

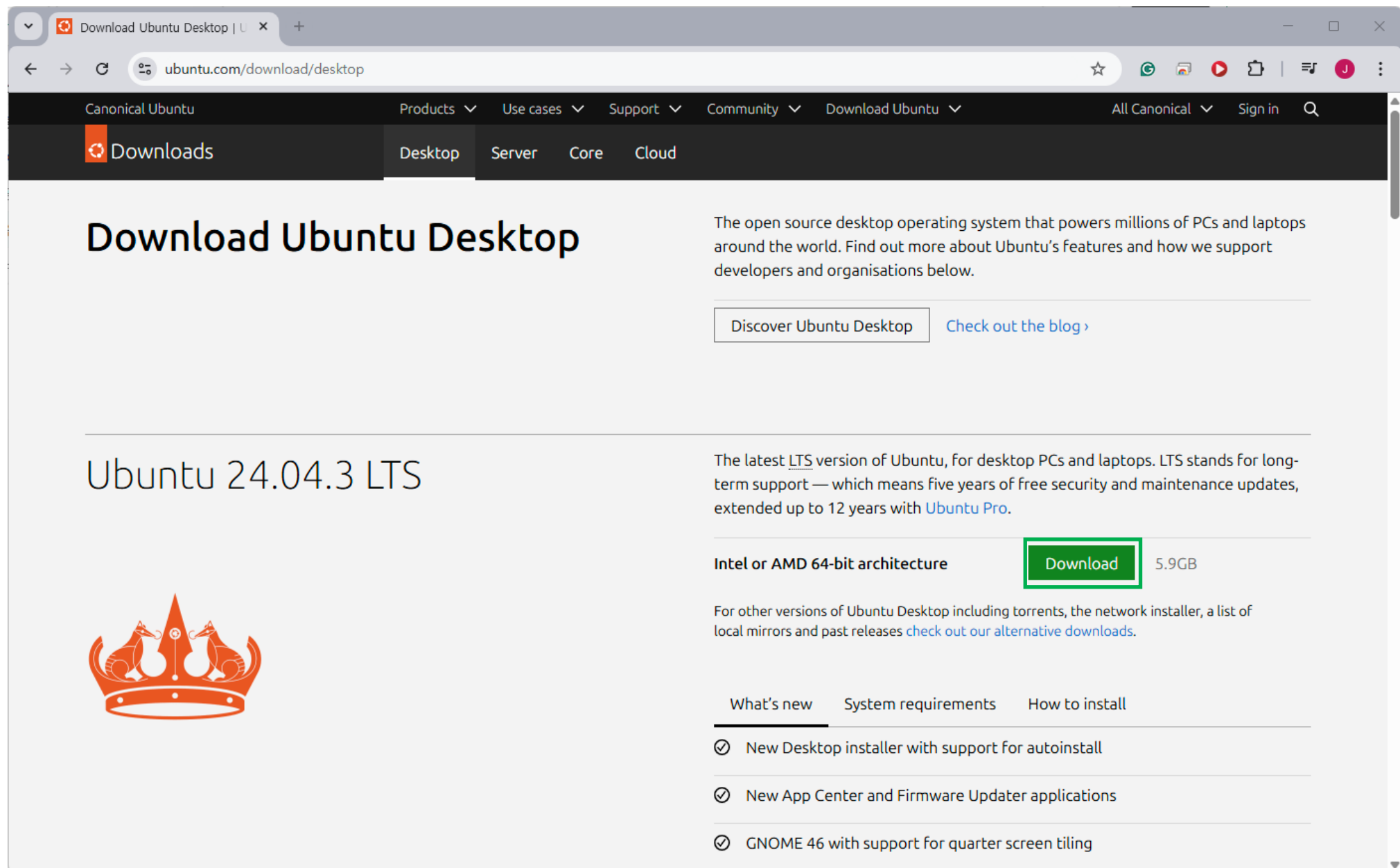
Virtual machine setup

OPERATING SYSTEM BASED ON PBL

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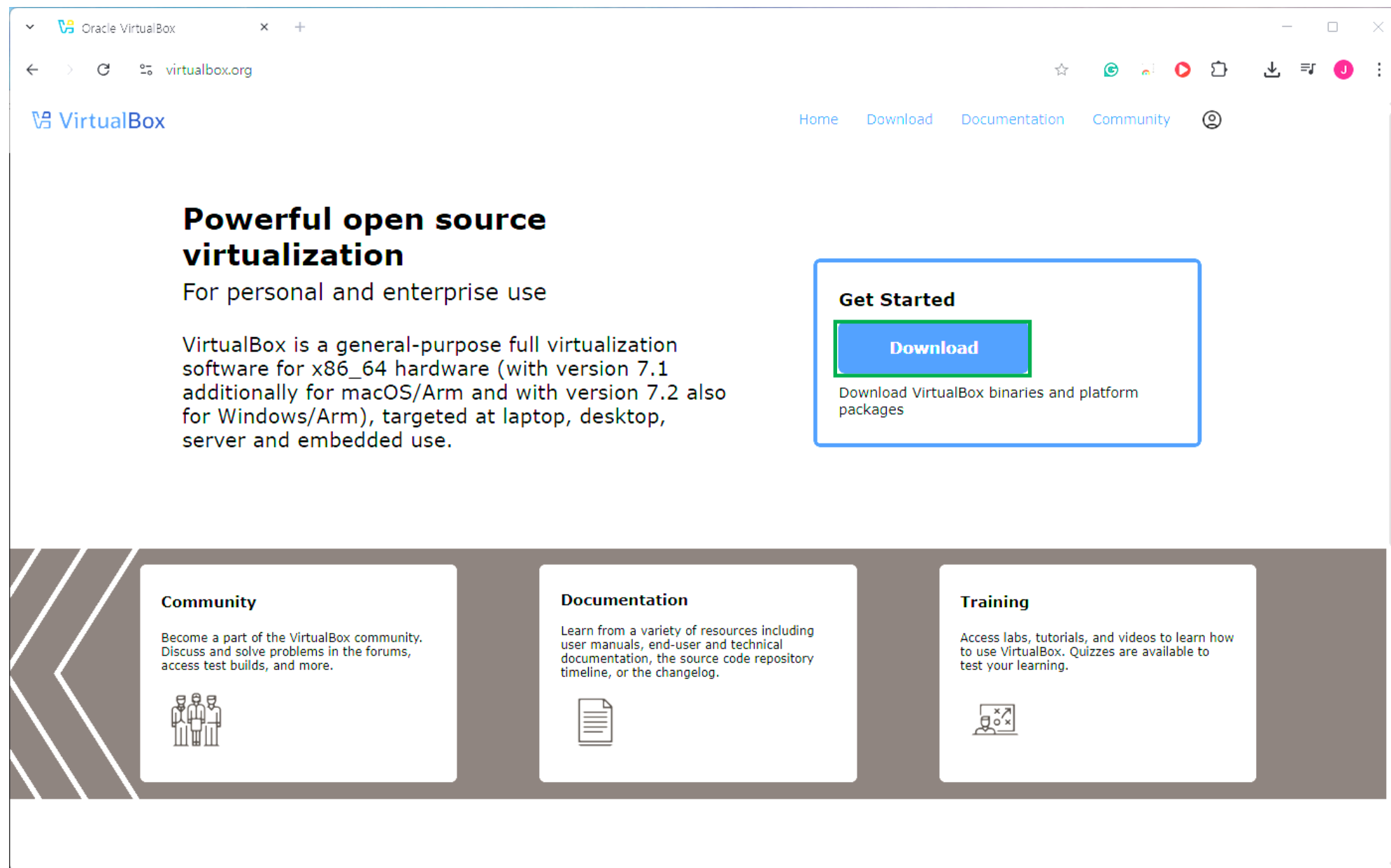
Download Linux Image

- Visit Ubuntu Desktop homepage
 - ▶ <https://ubuntu.com/download/desktop>
- Press Download 24.04.3



