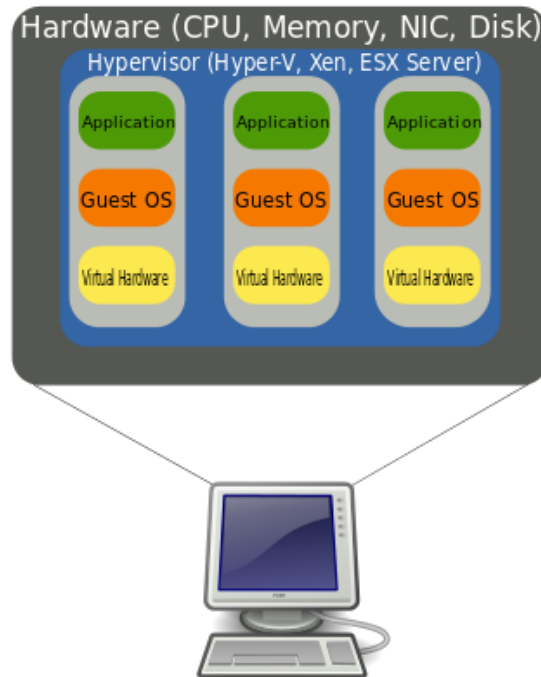
- Any other features?

Virtual Machine (VM)

- What is it?

Virtual Machine (VM)

- What is it?
 - A complete environment for a guest operating system to function as though that operating system were installed on its own computer



Virtual Machine (VM)

- What VM is not:
 - Virtual machine \neq Emulator
 - Emulator converts commands to and from a host machine to an entirely different platform
 - Emulator: DosBOX (CPU), PuTTY (Terminal), ZSNES (Gaming), PCSX2 (Gaming), N64 Emulator (Gaming)

Why do you need to know about VMs?

Why do you need to know about VMs?

- **SENARIO 1 (Flexibility):** The OS of your machine is not compatible with the application you need to run/test:
 - No spare machine for installing a new OS
 - No space or resources to create a dual boot

Why do you need to know about VMs?

- SENARIO 2 (Simulation): You want to simulate network connection to your web application in your own machine
 - No spare machine
 - Do not want to deploy in web server yet

Why do you need to know about VMs?

- SENARIO 3 (Security): Controlled/Quarantined environment for developing, testing or running applications
 - Potentially harmful applications
 - Secured VM

Why do you need to know about VMs?

- Any other scenario?

Let's create the first VM

- Applications for virtualization:
 - VM ware (Commercial)
 - **Oracle VM VirtualBox (Free and open-source)**
 - Vagrant (Free and open-source, but no GUI)
 - Other...

Let's create the first VM

- Check your machine
 - CPU: at least 2 cores
 - RAM: Host OS minimal requirement + Guest OS minimal requirement
 - Hard disk: Guest OS minimal requirement or External HDD or USB Flash drive

Let's create the first VM



The screenshot shows a web browser window with the address bar displaying <https://www.virtualbox.org/wiki/Downloads>. The page features the VirtualBox logo on the left and a large "VirtualBox" header. A sidebar on the left contains links: About, Screenshots, Downloads, Documentation (with sub-links for End-user docs and Technical docs), Contribute, and Community. The main content area is titled "Download VirtualBox" and includes a search bar, "Login", and "Preferences" links. The text states: "Here you will find links to VirtualBox binaries and its source code." Below this is the section "VirtualBox binaries" with the note: "By downloading, you agree to the terms and conditions of the respective license." It then says: "If you're looking for the latest VirtualBox 5.1 packages, see [VirtualBox 5.1 builds](#). Consider upgrading." The section "VirtualBox 5.2.18 platform packages" lists four options: [Windows hosts](#), [OS X hosts](#), [Linux distributions](#), and [Solaris hosts](#). A large blue arrow points to the "Linux distributions" link. Below the list, it says: "The binaries are released under the terms of the GPL version 2." and "See the [changelog](#) for what has changed." A paragraph follows: "You might want to compare the checksums to verify the integrity of downloaded packages. *The SHA256 checksums should be favored as the MD5 algorithm must be treated as insecure!*" This is followed by a bullet point: [SHA256 checksums, MD5 checksums](#). A "Note" states: "After upgrading VirtualBox it is recommended to upgrade the guest additions as well." The page ends with the section "VirtualBox 5.2.18 Oracle VM VirtualBox Extension Pack".

VirtualBox

Download VirtualBox

Here you will find links to VirtualBox binaries and its source code.

VirtualBox binaries

By downloading, you agree to the terms and conditions of the respective license.

If you're looking for the latest VirtualBox 5.1 packages, see [VirtualBox 5.1 builds](#). Consider upgrading.

VirtualBox 5.2.18 platform packages

- [Windows hosts](#)
- [OS X hosts](#)
- [Linux distributions](#)
- [Solaris hosts](#)

The binaries are released under the terms of the GPL version 2.

See the [changelog](#) for what has changed.

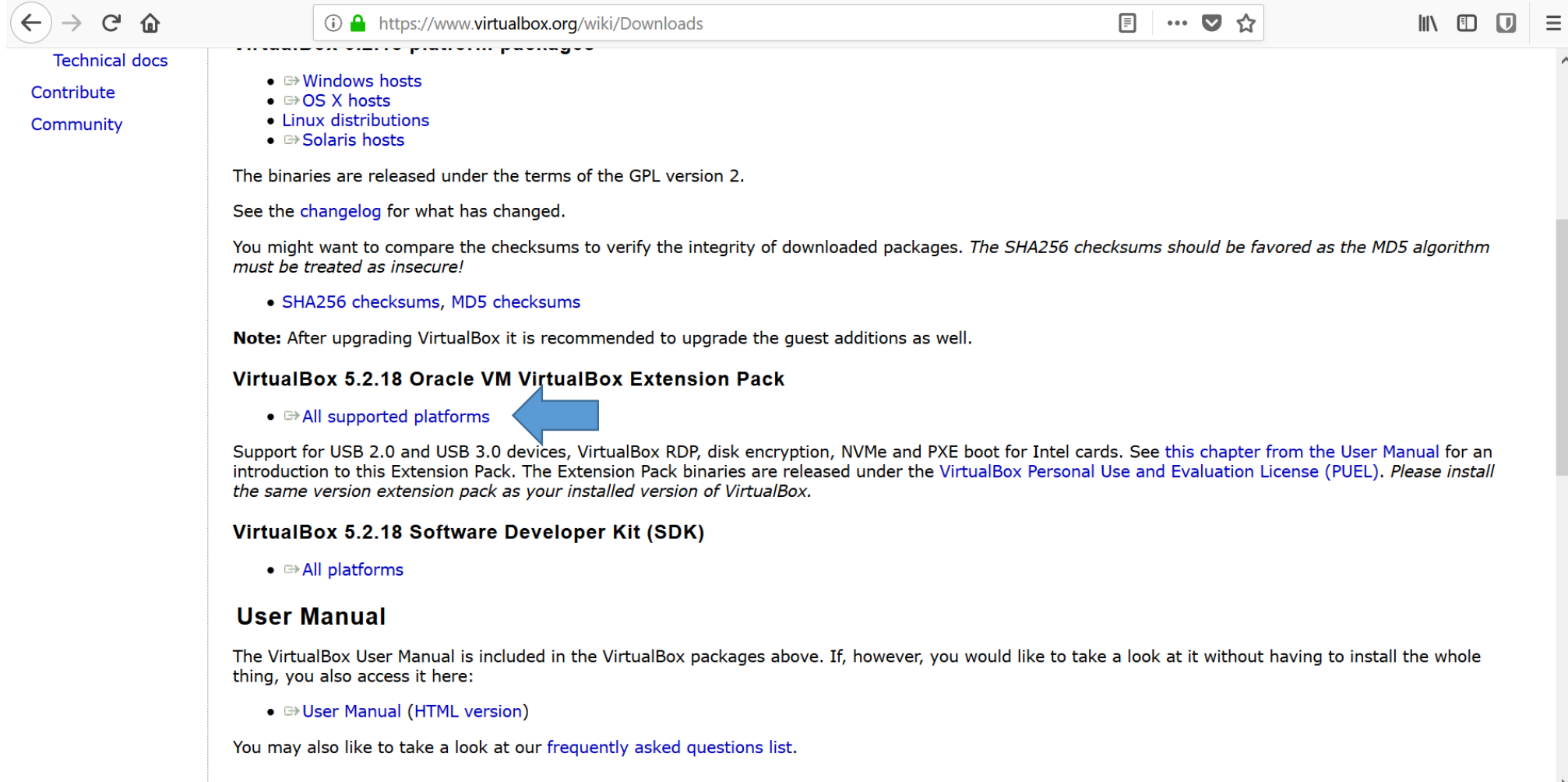
You might want to compare the checksums to verify the integrity of downloaded packages. *The SHA256 checksums should be favored as the MD5 algorithm must be treated as insecure!*

- [SHA256 checksums, MD5 checksums](#)

Note: After upgrading VirtualBox it is recommended to upgrade the guest additions as well.

