Homework #3:
Measuring IO Performance in Your Desktop

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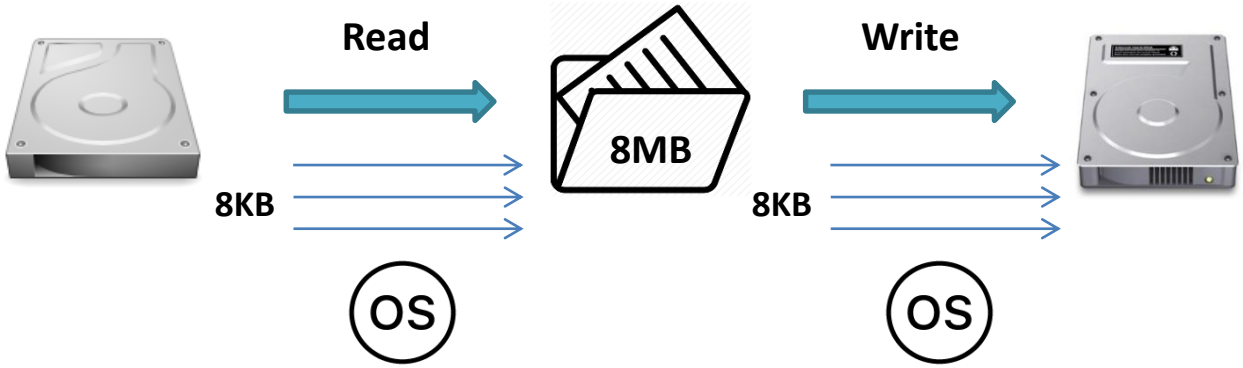
Introduction

- **What is I/O ?**
  - When you reading from / writing to storage hardware you're performing Input / Output operation
- **I/O Commands**



- **IOPS**
  - I/O operation per second
  - Measure of storage performance

Introduction

- **Sequential I/O**
  - next block happened to be located directly after the pr evious one on the same track
  - No wait time (Latency)

- **Random I/O**
  - next block is somewhere else on the disk
  - need to incur the same penalties of seek time and rotat ional latency

Tool

- **FIO**

– Flexible I/O Tester
– benchmarking specific disk IO workloads
– http://linux.die.net/man/1/fio

Tool - FIO (Linux)

- **Install at Oracle VM**

– sudo yum install fio

- **Usage**

- Command

```
fio --rw=randwirte --sige=1G --direct=0 --directory=./ --numjobs=1
--group_reporting --name=random-write --bs=8KB --runtime=60 --fsync=1
```

- Using Job file

```
jong@ubuntu:~$ fio Random.conf
```

<Random.conf>

```
[random-write]
rw=randwrite
size=4G
direct=0
directory=./
numjobs=1
group_reporting
name=random-write
bs=8KB
runtime=60
fsync=1
```

Tool - FIO (Linux)

- **Parameter (Detail is in Document)**

rw	IO 의 패턴 지정 파라미터 - randwrite, read(seq), write, randread, rw, randrw
size	한 쓰레드가 접근할 파일 크기 (B,k,M,G, 등등 단위 지정 가능)
direct	direct I/O 여부(0:non, 1 : direct)
directory	테스트를 진행할 폴더 (접근할 파일들을 생성하고 실제 I/O를 진행하는 위치)
numjobs	동시 수행할 thread/process 수 (기본 process, 설정 파일에 thread 옵션을 줄경우 thread 로 진행)
group_reporting	전체 작업에 대한 결과만 출력
bs	block size, I/O 단위 지정 , b,k,m,g 등
runtime	수행 시간
fsync	fsync 호출 주기

Usage : https://linux.die.net/man/1/fio

Tool - FIO (Linux)

- **Output**

io	Total io
bw	Average Bandwidth
iops	Average iops
runt	Total runtime

```
jong@ubuntu:~$ fio Random.conf
random-write: (g=0): rw=randwrite, bs=8K-8K/8K-8K/8K-8K, ioengine=sync, iodepth=1
fio-2.1.3
Starting 1 process
random-write: Laying out IO file(s) (1 file(s) / 4096MB)
Jobs: 1 (f=1): [w] [100.0% done] [0KB/11837KB/0KB /s] [0/1479/0 iops] [eta 00m:00s]
random-write: (groupid=0, jobs=1): err= 0: pid=33721: Sun May  1 06:17:44 2016
  write: io=617272KB, bw=10288KB/s, iops=1285, runt= 60001msec
    clat (usec): min=12, max=3621, avg=26.87, stdev=40.36
     lat (usec): min=12, max=3621, avg=27.19, stdev=40.37
    clat percentiles (usec):
     |  1.00th=[   14],  5.00th=[   15], 10.00th=[   15], 20.00th=[   16],
     | 30.00th=[   18], 40.00th=[   19], 50.00th=[   20], 60.00th=[   20],
     | 70.00th=[   22], 80.00th=[   24], 90.00th=[   50], 95.00th=[   77],
     | 99.00th=[   97], 99.50th=[  123], 99.90th=[  386], 99.95th=[  636],
     | 99.99th=[ 1624]
    bw (KB  /s): min= 6992, max=11872, per=99.98%, avg=10284.87, stdev=902.78
    lat (usec) : 20=47.47%, 50=42.35%, 100=9.28%, 250=0.59%, 500=0.23%
    lat (usec) : 750=0.04%, 1000=0.01%
    lat (msec) : 2=0.02%, 4=0.01%
  cpu          : usr=0.05%, sys=45.43%, ctx=259121, majf=0, minf=6
  IO depths    : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%
     submit    : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
     complete  : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
     issued    : total=r=0/w=77159/d=0, short=r=0/w=0/d=0

Run status group 0 (all jobs):
  WRITE: io=617272KB, aggrb=10287KB/s, minb=10287KB/s, maxb=10287KB/s, mint=60001msec, maxt=60001
msec

Disk stats (read/write):
  sda: ios=149/245834, merge=8/95047, ticks=76/57016, in_queue=57080, util=94.20%
```