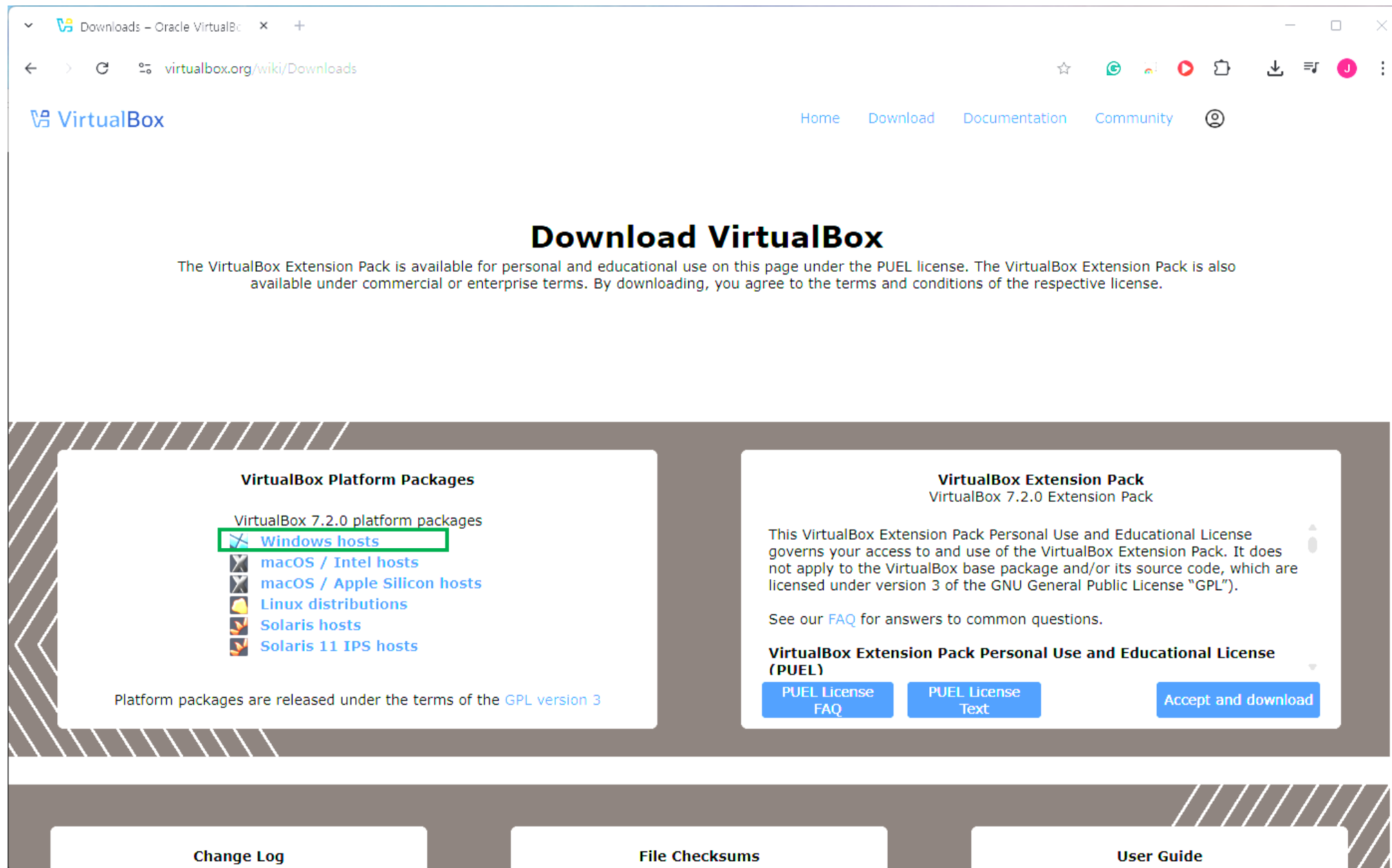
Install VirtualBox

- Visit VirtualBox homepage
 - ▶ <https://www.virtualbox.org/>
 - ▶ Click Download



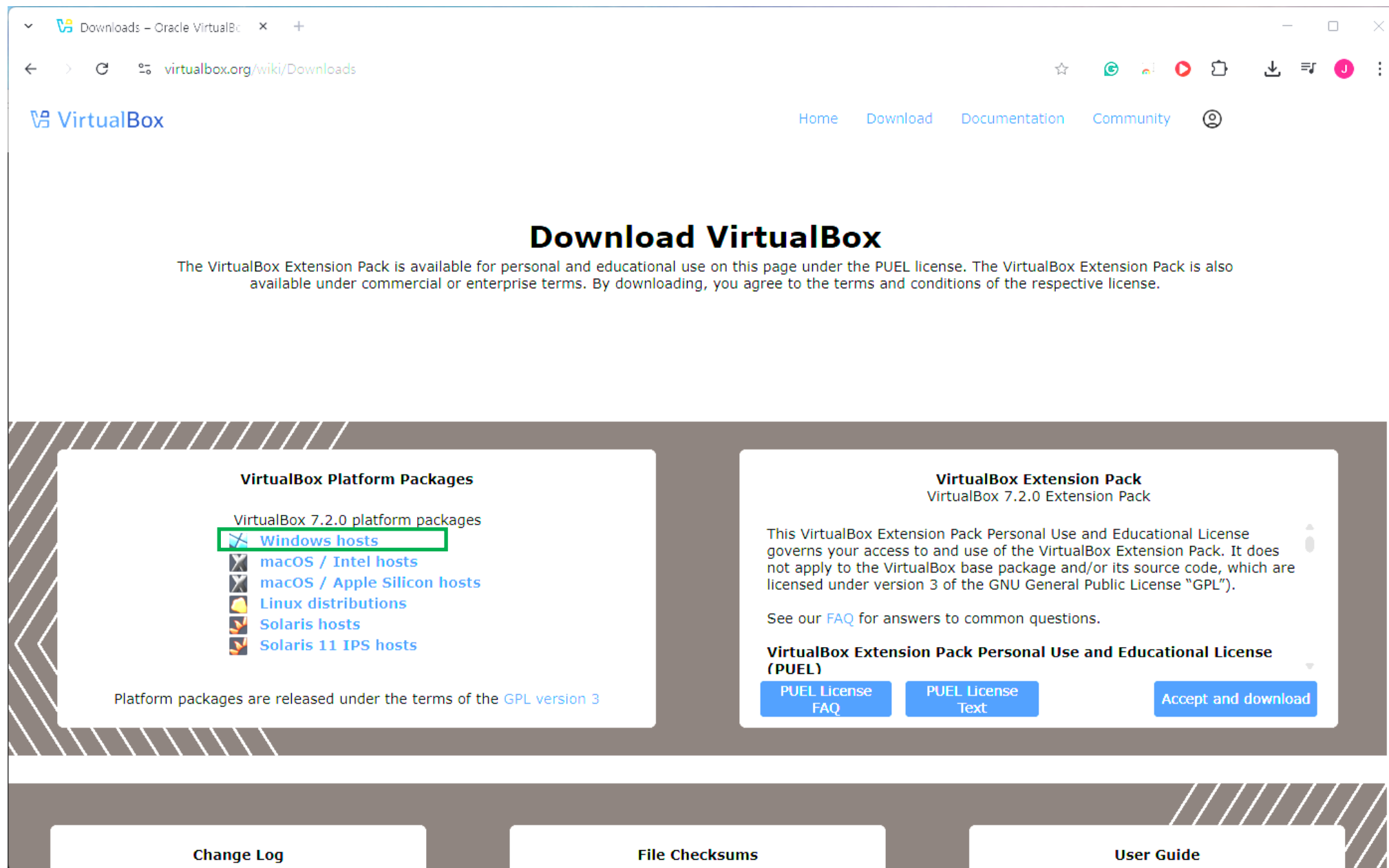
Install VirtualBox

- ▶ Download a VirtualBox Platform Packages
 - Windows hosts



Install VirtualBox

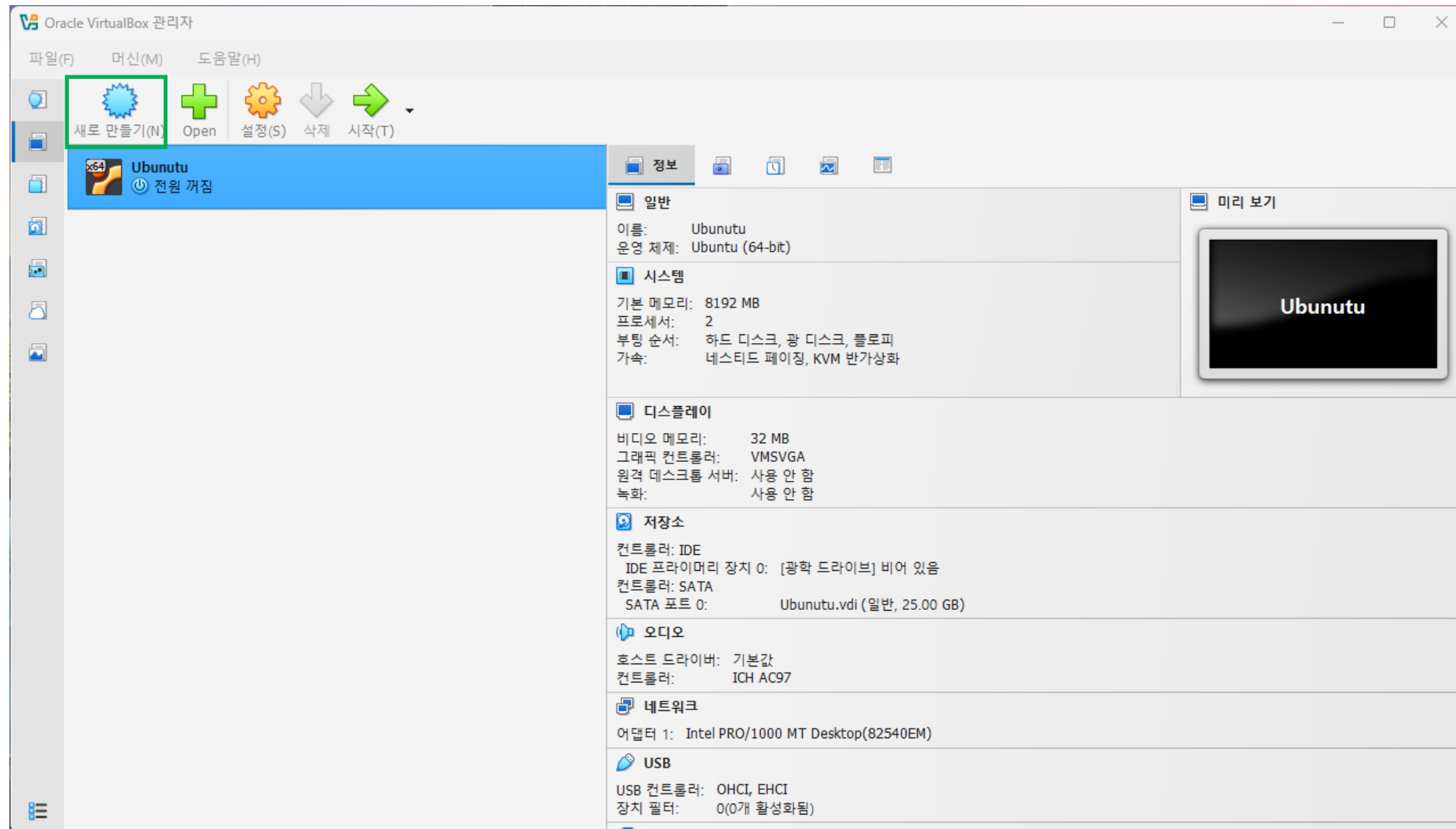
- ▶ Download a VirtualBox Platform Packages
 - Windows hosts



