

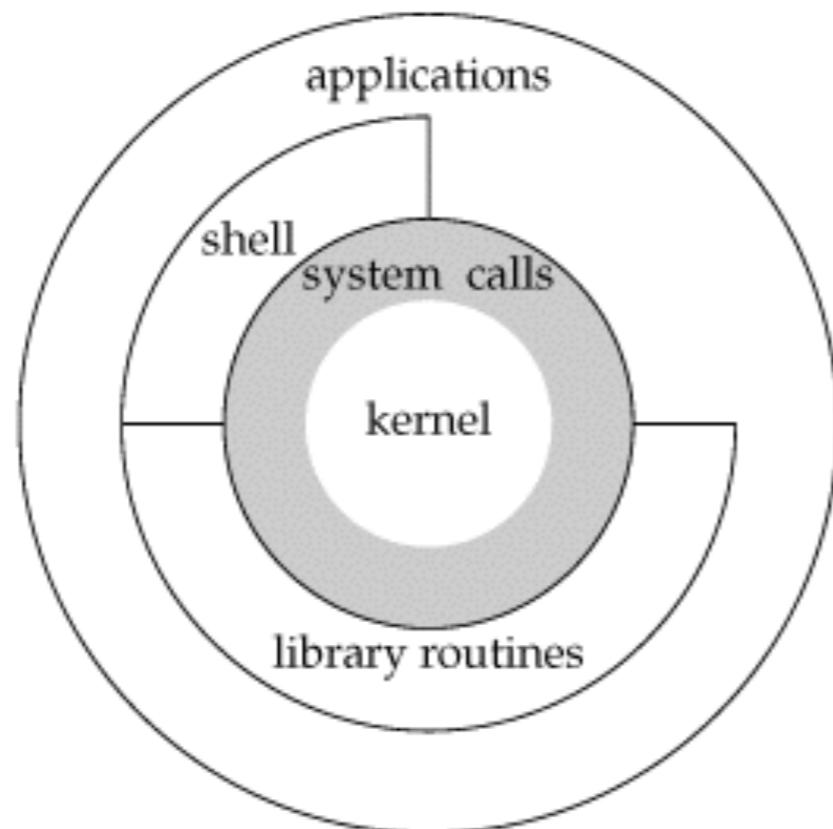
# System Programming

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# Introduction

# UNIX Architecture

**Figure 1.1. Architecture of the UNIX operating system**



**Kernel:** the software that controls the hardware resources of the computer and provides an environment under which programs can run

**System call:** the interface to the kernel is a layer of software

**Libraries of common functions** are built on top of the system call interface

**Shell:** A special application that provides an interface for running other applications

# Logging In

- **/etc/passwd**
  - the login name, encrypted password, numeric user ID (205), numeric group ID (105), a comment field, home directory (/home/sar), and shell program (/bin/ksh).
  - **sar:x:205:105:Stephen Rago:/home/sar:/bin/ksh**

# Shell

- The shell is the program that runs when you log in.
  - It prints the prompt and reads what you type, invokes programs, etc.
  - Your window to the Unix world!!

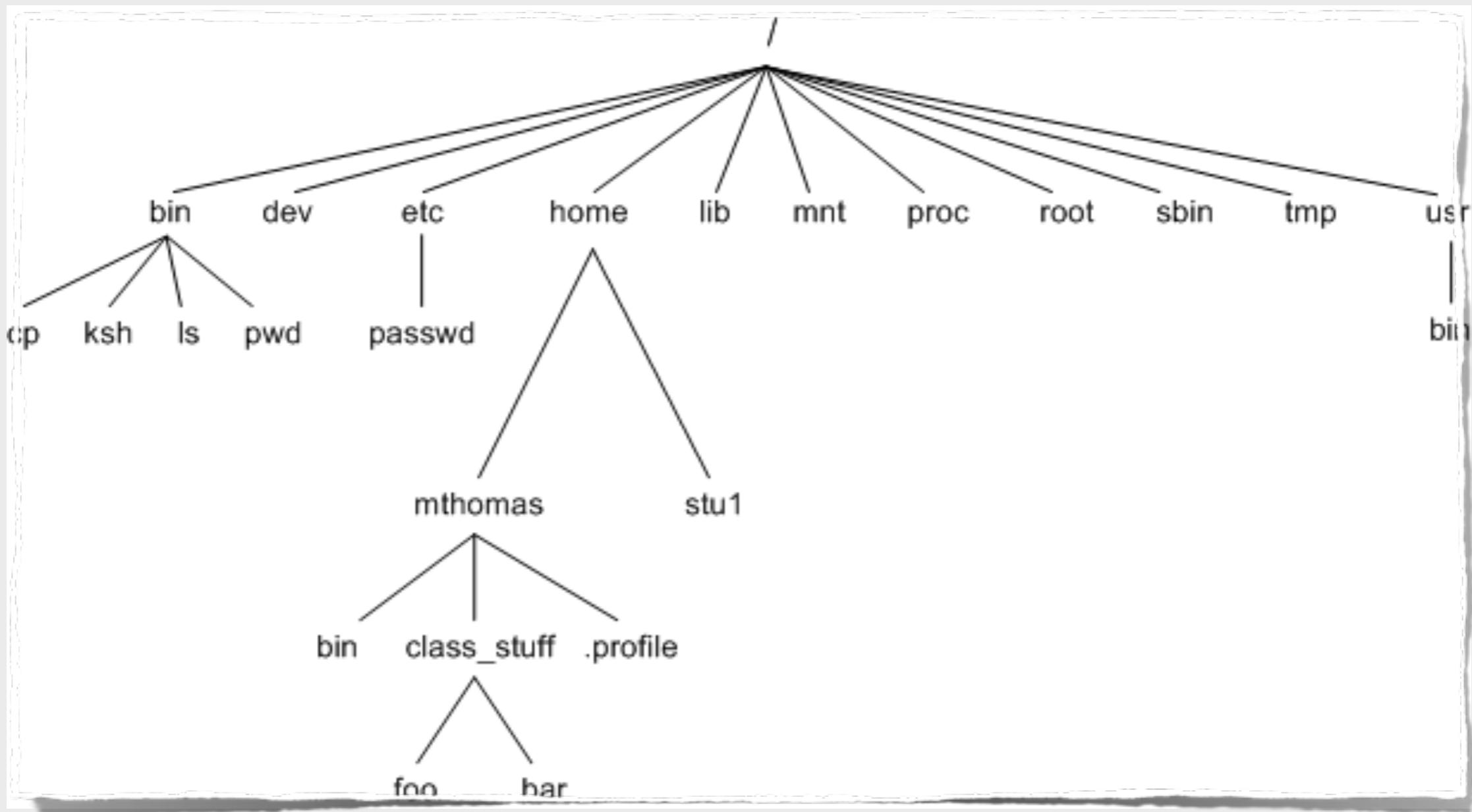
**Figure 1.2. Common shells used on UNIX systems**

Name	Path	FreeBSD 5.2.1	Linux 2.4.22	Mac OS X 10.3	Solaris 9
Bourne shell	/bin/sh	•	link to bash	link to bash	•
Bourne-again shell	/bin/bash	optional	•	•	•
C shell	/bin/csh	link to tcsh	link to tcsh	link to tcsh	•
Korn shell	/bin/ksh				•
TENEX C shell	/bin/tcsh	•	•	•	•

# Files and Directories

- **Filesystem**
  - A hierarchical arrangement of directories and files
    - starting in root /
- **File**
  - No / or **null** char in filenames
    - . and ..
  - BSD: 255-char filenames (14 in the past)

# Files and Directories



# Files and Directories

- Path name
  - Absolute path name
    - Start at the root `/` of the file system
      - `/user/john/fileA`
  - Relative path name
    - Start at the “current directory” which is an attribute of the process accessing the path name.
      - `./dirA/fileB`

# Task I: Install Ubuntu on Your Computer

## I. Download and install VirtualBox

- <https://www.virtualbox.org/>
- VirtualBox 4.3.22 for Windows hosts
- VirtualBox 4.3.22 for OS X hosts

## 2. Download Ubuntu

- <http://www.ubuntu.com/>
- Ubuntu 14.04.2 LTS

# Task I: Install Ubuntu on Your Computer

## 3. Installing Ubuntu inside Windows using VirtualBox

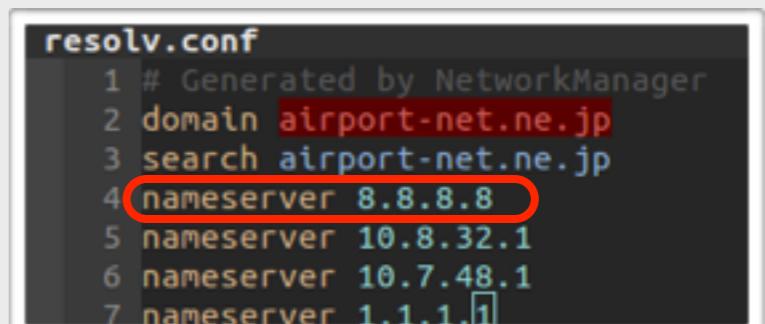
- <http://www.psychocats.net/ubuntu/virtualbox>
- <http://it-easy.tw/ubuntu-11-04-install/>

!! Before installation, choose bridge\* to attach your network (optional).