VirtualBox 5.2.18 Oracle VM VirtualBox Extension Pack

Let's create the first VM



The screenshot shows a web browser window with the address bar displaying <https://www.virtualbox.org/wiki/Downloads>. The page content includes a sidebar with links to 'Technical docs', 'Contribute', and 'Community'. The main content area lists download links for various operating systems: Windows hosts, OS X hosts, Linux distributions, and Solaris hosts. It also mentions that binaries are released under the GPL version 2 and provides a changelog link. A note advises upgrading guest additions after upgrading VirtualBox. The 'VirtualBox 5.2.18 Oracle VM VirtualBox Extension Pack' section is highlighted with a blue arrow pointing to the 'All supported platforms' link. Below this, the 'VirtualBox 5.2.18 Software Developer Kit (SDK)' section is shown with a link to 'All platforms'. The 'User Manual' section is also visible, with a link to the 'User Manual (HTML version)'. The page footer mentions a 'frequently asked questions list'.

Technical docs
Contribute
Community

- [Windows hosts](#)
- [OS X hosts](#)
- [Linux distributions](#)
- [Solaris hosts](#)

The binaries are released under the terms of the GPL version 2.

See the [changelog](#) for what has changed.

You might want to compare the checksums to verify the integrity of downloaded packages. *The SHA256 checksums should be favored as the MD5 algorithm must be treated as insecure!*

- [SHA256 checksums, MD5 checksums](#)

Note: After upgrading VirtualBox it is recommended to upgrade the guest additions as well.

VirtualBox 5.2.18 Oracle VM VirtualBox Extension Pack

- [All supported platforms](#)

Support for USB 2.0 and USB 3.0 devices, VirtualBox RDP, disk encryption, NVMe and PXE boot for Intel cards. See [this chapter from the User Manual](#) for an introduction to this Extension Pack. The Extension Pack binaries are released under the [VirtualBox Personal Use and Evaluation License \(PUEL\)](#). *Please install the same version extension pack as your installed version of VirtualBox.*

VirtualBox 5.2.18 Software Developer Kit (SDK)

- [All platforms](#)

User Manual

The VirtualBox User Manual is included in the VirtualBox packages above. If, however, you would like to take a look at it without having to install the whole thing, you also access it here:

- [User Manual \(HTML version\)](#)

You may also like to take a look at our [frequently asked questions list](#).

Let's create the first VM

- Ubuntu.iso will be used for the demonstration

The screenshot shows the Ubuntu website's download page. The browser address bar displays `https://ubuntu.net/downloads/`. The website header includes the Ubuntu logo and navigation links: HOME, DOWNLOAD, BLOG, FORUM, DOCUMENTATION, SUPPORT, and ABOUT. The main heading is "Download Latest ubuntu Version 18.04", with a blue arrow pointing to the text "Suitable for most computers: ubuntu Desktop 64-bit". Below this, there are links for "ubuntu Desktop 32-bit", "ubuntu Alternate 32-bit", and "ubuntu Alternate 64-bit". A section titled "Choosing the right version:" lists several options, including "64-bit version suitable for PCs with Intel", "32-bit version, for most PCs older than", "PowerPC version for Apple Macintosh", "Mac64 version for Intel Macs, 2006 and later", and "For low-RAM (less than 700 MB) PCs". A file download dialog box is overlaid on the page, titled "Opening lubuntu-18.04-desktop-amd64.iso". It shows the file name "lubuntu-18.04-desktop-amd64.iso" (1.0 GB) and the source "http://cdimage.ubuntu.com". The dialog asks "What should Firefox do with this file?" and has three options: "Open with" (with a "Browse..." button), "Save File" (selected), and "Do this automatically for files like this from now on." (unchecked). The "OK" and "Cancel" buttons are at the bottom. On the right side of the page, there is a section for the "lubuntu Distro Generator Community" featuring tweets from users like Harsh Lathwal and Tarun Kumar.

lubuntu

HOME DOWNLOAD BLOG FORUM DOCUMENTATION SUPPORT ABOUT

Download Latest ubuntu Version 18.04

Suitable for most computers: ubuntu Desktop 64-bit

ubuntu Desktop 32-bit |
ubuntu Alternate 32-bit |
ubuntu Alternate 64-bit |

Choosing the right version:

- 64-bit version suitable for PCs with Intel
- 32-bit version, for most PCs older than
- PowerPC version for Apple Macintosh
- Mac64 version for Intel Macs, 2006 and later
- For low-RAM (less than 700 MB) PCs

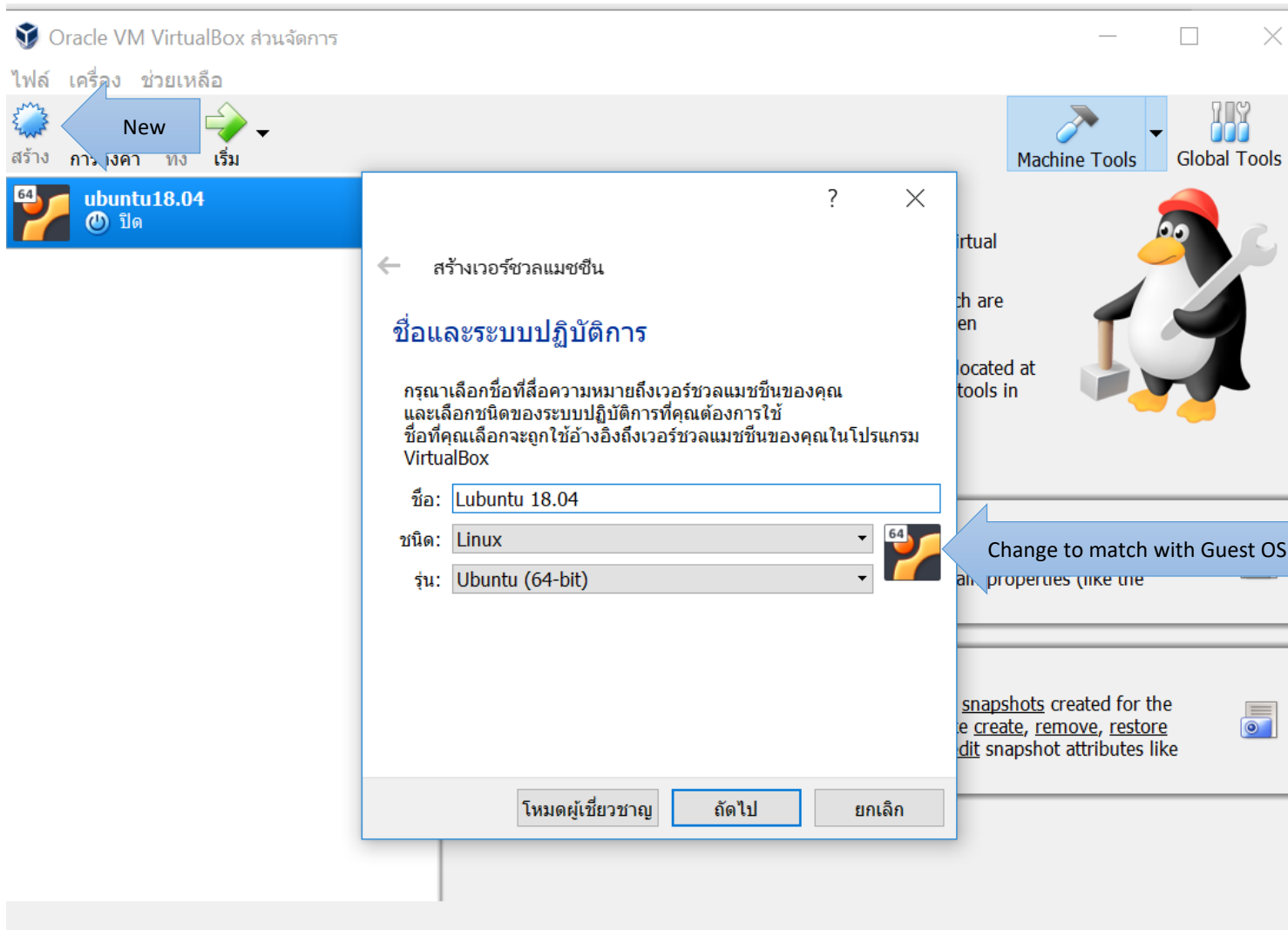
Download Raspberry Pi 2 & 3 Version (16.04)