- Run 'VirtualBox-7.2.0-170228-Win.exe'

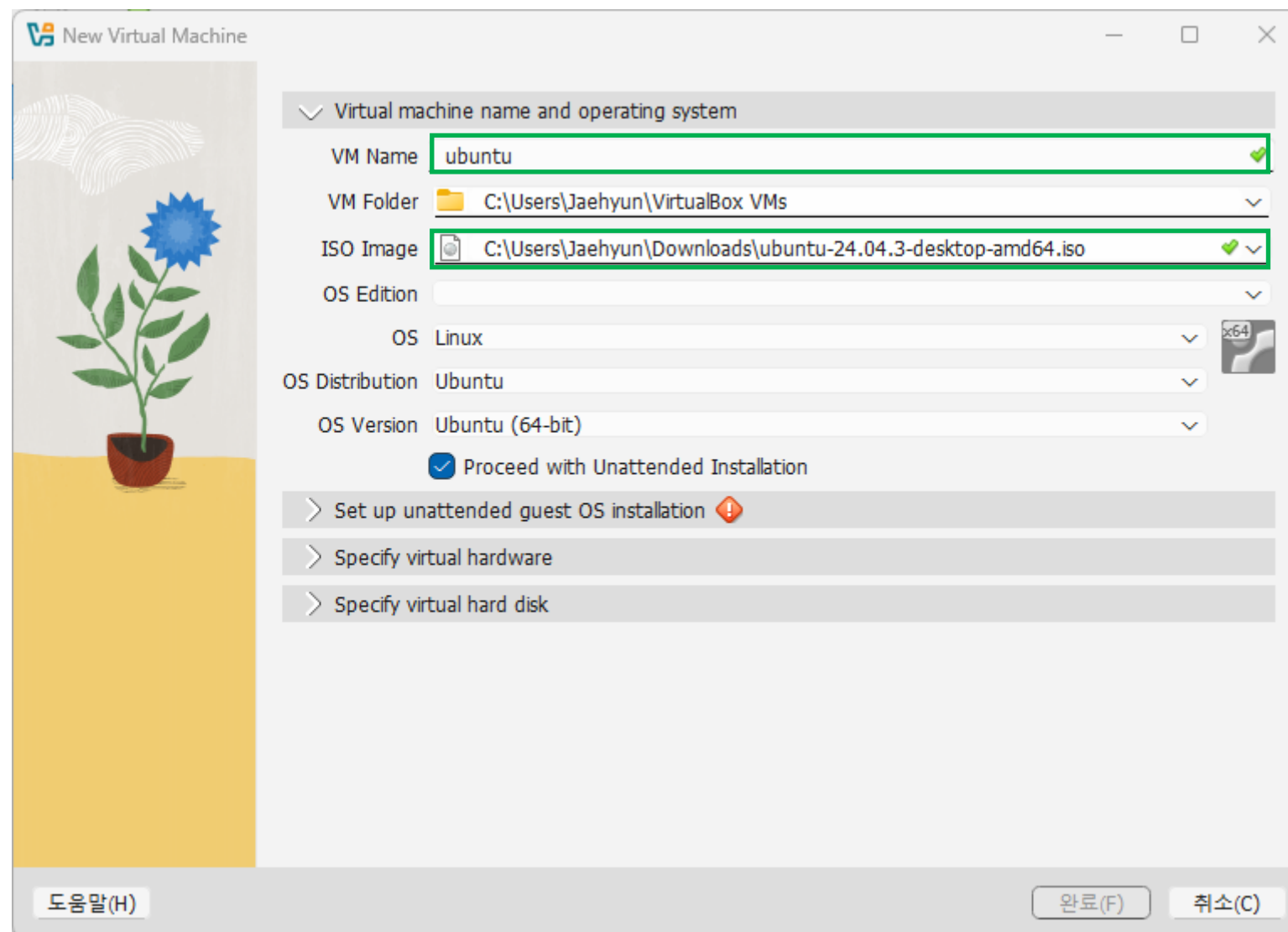
Create Virtual Machine

- Run VirtualBox
 - ▶ Create a virtual machine



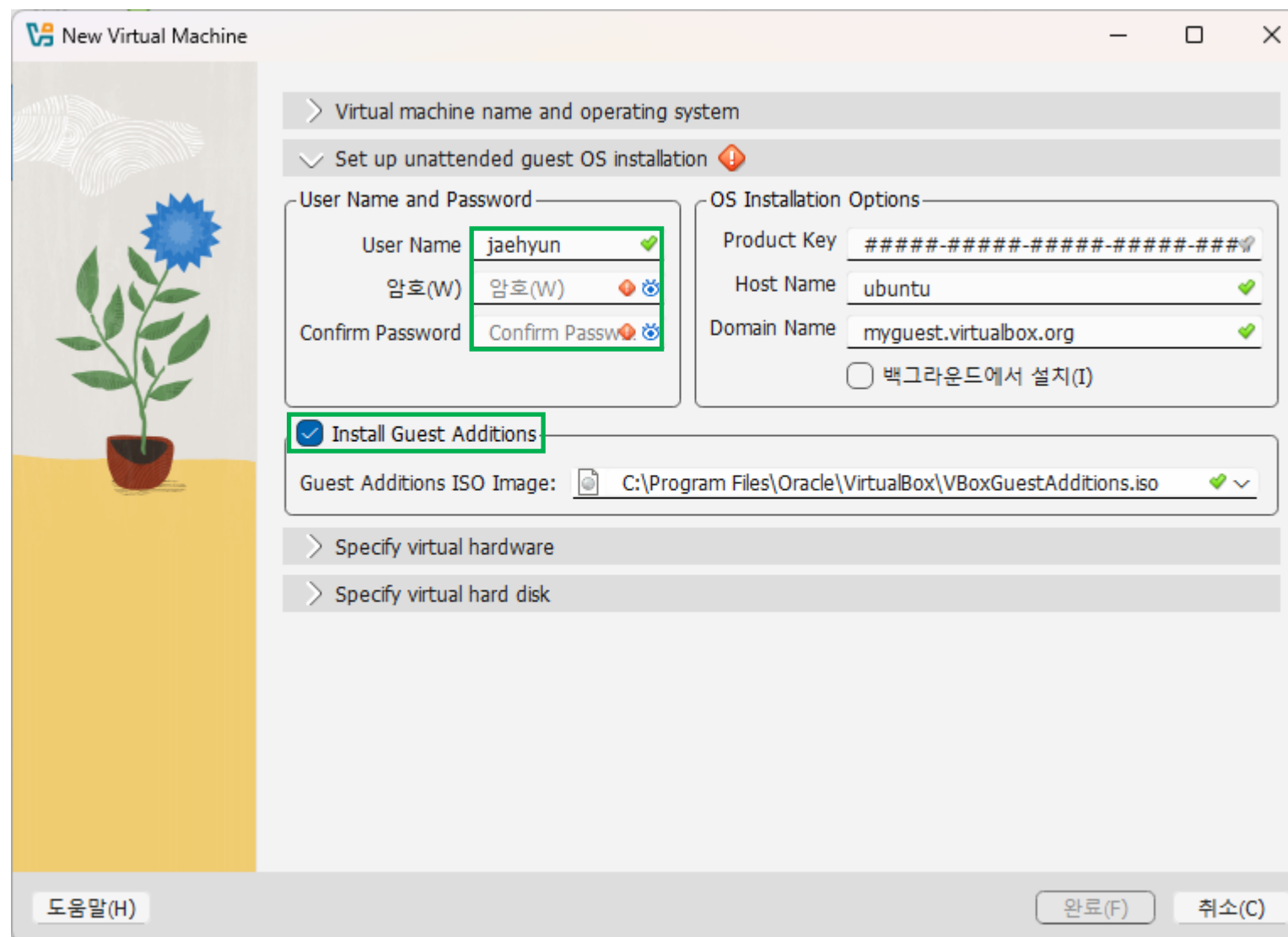
Create Virtual Machine

- Open Virtual machine name and operating system
 - ▶ Enter VM Name and search iso file of ubuntu 24.04.3



