

SDN Environment Setup

Install ONOS in VM





Outline

- ☐ Objective
- ☐ Experiment Environment
- ☐ Installation
 - VirtualBox 6.1.26
 - Add VM
 - SDN development environment



Objective

- ❑ Prepare a operational environment
 - VirtualBox: Open-source cross-platform virtualization application
 - Run virtual machines
 - Ubuntu: Open-source operating system
 - A most popular OS for software development
 - ONOS: Open Network Operating System in SDN
 - Offer a graphic interface for observing network topology
 - Mininet: Network Emulator
 - Make virtual network environment setup easily



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Experiment Environment

- ❑ Ubuntu Desktop **16.04**
- ❑ **Minimum** Hardware Requirements:
 - **2** Cores (CPUs)
 - **8GB** RAM
 - **20GB** HDD



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VirtualBox Installation (1/6)

- ❑ Go to official website:

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

- ❑ Download the “platform packages” according to your host OS

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 6.0 packages, see [VirtualBox 6.0 builds](#). Please note that version 6.0 will remain supported until July 2020.

If you're looking for the latest VirtualBox 5.2 packages, see [VirtualBox 5.2 builds](#). Please note that version 5.2 will remain supported until July 2020.

VirtualBox 6.1.26 platform packages

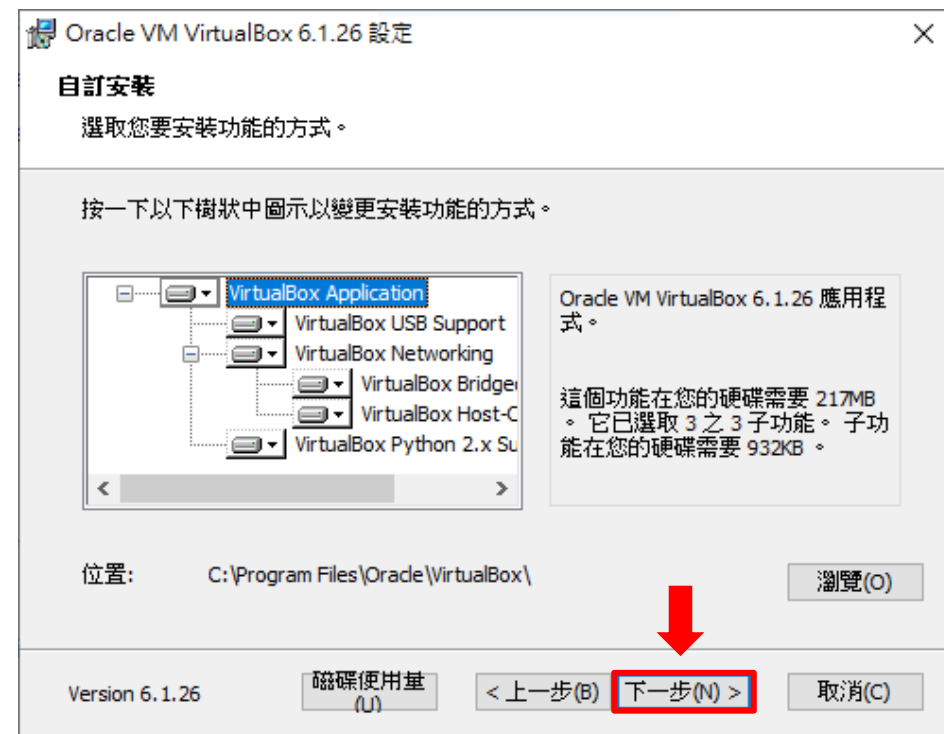
- [Windows hosts](#)
- [OS X hosts](#)
- [Linux distributions](#)
- [Solaris hosts](#)
- [Solaris 11 IPS hosts](#)



VirtualBox Installation (2/6)

❑ Execute downloaded package

名稱	修改日期	類型
上週 (1)		
VirtualBox-6.1.26-145957-Win.exe	2021/8/23 上午 11:06	應用程式





VirtualBox Installation (3/6)

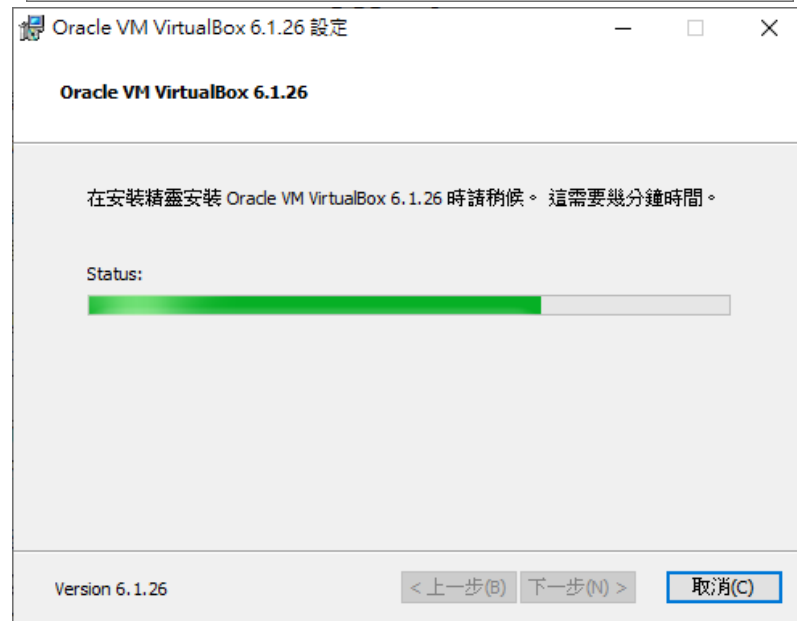
- ❑ Choose how you want to install





VirtualBox Installation (4/6)

1. Click "Yes"
2. Click "Install"
3. Wait for installing





VirtualBox Installation (5/6)

- ☐ Click “Always trust software from ‘Oracle Corporation’”
- ☐ Waiting





VirtualBox Installation (6/6)

- Click “Finish”





Outline

- Experiment Environment
- Installation
 - VirtualBox 6.1.26
 - Add VM
 - Download image file
 - Virtual machine setting
 - Ubuntu installation
 - SDN development environment



Download image file (1/10)

- ❑ Download image file (.iso) first
 - <https://www.ubuntu-tw.org/modules/tinyd0/>
 - Ubuntu Desktop 16.04

ubuntu® 正體中文站

下載 新聞 論壇 星球 Wiki 聯絡我們

下載 Ubuntu Ubuntu 行為規範 (第二版) Ubuntu@Taiwan 論壇規範 IRC 聊天室

Google 自訂搜尋

Ubuntu 行為規範 (第二版)

下載 Ubuntu

發行版	版本	電腦架構	下載選項
<input checked="" type="radio"/> Ubuntu 桌面版本	<input type="radio"/> 18.04 LTS (支援至 2023 年 04 月)	<input type="radio"/> 32 位元版本	<input type="checkbox"/> 下載 BitTorrent 種子
<input type="radio"/> Ubuntu 伺服器版本	<input checked="" type="radio"/> 16.04 LTS (支援至 2021 年 04 月)	<input checked="" type="radio"/> 64 位元版本	<input type="button" value="開始下載"/>
	<input type="radio"/> 14.04 LTS (支援至 2019 年 04 月)		或是 至此瀏覽所有版本及檔案

不同發行版具備不同的圖形環境與配套軟體。如果您不知道如何選擇，請選擇 Ubuntu 桌面版本。

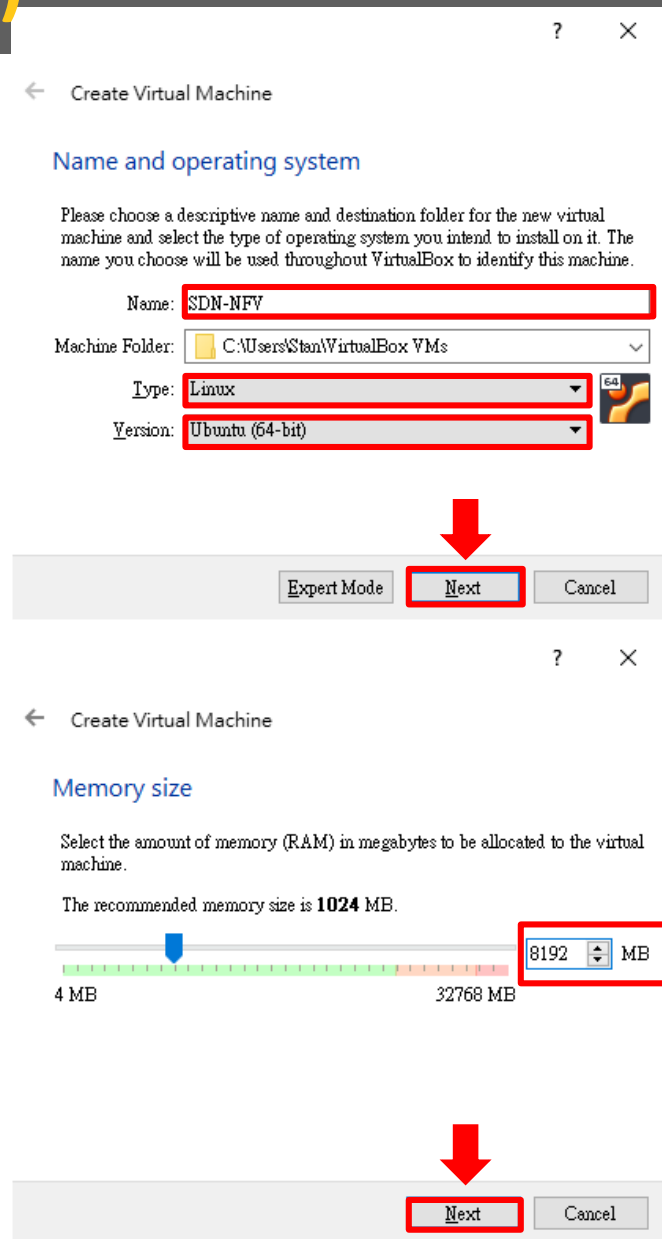
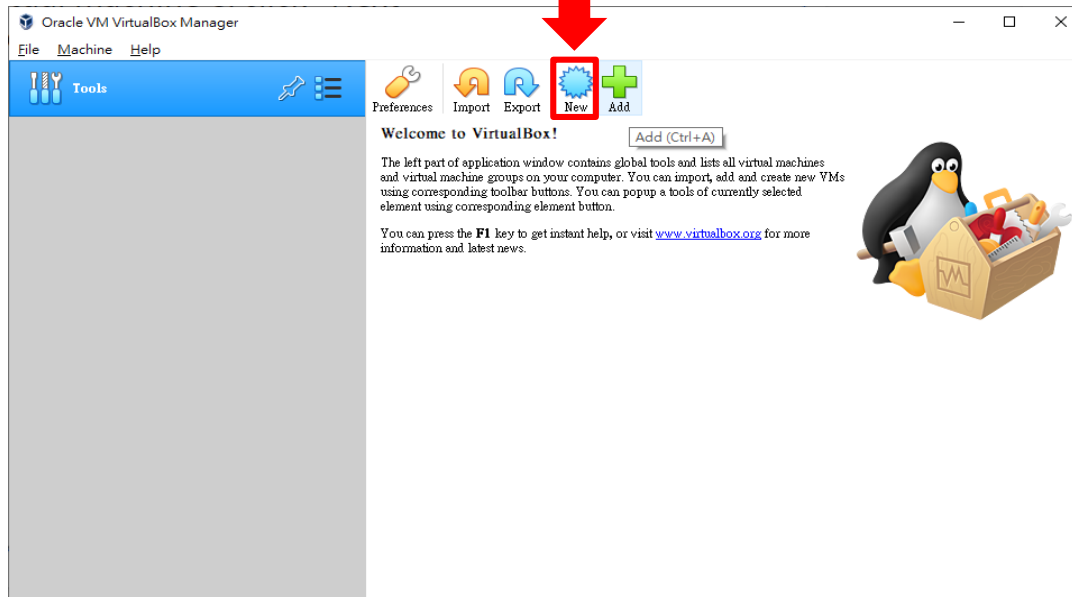
最新長期支援 (穩定，五年支援) 版為 18.04 LTS (2018/04 - 2023/04)。16.04 及之前版本的預設桌面為經典 Unity，18.04 開始為 Gnome 3，但您仍可手動安裝 Unity 並進行切換。詳細資訊請參考 Release End of Life

目前一般電腦大多使用 64 位元架構，故從 18.04 開始，桌面版也將不再提供 32 位元版本。另外，目前在下載區無 Mac 版本可下載。



Virtual machine setting (2/10)