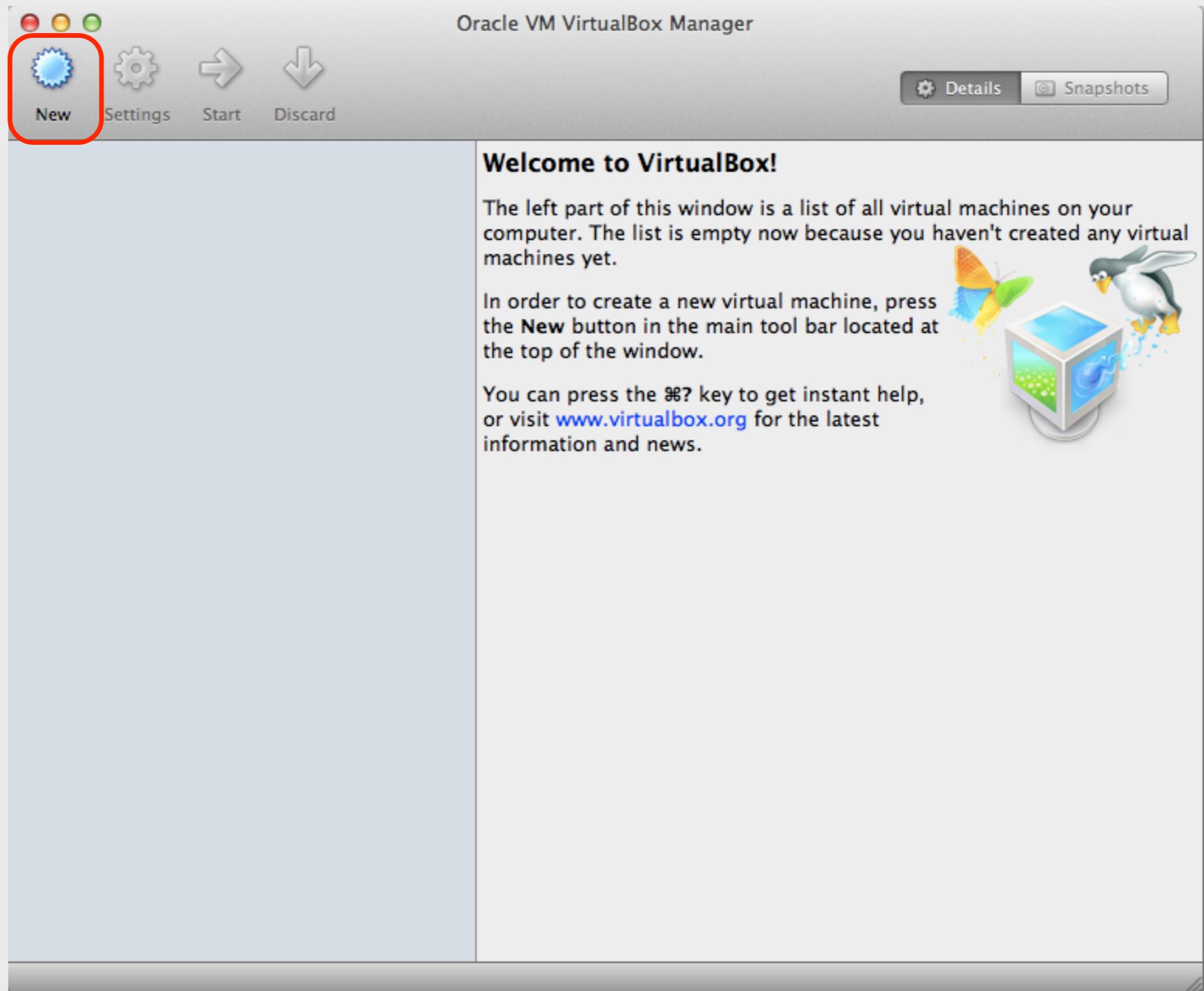
## 4. Install Guest Additions

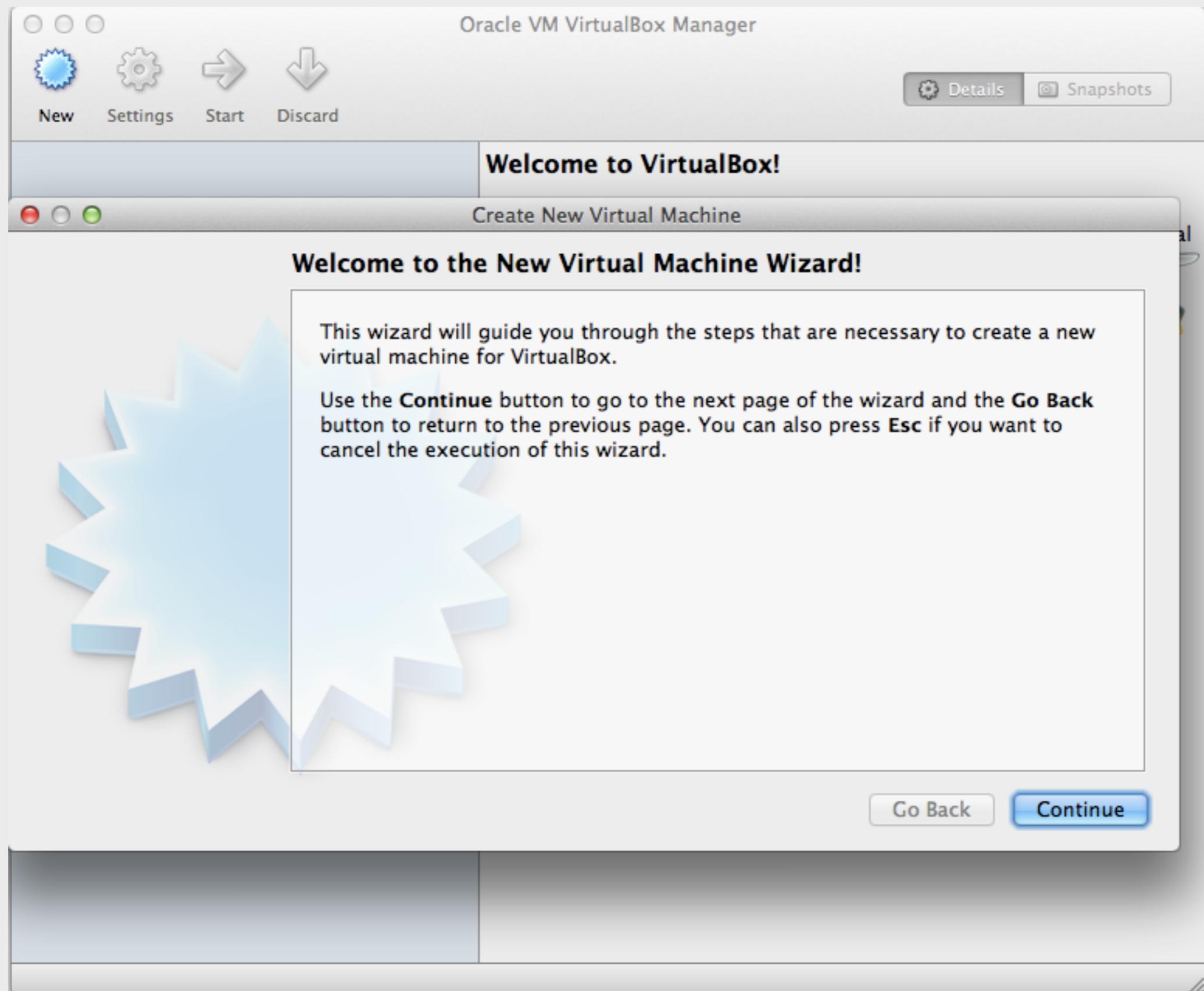
- Devices -> Install Guest Addition

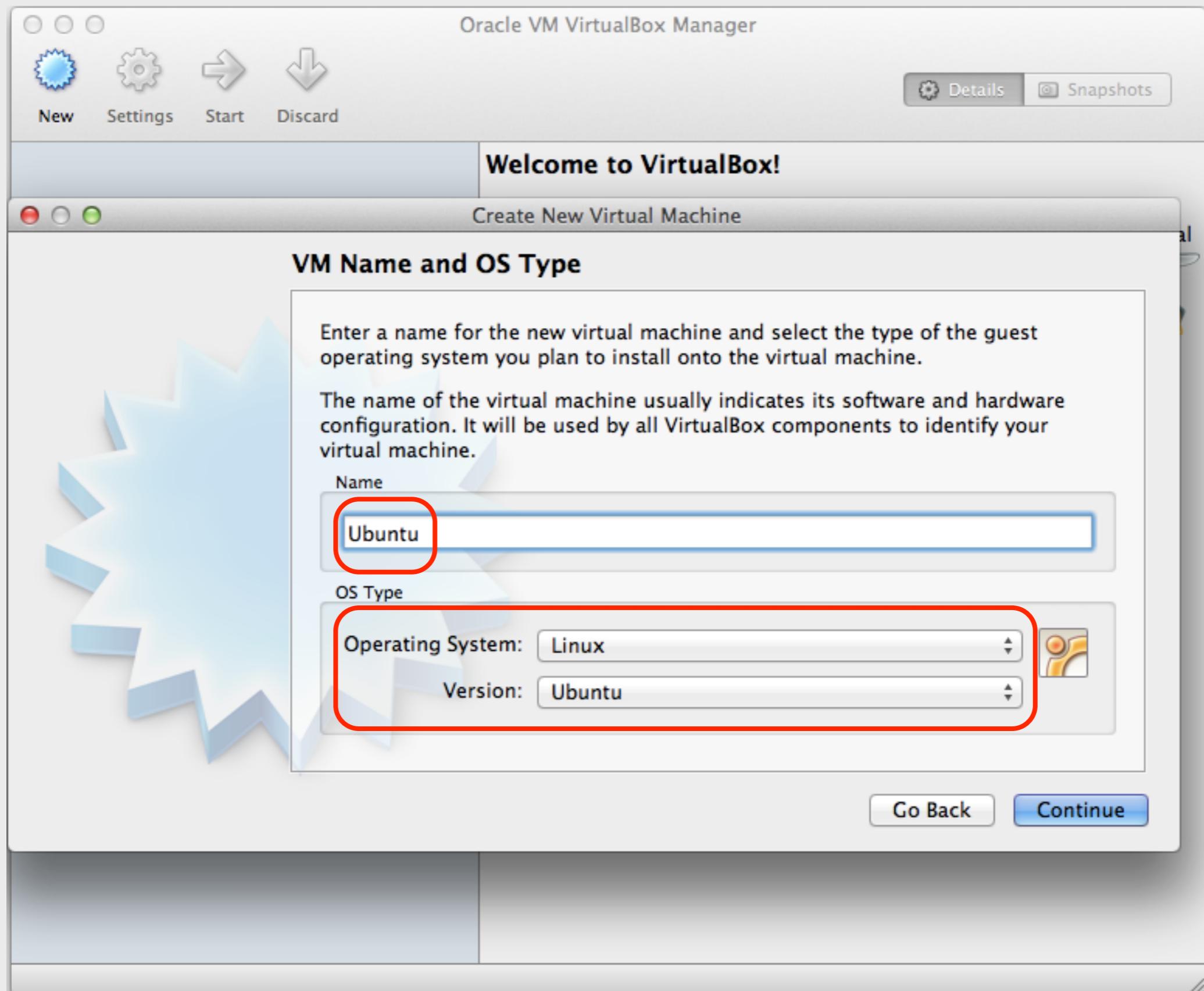
\* The default setting for networking is NAT. You may need to add a valid DNS server (such as 8.8.8.8) in the file /etc/resolv.conf.

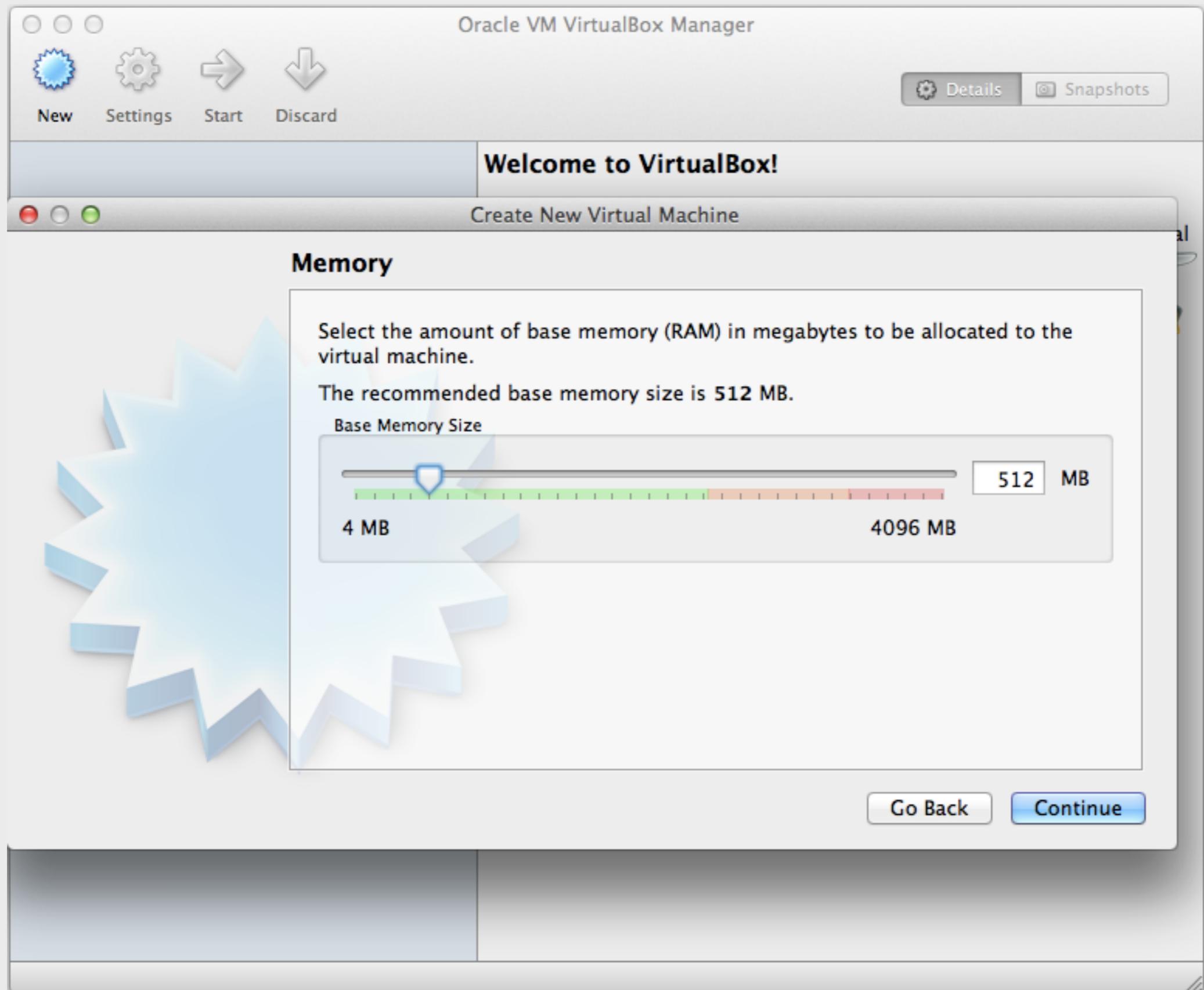


```
resolv.conf
1 # Generated by NetworkManager
2 domain airport-net.ne.jp
3 search airport-net.ne.jp
4 nameserver 8.8.8.8
5 nameserver 10.8.32.1
6 nameserver 10.7.48.1
7 nameserver 1.1.1.1
```