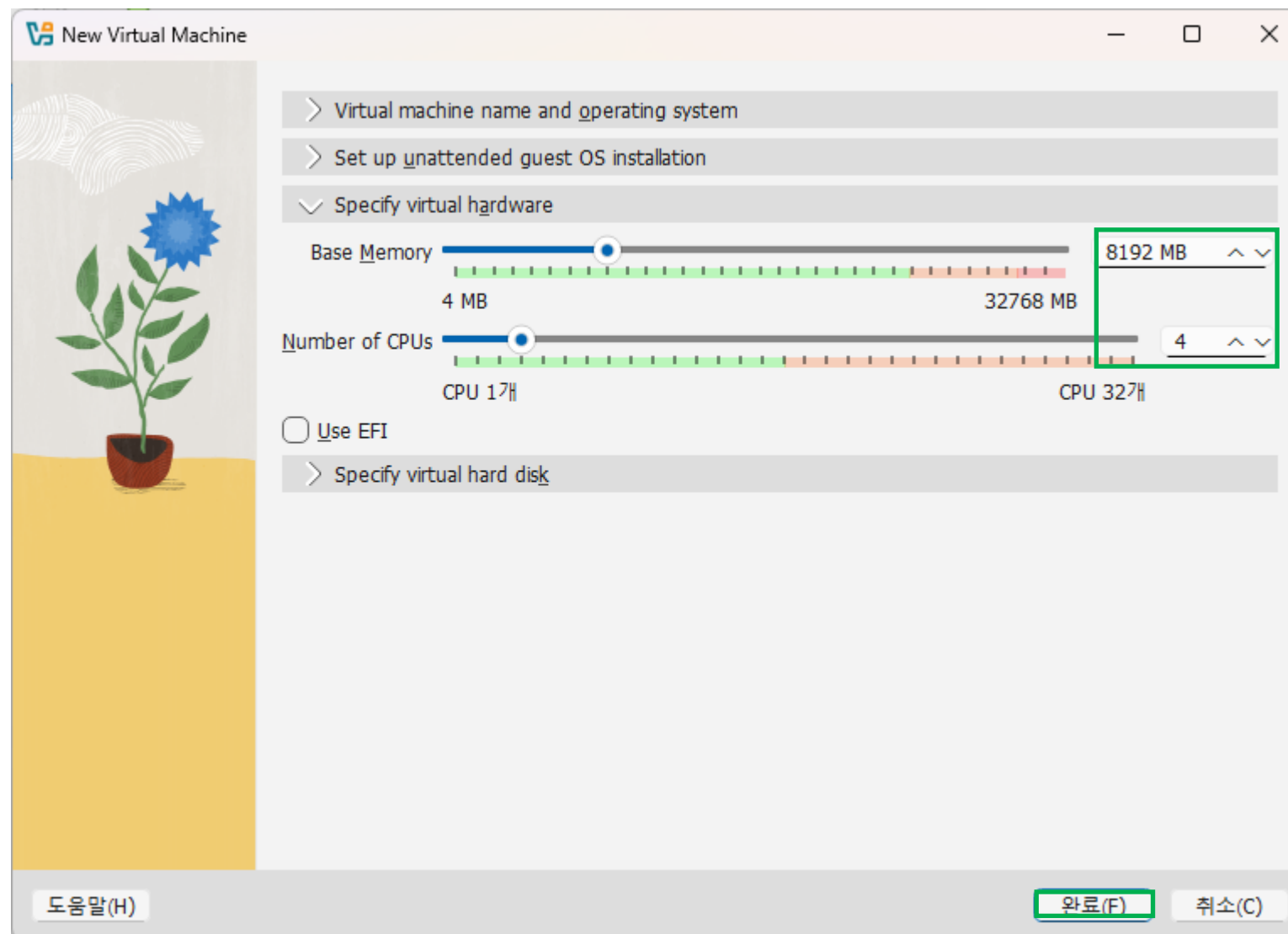
Create Virtual Machine

- Open Set up unattended guest OS installation
 - ▶ Set User Name as your first name and set password
 - ▶ Check Install Guest Additions



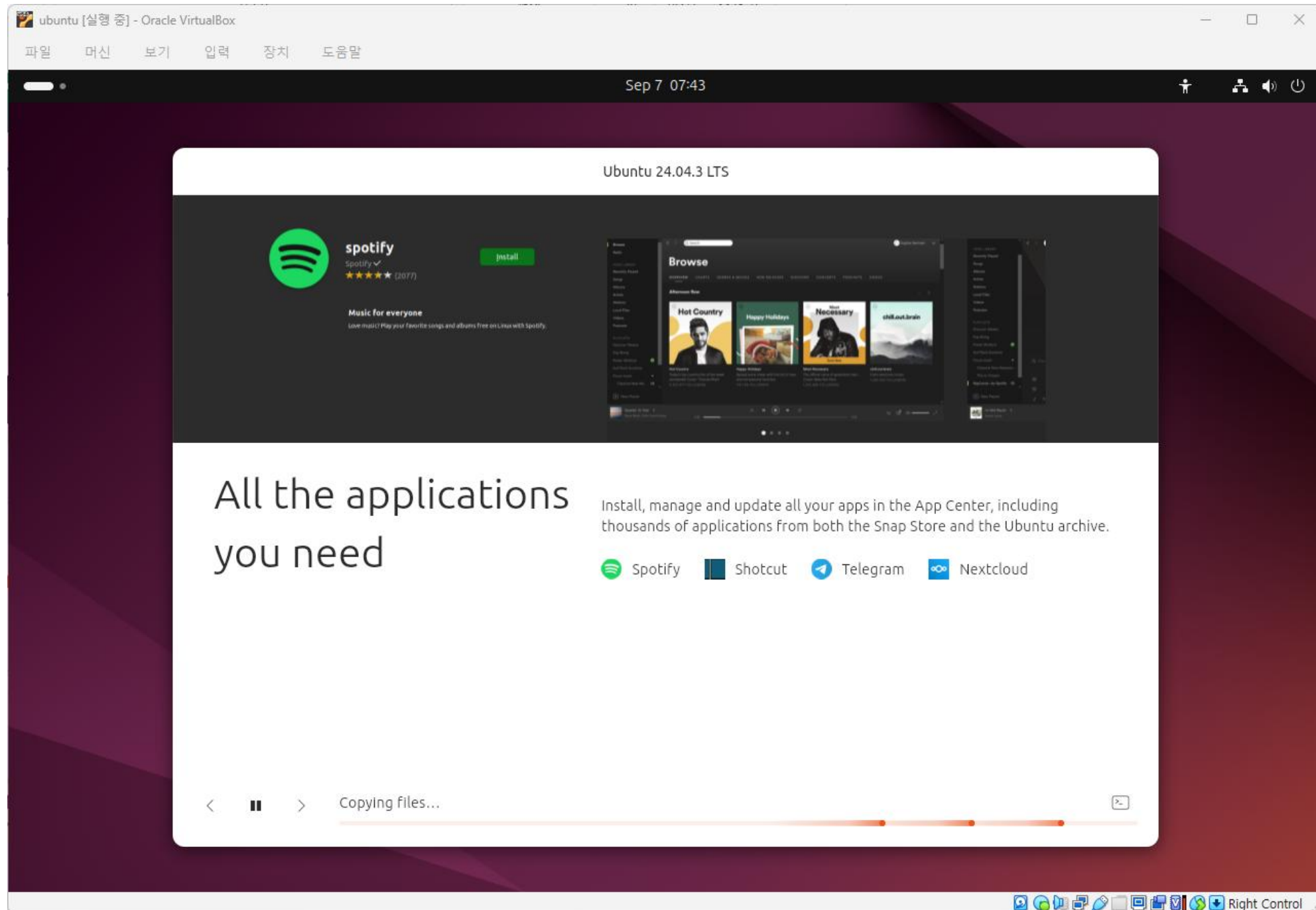
Create Virtual Machine

- Open Specify virtual hardware
 - ▶ Set Base Memory more than 8192 MB
 - ▶ Set Number of CPUs more than 2
- Click Finish button