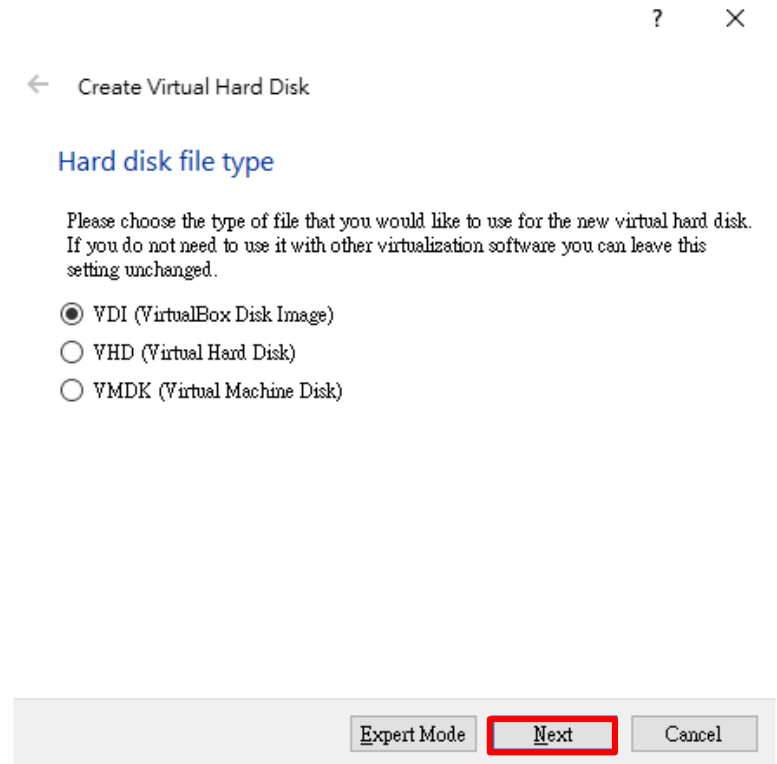
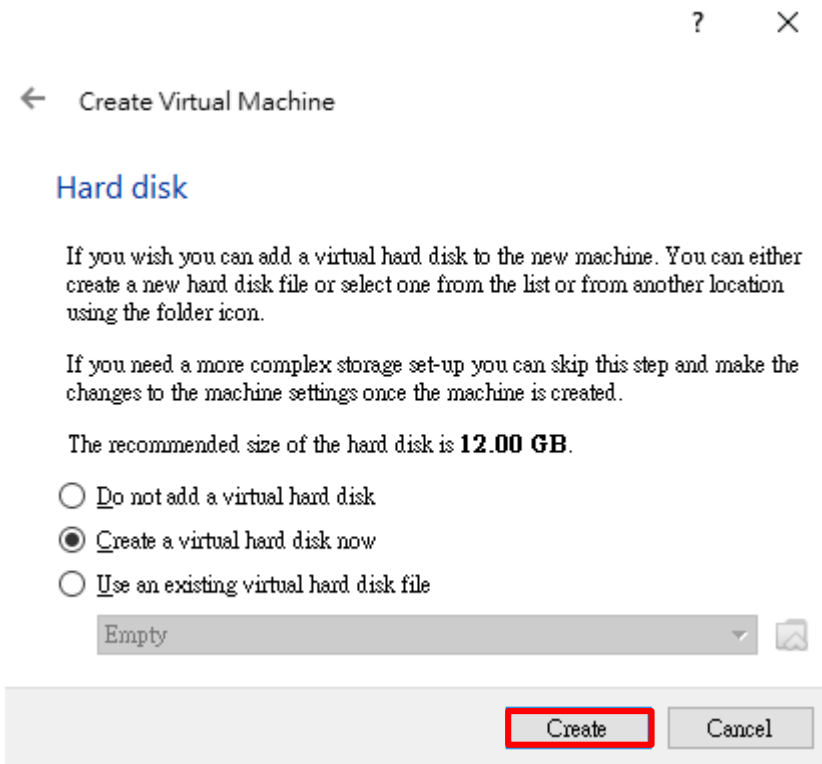
1. Start VirtualBox & Click “New”
2. Name the virtual machine (**SDN-NFV**), then click “Next”
3. Adjust the memory size to **8192MB**, then click “Next”





Virtual machine setting (3/10)

1. Click “Create”
2. Click “Next”





Virtual machine setting (4/10)

1. Click “Next”
2. Adjust the size of virtual HD to **20GB**, then click “Create”

← Create Virtual Hard Disk

Storage on physical hard disk

Please choose whether the new virtual hard disk file should grow as it is used (dynamically allocated) or if it should be created at its maximum size (fixed size).

A **dynamically allocated** hard disk file will only use space on your physical hard disk as it fills up (up to a maximum **fixed size**), although it will not shrink again automatically when space on it is freed.

A **fixed size** hard disk file may take longer to create on some systems but is often faster to use.

☒ Dynamically allocated

☐ Fixed size

Next Cancel

← Create Virtual Hard Disk

File location and size

Please type the name of the new virtual hard disk file into the box below or click on the folder icon to select a different folder to create the file in.

C:\Users\Stan\VirtualBox VMs\SDN_NFV\SDN_NFV.vdi

Select the size of the virtual hard disk in megabytes. This size is the limit on the amount of file data that a virtual machine will be able to store on the hard disk.

4.00 MB 2.00 TB

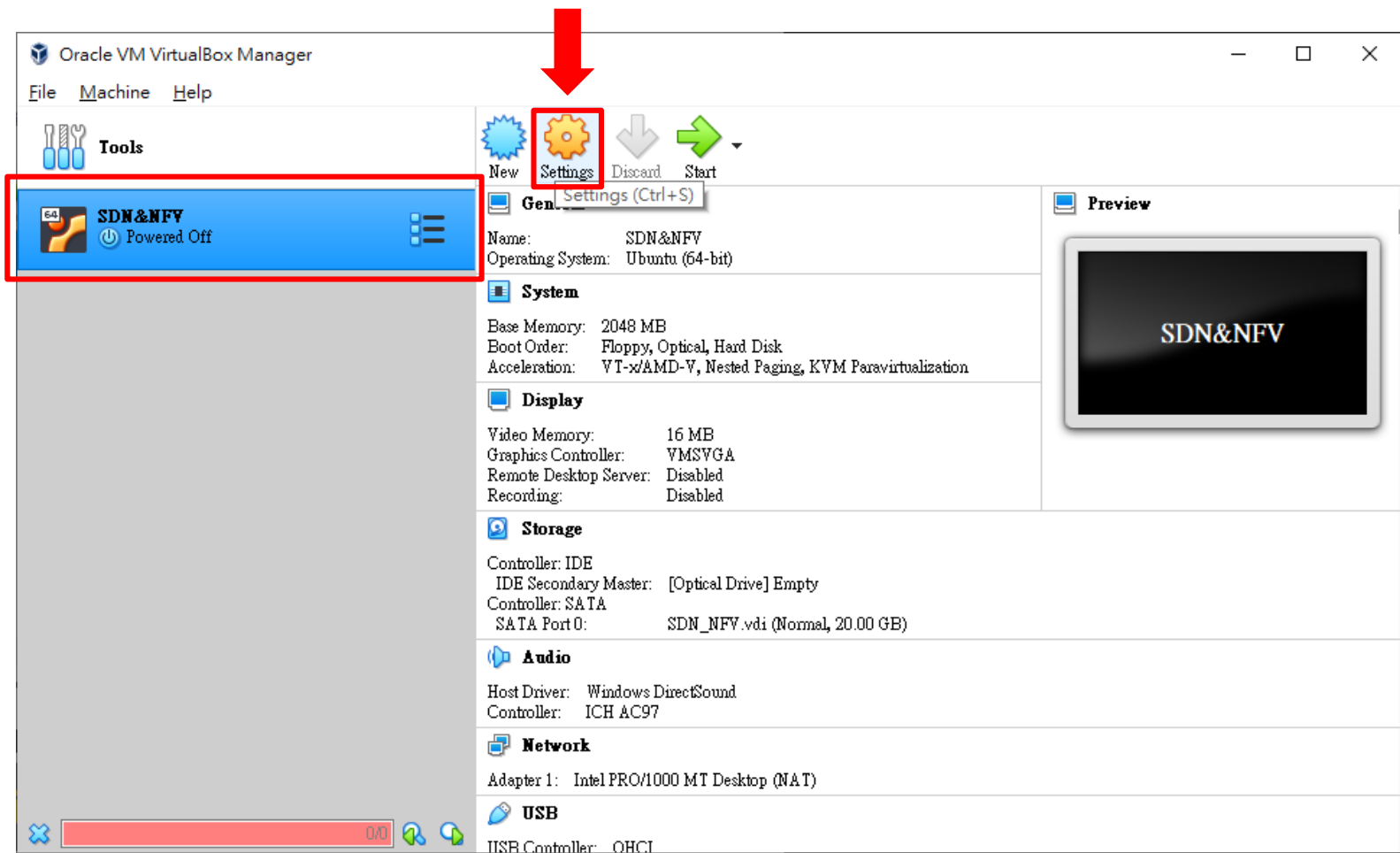
20 GB

Create Cancel



Virtual machine setting (5/10)

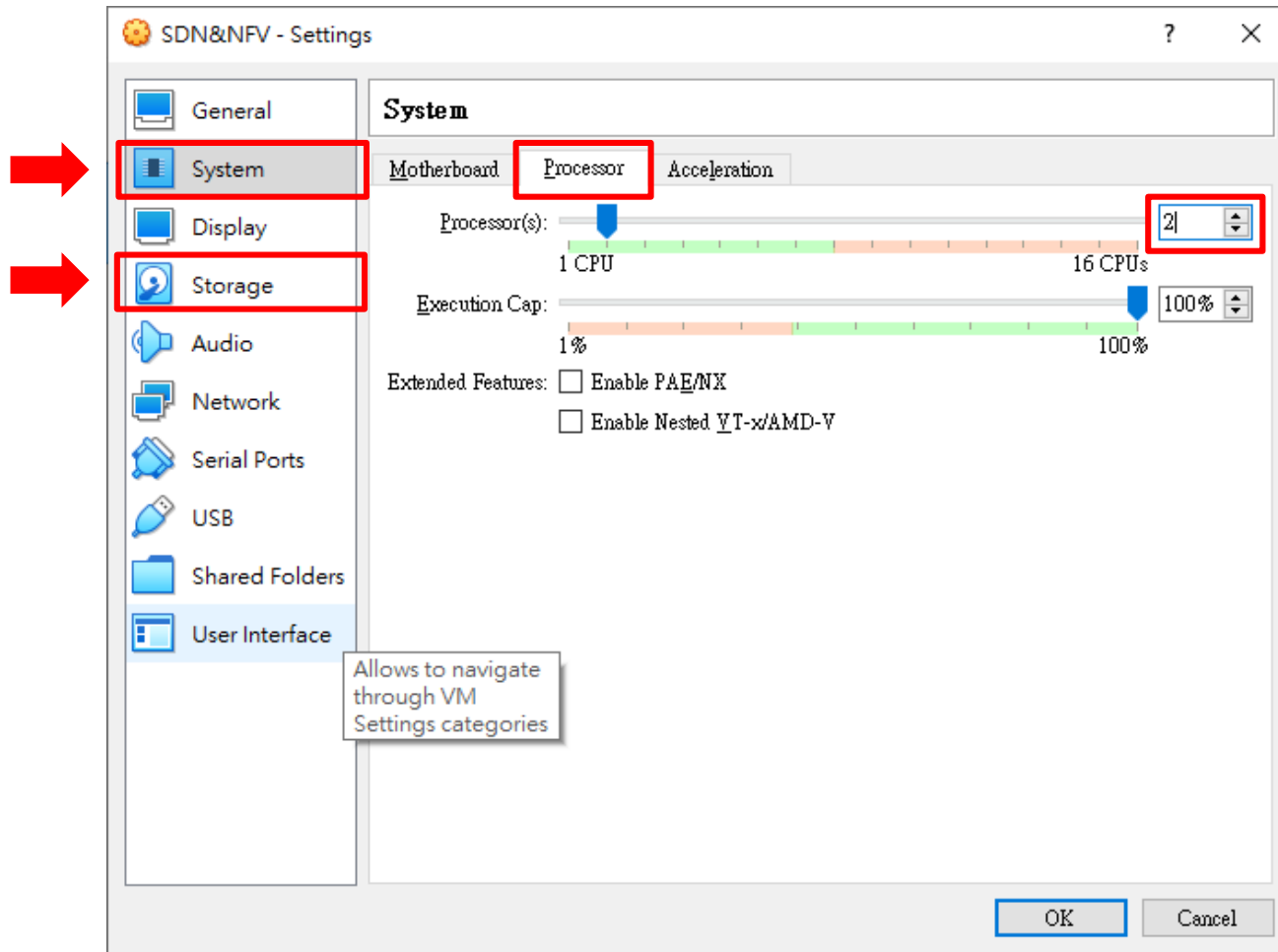
- Click “Settings”





Virtual machine setting (6/10)