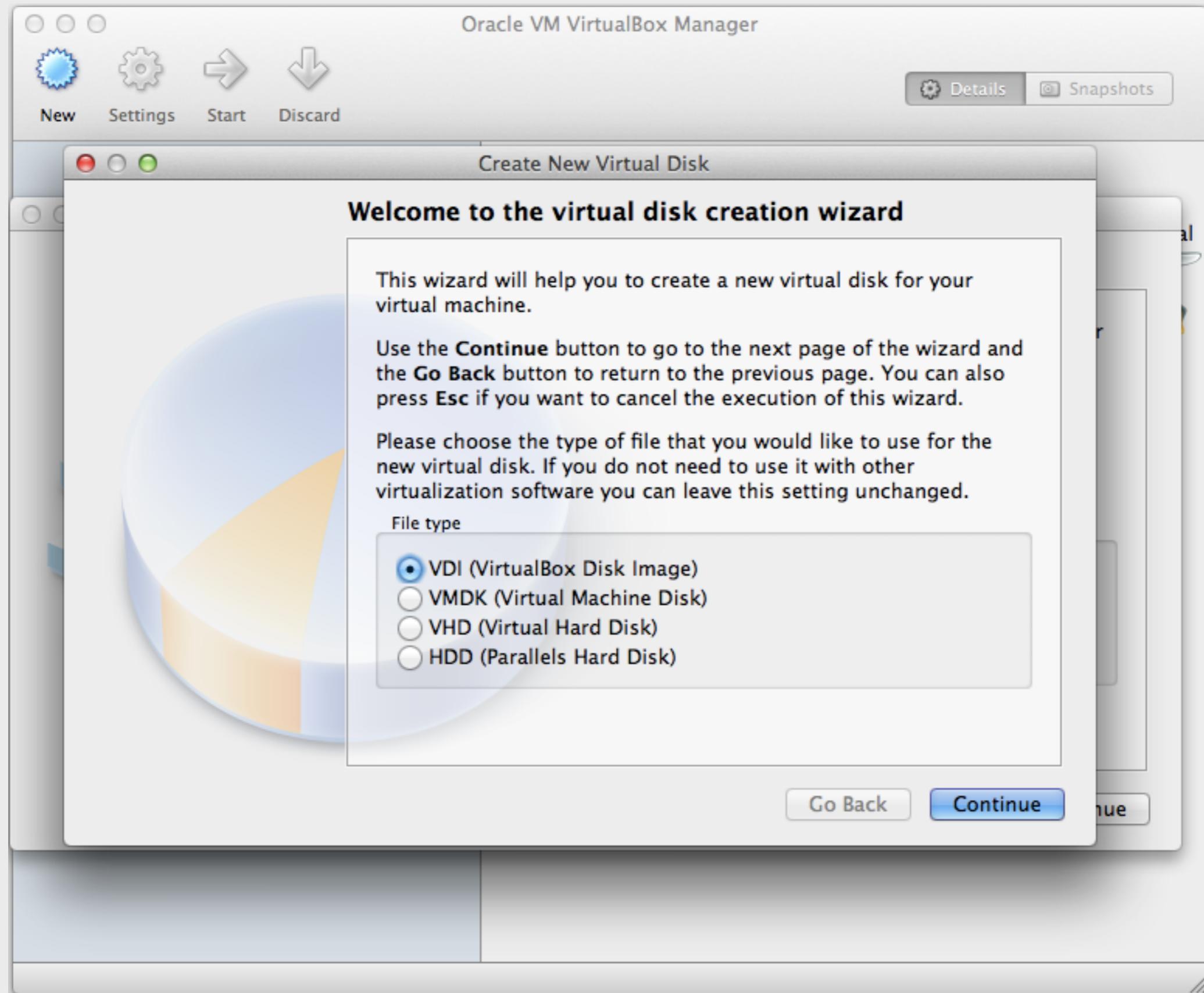


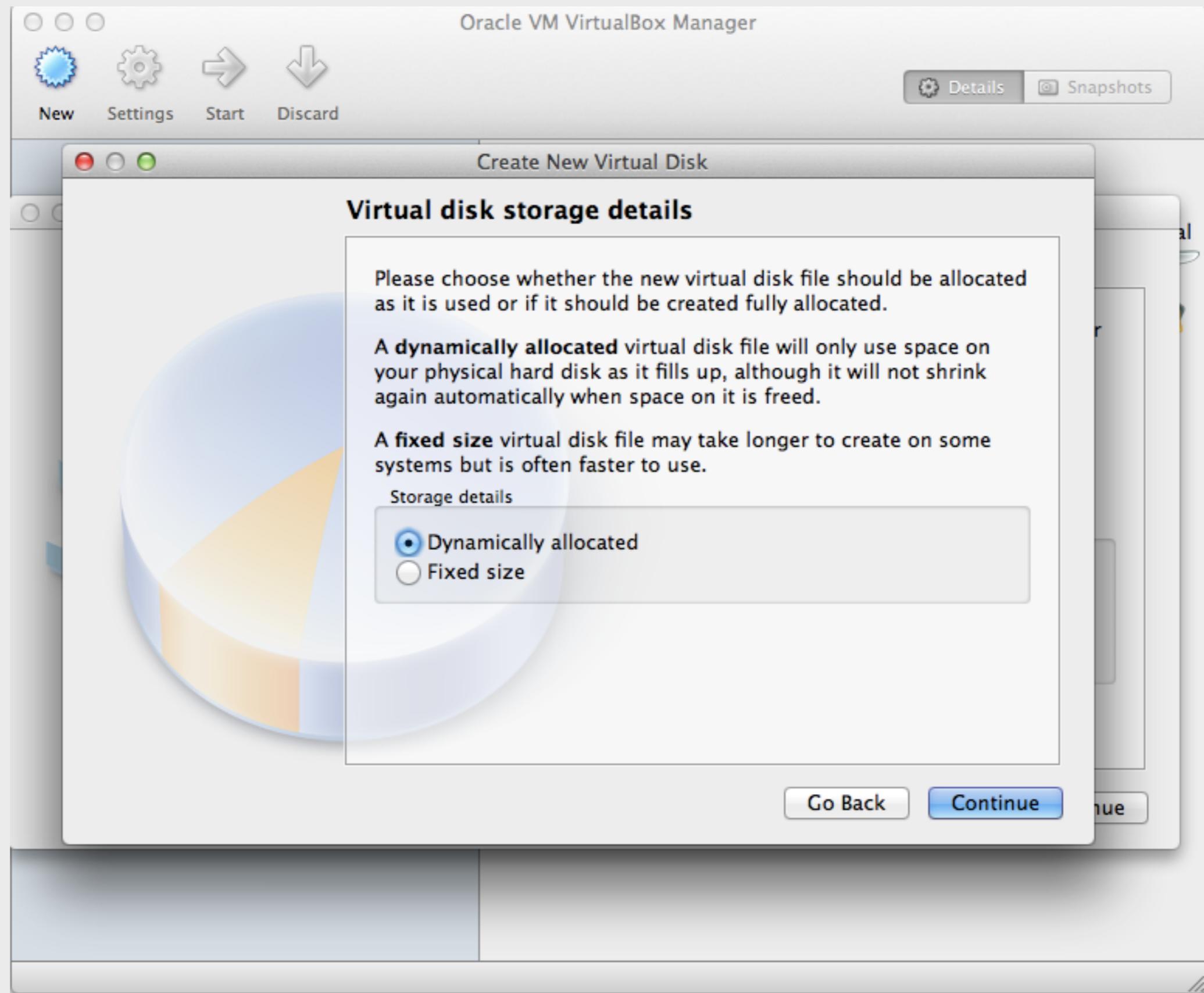


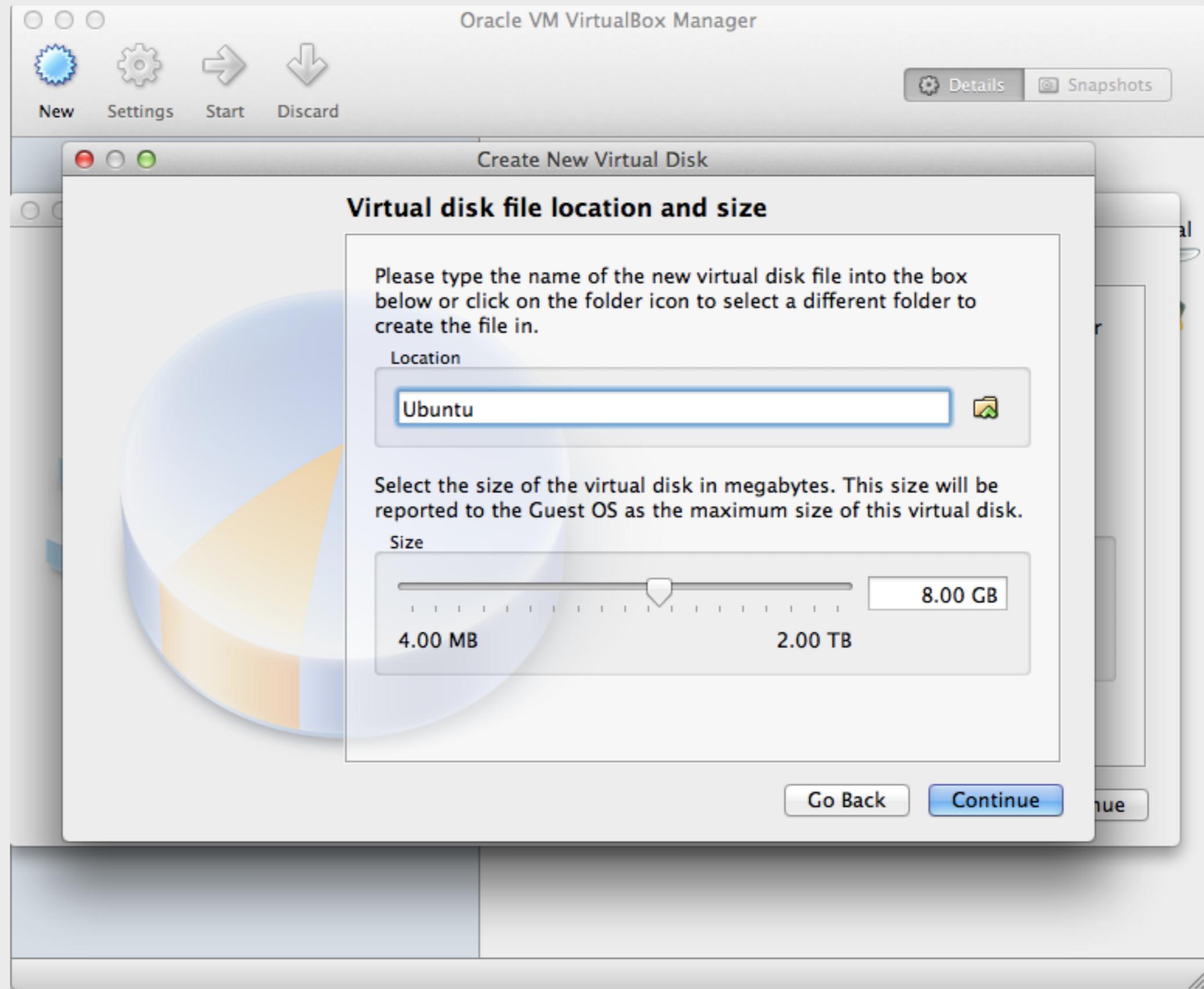


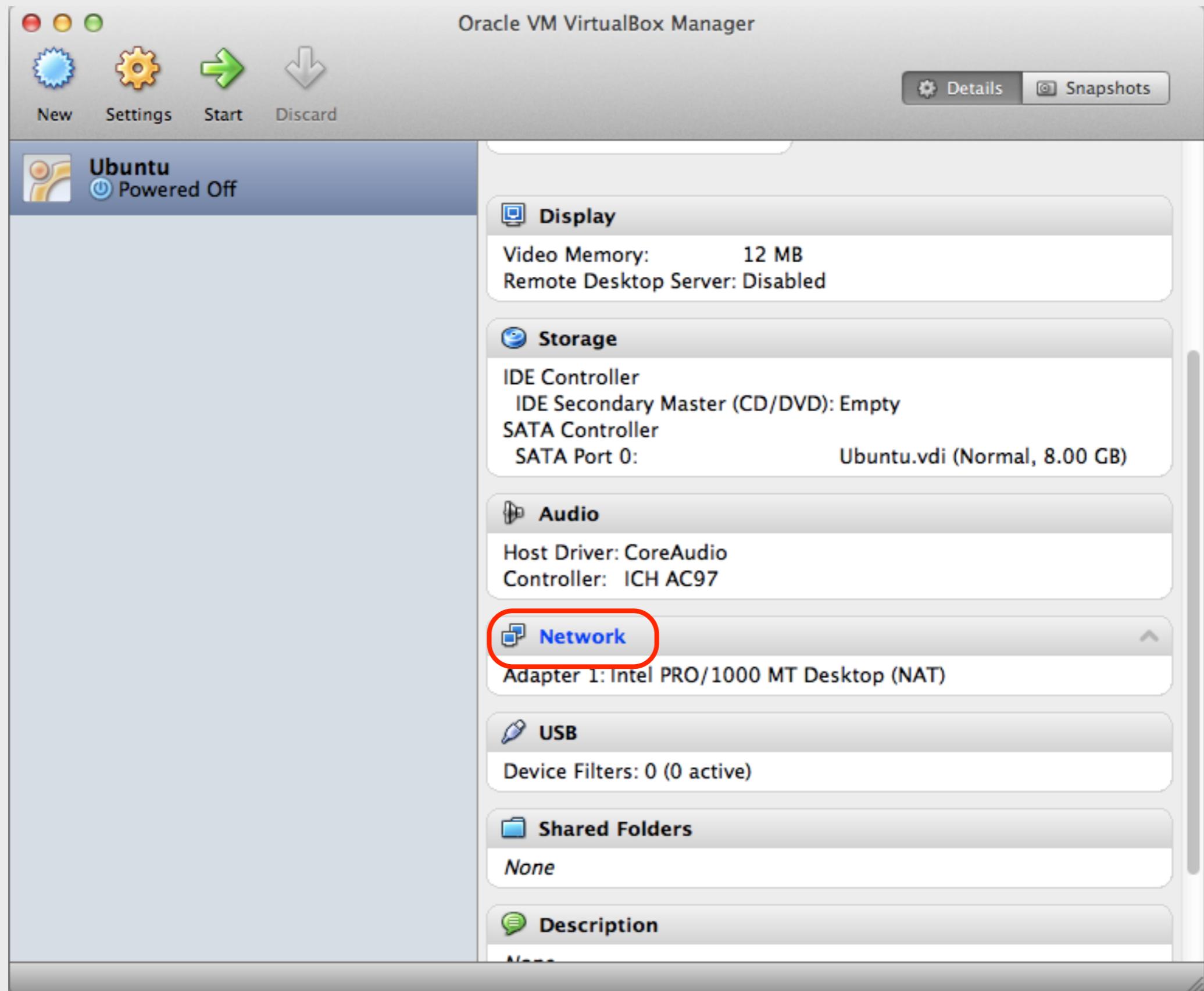


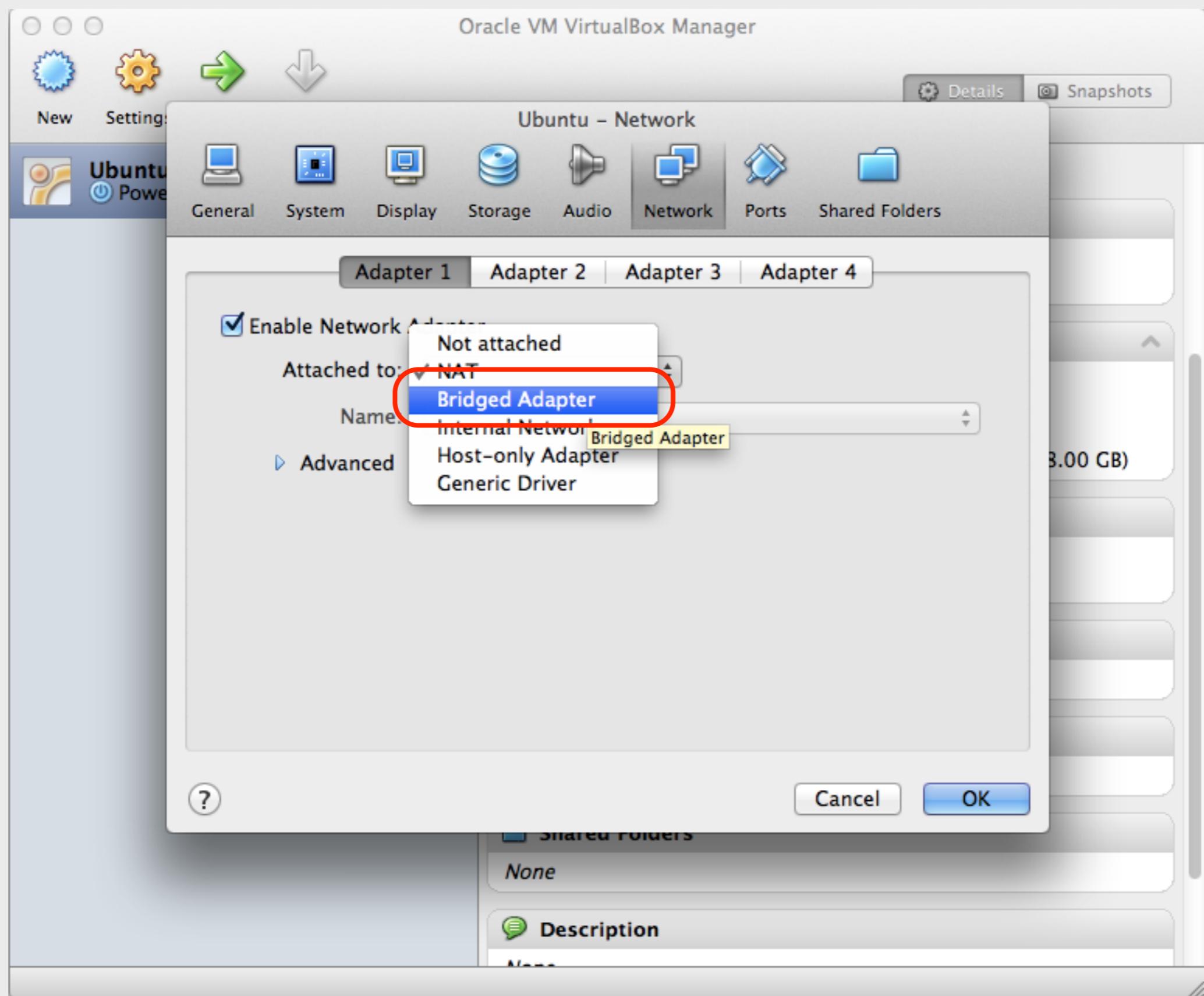


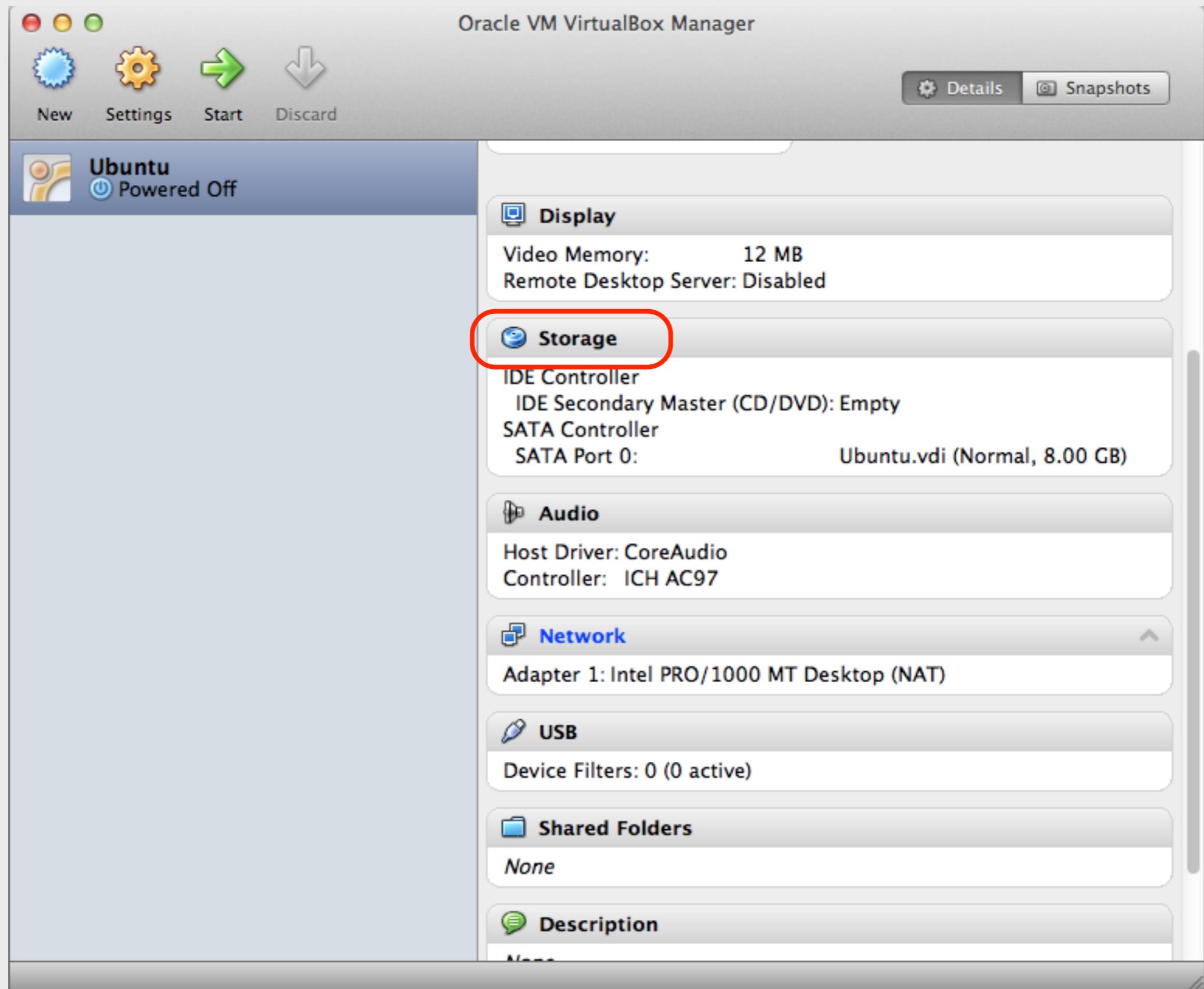


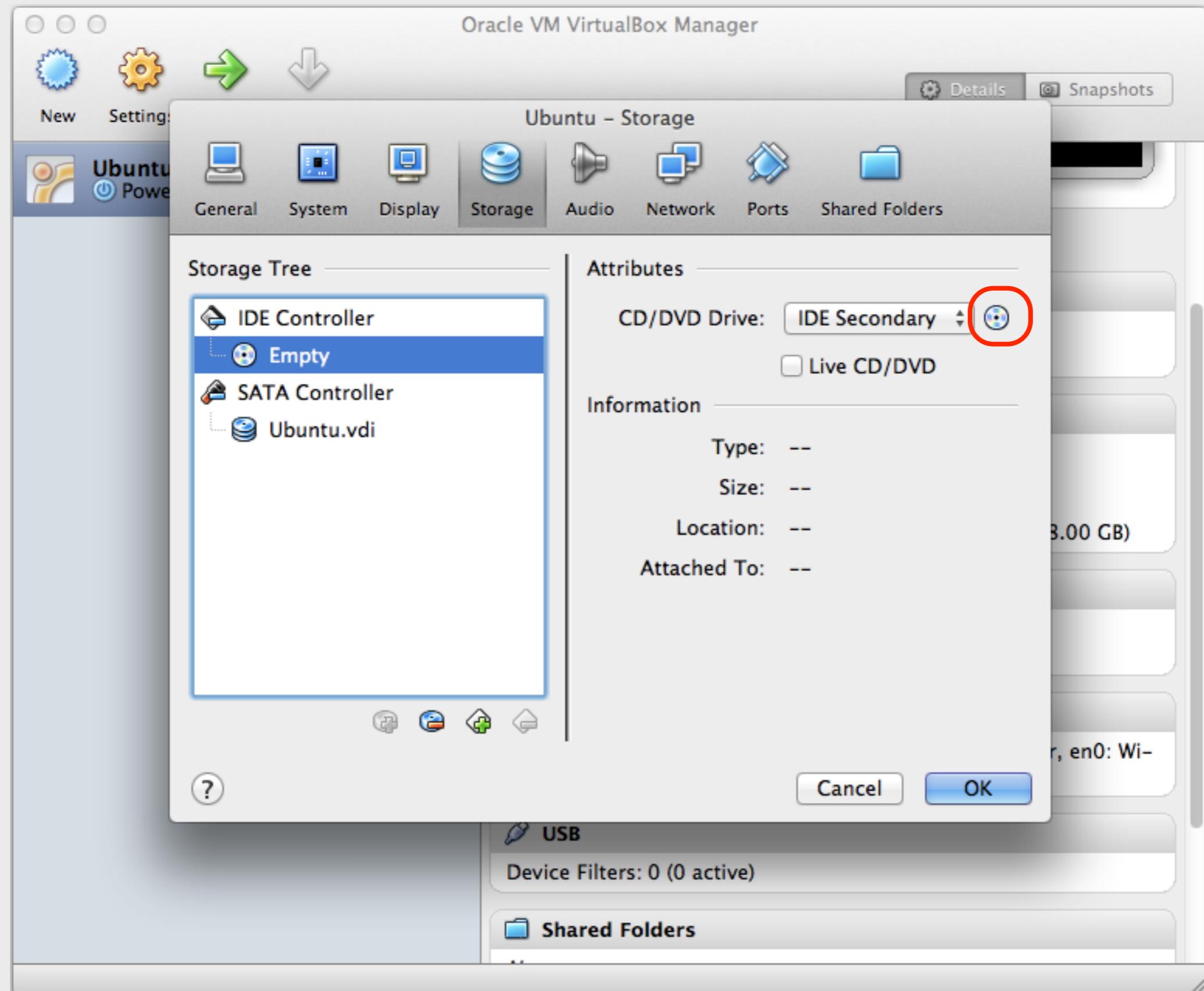


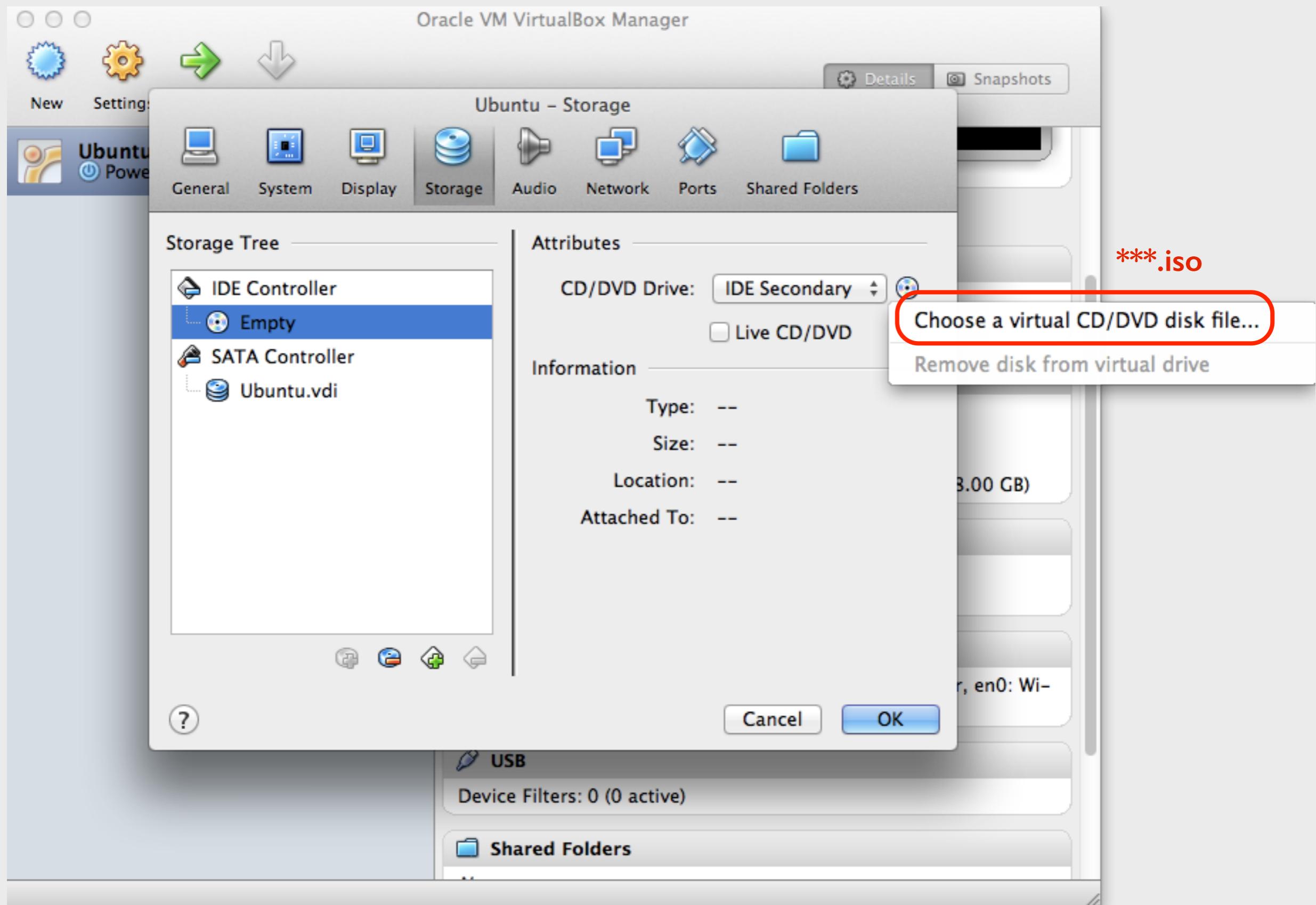


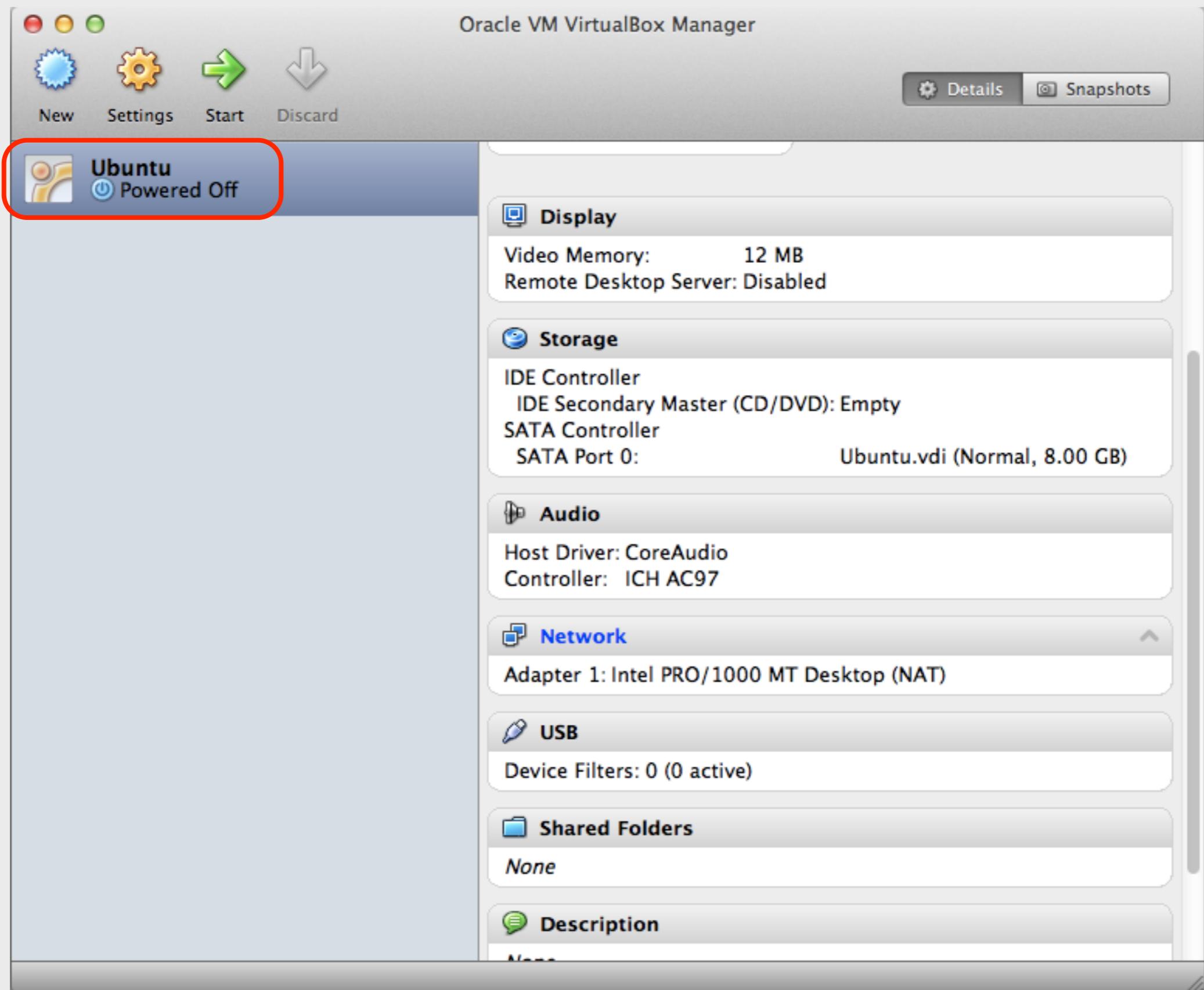










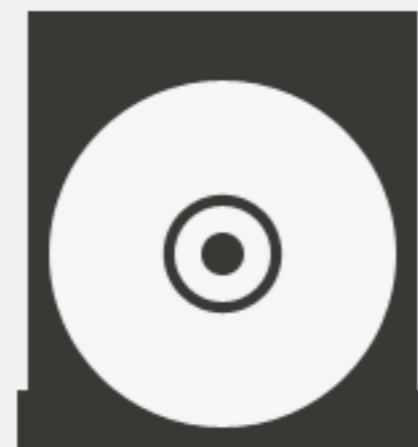
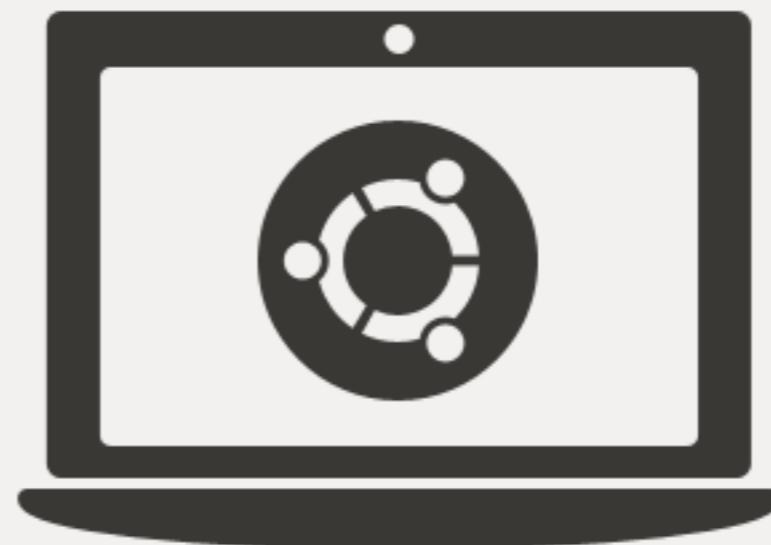




Install

## Welcome

- Asturianu
- Bahasa Indonesia
- Bosanski
- Català
- Čeština
- Dansk
- Deutsch
- Eesti
- English
- Español
- Esperanto
- Euskara
- Français
- Gaeilge
- Galego
- Hrvatski
- Íslenska
- Italiano
- Kurdî