How to check Disk Information

- **Linux**
  1. Check disk list using **sudo fdisk -l**


```
pjh@PJH-SERVER:~$ sudo fdisk -l

Disk /dev/sdb: 256.1 GB, 256060514304 bytes
234 heads, 63 sectors/track, 33924 cylinders, total 500118192 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0x875a36ee

   Device Boot      Start         End      Blocks   Id  System
/dev/sdb1            2048   500118191   250058072   83  Linux
```

How to check Disk Information

- **Linux**
  1. Check disk list using **sudo fdisk –l**
  2. Use **sudo hdparm –I /dev/sdx** (device name)

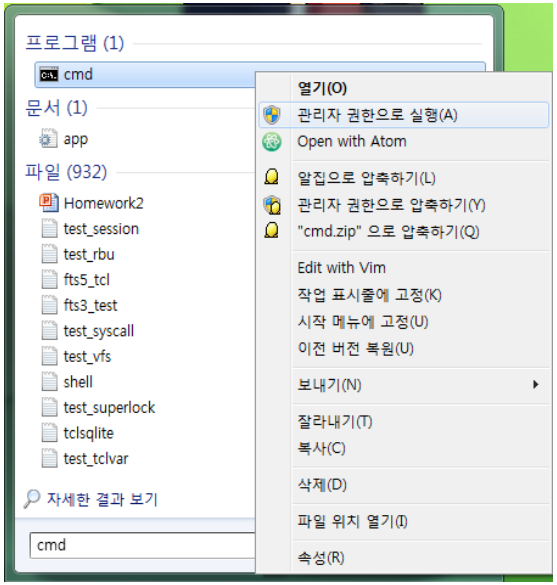
```
pjh@PJH-SERVER:~$ sudo hdparm -I /dev/sdb

/dev/sdb:

ATA device, with non-removable media
        Model Number:       Samsung SSD 850 PRO 256GB
        Serial Number:      S258NXAG911338M
        Firmware Revision:  EXM02B6Q
        Transport:          Serial, ATA8-AST, SATA 1.0a, SATA II Extensions, SATA Rev 2.5, SATA Rev 2
.6, SATA Rev 3.0
Standards:
        Used: unknown (minor revision code 0x0039)
        Supported: 9 8 7 6 5
        Likely used: 9
Configuration:
        Logical         max     current
        cylinders       16383   16383
        heads           16      16
        sectors/track   63      63
        --
        CHS current addressable sectors:   16514064
        LBA    user addressable sectors:  268435455
        LBA48  user addressable sectors:  500118192
        Logical  Sector size:                   512 bytes
        Physical Sector size:                   512 bytes
        Logical Sector-0 offset:                  0 bytes
        device size with M = 1024*1024:      244198 MBytes
        device size with M = 1000*1000:      256060 MBytes (256 GB)
        cache/buffer size  = unknown
        Nominal Media Rotation Rate: Solid State Device
```

디스크 정보 파악하기

- **Window**
  - Open CMD with **administrator privileges (관리자모드)**
  - **wmic diskdrive get name,size,model**




```
C:₩Users₩pjh>wmic diskdrive get name,size,model
Model                                 Name                Size
Crucial_ CT250MX200SSD1 SCSI Disk Device  ₩₩.₩PHYSICALDRIVE0  250059290624
```

Homework #3

- For each harddisk or SSD in your computer, please fill the following information from the specification provided by the vendor

	Model	Price	Capacity	Bandwidth (Read/Write)	Random IO (4KB RD/WR)	Weight	Power Consumption
HDD							
SSD							

- Using either FIO or DISKSPD, measure and fill the following performance values by yourself in your computer system

	Seq. RD / WR Bandwidth (1 user)	Seq. RD / WR Bandwidth (4 users)	Rand. RD / WR IOPS (1user)	Rand. RD / WR IOPS (32users)	Random WR IOPS (32 users, fsync = 1 vs. 64)	Rand. RD Bandwidth (4KB * IOPS) /Seq. RD Bandwidth	Random WR IOPS / Random RD IOPS (using column #4)
HDD							
SSD							

Choose your own device (자신의 실험환경에 맞는 SSD 혹은 HDD 중에 하나만 하세요.)