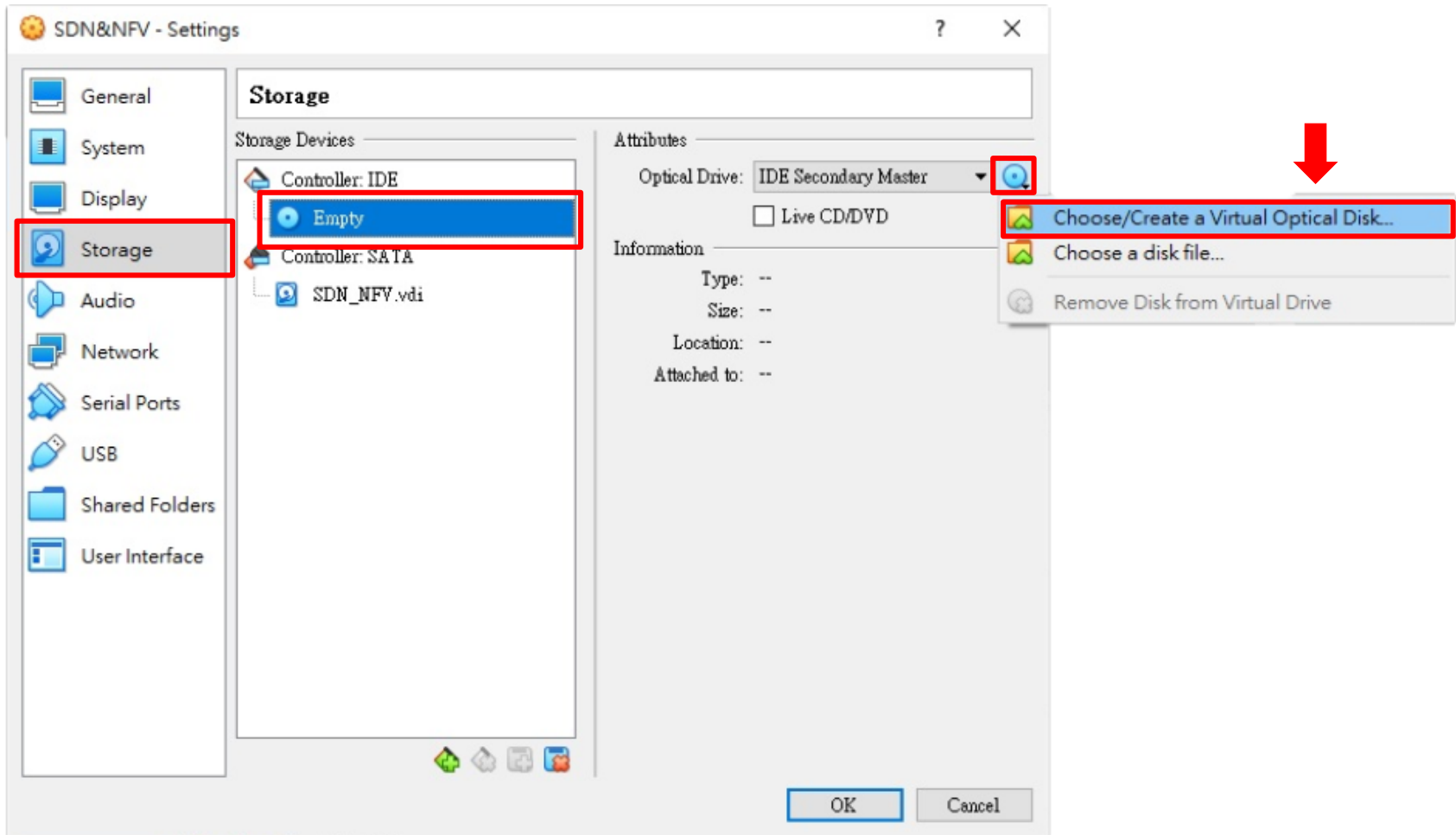
- ❑ System > Processor
 - Set **2 CPUs**, then click “Storage”





Virtual machine setting (7/10)

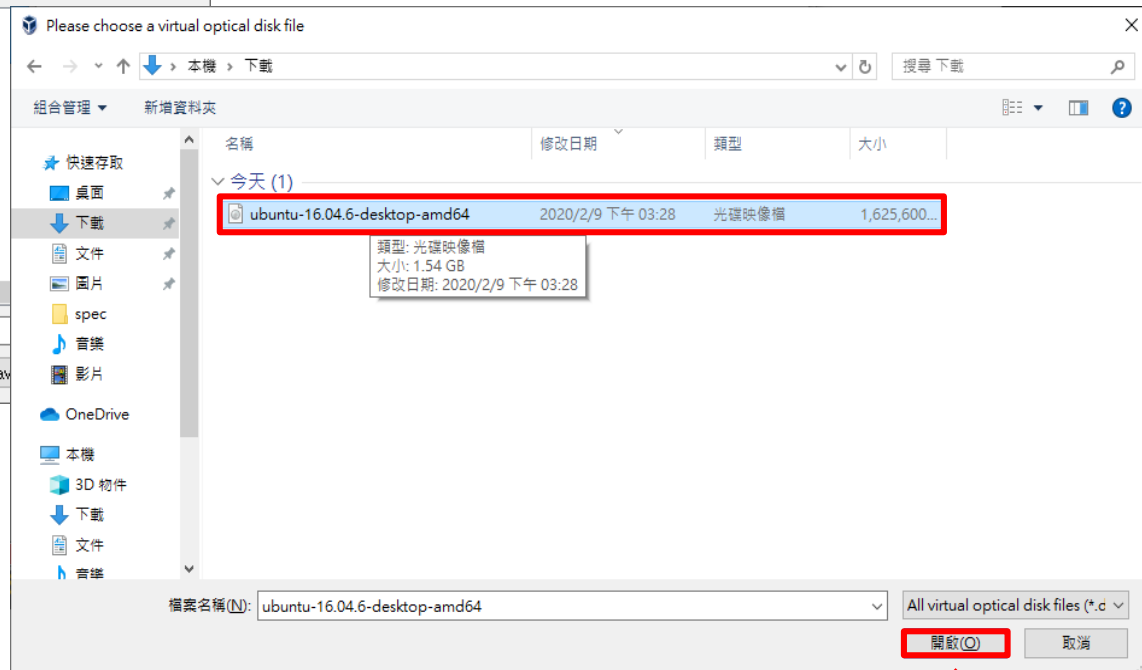
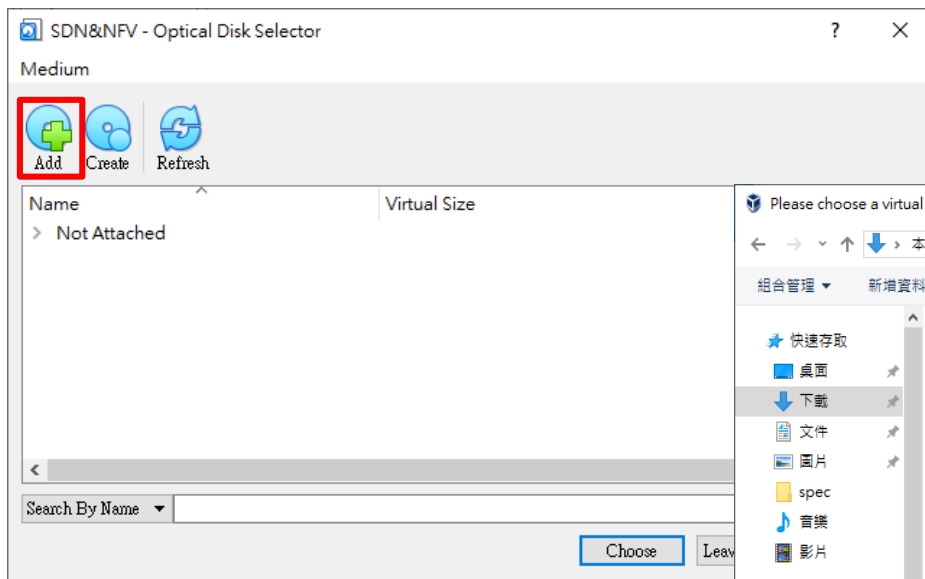
□ Storage > Controller: IDE





Virtual machine setting (8/10)

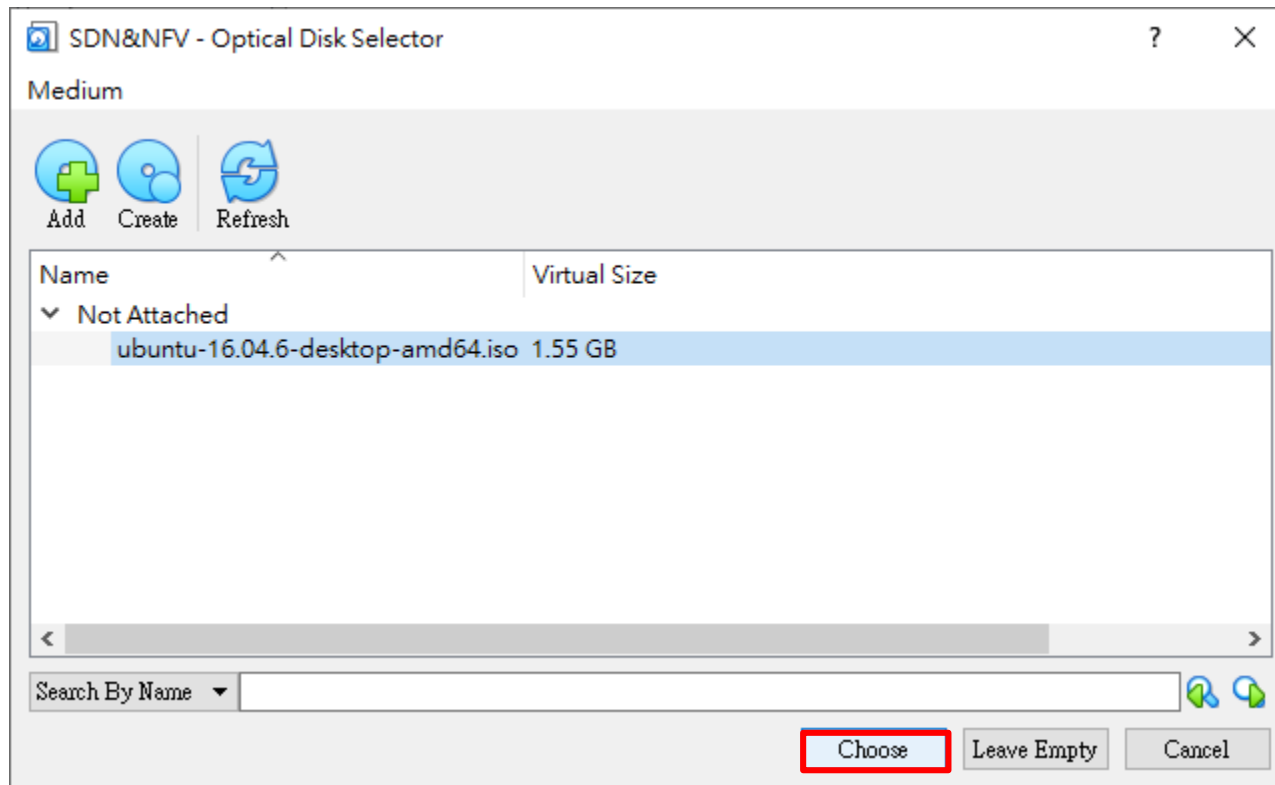
1. Click “Add”
2. Choose the previously downloaded image file (.iso)
3. Click “Open”





Virtual machine setting (9/10)

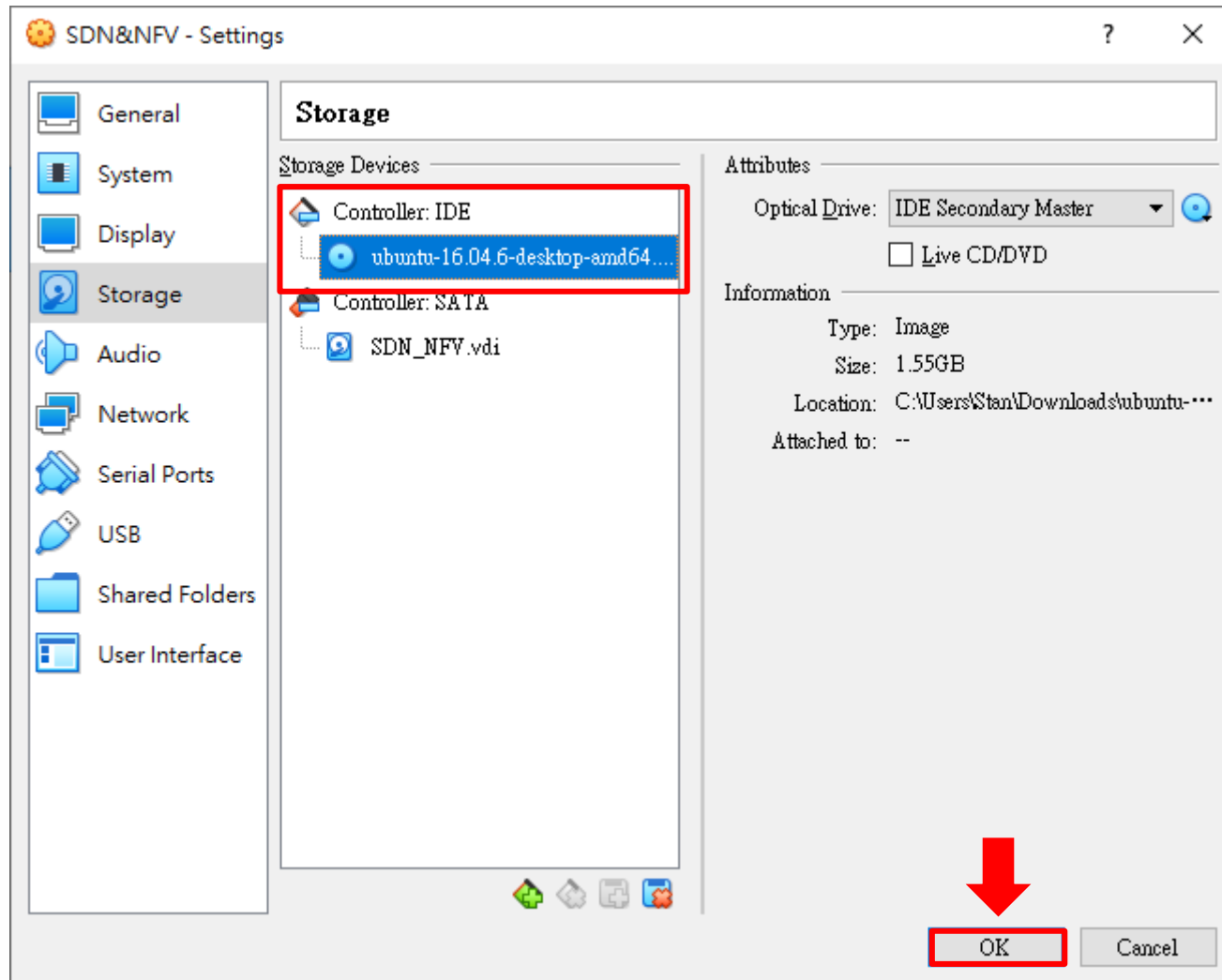
- ❑ Click “Choose”