[Try Ubuntu](#)[Install Ubuntu](#)

You can try Ubuntu without making any changes to your computer, directly from this CD.

Or if you're ready, you can install Ubuntu alongside (or instead of) your current operating system. This shouldn't take too long.

You may wish to read the [release notes](#).



## Install

## Preparing to install Ubuntu

For best results, please ensure that this computer:

has at least 4.4 GB available drive space

is plugged in to a power source

is connected to the Internet

Download updates while installing

Ubuntu uses third-party software to display Flash, MP3 and other media, and to work with some wireless hardware. Some of this software is closed-source. The software is subject to the license terms included with the software's documentation.

Install this third-party software

Fluendo MP3 plugin includes MPEG Layer-3 audio decoding technology licensed from Fraunhofer IIS and Thomson.

Quit

Back

Continue



**Install**

## Installation type

This computer currently has no detected operating systems. What would you like to do?

 Erase disk and install Ubuntu  
Warning: This will delete any files on the disk.

---

 Something else  
You can create or resize partitions yourself, or choose multiple partitions for Ubuntu.

**Quit** **Back** **Continue**



Install

## Erase disk and install Ubuntu

Select drive: SCSI3 (0,0,0) (sda) - 8.6 GB ATA VBOX HARDDISK

The entire disk will be used:

ubuntu  