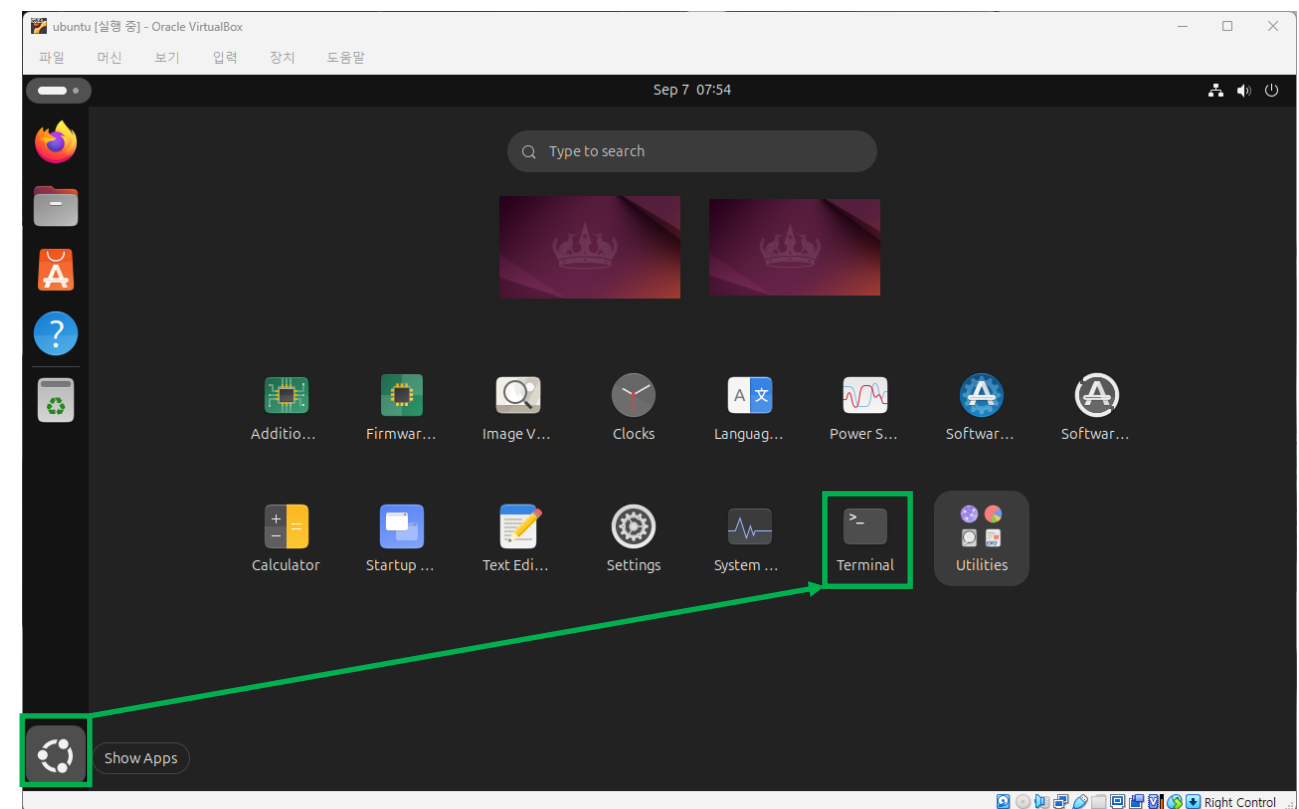
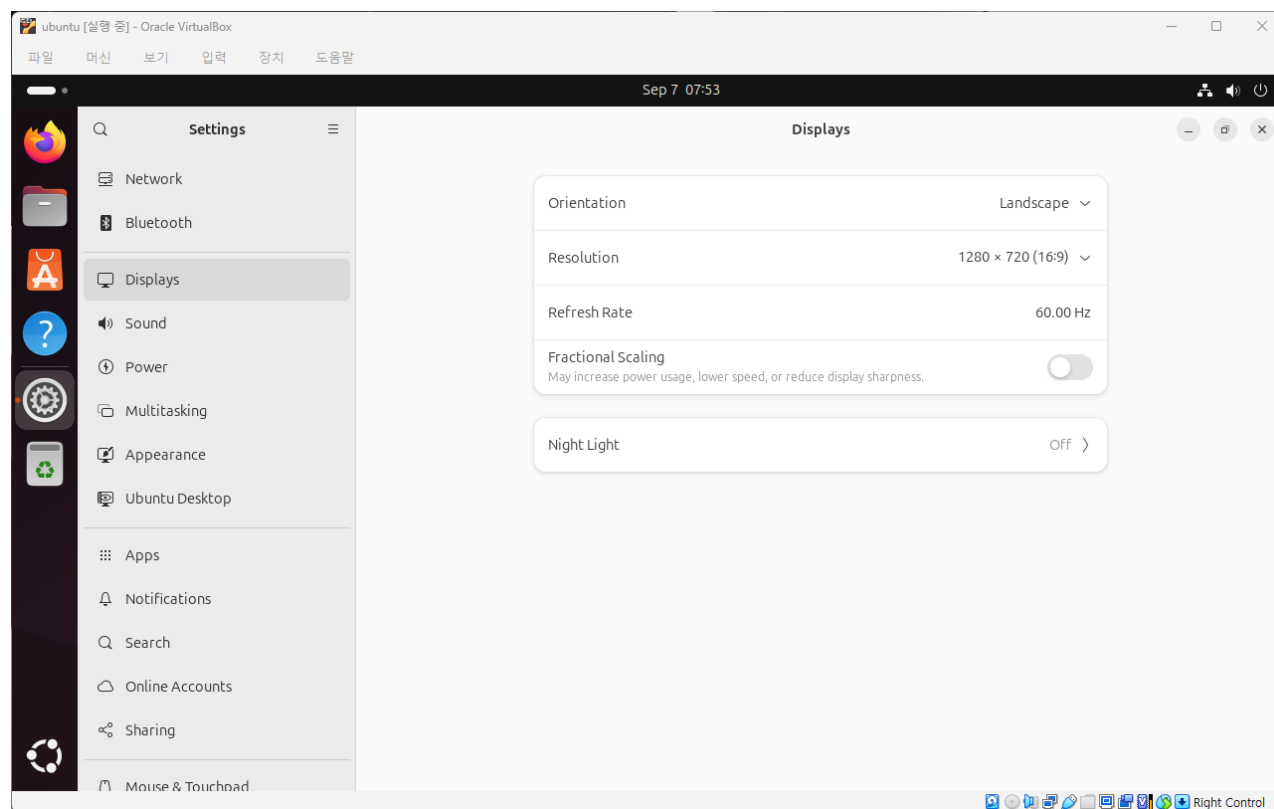
Create Virtual Machine

- Install Ubuntu
 - ▶ Reboot after install Ubuntu



Setup Ubuntu

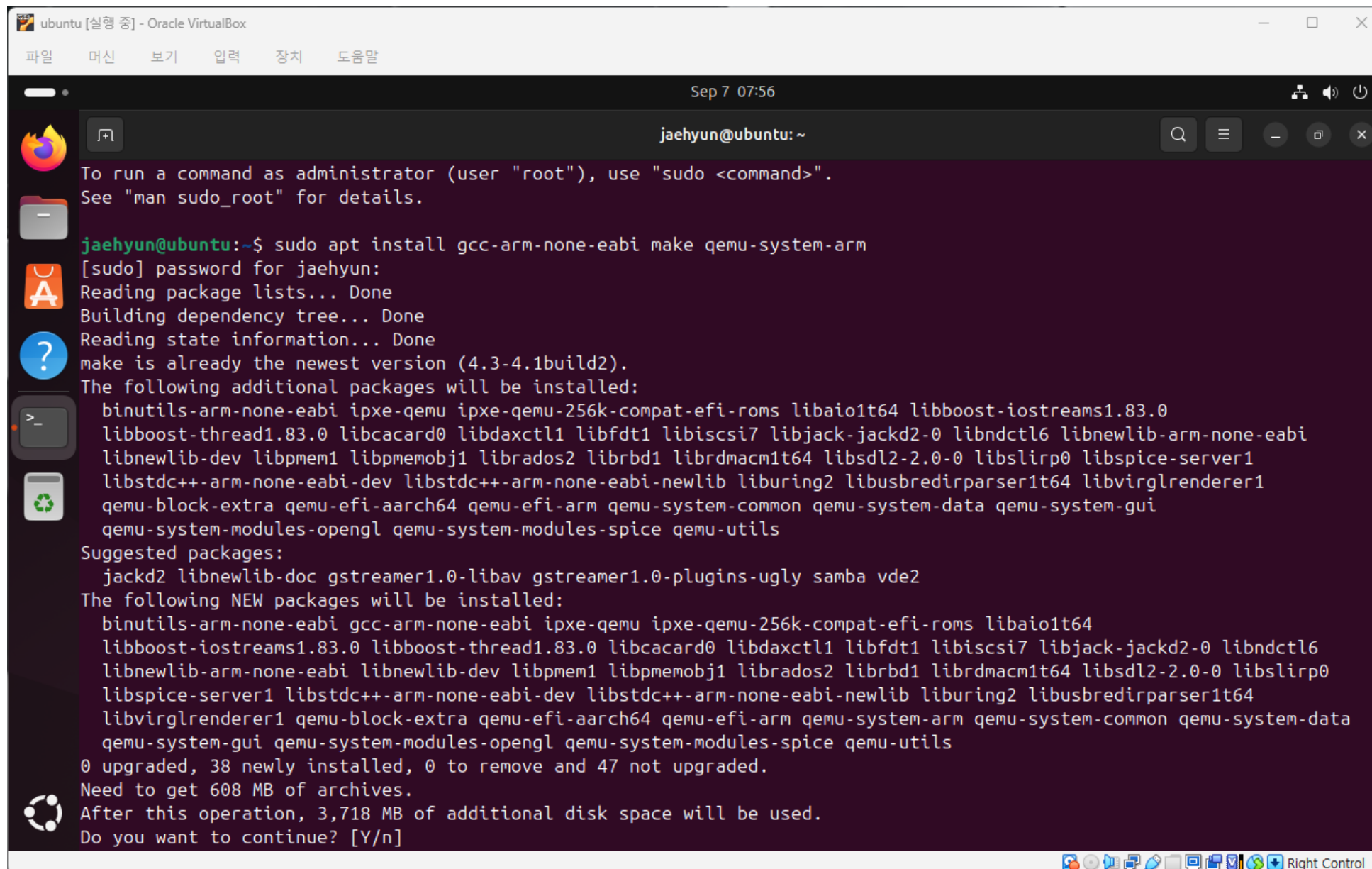
- After installation, it will show Ubuntu Desktop virtual machine
 - ▶ Don't need Ubuntu Pro
- Open Settings and set Displays Resolution
- Open Terminal



Setup Ubuntu

- Install ARM cross compiler, Make tool, and QEMU
 - ▶ \$ sudo apt install gcc-arm-none-eabi make qemu-system-arm