lubuntu Distro Generator Community

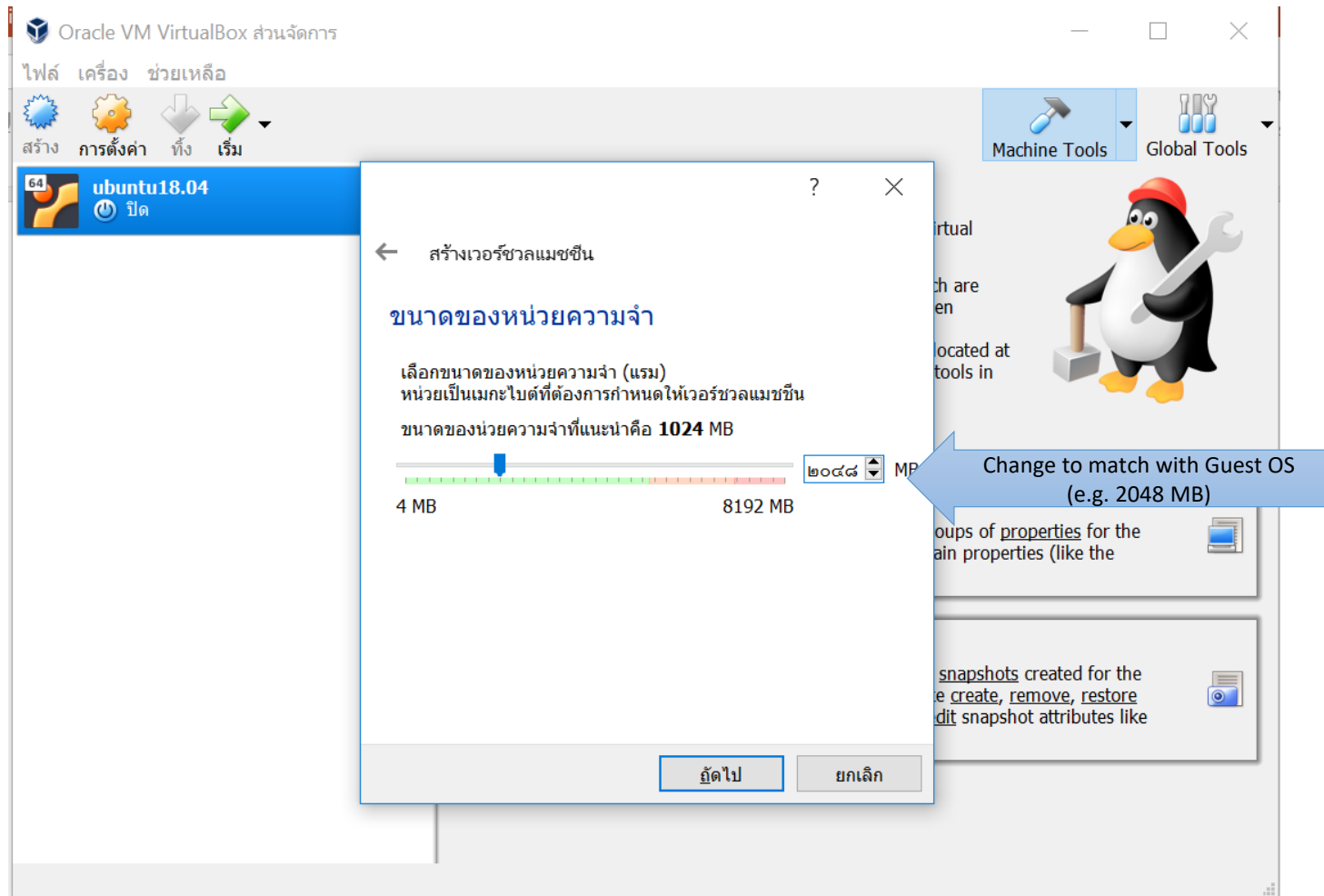
Meilix Retweeted
Harsh Lathwal @Xeon_Zolt
@fossasia @meilix_ @mariobehling
@dannhaltomeson @TarunKumar100
Feb 18, 2018

Meilix Retweeted
Tarun Kumar @TarunKumar100
Hosted the Open Source Session in IIT Patna with
@fossasia @mariobehling @hpdang @meilix_
@edenyay @mielamvn #FOSSASIA @gsoc