/dev/sda (ext4)  
8.6 GB

Quit Back **Install Now**



Install

## Erase disk and install Ubuntu

Select drive: SCSI3 (0,0,0) (sda) - 8.6 GB ATA VBOX HARDDISK



Ubuntu

/dev/sda (ext4)

8.6 GB

Back

Install Now

▶ Copying files...



Install

## Who are you?

Your name

Place your ID (ex: u9916001)

Your computer's name:

The name it uses when it talks to other computers.

Pick a username: Username

Choose a password: Password

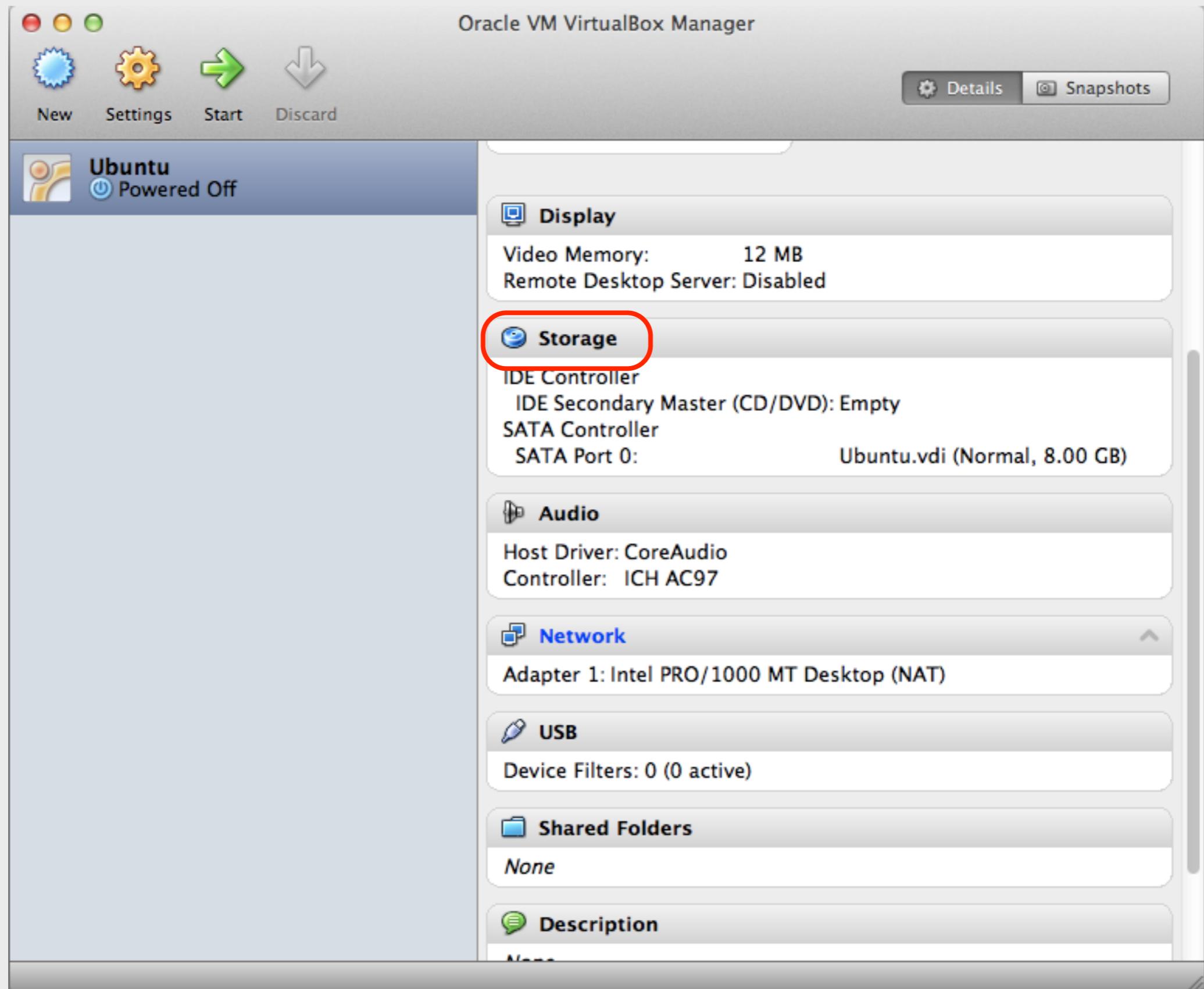
Confirm your password: Confirm password

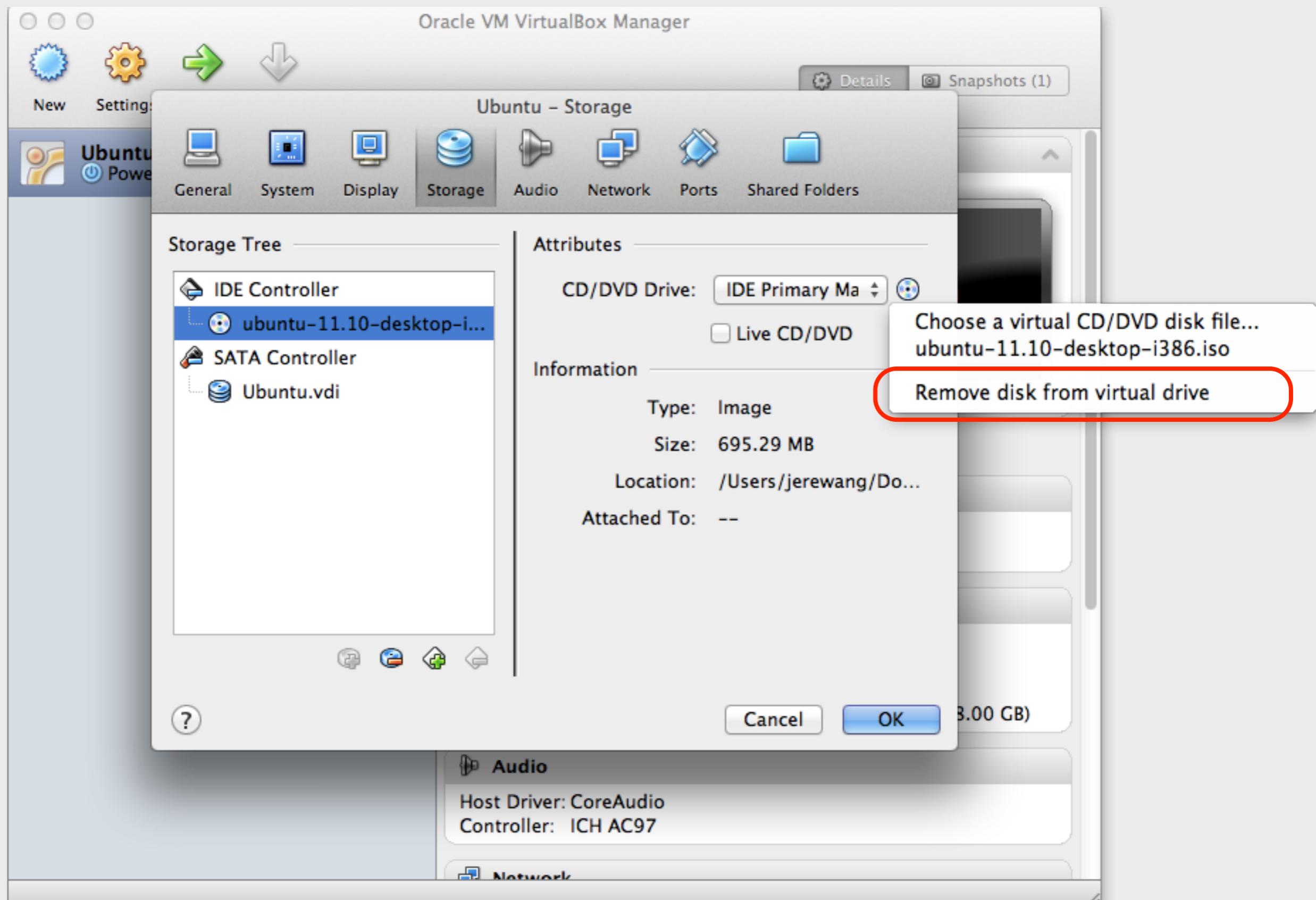
 Log in automatically Require my password to log in Encrypt my home folder

Back

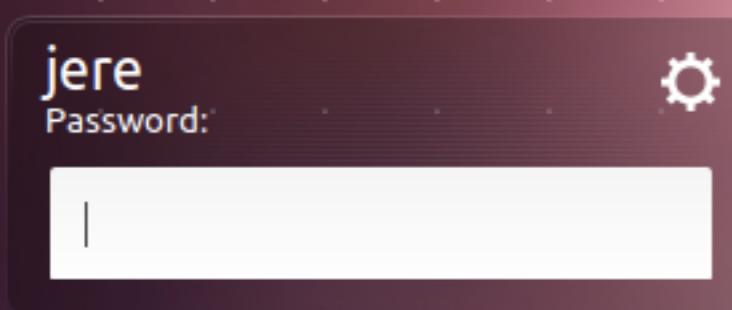
Continue

▶ Ready when you are...