Targeting ARM No operating system Embedded ABI



```
ubuntu [실행 중] - Oracle VirtualBox
파일  머신  보기  입력  장치  도움말

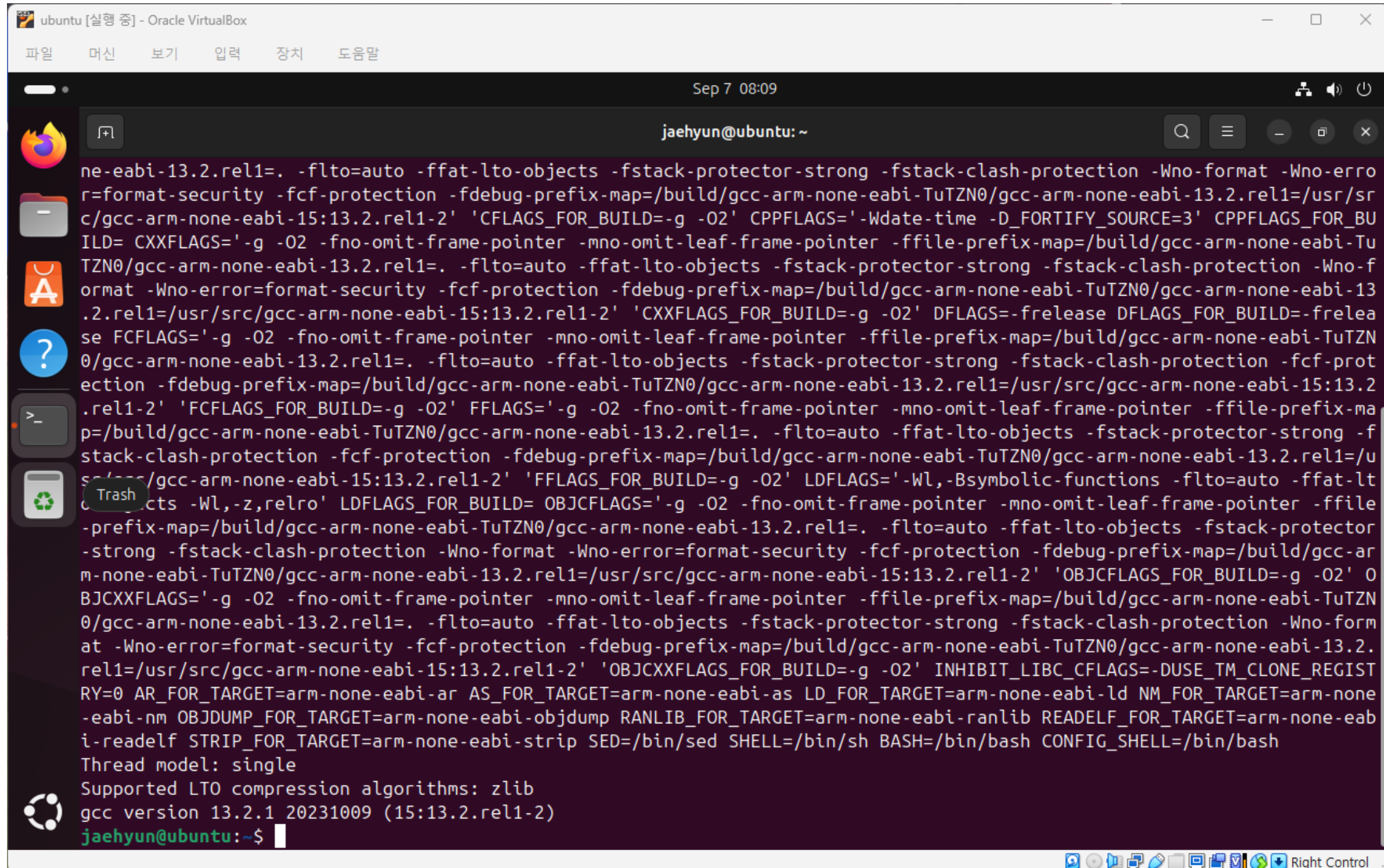
Sep 7 07:56
jaehyun@ubuntu: ~

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

jaehyun@ubuntu:~$ sudo apt install gcc-arm-none-eabi make qemu-system-arm
[sudo] password for jaehyun:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
make is already the newest version (4.3-4.1build2).
The following additional packages will be installed:
  binutils-arm-none-eabi ipxe-qemu ipxe-qemu-256k-compat-efi-roms libaio1t64 libboost-iostreams1.83.0
  libboost-thread1.83.0 libcacard0 libdaxctl1 libfdt1 libiscsi7 libjack-jackd2-0 libndctl6 libnewlib-arm-none-eabi
  libnewlib-dev libpmem1 libpmemobj1 librados2 librbd1 librdmacm1t64 libsdsl2-2.0-0 libslirp0 libspice-server1
  libstdc++-arm-none-eabi-dev libstdc++-arm-none-eabi-newlib liburing2 libusbredirparser1t64 libvirglrenderer1
  qemu-block-extra qemu-efi-aarch64 qemu-efi-arm qemu-system-common qemu-system-data qemu-system-gui
  qemu-system-modules-opengl qemu-system-modules-spice qemu-utils
Suggested packages:
  jackd2 libnewlib-doc gstreamer1.0-libav gstreamer1.0-plugins-ugly samba vde2
The following NEW packages will be installed:
  binutils-arm-none-eabi gcc-arm-none-eabi ipxe-qemu ipxe-qemu-256k-compat-efi-roms libaio1t64
  libboost-iostreams1.83.0 libboost-thread1.83.0 libcacard0 libdaxctl1 libfdt1 libiscsi7 libjack-jackd2-0 libndctl6
  libnewlib-arm-none-eabi libnewlib-dev libpmem1 libpmemobj1 librados2 librbd1 librdmacm1t64 libsdsl2-2.0-0 libslirp0
  libspice-server1 libstdc++-arm-none-eabi-dev libstdc++-arm-none-eabi-newlib liburing2 libusbredirparser1t64
  libvirglrenderer1 qemu-block-extra qemu-efi-aarch64 qemu-efi-arm qemu-system-arm qemu-system-common qemu-system-data
  qemu-system-gui qemu-system-modules-opengl qemu-system-modules-spice qemu-utils
0 upgraded, 38 newly installed, 0 to remove and 47 not upgraded.
Need to get 608 MB of archives.
After this operation, 3,718 MB of additional disk space will be used.
Do you want to continue? [Y/n]
```