Virtual machine setting (10/10)

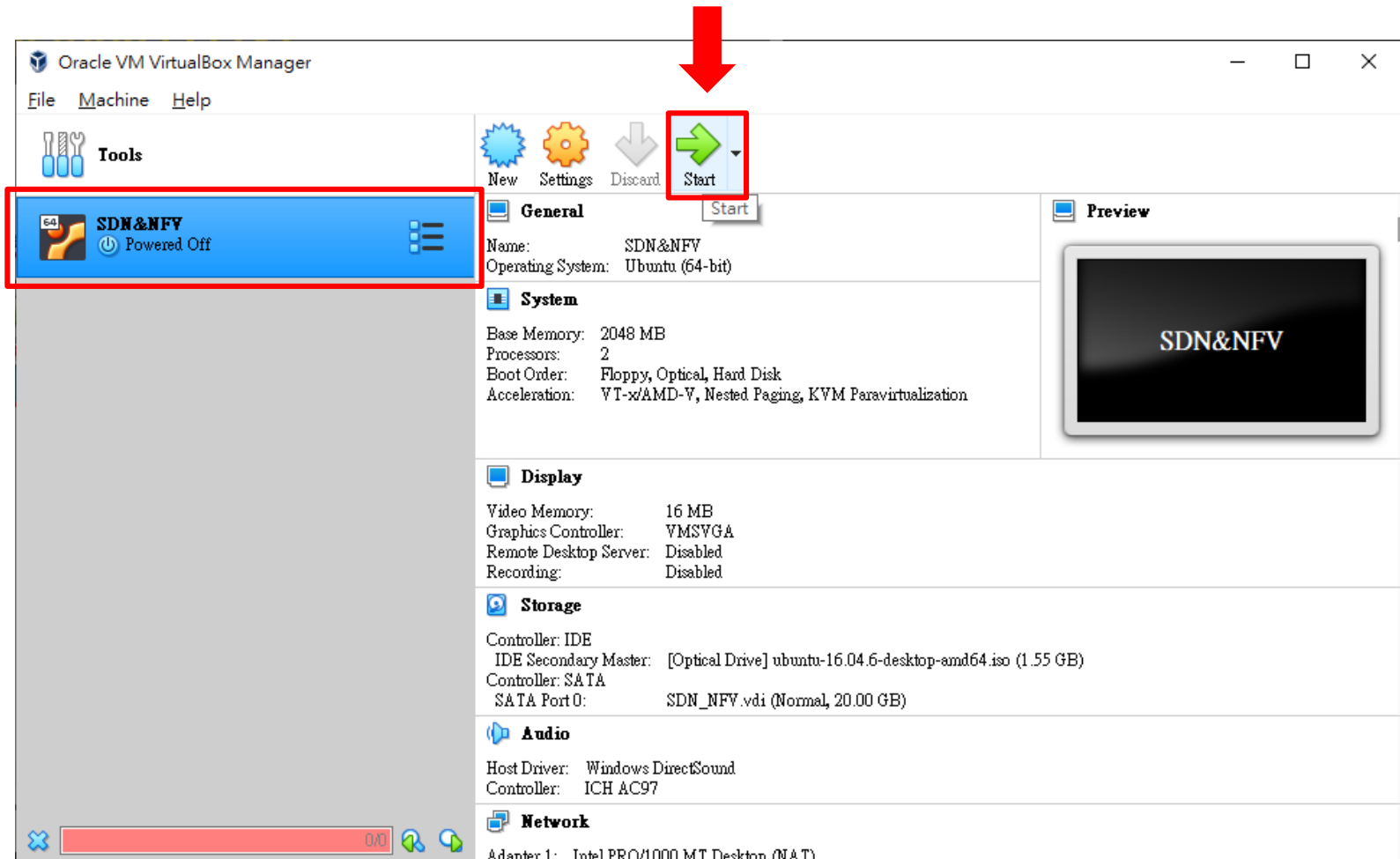
- Make sure all settings are right, then click “OK”





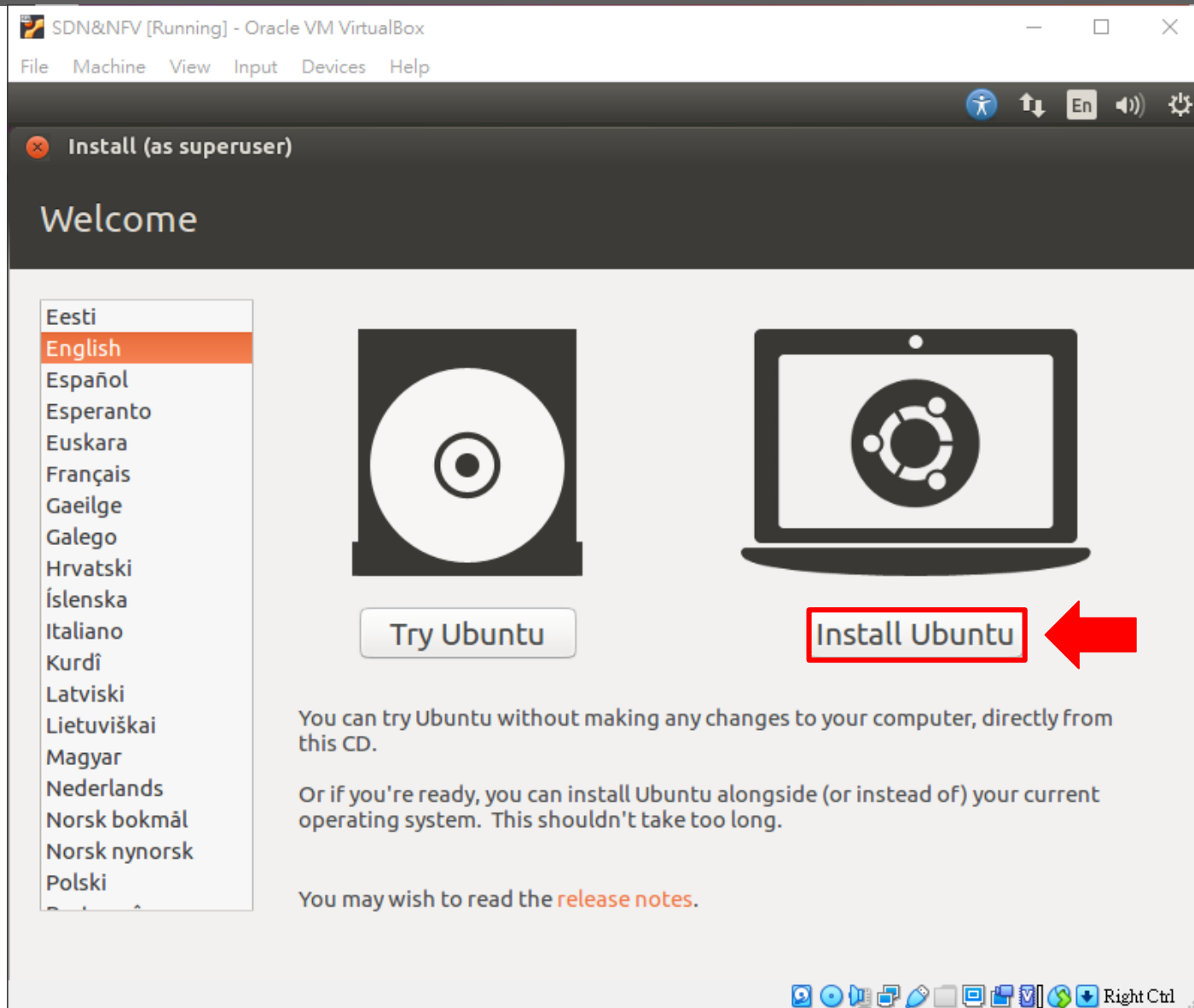
Ubuntu Installation (1/12)

Click “Start”



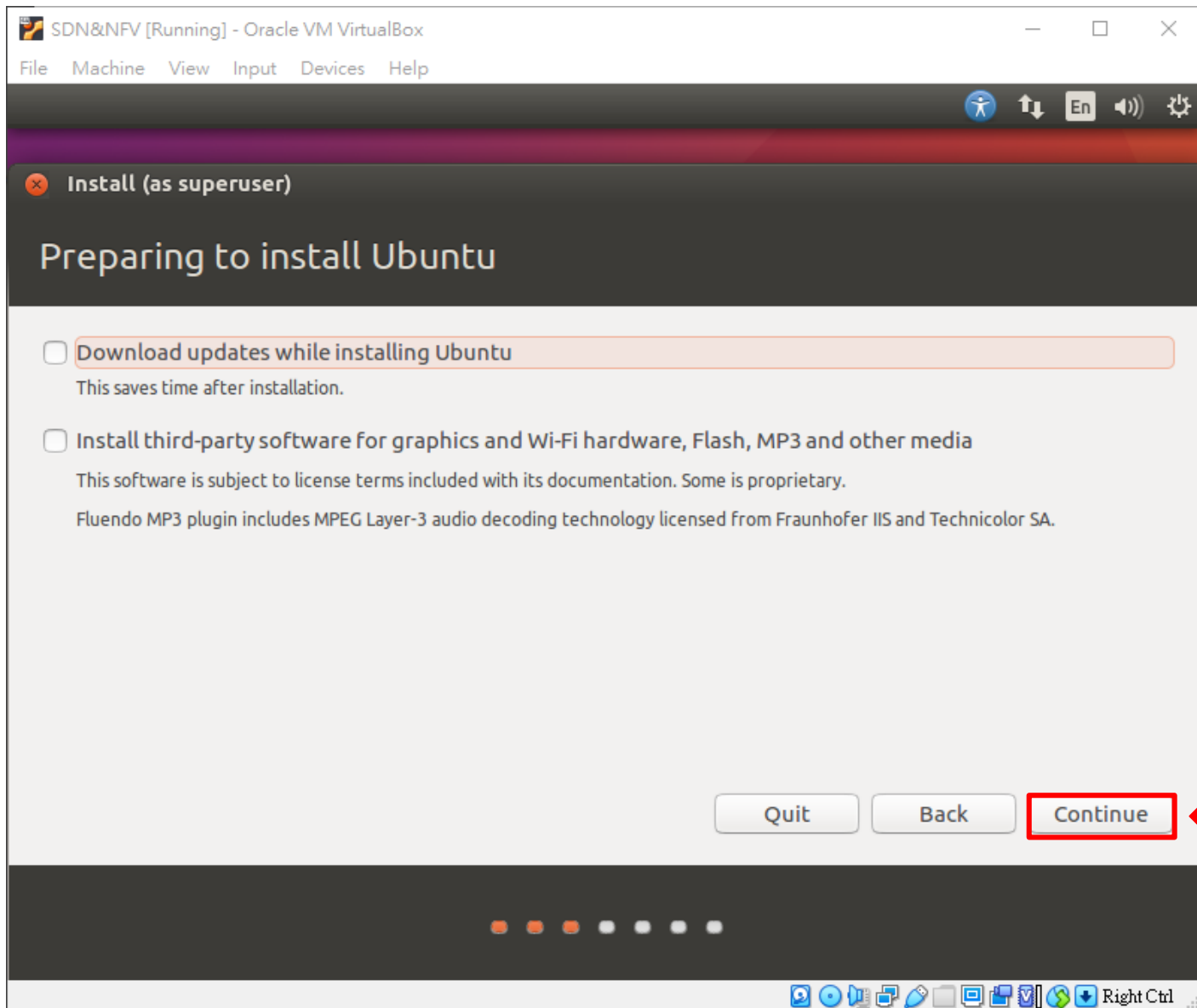


Ubuntu Installation (2/12)