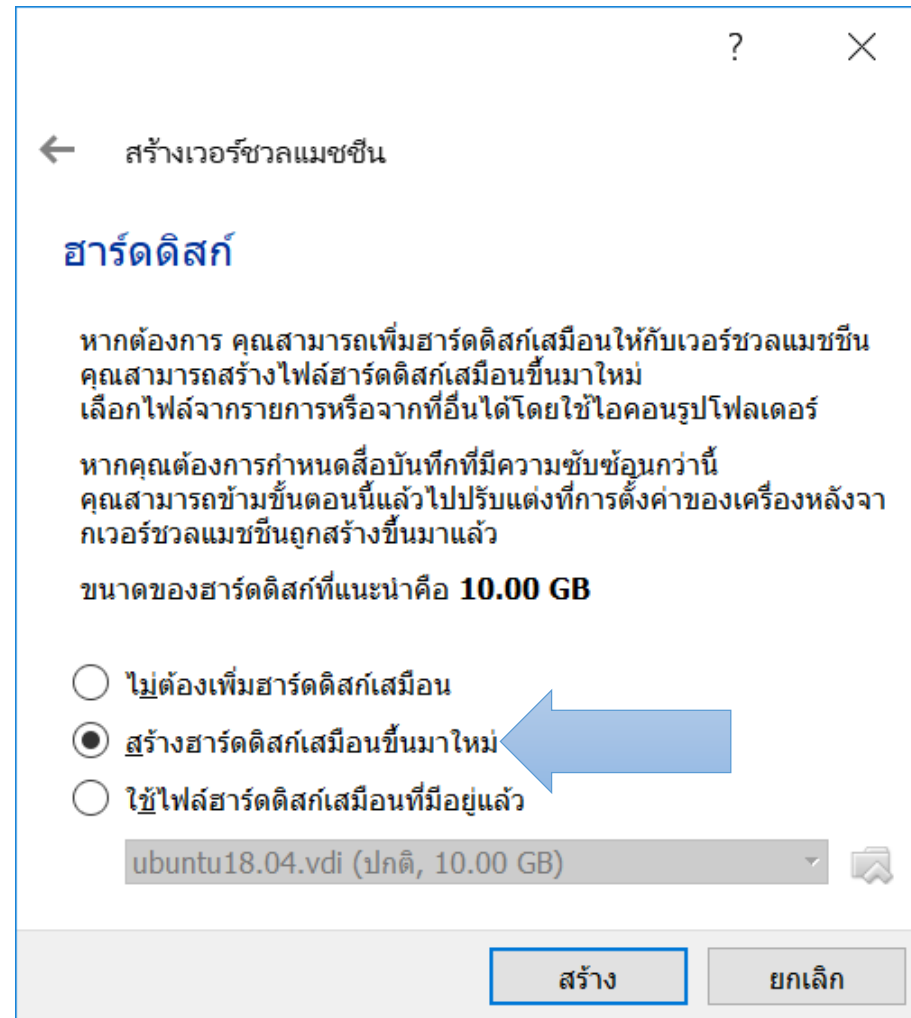
Let's create the first VM



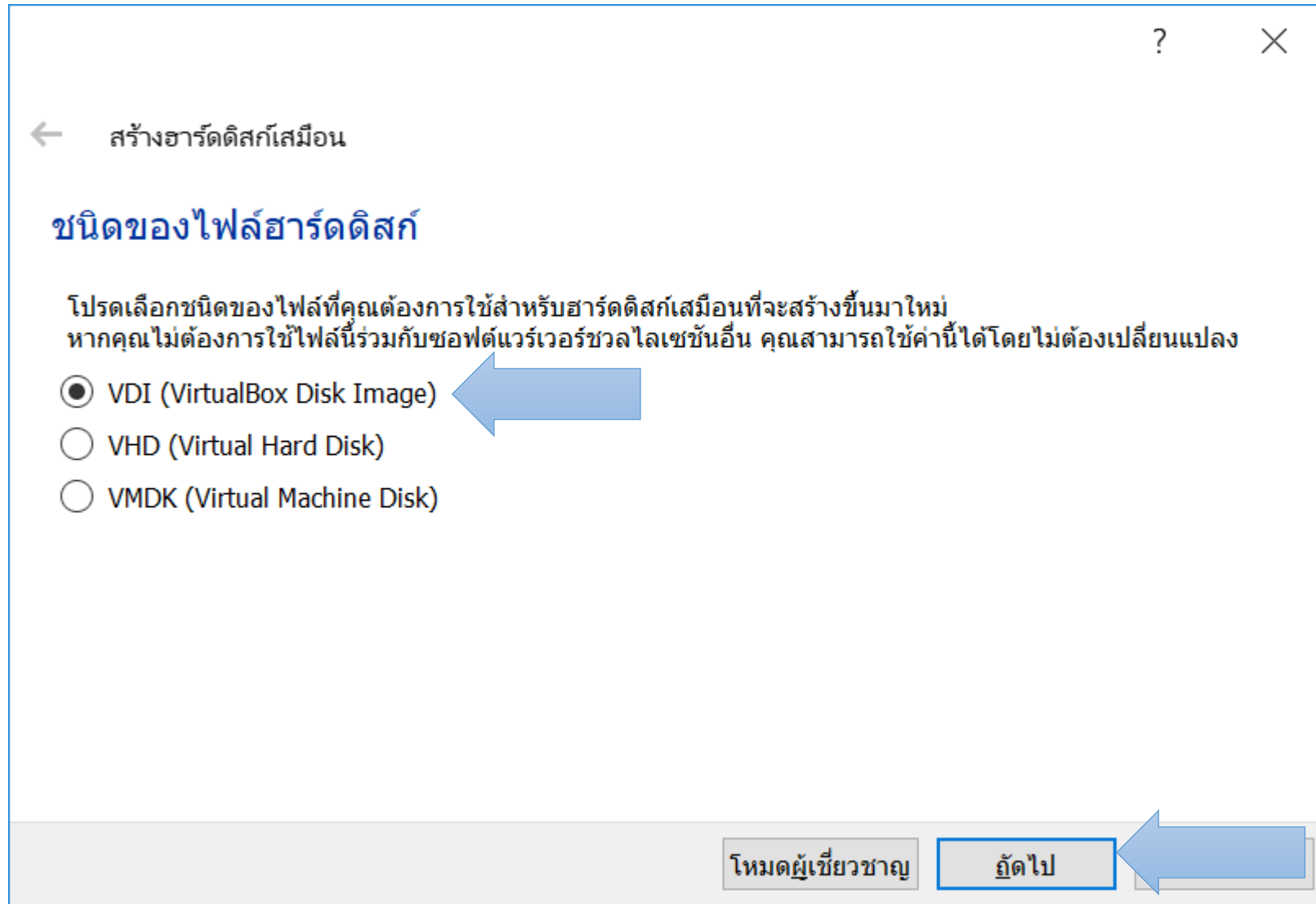
Let's create the first VM



Let's create the first VM



Let's create the first VM



Let's create the first VM

? ×

← สร้างฮาร์ดดิสก์เสมือน

สื่อบันทึกบนฮาร์ดดิสก์จริง

โปรดเลือกไฟล์ฮาร์ดดิสก์เวอร์ชวลบล็อกซ์ควรขยายขนาดตามการใช้งาน (จัดสรรแบบพลวัต)
หรือควรสร้างโดยใช้ขนาดสูงสุด (ขนาดคงที่)

ฮาร์ดดิสก์ที่**จัดสรรแบบพลวัต** จะใช้พื้นที่บนฮาร์ดดิสก์กายภาพของคุณเพิ่มขึ้นตามการใช้งาน (จนถึง **ขนาดคงที่** ที่ระบุไว้) แต่มันจะไม่ลดขนาดลงโดยอัตโนมัติแม้พื้นที่ภายในจะว่างลง

ไฟล์ฮาร์ดดิสก์ **ขนาดคงที่** อาจใช้เวลานานในการสร้างบนบางระบบ แต่มักทำงานได้เร็วกว่า

☒ จัดสรรแบบ**พลวัต** ← Dynamics
☐ ขนาด**คงที่**

ถัดไป

←

Let's create the first VM

← สร้างฮาร์ดดิสก์เสมือน

ที่ตั้งและขนาดของไฟล์

โปรดป้อนชื่อไฟล์สำหรับฮาร์ดดิสก์เสมือนที่สร้างขึ้นใหม่ลงในกล่องด้านล่าง
หรือคลิกไอคอนโฟลเดอร์เพื่อเลือกโฟลเดอร์อื่นสำหรับการสร้างไฟล์

D:\virtualbox\Lubuntu 18.04.vdi

เลือกขนาดไฟล์เวอร์ชวลฮาร์ดดิสก์มีหน่วยเป็นเมกะไบต์
ขนาดนี้ถูกใช้เพื่อจำกัดขนาดของข้อมูลที่เวอร์ชวลแมชีนจะสามารถบันทึกลงในฮาร์ดดิสก์ได้