Setup Ubuntu

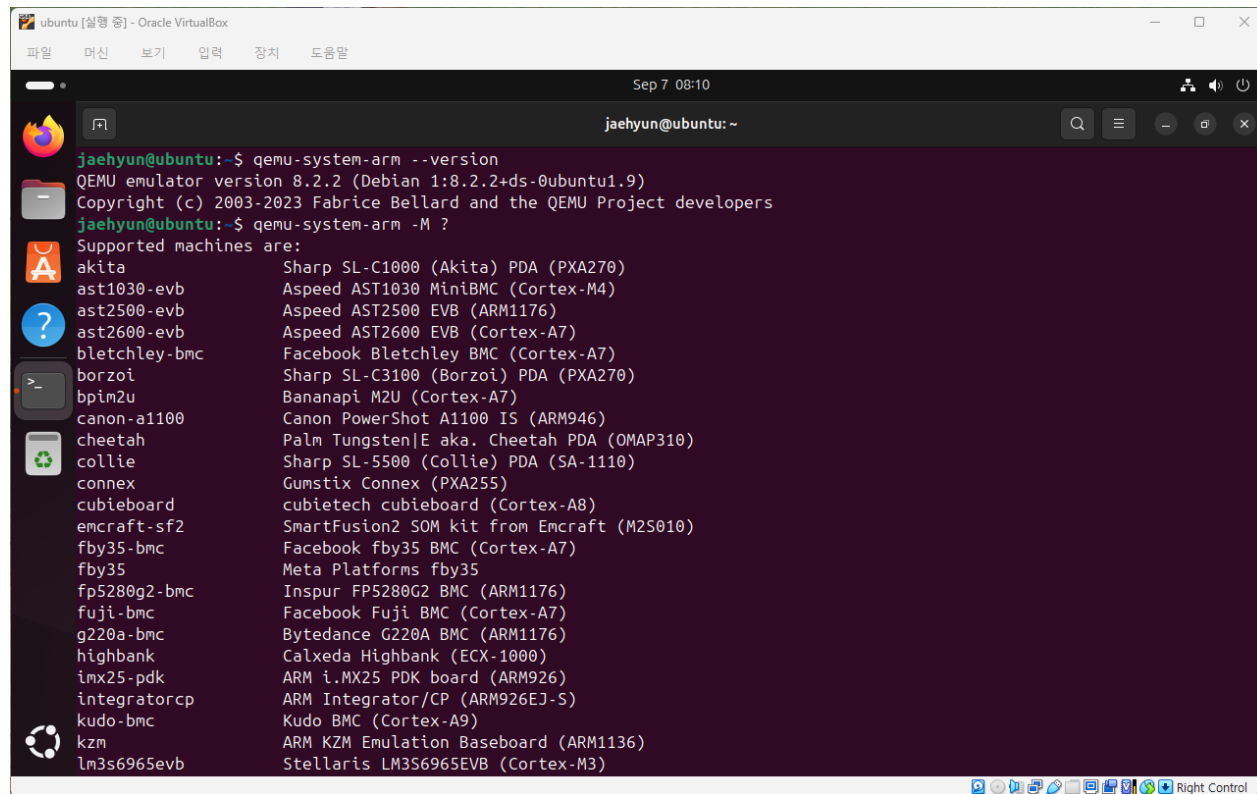
- Check ARM cross compiler
 - ▶ \$ arm-none-eabi-gcc -v



```
ubuntu [실행 중] - Oracle VirtualBox
파일  머신  보기  입력  장치  도움말
Sep 7 08:09
jaehyun@ubuntu: ~
ne-eabi-13.2.rel1=. -flto=auto -ffat-lto-objects -fstack-protector-strong -fstack-clash-protection -Wno-format -Wno-error=format-security -fcf-protection -fdebug-prefix-map=/build/gcc-arm-none-eabi-TuTZN0/gcc-arm-none-eabi-13.2.rel1=/usr/src/gcc-arm-none-eabi-15:13.2.rel1-2' 'CXXFLAGS_FOR_BUILD=-g -O2' CPPFLAGS=-Wdate-time -D_FORTIFY_SOURCE=3' CPPFLAGS_FOR_BUILD= CXXFLAGS=-g -O2 -fno-omit-frame-pointer -mno-omit-leaf-frame-pointer -ffile-prefix-map=/build/gcc-arm-none-eabi-TuTZN0/gcc-arm-none-eabi-13.2.rel1=. -flto=auto -ffat-lto-objects -fstack-protector-strong -fstack-clash-protection -Wno-format -Wno-error=format-security -fcf-protection -fdebug-prefix-map=/build/gcc-arm-none-eabi-TuTZN0/gcc-arm-none-eabi-13.2.rel1=/usr/src/gcc-arm-none-eabi-15:13.2.rel1-2' 'CXXFLAGS_FOR_BUILD=-g -O2' DFLAGS=-frelease DFLAGS_FOR_BUILD=-frelease FCFLAGS=-g -O2 -fno-omit-frame-pointer -mno-omit-leaf-frame-pointer -ffile-prefix-map=/build/gcc-arm-none-eabi-TuTZN0/gcc-arm-none-eabi-13.2.rel1=. -flto=auto -ffat-lto-objects -fstack-protector-strong -fstack-clash-protection -fcf-protection -fdebug-prefix-map=/build/gcc-arm-none-eabi-TuTZN0/gcc-arm-none-eabi-13.2.rel1=/usr/src/gcc-arm-none-eabi-15:13.2.rel1-2' 'FCFLAGS_FOR_BUILD=-g -O2' FFLAGS=-g -O2 -fno-omit-frame-pointer -mno-omit-leaf-frame-pointer -ffile-prefix-map=/build/gcc-arm-none-eabi-TuTZN0/gcc-arm-none-eabi-13.2.rel1=. -flto=auto -ffat-lto-objects -fstack-protector-strong -fstack-clash-protection -fcf-protection -fdebug-prefix-map=/build/gcc-arm-none-eabi-TuTZN0/gcc-arm-none-eabi-13.2.rel1=/usr/src/gcc-arm-none-eabi-15:13.2.rel1-2' 'FFLAGS_FOR_BUILD=-g -O2' LDFLAGS=-Wl,-Bsymbolic-functions -flto=auto -ffat-lto-objects -Wl,-z,relro' LDFLAGS_FOR_BUILD= OBJCFLAGS=-g -O2 -fno-omit-frame-pointer -mno-omit-leaf-frame-pointer -ffile-prefix-map=/build/gcc-arm-none-eabi-TuTZN0/gcc-arm-none-eabi-13.2.rel1=. -flto=auto -ffat-lto-objects -fstack-protector-strong -fstack-clash-protection -Wno-format -Wno-error=format-security -fcf-protection -fdebug-prefix-map=/build/gcc-arm-none-eabi-TuTZN0/gcc-arm-none-eabi-13.2.rel1=/usr/src/gcc-arm-none-eabi-15:13.2.rel1-2' 'OBJCFLAGS_FOR_BUILD=-g -O2' OBJCXXFLAGS=-g -O2 -fno-omit-frame-pointer -mno-omit-leaf-frame-pointer -ffile-prefix-map=/build/gcc-arm-none-eabi-TuTZN0/gcc-arm-none-eabi-13.2.rel1=. -flto=auto -ffat-lto-objects -fstack-protector-strong -fstack-clash-protection -Wno-format -Wno-error=format-security -fcf-protection -fdebug-prefix-map=/build/gcc-arm-none-eabi-TuTZN0/gcc-arm-none-eabi-13.2.rel1=/usr/src/gcc-arm-none-eabi-15:13.2.rel1-2' 'OBJCXXFLAGS_FOR_BUILD=-g -O2' INHIBIT_LIBC_CFLAGS=-DUSE_TM_CLONE_REGISTRY=0 AR_FOR_TARGET=arm-none-eabi-ar AS_FOR_TARGET=arm-none-eabi-as LD_FOR_TARGET=arm-none-eabi-ld NM_FOR_TARGET=arm-none-eabi-nm OBJDUMP_FOR_TARGET=arm-none-eabi-objdump RANLIB_FOR_TARGET=arm-none-eabi-ranlib READelf_FOR_TARGET=arm-none-eabi-readelf STRIP_FOR_TARGET=arm-none-eabi-strip SED=/bin/sed SHELL=/bin/sh BASH=/bin/bash CONFIG_SHELL=/bin/bash
Thread model: single
Supported LTO compression algorithms: zlib
gcc version 13.2.1 20231009 (15:13.2.rel1-2)
jaehyun@ubuntu:~$
```