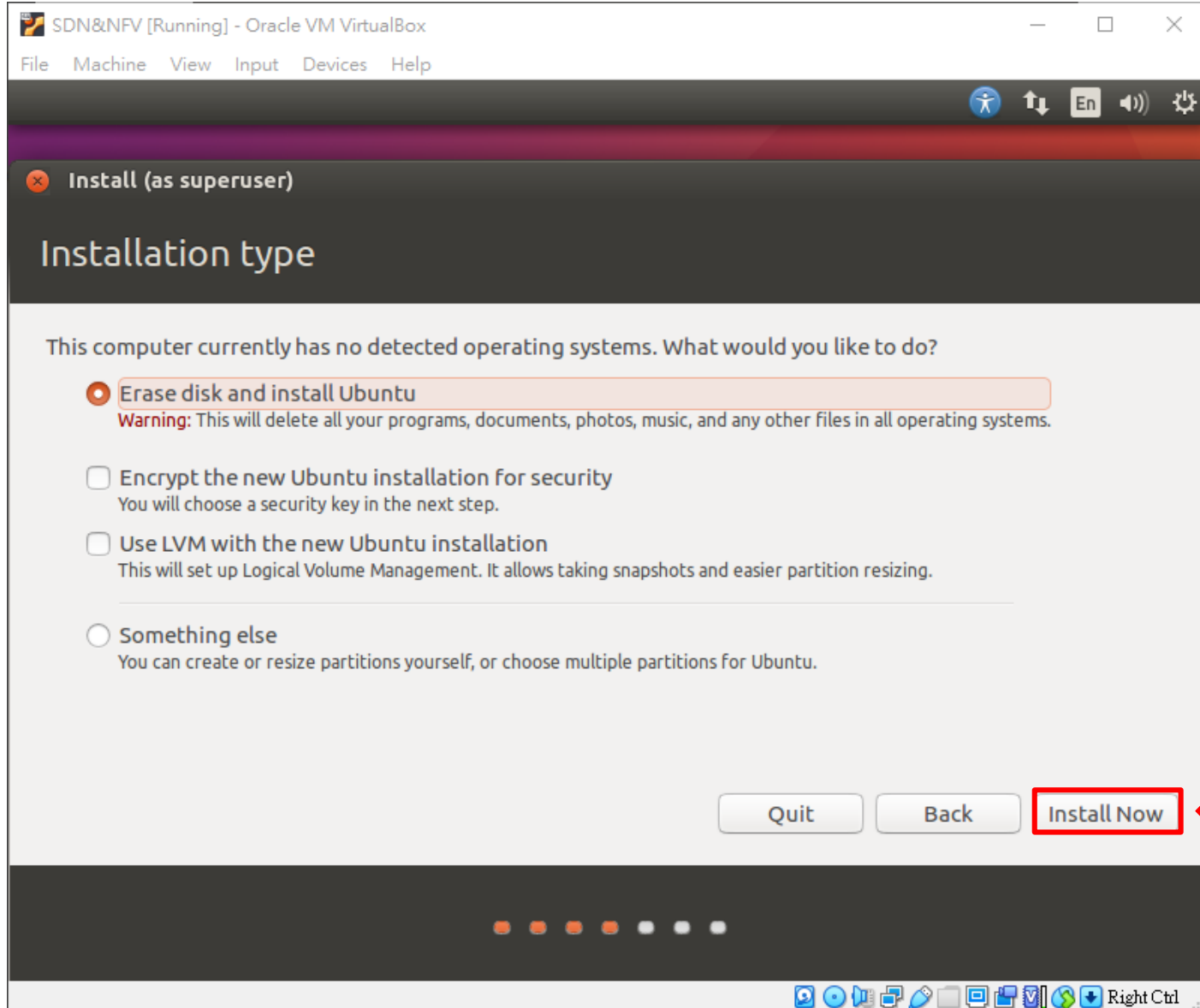


Ubuntu Installation (3/12)



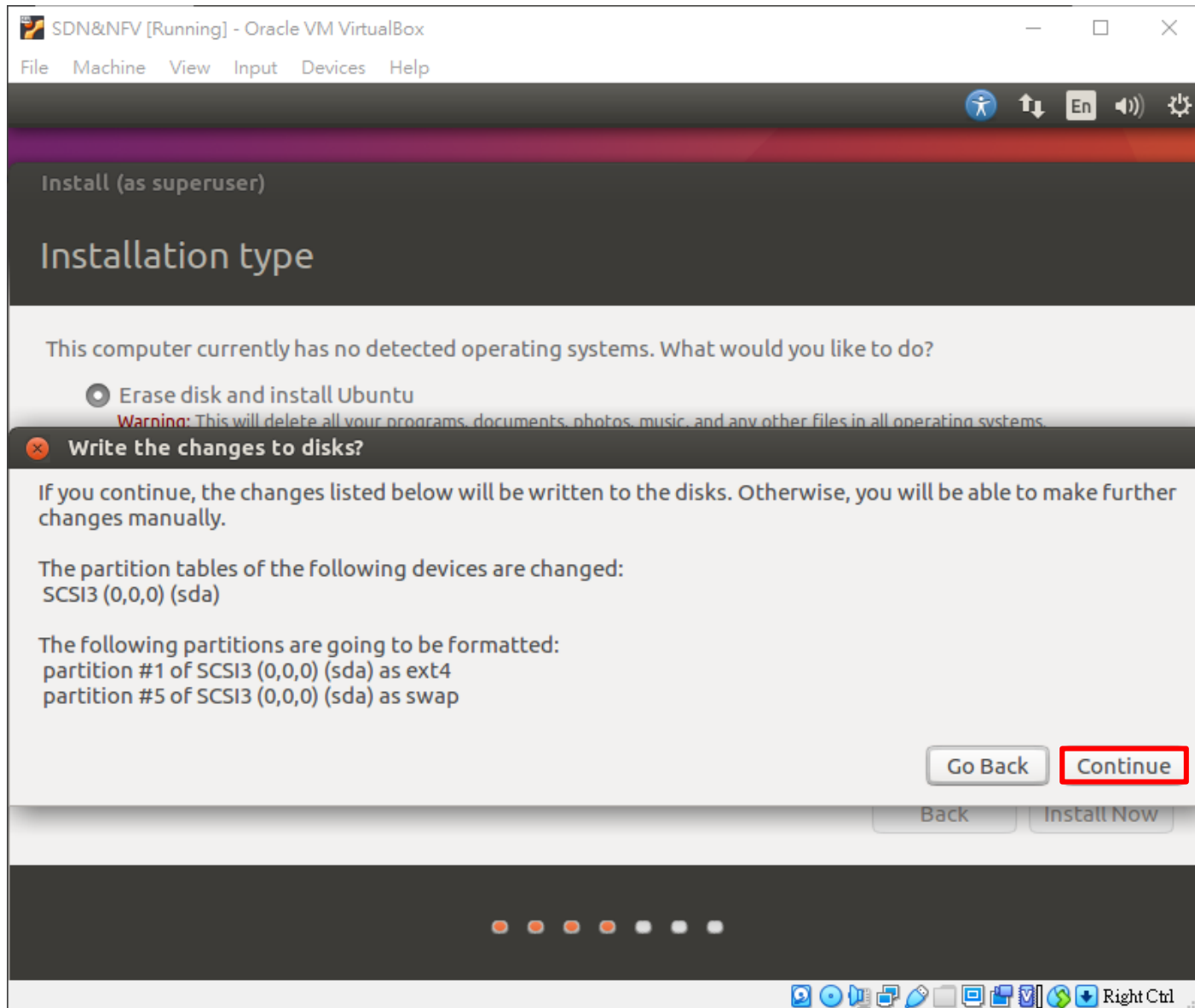


Ubuntu Installation (4/12)



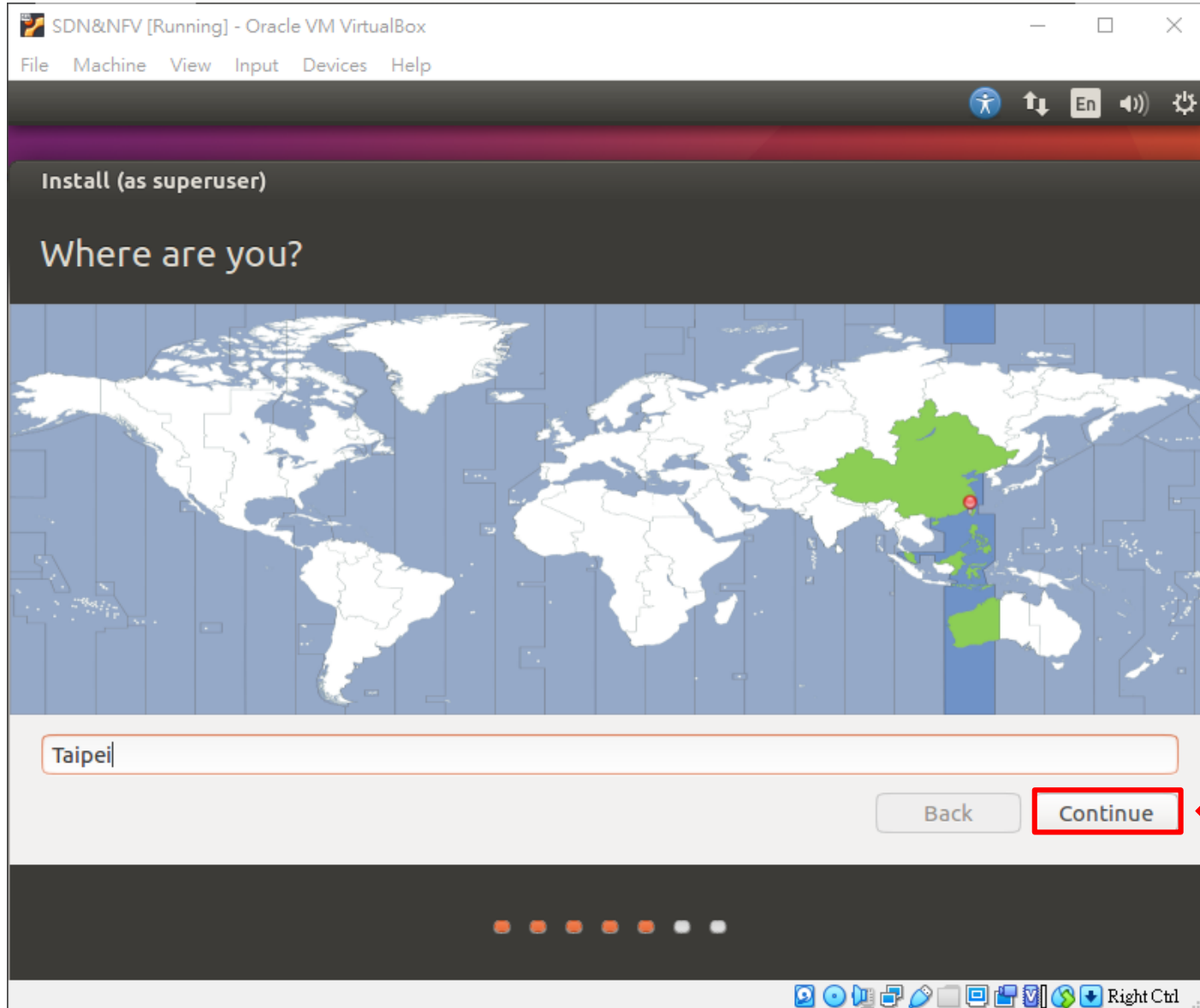


Ubuntu Installation (5/12)



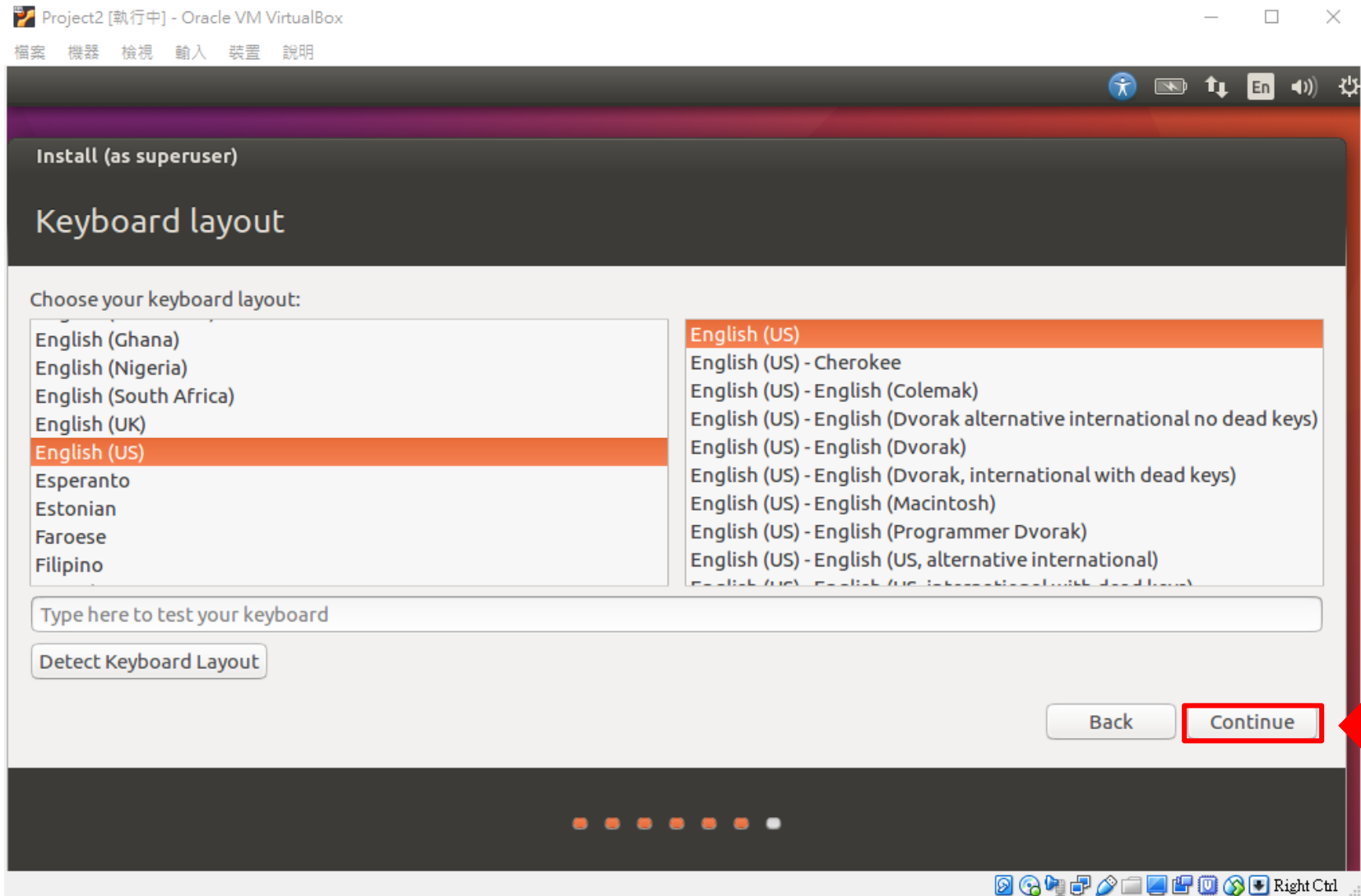


Ubuntu Installation (6/12)