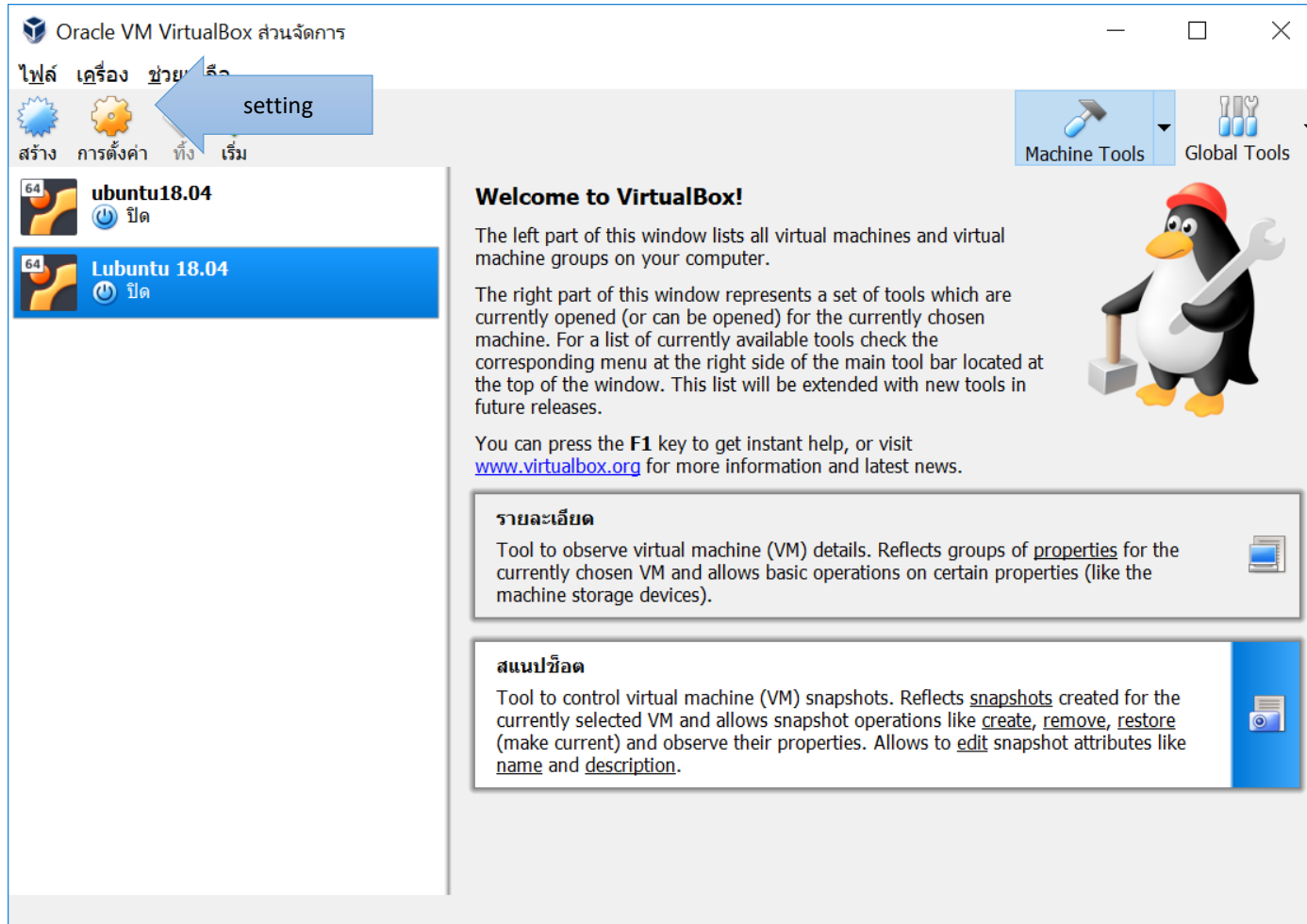
4.00 MB 2.00 TB 50 GB

สร้าง

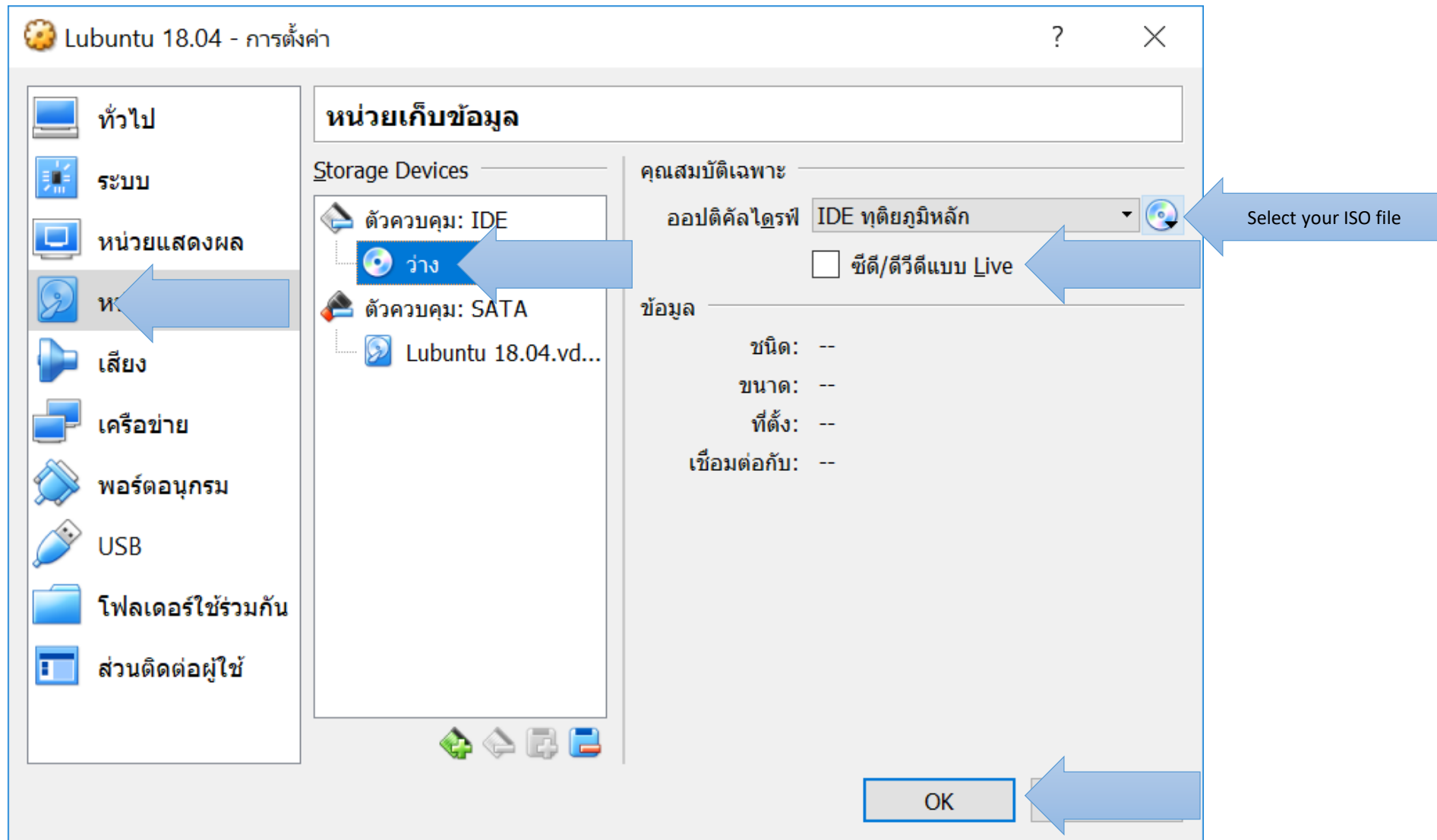
Change to appropriate path

Change to appropriate size

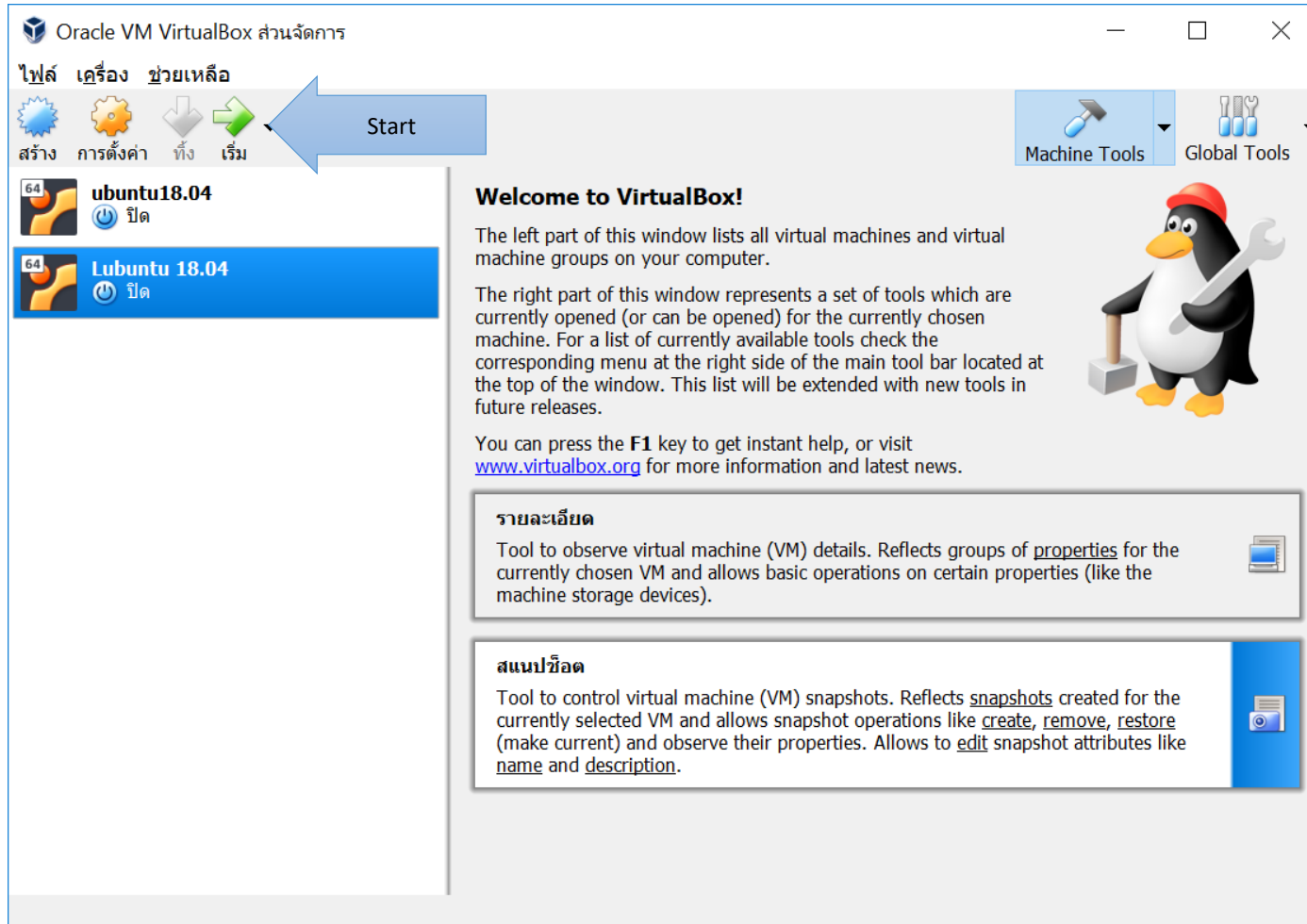
Let's create the first VM



Let's create the first VM