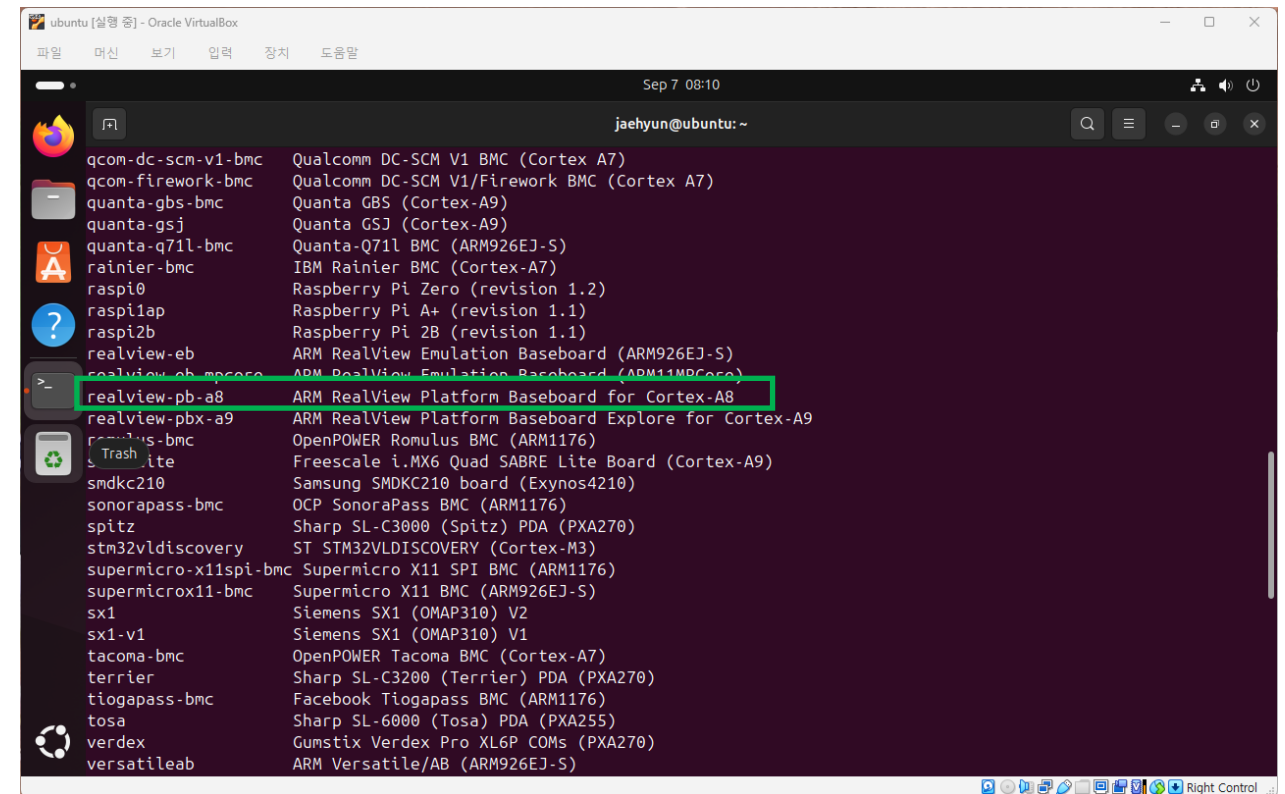

Setup Ubuntu

- Check QEMU installation and supported machine list
 - ▶ \$ qemu-system-arm --version
 - ▶ \$ qemu-system-arm -M ?
 - We will use realview-pb-a8 processor



```
jaehyun@ubuntu:~$ qemu-system-arm --version
QEMU emulator version 8.2.2 (Debian 1:8.2.2+ds-0ubuntu1.9)
Copyright (c) 2003-2023 Fabrice Bellard and the QEMU Project developers

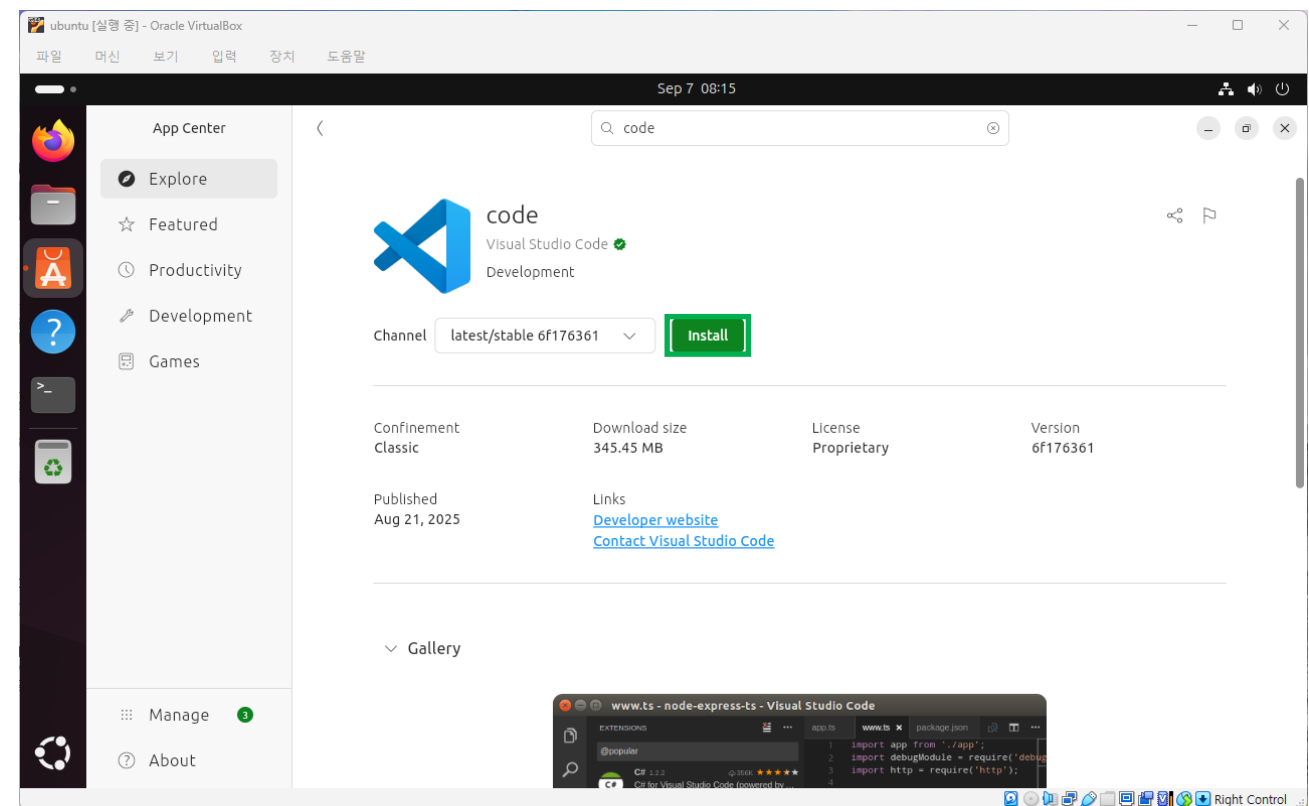
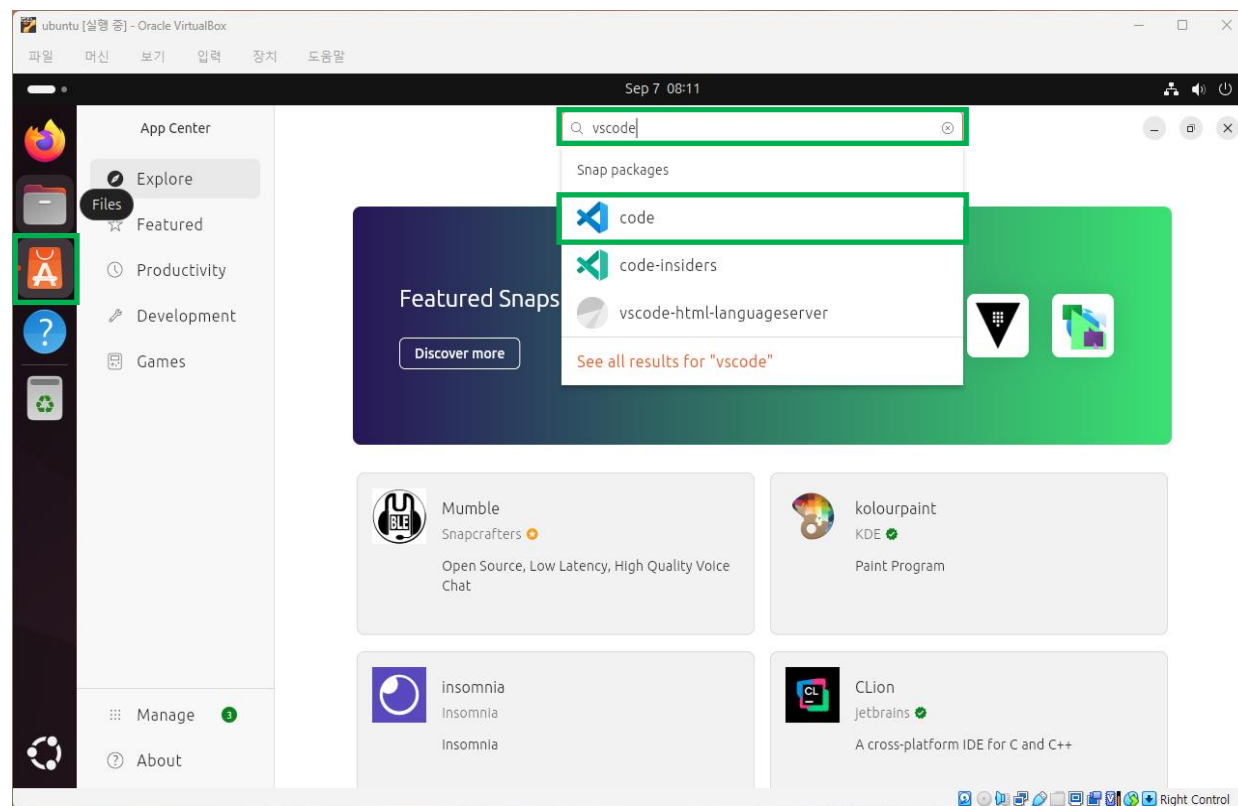
jaehyun@ubuntu:~$ qemu-system-arm -M ?
Supported machines are:
akita             Sharp SL-C1000 (Akita) PDA (PXA270)
ast1030-evb       Aspeed AST1030 MiniBMC (Cortex-M4)
ast2500-evb       Aspeed AST2500 EVB (ARM1176)
ast2600-evb       Aspeed AST2600 EVB (Cortex-A7)
bletchley-bmc     Facebook Bletchley BMC (Cortex-A7)
borzoi            Sharp SL-C3100 (Borzoi) PDA (PXA270)
bpim2u            Bananapi M2U (Cortex-A7)
canon-a1100       Canon PowerShot A1100 IS (ARM946)
cheetah           Palm Tungsten|E aka. Cheetah PDA (OMAP310)
collie            Sharp SL-5500 (Collie) PDA (SA-1110)
connex            Gumstix Connex (PXA255)
cubieboard        cubietech cubieboard (Cortex-A8)
emcraft-sf2       SmartFusion2 SOM kit from Emcraft (M25010)
fby35-bmc         Facebook fby35 BMC (Cortex-A7)
fby35             Meta Platforms fby35
fp5280g2-bmc      Inspur FP5280G2 BMC (ARM1176)
fuji-bmc          Facebook Fuji BMC (Cortex-A7)
g220a-bmc         Bytedance G220A BMC (ARM1176)
highbank          Calxeda Highbank (ECX-1000)
imx25-pdk         ARM i.MX25 PDK board (ARM926)
integratorcp      ARM Integrator/CP (ARM926EJ-S)
kudo-bmc          Kudo BMC (Cortex-A9)
kzm               ARM KZM Emulation Baseboard (ARM1136)
lm3s6965evb       Stellaris LM3S6965EVB (Cortex-M3)
```



```
qcom-dc-scm-v1-bmc  Qualcomm DC-SCM V1 BMC (Cortex A7)
qcom-firework-bmc  Qualcomm DC-SCM V1/Firework BMC (Cortex A7)
quanta-gbs-bmc      Quanta GBS (Cortex-A9)
quanta-gsj          Quanta GSJ (Cortex-A9)
quanta-q71l-bmc     Quanta-Q71l BMC (ARM926EJ-S)
rainier-bmc         IBM Rainier BMC (Cortex-A7)
raspi0              Raspberry Pi Zero (revision 1.2)
raspi1ap            Raspberry Pi A+ (revision 1.1)
raspi2b             Raspberry Pi 2B (revision 1.1)
realview-eb         ARM RealView Emulation Baseboard (ARM926EJ-S)
realview-pb-mpcore  ARM RealView Emulation Baseboard (ARM1176)
realview-pb-a8      ARM RealView Platform Baseboard for Cortex-A8
realview-pbx-a9     ARM RealView Platform Baseboard Explore for Cortex-A9
romulus-bmc         OpenPOWER Romulus BMC (ARM1176)
smdkc210            Freescale i.MX6 Quad SABRE Lite Board (Cortex-A9)
sonorapass-bmc      Samsung SMDKC210 board (Exynos4210)
spitz               OCP SonoraPass BMC (ARM1176)
stm32vldiscovery    Sharp SL-C3000 (Spitz) PDA (PXA270)
supermicro-x11spi-bmc ST STM32VLDISCOVERY (Cortex-M3)
supermicrox11-bmc   Supermicro X11 SPI BMC (ARM1176)
sx1                 Supermicro X11 BMC (ARM926EJ-S)
sx1-v1              Siemens SX1 (OMAP310) V2
tacoma-bmc          Siemens SX1 (OMAP310) V1
terrier             OpenPOWER Tacoma BMC (Cortex-A7)
tiogapass-bmc       Sharp SL-C3200 (Terrier) PDA (PXA270)
tosa                Facebook Tiogapass BMC (ARM1176)
verdex              Sharp SL-6000 (Tosa) PDA (PXA255)
versatileab         Gumstix Verdex Pro XL6P COMs (PXA270)
                    ARM Versatile/AB (ARM926EJ-S)
```

Setup Ubuntu

- Open App Center
 - ▶ Search vscode
 - ▶ Click Install



Setup Ubuntu

- Create a project directory and move to the project directory
 - ▶ ~\$ mkdir RTOS
 - ▶ ~\$ cd RTOS
- Run Visual Studio Code
 - ▶ ~/RTOS\$ code .
 - Trust the authors of the files in the folder