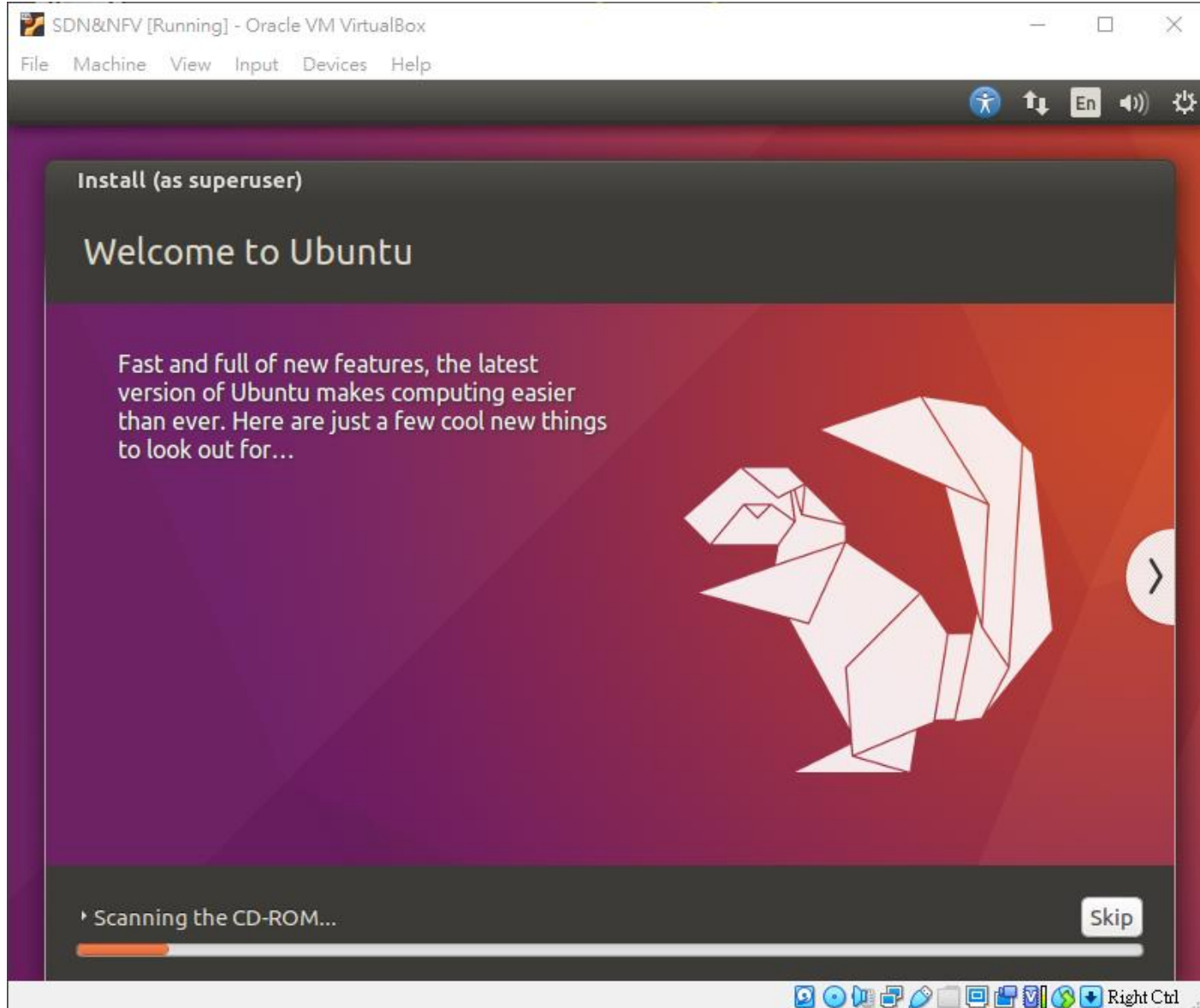
Ubuntu Installation (7/12)





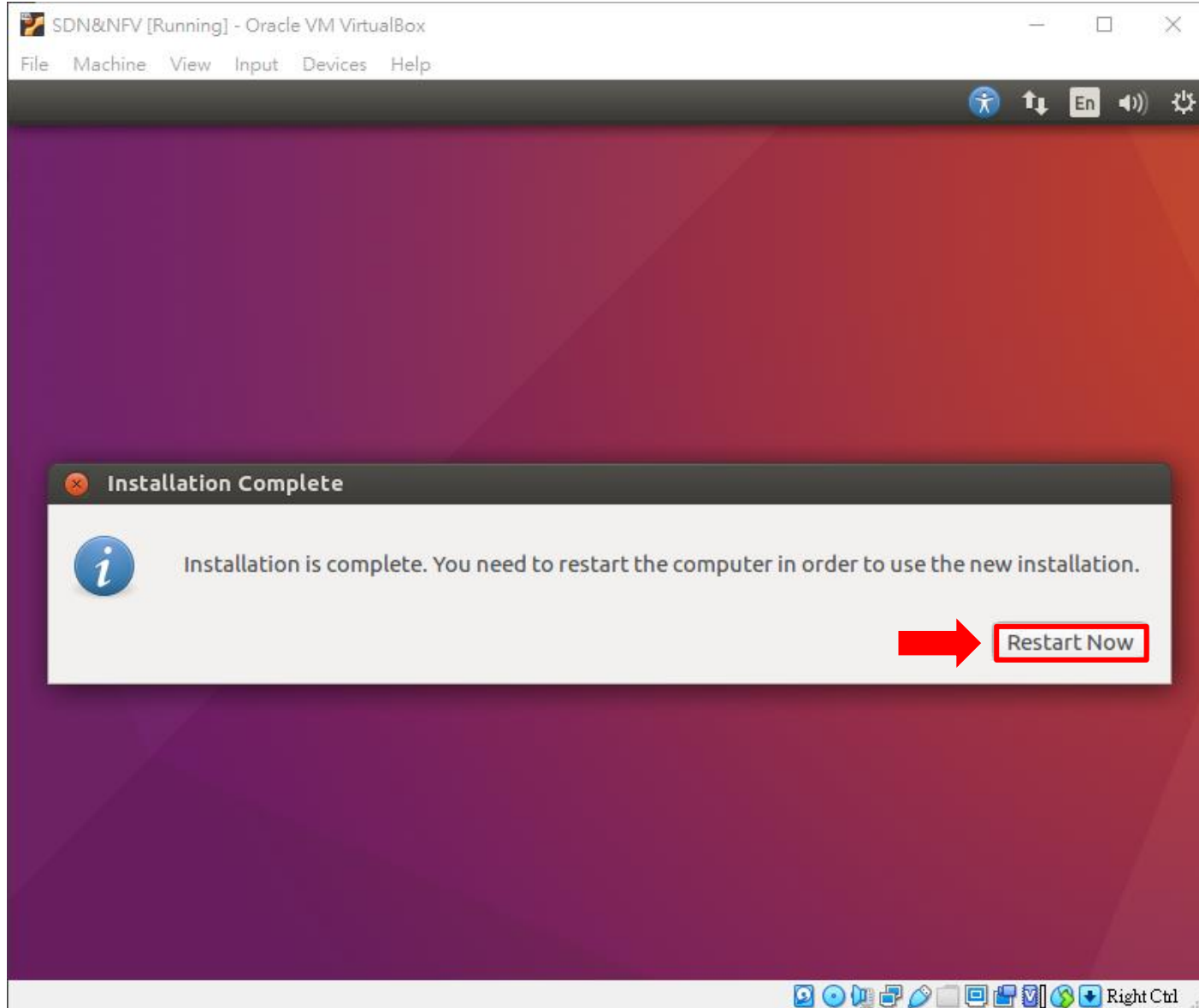


Ubuntu Installation (9/12)





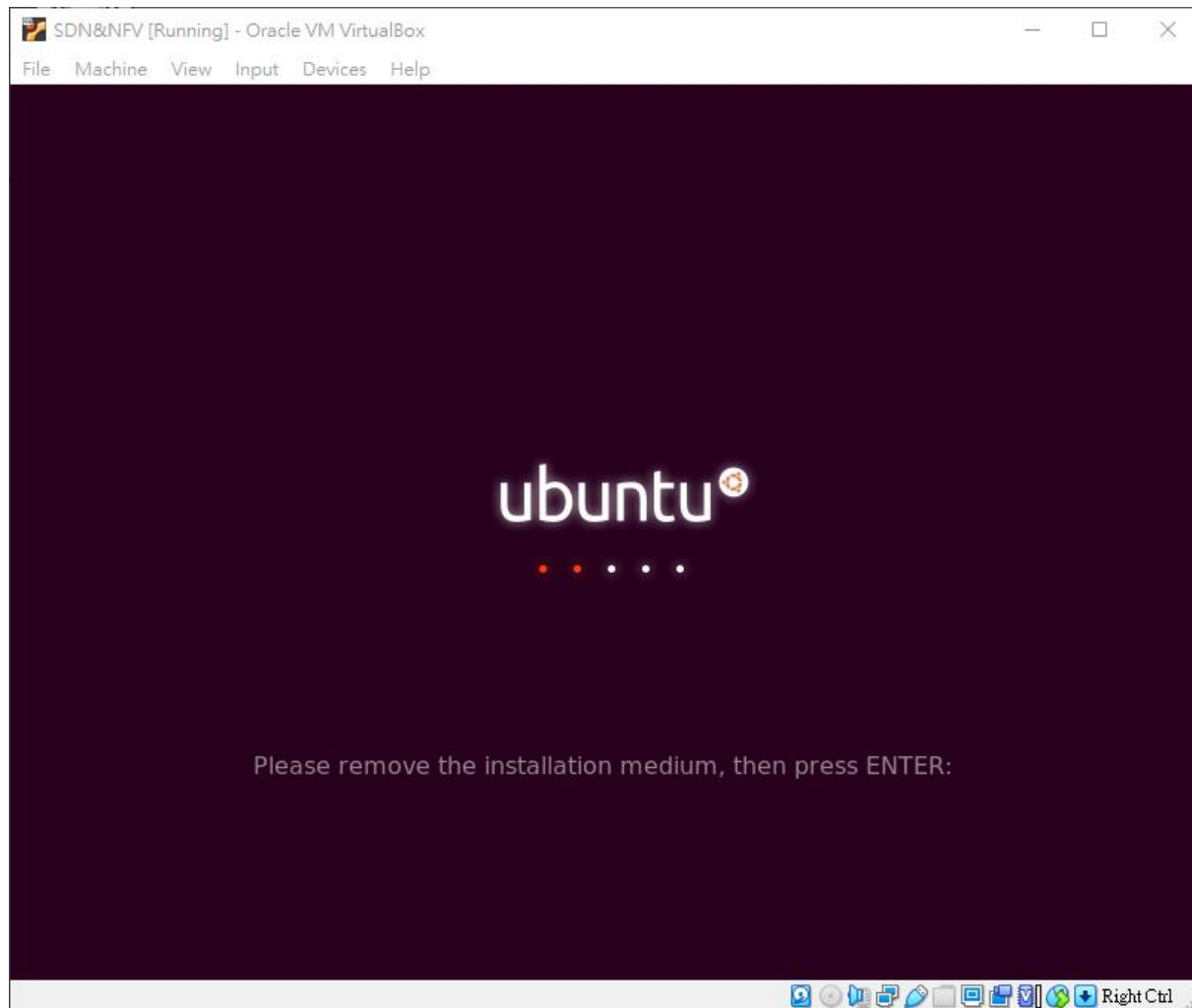
Ubuntu Installation (10/12)





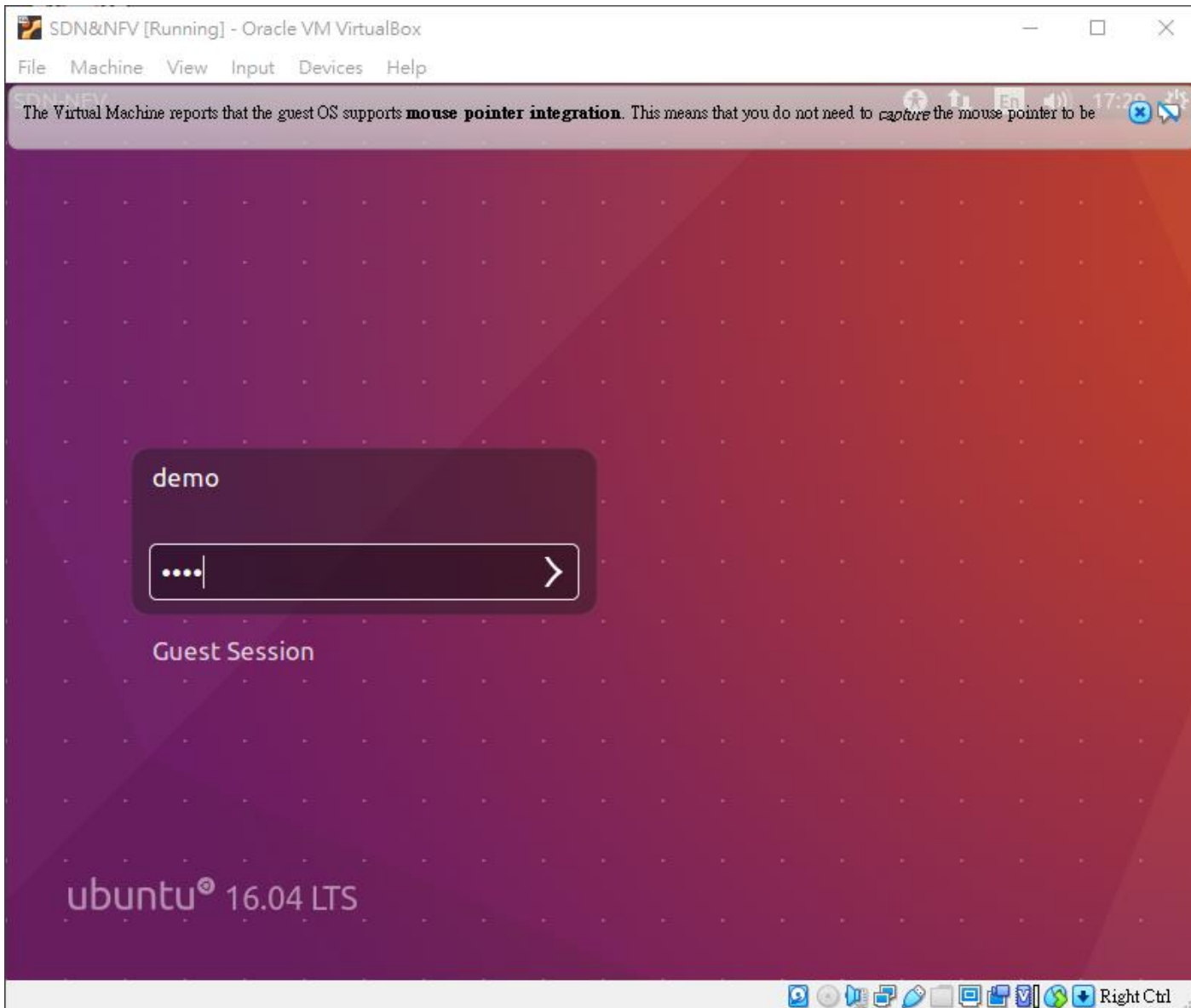
Ubuntu Installation (11/12)