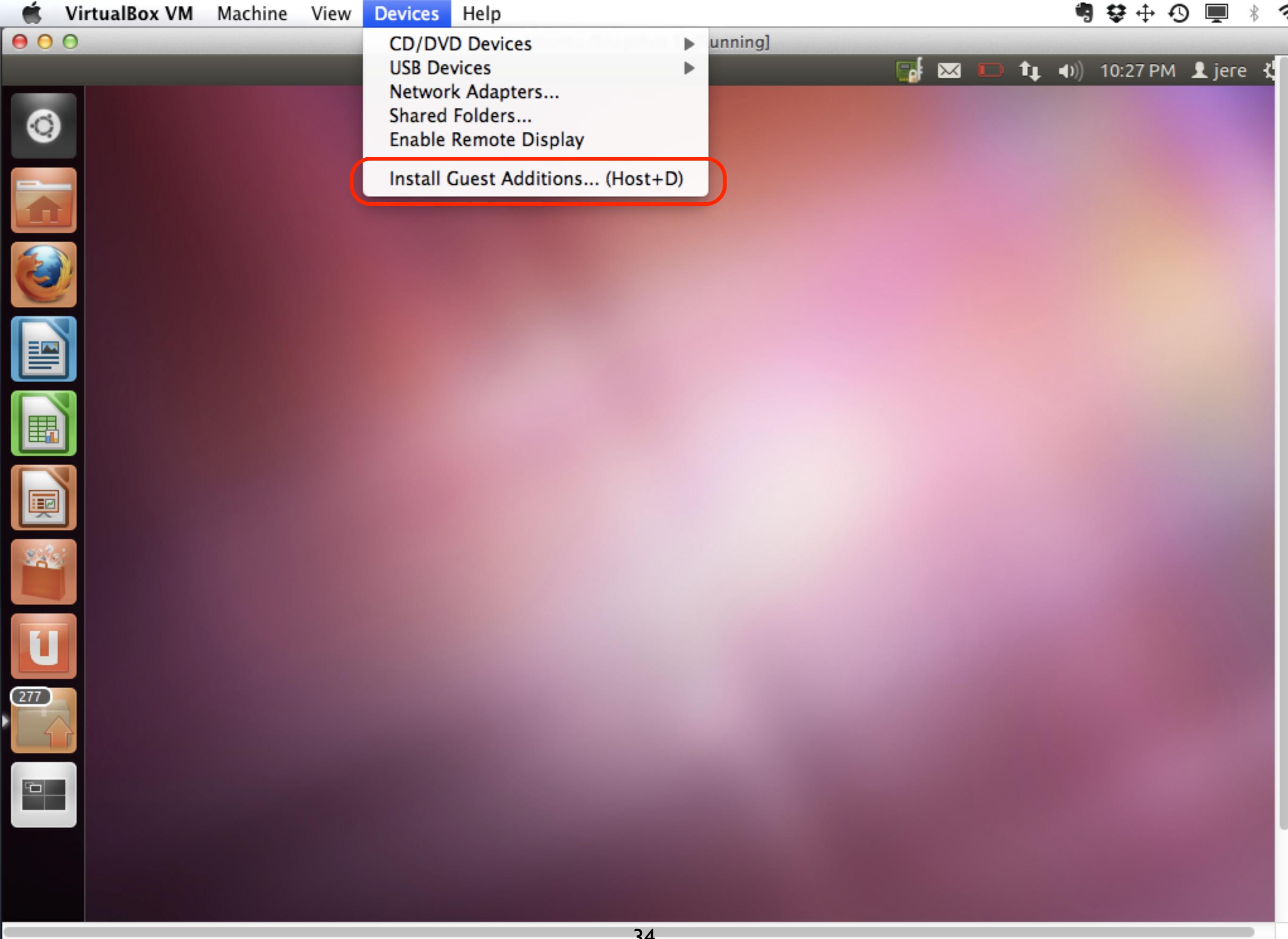




Other...



Guest Session



# Basic Commands

- `ls, cd, mv, cp, mkdir, tar, etc.`
- <http://www.mgt.ncu.edu.tw/~dino/unix/cmd01.htm>
- Use `man` when you don't know how to use them

# Basic Commands

Connections and users	
<code>whoami</code>	prints the ID of the current logged-in user
<code>who</code>	prints a list of other users who are logged
Directories	
<code>pwd</code>	prints the full path of the current directory
<code>cd dirPath</code>	changes your current working directory to be dirPath
<code>ls</code>	prints a list of the files & directories
<code>mkdir dirPath</code>	creates a new directory of dirPath
Environment Variables	
<code>echo \$SHELL</code>	shows the currently used shell
<code>export</code>	<code>export PATH=\$HOME/bin:\$PATH</code>
<code>env</code>	set and print environment variables
<code>set</code>	shows all shell variables

# Basic Commands

Displaying the contents of files	
<b>cat filePath</b>	concatenate files and print on the standard output
<b>more filePath</b>	prints contents of specified file one screen at a time
<b>less filePath</b>	similar to more
<b>head filePath</b>	prints first few lines at top of specified file
<b>tail filePath</b>	prints last few lines at bottom of specified file
<b>file filePath</b>	examines specified file and makes a good guess as to its type
<b>cp from to</b>	copies specified file
<b>mv from to</b>	same as cp except source file is deleted
<b>rm filePath</b>	deletes specified file(s)
<b>rmdir filePath</b>	delete specified directory (or directories)

# Basic Commands

Finding files that satisfy a criteria	
<b>find dirPath -name '*.txt'</b>	finds and lists all files under the specified directory whose name ends with .txt
Searching for text patterns inside files	
<b>grep 'keyword' *.txt</b>	searches all .txt files in current directory hierarchy for the text "keyword". For each match a filename and the matching line of text from the file is displayed.
Some other powerful utilities and commands	
<b>wc filePath</b>	displays number of lines, words, chars and bytes in that file
<b>diff filePath1</b>	displays the line by line differences between two text files
<b>comm filePath1</b>	like diff but displays common lines instead of differences
<b>cmp filePath1</b>	like diff, but for binary files
<b>od filePath</b>	displays specified binary file in octal or hex

# Basic Commands

## Creating a symlink (a shortcut)

<code>ln -s source_file target_file</code>	create a symlink or shortcut to that directory/file
------------------------------------------------	-----------------------------------------------------

## File paths, directories and volumes

<code>whereis cmd</code>	finds out the paths of the cmd in standard binary directories
--------------------------	---------------------------------------------------------------

<code>which cmd</code>	find the command actually been invoked.
------------------------	-----------------------------------------

## On-line Manual Pages

<code>man cmd</code>	displays the on-line manual pages
----------------------	-----------------------------------

# Basic Commands

## Make a file compressed or uncompressed

`tar jcvf filename.tar.bz2 targetfile`

compress file by bzip2

`tar jxvf filename.tar.bz2 [-C /dir]`

uncompress a bzip2 file [and save the files to /dir]

`tar zcvf filename.tar.gz targetfile`

compress file by gzip

`tar zxvf filename.tar.gz [-C /dir]`

uncompress a gzip file [and save the files to /dir]

# Basic Commands

- A man page (short for manual page) is the software documentation for a computer program in a Unix, or Unix-like operating systems.
- To read a manual page for a Unix command, one can use
  - `man <command_name>`