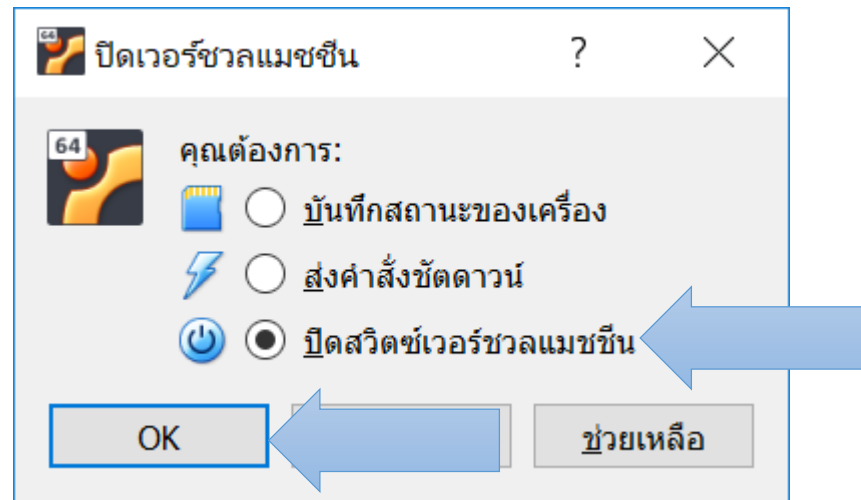


Let's create the first VM

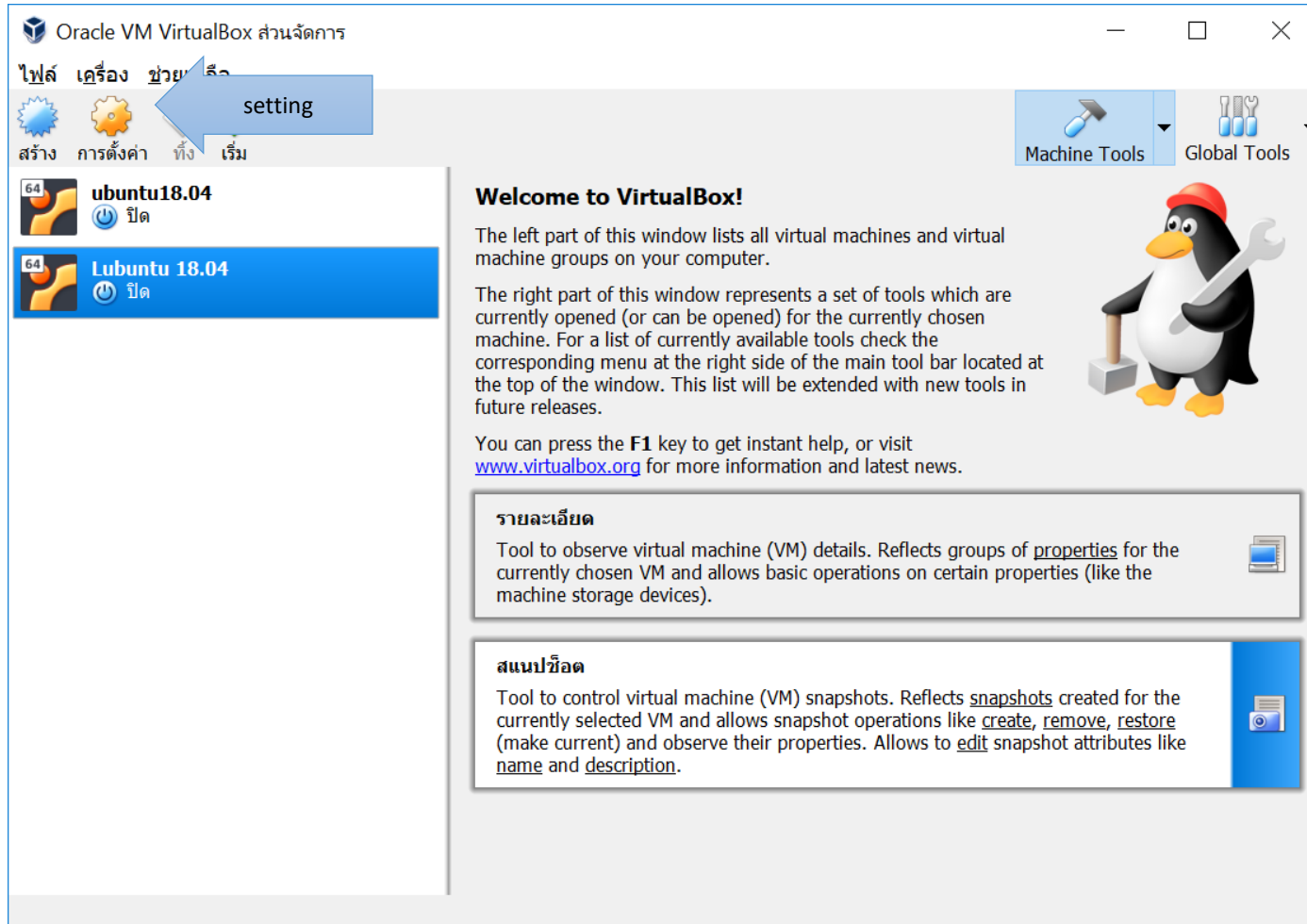


Let's create the first VM

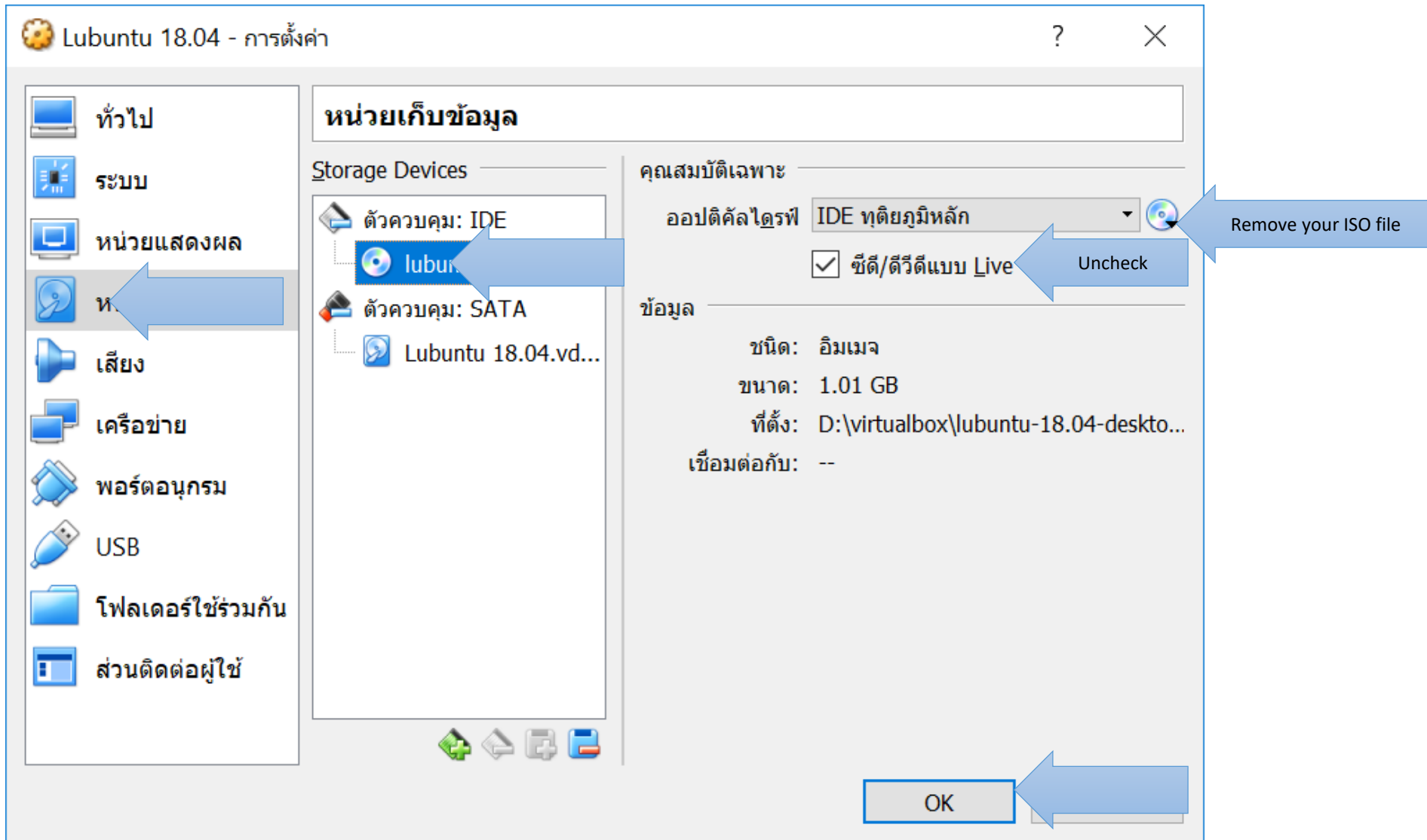
- Install Ubuntu according to instructions
- After installation is done, close the VM → Switch off