- Press “Enter”, then VM will restart





Ubuntu Installation (12/12)





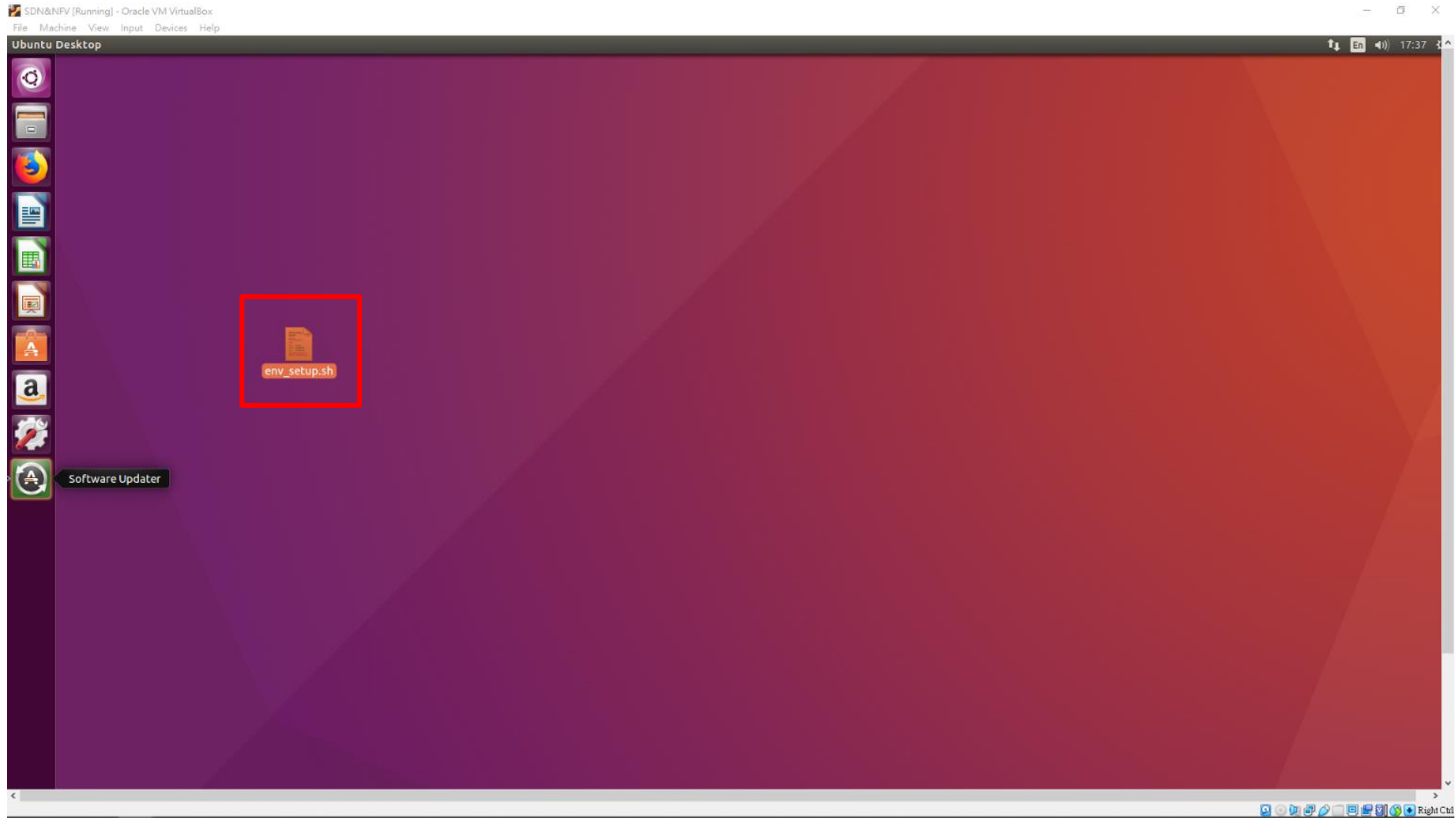
Outline

- ❑ Experiment Environment
- ❑ Installation
 - VirtualBox 6.1.2
 - Add VM
 - SDN development environment



SDN development environment (1/7)

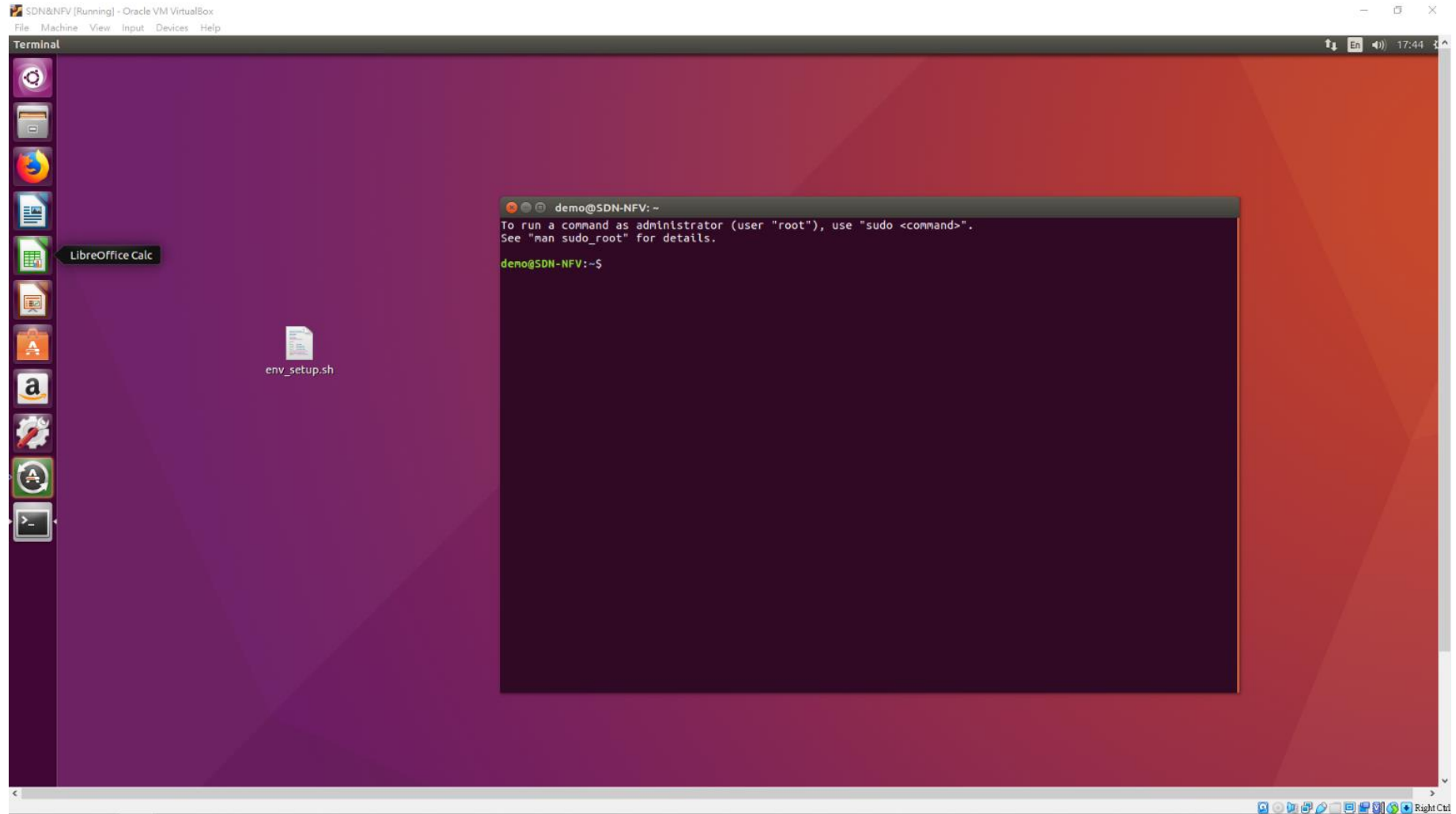
- Download “*env_setup.sh*” from e3





SDN development environment (2/7)

□ Open terminal





SDN development environment (3/7)

- ☐ Go to directory where the “env_setup.sh” is

```
$ cd ~/Desktop
```

- ☐ Change file permission to execute

```
$ chmod +x env_setup.sh
```

- ☐ Execute the shell script

```
$ ./env_setup.sh
```

```
demo@SDN-NFV:~$ cd ~/Desktop/  
demo@SDN-NFV:~/Desktop$ chmod +x env_setup.sh  
demo@SDN-NFV:~/Desktop$ ./env_setup.sh  
[sudo] password for demo: █
```



SDN development environment (4/7)

❑ Shell script will automatically install:

- Bazel 0.27.0
- ONOS 2.2.0
- Mininet
- OvS 2.11.4

```
demo@SDN-NFV:~/Downloads$ ./env_setup.sh
[sudo] password for demo:
Hit:1 http://tw.archive.ubuntu.com/ubuntu xenial InRelease
Hit:2 http://tw.archive.ubuntu.com/ubuntu xenial-updates InRelease
Hit:3 http://tw.archive.ubuntu.com/ubuntu xenial-backports InRelease
Hit:4 http://security.ubuntu.com/ubuntu xenial-security InRelease
Reading package lists... Done
Building dependency tree
Reading state information... Done
317 packages can be upgraded. Run 'apt list --upgradable' to see them.
[*] Begin to install Bazel...
Reading package lists... Done
Building dependency tree
Reading state information... Done
g++ is already the newest version (4:5.3.1-1ubuntu1).
pkg-config is already the newest version (0.29.1-0ubuntu1).
python3 is already the newest version (3.5.1-3).
unzip is already the newest version (6.0-20ubuntu1).
zip is already the newest version (3.0-11).
The following additional packages will be installed:
  zlib1g
The following NEW packages will be installed:
  zlib1g-dev
The following packages will be upgraded:
  zlib1g
1 upgraded, 1 newly installed, 0 to remove and 316 not upgraded.
Need to get 218 kB of archives.
After this operation, 424 kB of additional disk space will be used.
Get:1 http://tw.archive.ubuntu.com/ubuntu xenial-updates/main amd64 zlib1g amd64 1:1.2.8.dfsg-2ubuntu4.3 [51.2 kB]
Get:2 http://tw.archive.ubuntu.com/ubuntu xenial-updates/main amd64 zlib1g-dev amd64 1:1.2.8.dfsg-2ubuntu4.3 [167 kB]
Fetched 218 kB in 0s (3860 kB/s)
(Reading database ... 177098 files and directories currently installed.)
Preparing to unpack .../zlib1g_1%3a1.2.8.dfsg-2ubuntu4.3_amd64.deb ...
Unpacking zlib1g:amd64 (1:1.2.8.dfsg-2ubuntu4.3) over (1:1.2.8.dfsg-2ubuntu4.1) ...
Processing triggers for libc-bin (2.23-0ubuntu1) ...
Setting up zlib1g:amd64 (1:1.2.8.dfsg-2ubuntu4.3) ...
Processing triggers for libc-bin (2.23-0ubuntu1) ...
Selecting previously unselected package zlib1g-dev:amd64.
(Reading database ... 177098 files and directories currently installed.)
Preparing to unpack .../zlib1g-dev_1%3a1.2.8.dfsg-2ubuntu4.3_amd64.deb ...
Unpacking zlib1g-dev:amd64 (1:1.2.8.dfsg-2ubuntu4.3) ...
Processing triggers for man-db (2.7.5-1) ...
Setting up zlib1g-dev:amd64 (1:1.2.8.dfsg-2ubuntu4.3) ...
```




SDN development environment (5/7)