# Basic Commands

- Pages are traditionally referred to using the notation "name(section)": for example, `ftp(1)`
  - `man 3 printf`

```
DESCRIPTION
man is the system's manual pager. Each page argument given to man is normally the name of a
manual page associated with each of these arguments is then found and displayed. A search is
only in that section of the manual. The default action is to search in all of the available
order and to show only the first page found, even if page exists in several sections.

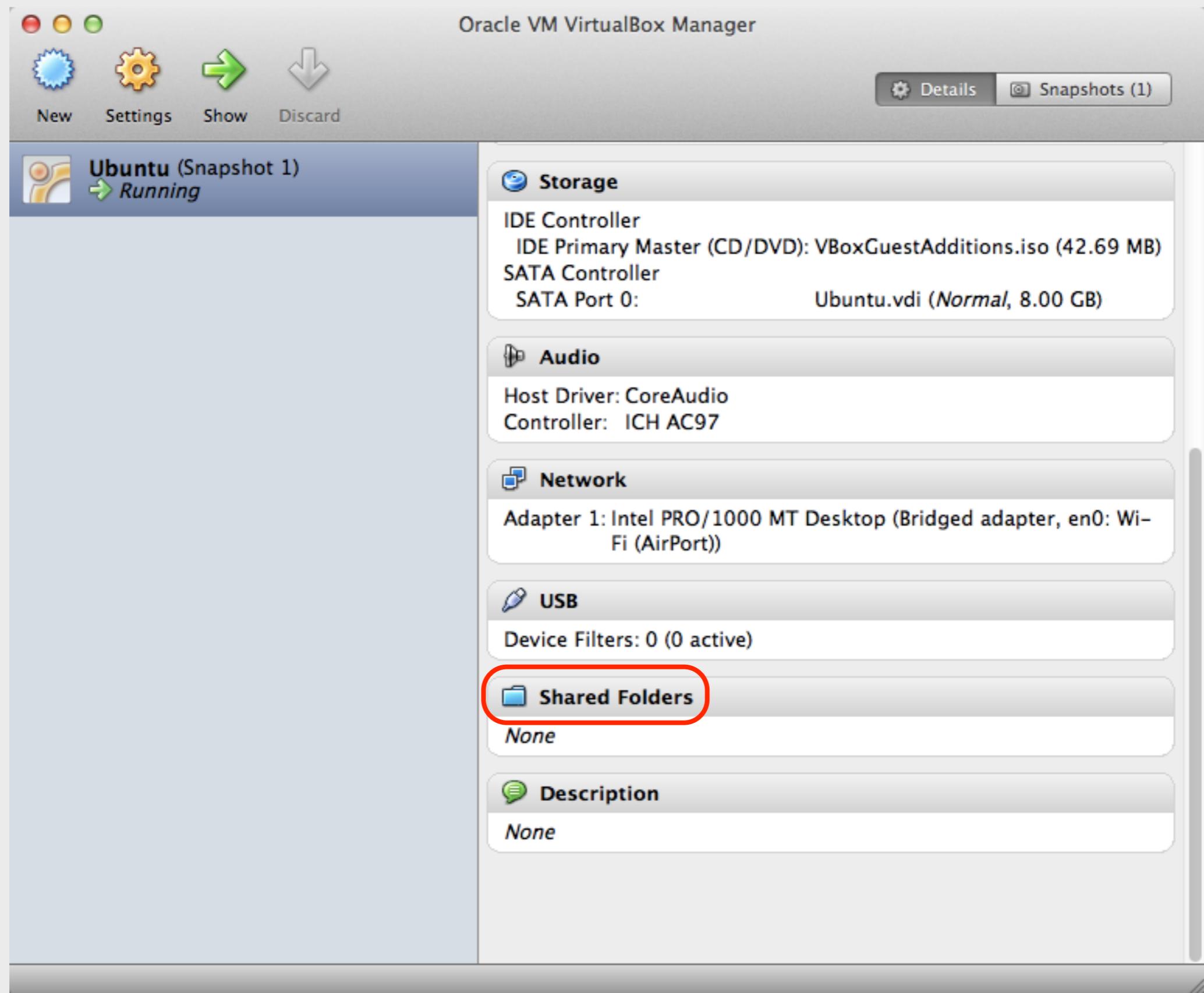
The table below shows the section numbers of the manual followed by the types of pages

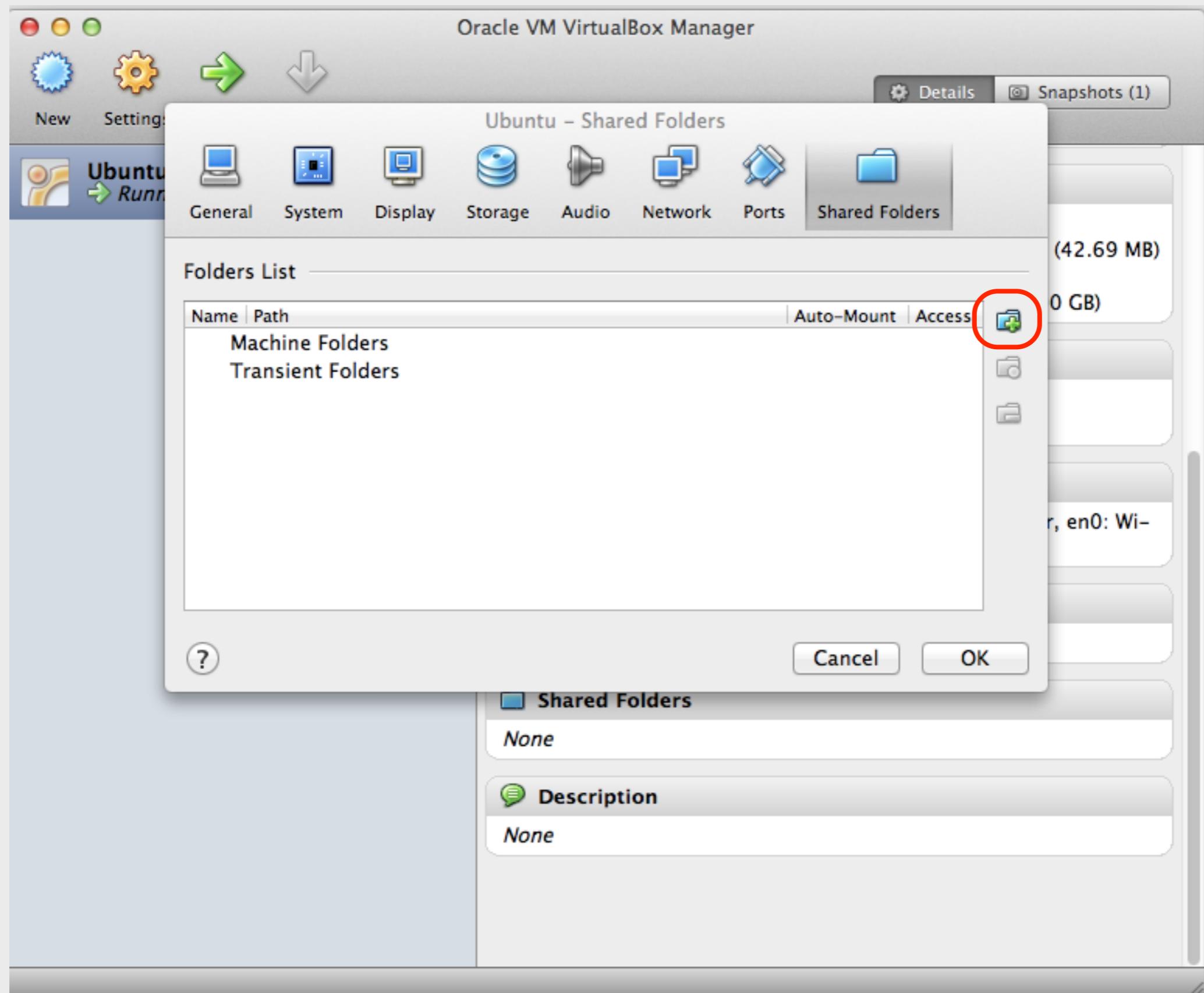
1 Executable programs or shell commands
2 System calls (functions provided by the kernel)
3 Library calls (functions within program libraries)
4 Special files (usually found in /dev)
5 File formats and conventions eg /etc/passwd
6 Games
7 Miscellaneous (including macro packages and conventions), e.g. man(7), groff(7)
8 System administration commands (usually only for root)
9 Kernel routines [Non standard]
```

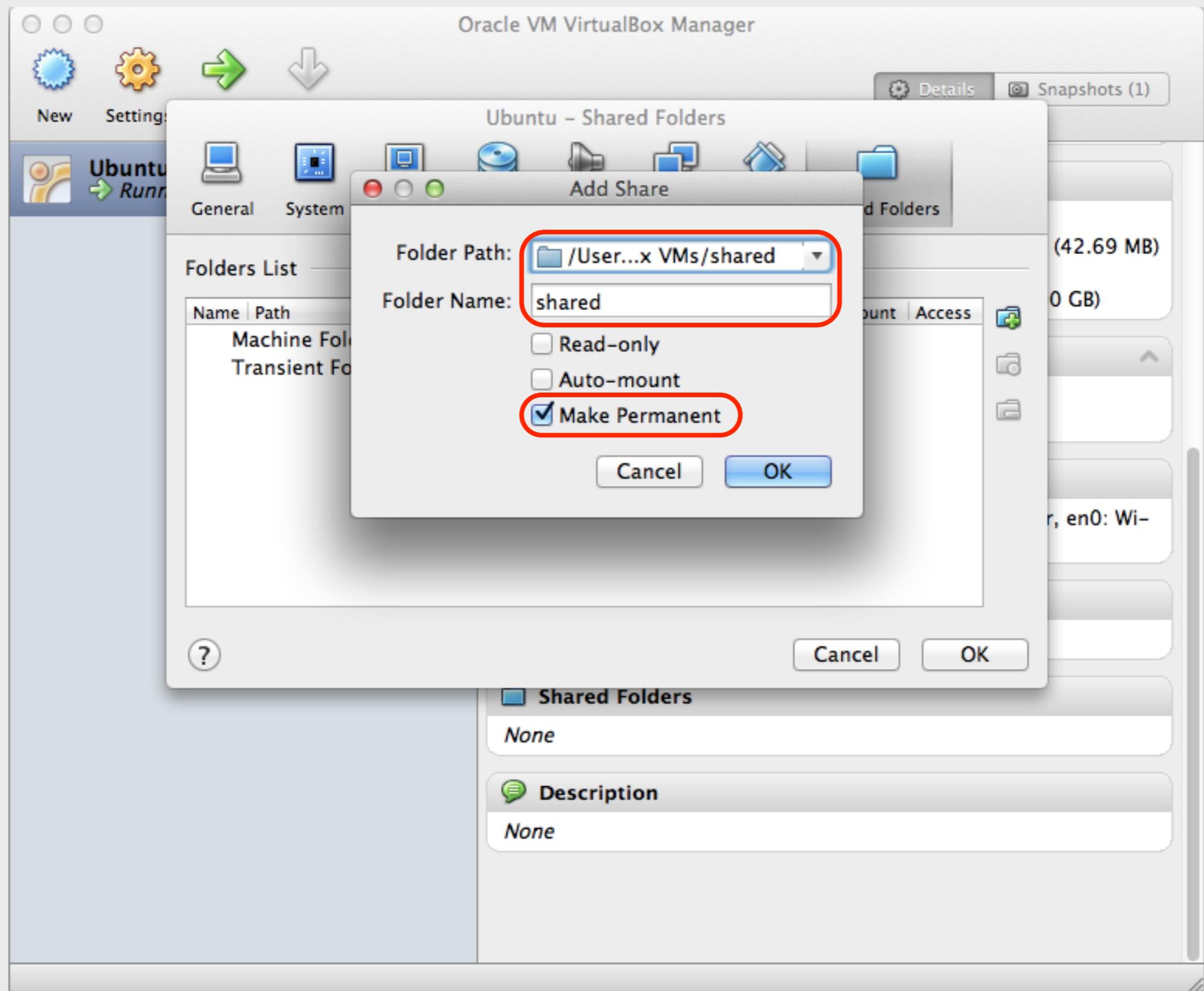
\* Make your man page colorful: <http://unstableme.blogspot.com/2009/01/colorful-man-pages-in-linux-ubuntu-tips.html>

# Task2: Make a folder shared

- Make a folder shared
    - <http://briian.com/?p=6241>
      - Use mount command
- !!** Do not choose auto-mount!









terminal

Applications



Terminal



UXTerm



XTerm



```
jere@jere-VirtualBox: ~/shared
jere@jere-VirtualBox:~$ ls
Desktop Downloads Music Public Videos
Documents examples.desktop Pictures Templates
jere@jere-VirtualBox:~$ mkdir shared
jere@jere-VirtualBox:~$ ls
Desktop Downloads Music Public Templates
Documents examples.desktop Pictures shared Videos
jere@jere-VirtualBox:~$ mount -t vboxsf shared ~/shared
mount: only root can do that
jere@jere-VirtualBox:~$ sudo mount -t vboxsf shared ~/shared
[sudo] password for jere:
jere@jere-VirtualBox:~$ cd shared/
jere@jere-VirtualBox:~/shared$ ls
100-Calendar.pdf
jere@jere-VirtualBox:~/shared$
```

# Utilities for Development

- Editor: vi/vim
- Compiler
- Makefile
- Shell script (Bash)

# Vi/Vim

- Editor -- Vim
  - How to install it?\*
  - <https://help.ubuntu.com/community/VimHowto>
  - How to customize it?
  - Put **.vimrc** (file) and **.vim** (directory) under **~/**
    - Create **~/Trash** folder for vi backup
  - You can customize your vi via these files

\* If some problems are encountered when you install vim via using apt-get, you may find the solution here: <http://www.hbyconsultancy.com/blog/ubuntu-howto-fix-repository-signature-verification-issues.html>

\* /etc/apt/sources.list -> remove tw if the sources are bad.

\* Show the List of Installed Packages on Ubuntu or Debian: <http://www.howtogeek.com/howto/linux/show-the-list-of-installed-packages-on-ubuntu-or-debian/>

# Vi/Vim

- Two vivid introduction slides in course web site
  - Vim\_Hacks.pdf
  - Vim\_Hack\_Your\_Editor.pdf
- Resources
  - <http://www.study-area.org/tips/vim/>
  - <http://www.openvim.com/>
  - <http://vimcast.wordpress.com/>
  - [http://vim.wikia.com/wiki/Vim\\_Tips\\_Wiki](http://vim.wikia.com/wiki/Vim_Tips_Wiki)
  - <http://www.rayninfo.co.uk/vimtips.html>
  - <http://blog.vgod.tw/2009/12/08/vim-cheat-sheet-for-programmers/>

# Vi/Vim

## Learning curves