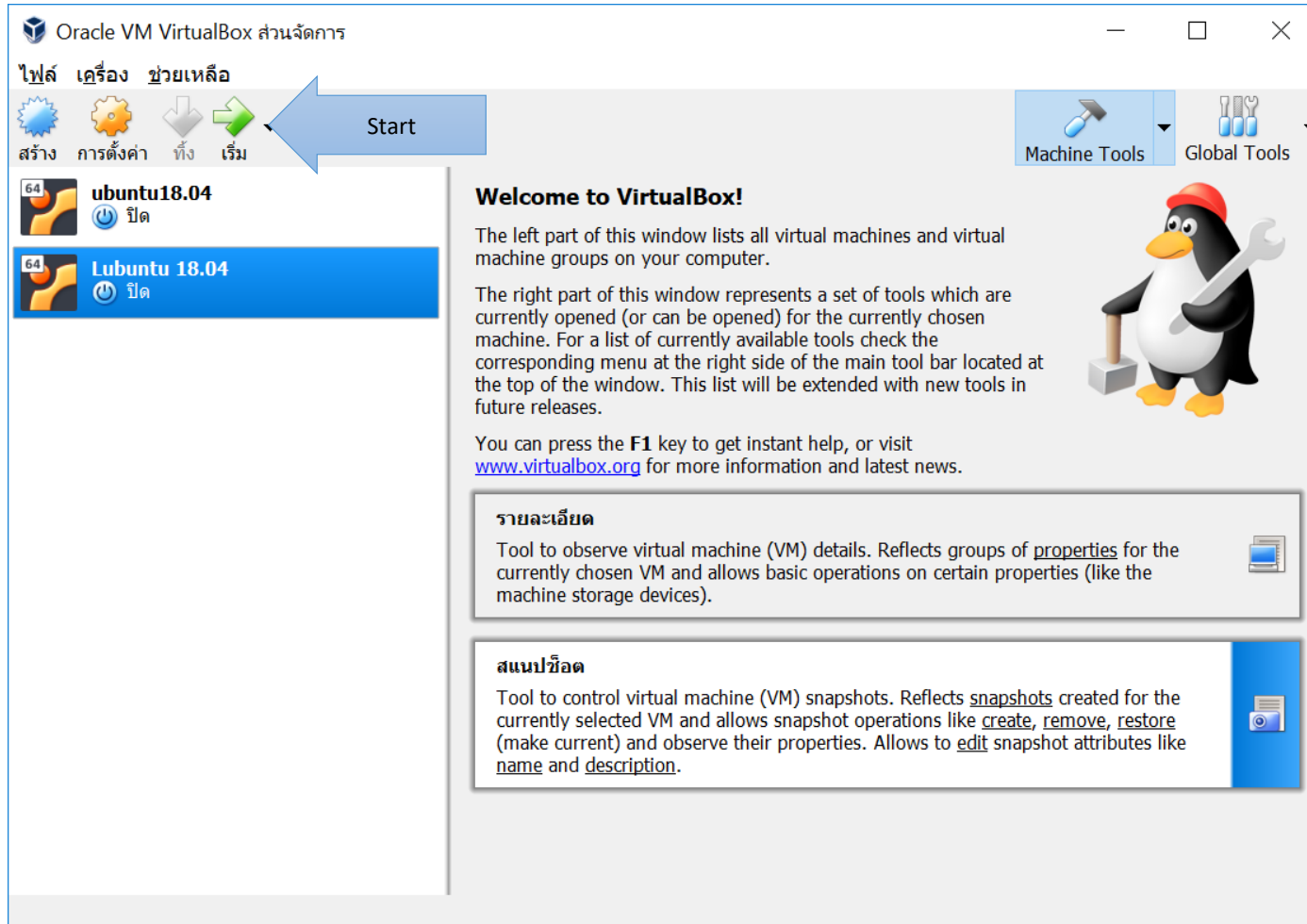
Let's create the first VM



Let's create the first VM



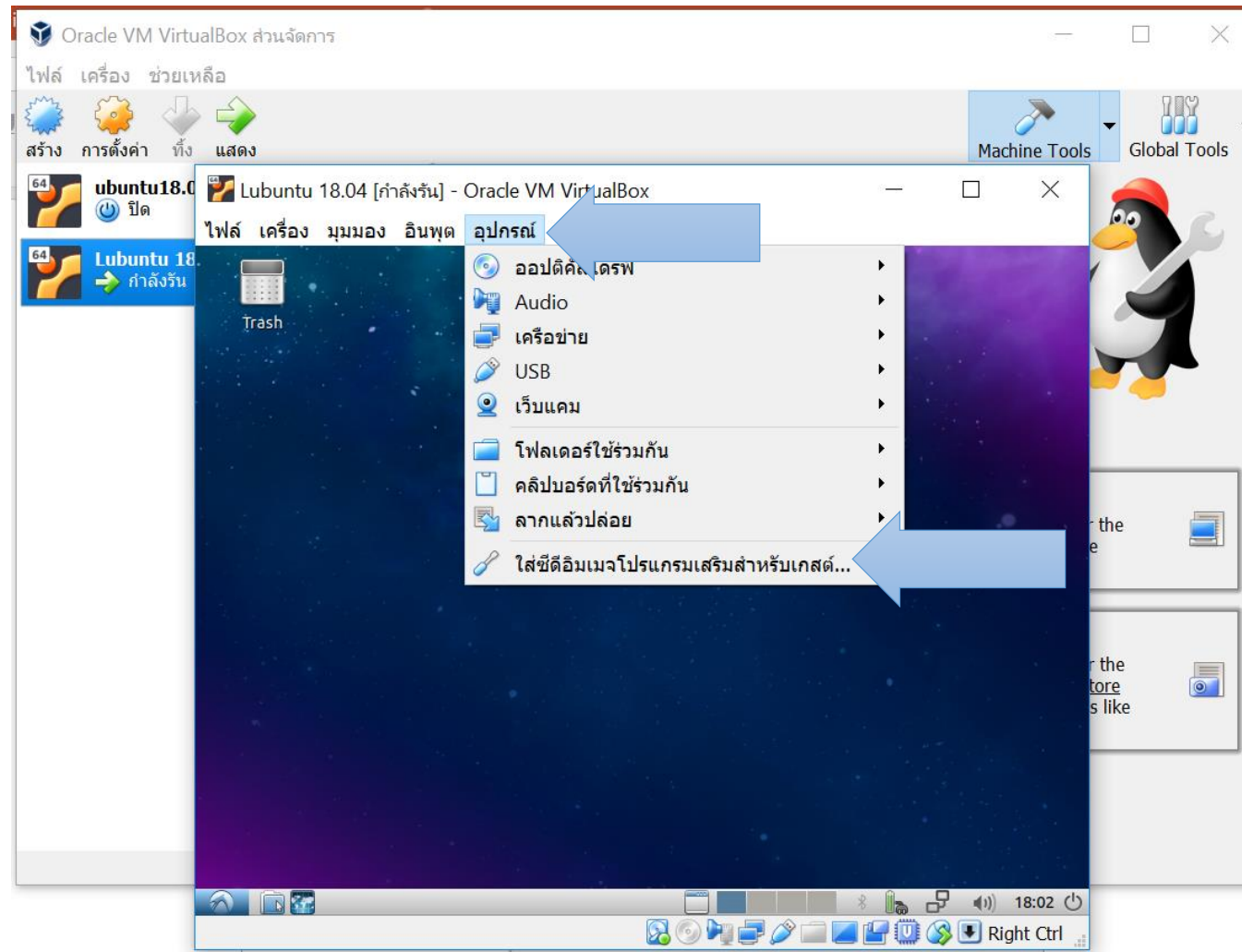
Let's create the first VM



Let's create the first VM

1. Run guest additions
2. Set a shared folder

Run guest additions



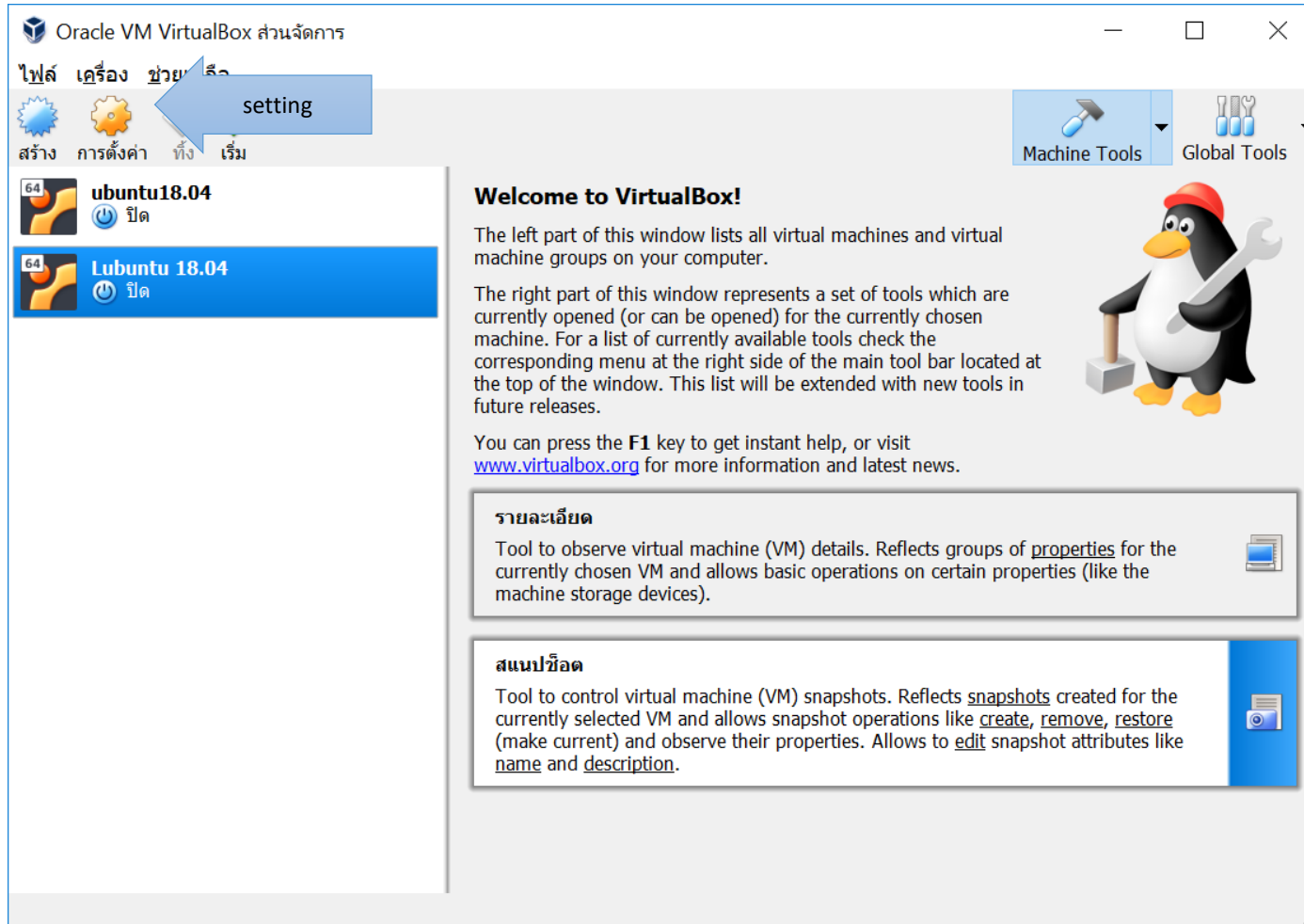
Run guest additions

- Open the Terminal

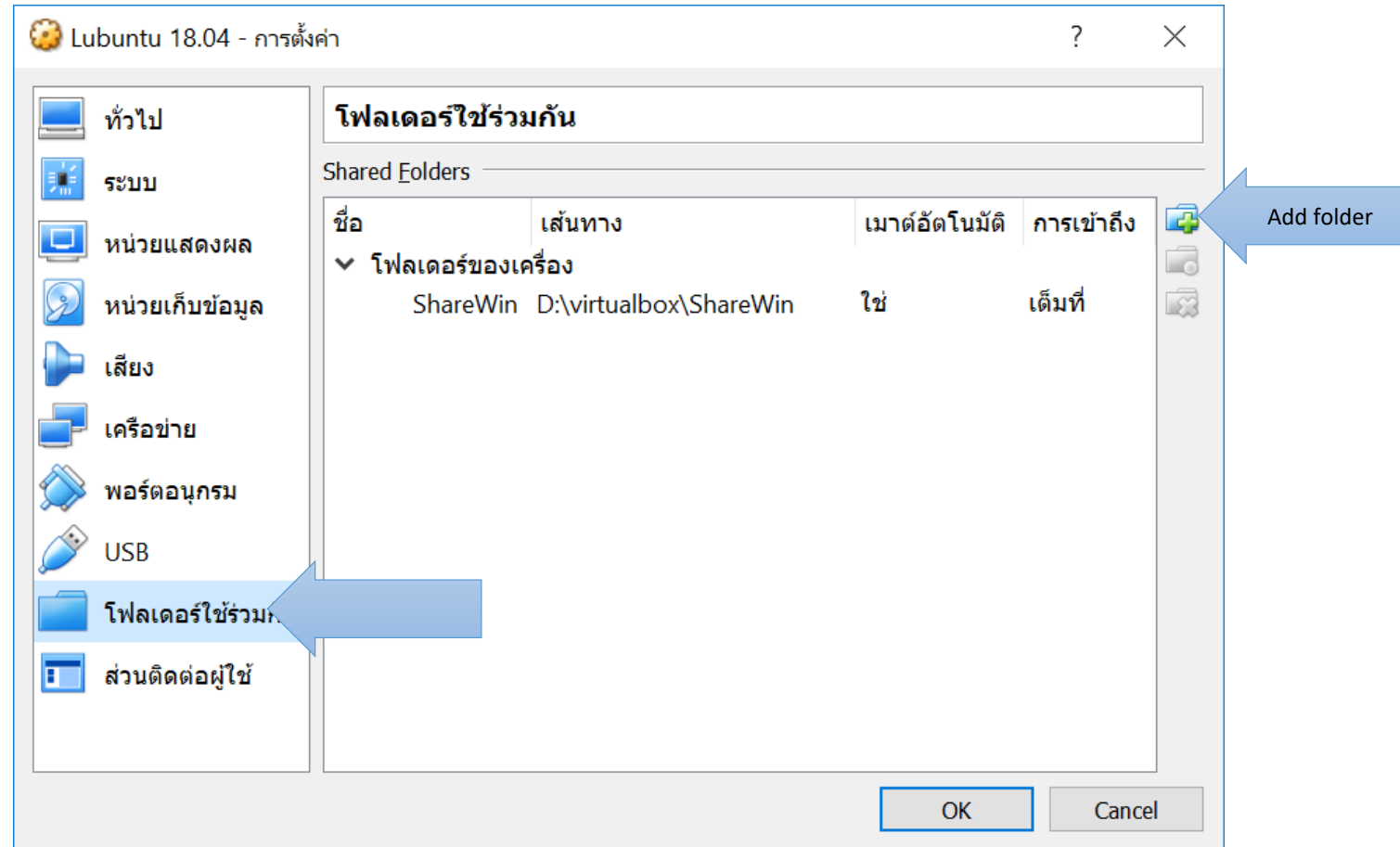
```
cd /media/YourName/VBox_GAs_5.x.x  
sudo sh ./VBoxLinuxAdditions.run
```

- Shutdown and restart

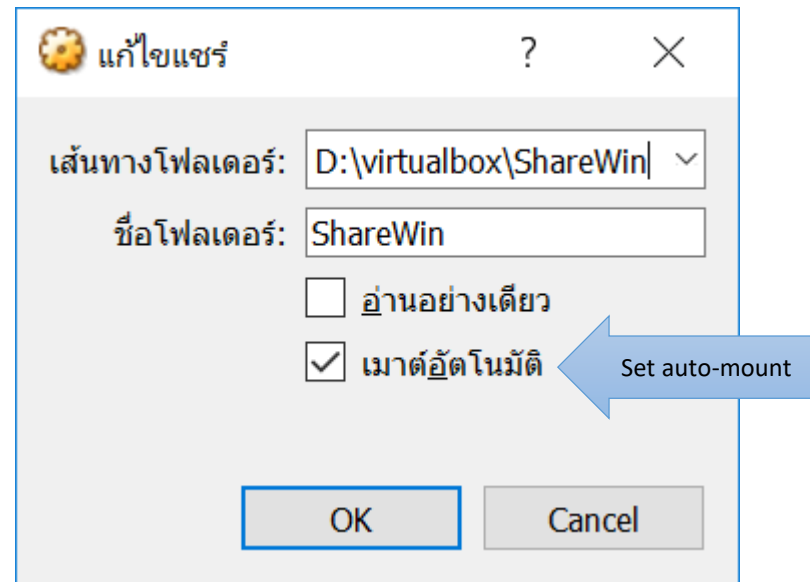
Set a shared folder



Set a shared folder



Set a shared folder



Set a shared folder

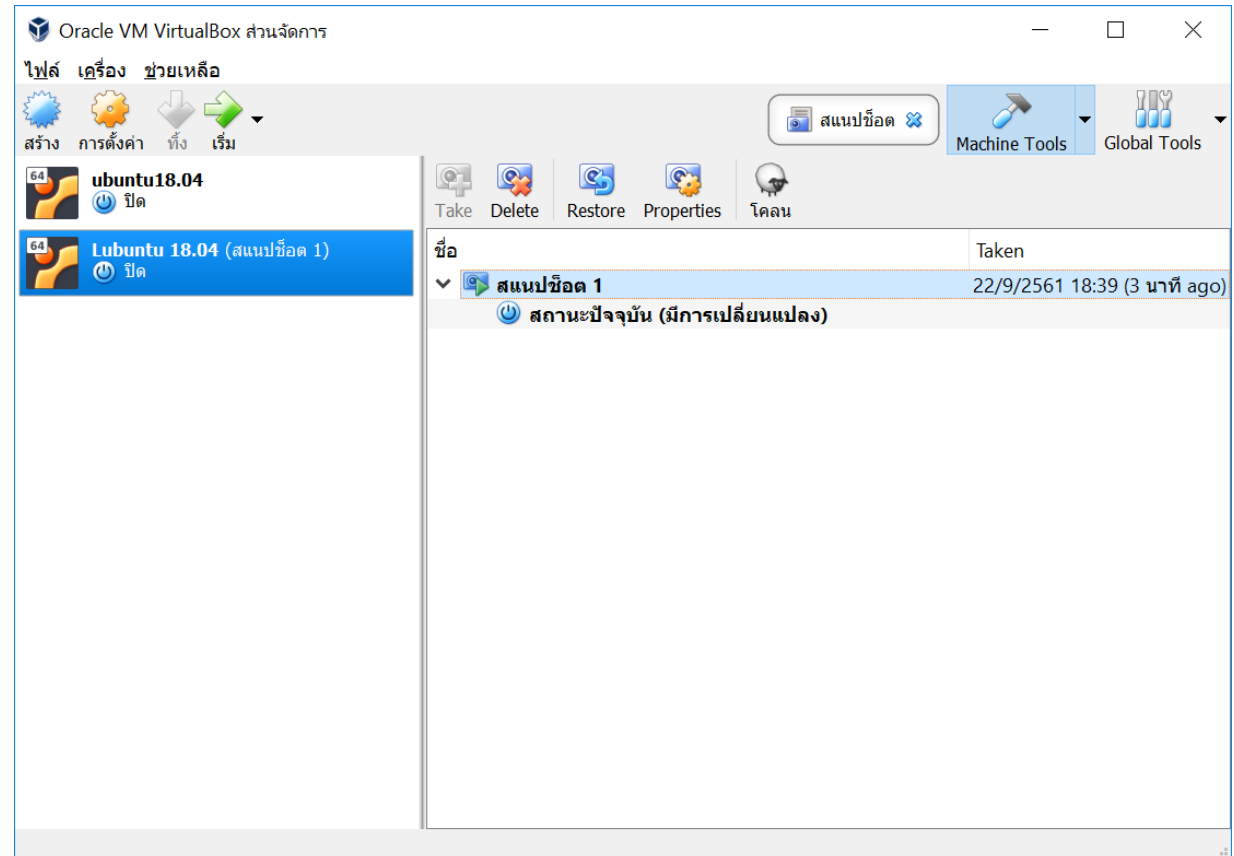
- Switch on the VM
- Open the Terminal

```
sudo usermod -aG vboxsf YourName
```

- Shutdown and restart

Backups by snapshot

- Backup = A copy of files from a computer's hard disk, usually made on some external medium such as CD-ROM or flash drive
- Save a snapshot (R Ctrl + T)



Portable VM

- You can save file.vdi to external HDD or USB flash drive
- Connect to any host machine with Virtualbox to quickly create a copy of VM in file.vdi
- **NOTE:**
 - USB flash drive must be formatted as NTFS
 - FAT32 format (default format in some USB flash drives) cannot accommodate a single file larger than 4GB

Cloud computing

- What is it?

Cloud computing

- What is it?
- Cloud computing, often referred to as simply “the cloud,” is the delivery of on-demand computing resources — everything from applications to data centers — over the internet on a pay-for-use basis.
 - Elastic resources — Scale up or down quickly and easily to meet demand
 - Metered service so you only pay for what you use
 - Self service — All the IT resources you need with self-service access



IBM Cloud






<https://www.ibm.com/cloud/learn/what-is-cloud-computing>

Why do you need to know Cloud Computing?

Why do you need to know Cloud Computing?

- Web application deployment
- Requiring intensive but transient computing power
- Backup and archive
- Sharing and hosting (Public cloud)
- Anything else?

Cloud service providers

- Amazon web services 
- Google cloud platform  Google Cloud Platform
- Microsoft Azure 
- IBM cloud  IBM **Cloud**
- Digital Ocean  **DigitalOcean**

Hands on: Cloud Computing PPT