❑ Ignore those Error messages

```
Setting up curl (7.47.0-1ubuntu2.14) ...
Setting up liberror-perl (0.17-1.2) ...
Setting up git-man (1:2.7.4-0ubuntu1.7) ...
Setting up git (1:2.7.4-0ubuntu1.7) ...
Processing triggers for libc-bin (2.23-0ubuntu11) ...
Cloning into 'onos'...
remote: Counting objects: 177, done
remote: Finding sources: 100% (580274/580274)
remote: Total 580274 (delta 232665), reused 580229 (delta 232665)
Receiving objects: 100% (580274/580274), 174.82 MiB | 6.40 MiB/s, done.
Resolving deltas: 100% (232665/232665), done.
Checking connectivity... done.
Note: checking out '2.2.0'.

You are in 'detached HEAD' state. You can look around, make experimental
changes and commit them, and you can discard any commits you make in this
state without impacting any branches by performing another checkout.

If you want to create a new branch to retain commits you create, you may
do so (now or later) by using -b with the checkout command again. Example:

  git checkout -b <new-branch-name>

HEAD is now at dc713f4... Tagging 2.2.0
Starting local Bazel server and connecting to it...
INFO: Call stack for the definition of repository 'com_google_android_annotations' which is a jvm_import_external (rule definition at /home/demo/.cache/bazel/_bazel_demo/f44ec76501ebb182b3e91b698a15afc2/external/bazel_tools/tools/build_defs/repo/jvm.bzl:203:23):
- /home/demo/.cache/bazel/_bazel_demo/f44ec76501ebb182b3e91b698a15afc2/external/bazel_tools/tools/build_defs/repo/jvm.bzl:263:5
- /home/demo/.cache/bazel/_bazel_demo/f44ec76501ebb182b3e91b698a15afc2/external/io_grpc_grpc_java/repositories.bzl:146:5
- /home/demo/.cache/bazel/_bazel_demo/f44ec76501ebb182b3e91b698a15afc2/external/io_grpc_grpc_java/repositories.bzl:48:9
- /home/demo/onos/WORKSPACE:47:1
ERROR: An error occurred during the fetch of repository 'com_google_android_annotations':
  java.io.IOException: Error downloading [http://central.maven.org/maven2/com/google/android/annotations/4.1.1.4/annotations-4.1.1.4.jar] to /home/demo/.cache/bazel/_bazel_demo/f44ec76501ebb182b3e91b698a15afc2/external/com_google_android_annotations/annotations-4.1.1.4.jar: Unknown host: central.maven.org
ERROR: /home/demo/.cache/bazel/_bazel_demo/f44ec76501ebb182b3e91b698a15afc2/external/io_grpc_grpc_java/core/BUILD.bazel:28:1: no such package '@com_google_android_annotations//jar': java.io.IOException: Error downloading [http://central.maven.org/maven2/com/google/android/annotations/4.1.1.4/annotations-4.1.1.4.jar] to /home/demo/.cache/bazel/_bazel_demo/f44ec76501ebb182b3e91b698a15afc2/external/com_google_android_annotations/annotations-4.1.1.4.jar: Unknown host: central.maven.org and referenced by '@io_grpc_grpc_java//core:internal'
ERROR: Analysis of target '//:onos' failed; build aborted: no such package '@com_google_android_annotations//jar': java.io.IOException: Error downloading [http://central.maven.org/maven2/com/google/android/annotations/4.1.1.4/annotations-4.1.1.4.jar] to /home/demo/.cache/bazel/_bazel_demo/f44ec76501ebb182b3e91b698a15afc2/external/com_google_android_annotations/annotations-4.1.1.4.jar: Unknown host: central.maven.org
INFO: Elapsed time: 57.220s
INFO: 0 processes.
FAILED: Build did NOT complete successfully (582 packages loaded, 4454 targets configured)
INFO: Analyzed target //:onos (202 packages loaded, 9183 targets configured).
INFO: Found 1 target...
[0 / 1] [Prepa] BazelWorkspaceStatusAction stable-status.txt
```



SDN development environment (6/7)

❑ Retype password

```
bazel-bin/models/microsemi/onos-models-microsemi-oar.oar
bazel-bin/models/polatis/onos-models-polatis-oar.oar
bazel-bin/models/ciena/waveserverai/onos-models-ciena-waveserverai-oar.oar
bazel-bin/pipelines/basic/onos-pipelines-basic-oar.oar
bazel-bin/pipelines/fabric/onos-pipelines-fabric-oar.oar
bazel-bin/protocols/grpc/onos-protocols-grpc-oar.oar
bazel-bin/protocols/p4runtime/onos-protocols-p4runtime-oar.oar
bazel-bin/protocols/gnmi/onos-protocols-gnmi-oar.oar
bazel-bin/protocols/gnoi/onos-protocols-gnoi-oar.oar
bazel-bin/protocols/xmpp/core/onos-protocols-xmpp-core-oar.oar
bazel-bin/protocols/xmpp/pubsub/onos-protocols-xmpp-pubsub-oar.oar
bazel-bin/apps/cpmapi/libonos-apps-cpmapi.jar
bazel-bin/apps/routing-api/libonos-apps-routing-api.jar
bazel-bin/apps/dhcp-api/libonos-apps-dhcp-api.jar
bazel-bin/apps/dhcp/app/libonos-apps-dhcp-app.jar
bazel-bin/apps/imr-api/libonos-apps-imr-api.jar
bazel-bin/apps/imr/app/libonos-apps-imr-app.jar
bazel-bin/apps/dhcprelay/app/libonos-apps-dhcprelay-app.jar
bazel-bin/apps/dhcprelay/web/libonos-apps-dhcprelay-web.jar
bazel-bin/apps/fwd/libonos-apps-fwd.jar
bazel-bin/apps/iptology-api/libonos-apps-iptology-api.jar
bazel-bin/apps/routing/common/libonos-apps-routing-common.jar
bazel-bin/apps/vtn/vtnrsc/libonos-apps-vtn-vtnrsc.jar
bazel-bin/apps/vtn/sfcmgr/libonos-apps-vtn-sfcmgr.jar
bazel-bin/apps/vtn/vtnmgr/libonos-apps-vtn-vtnmgr.jar
bazel-bin/apps/vtn/vtnweb/libonos-apps-vtn-vtnweb.jar
bazel-bin/apps/kafka-integration-api/libonos-apps-kafka-integration-api.jar
bazel-bin/apps/kafka-integration/app/libonos-apps-kafka-integration-app.jar
bazel-bin/tools/build/conf/libonos-build-conf.jar
bazel-bin/onos-admin.tar.gz
bazel-bin/onos-test.tar.gz
bazel-bin/onos.tar.gz
INFO: Elapsed time: 866.616s, Critical Path: 202.81s
INFO: 2444 processes: 2116 linux-sandbox, 1 local, 327 worker.
INFO: Build completed successfully, 2472 total actions
[*] Begin to install mininet...
Cloning into 'mininet'...
remote: Enumerating objects: 9, done.
remote: Counting objects: 100% (9/9), done.
remote: Compressing objects: 100% (9/9), done.
remote: Total 9705 (delta 3), reused 3 (delta 0), pack-reused 9696
Receiving objects: 100% (9705/9705), 3.01 MiB | 1.01 MiB/s, done.
Resolving deltas: 100% (6439/6439), done.
Checking connectivity... done.
Detected Linux distribution: Ubuntu 16.04 xenial amd64
sys.version_info(major=2, minor=7, micro=12, releaselevel='final', serial=0)
Detected python (python) version 2
Installing Mininet dependencies
[sudo] password for demo: █
```




SDN development environment (7/7)

- ❑ If the installation complete, you'll see finish message

```
/usr/bin/install -c -m 644 python/ovstest/__init__.py python/ovstest/args.py python/ovstest/rpcserver.py python/ovstest/tcp.py python/ovstest/tests.py python/ovstest/udp.py python/ovstest/util.py python/ovstest/vswitch.py '/usr/local/share/openvswitch/python/ovstest'
/bin/mkdir -p '/usr/local/share/openvswitch/python/ovs'
/usr/bin/install -c -m 644 python/ovs/__init__.py python/ovs/daemon.py python/ovs/fcctl_win.py python/ovs/fatal_signal.py python/ovs/json.py python/ovs/jsonrpc.py python/ovs/ovsuuid.py python/ovs/poller.py python/ovs/process.py python/ovs/reconnect.py python/ovs/socket_util.py python/ovs/stream.py python/ovs/timeval.py python/ovs/util.py python/ovs/version.py python/ovs/vlog.py python/ovs/winutils.py '/usr/local/share/openvswitch/python/ovs'
/bin/mkdir -p '/usr/local/include/openflow'
/usr/bin/install -c -m 644 include/openflow/intel-ext.h include/openflow/netronome-ext.h include/openflow/nicira-ext.h include/openflow/openflow-1.0.h include/openflow/openflow-1.1.h include/openflow/openflow-1.2.h include/openflow/openflow-1.3.h include/openflow/openflow-1.4.h include/openflow/openflow-1.5.h include/openflow/openflow-1.6.h include/openflow/openflow-common.h include/openflow/openflow.h '/usr/local/include/openflow'
/bin/mkdir -p '/usr/local/include/openvswitch'
/usr/bin/install -c -m 644 include/openvswitch/compiler.h include/openvswitch/dynamic-string.h include/openvswitch/hmap.h include/openvswitch/flow.h include/openvswitch/geneve.h include/openvswitch/json.h include/openvswitch/list.h include/openvswitch/netdev.h include/openvswitch/match.h include/openvswitch/meta-flow.h include/openvswitch/namemap.h include/openvswitch/ofpbuf.h include/openvswitch/ofp-actions.h include/openvswitch/ofp-bundle.h include/openvswitch/ofp-connection.h include/openvswitch/ofp-ed-props.h include/openvswitch/ofp-errors.h include/openvswitch/ofp-flow.h include/openvswitch/ofp-group.h include/openvswitch/ofp-ipfix.h include/openvswitch/ofp-match.h include/openvswitch/ofp-meter.h include/openvswitch/ofp-monitor.h include/openvswitch/ofp-msgs.h include/openvswitch/ofp-packet.h include/openvswitch/ofp-parse.h include/openvswitch/ofp-port.h include/openvswitch/ofp-print.h include/openvswitch/ofp-prop.h include/openvswitch/ofp-protocol.h include/openvswitch/ofp-queue.h include/openvswitch/ofp-switch.h include/openvswitch/ofp-table.h include/openvswitch/ofp-util.h include/openvswitch/packets.h include/openvswitch/poll-loop.h include/openvswitch/rconn.h include/openvswitch/shash.h include/openvswitch/thread.h include/openvswitch/token-bucket.h '/usr/local/include/openvswitch'
/usr/bin/install -c -m 644 include/openvswitch/tun-metadata.h include/openvswitch/type-props.h include/openvswitch/types.h include/openvswitch/util.h include/openvswitch/uuid.h include/openvswitch/version.h include/openvswitch/vconn.h include/openvswitch/vlog.h include/openvswitch/nsh.h '/usr/local/include/openvswitch'
/bin/mkdir -p '/usr/local/include/ovn'
/usr/bin/install -c -m 644 include/ovn/actions.h include/ovn/expr.h include/ovn/lex.h '/usr/local/include/ovn'
/bin/mkdir -p '/usr/local/lib/pkgconfig'
/usr/bin/install -c -m 644 lib/libopenvswitch.pc lib/libsflow.pc ofproto/libofproto.pc ovsdb/libovsdb.pc '/usr/local/lib/pkgconfig'
/bin/mkdir -p '/usr/local/share/openvswitch'
/usr/bin/install -c -m 644 vswitchd/vswitch.ovsschema vtep/vtep.ovsschema ovn/ovn-sb.ovsschema ovn/ovn-nb.ovsschema '/usr/local/share/openvswitch'
/bin/mkdir -p '/usr/local/share/openvswitch/scripts'
/usr/bin/install -c -m 644 utilities/ovs-lib '/usr/local/share/openvswitch/scripts'
/bin/mkdir -p '/usr/local/share/openvswitch/scripts'
/usr/bin/install -c utilities/ovs-check-dead-ifs utilities/ovs-ctl utilities/ovs-kmod-ctl utilities/ovs-save utilities/bugtool/ovs-bugtool-fdb-show utilities/bugtool/ovs-bugtool-tc-class-show utilities/bugtool/ovs-bugtool-daemons-ver utilities/bugtool/ovs-bugtool-ovs-ofctl-loop-over-bridges utilities/bugtool/ovs-bugtool-ovs-appctl-dpif utilities/bugtool/ovs-bugtool-ovs-bridge-datapath-type utilities/bugtool/ovs-bugtool-ovs-vswitchd-threads-affinity utilities/bugtool/ovs-bugtool-qos-configs utilities/bugtool/ovs-bugtool-get-dpdk-nic-numa ovn/utilities/bugtool/ovn-bugtool-nbctl-show ovn/utilities/bugtool/ovn-bugtool-sbctl-show ovn/utilities/bugtool/ovn-bugtool-sbctl-lflow-list ipsec/ovs-monitor-ipsec vtep/ovs-vtep ovn/utilities/ovn-ctl ovn/utilities/ovsdb-servers.ocf '/usr/local/share/openvswitch/scripts'
make[3]: Leaving directory '/home/demo/onos/openvswitch-2.11.0'
make[2]: Leaving directory '/home/demo/onos/openvswitch-2.11.0'
make[1]: Leaving directory '/home/demo/onos/openvswitch-2.11.0'
* Starting ovsdb-server
* system ID not configured, please use --system-id
* Configuring Open vSwitch system IDs
* Inserting openvswitch module
* Starting ovs-vswitchd
* Enabling remote OVSDB managers
*** Installation Finished! ***
demo@SDN-NFV:~/Downloads$
```