Output

- Fill the table (page 12)
- Report
  - FIO result screen shot
  - Table (page 12)
  - Compare read & write (sequential vs write)
    - Read 일때, sequential bandwidth vs random iops 비교
    - Write 일때, sequential bandwidth vs random iops 비교

- Upload I-Campus

Install VMWare

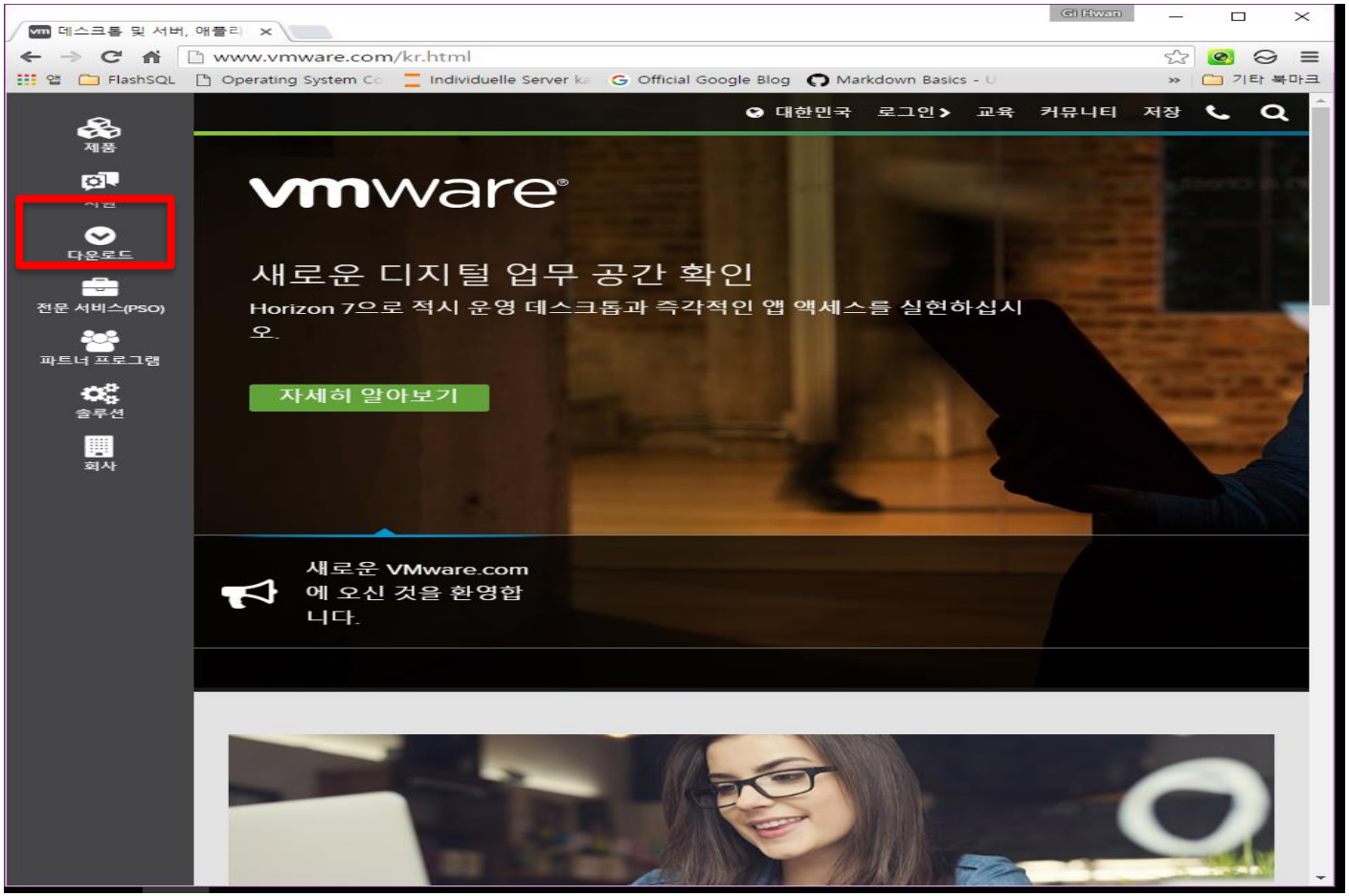
- Oracle Virtual Box 수행이 불가한 경우,
  다음 슬라이드 VMWare를 설치해 진행해주세요.

- FIO 사용 방법은 동일합니다.

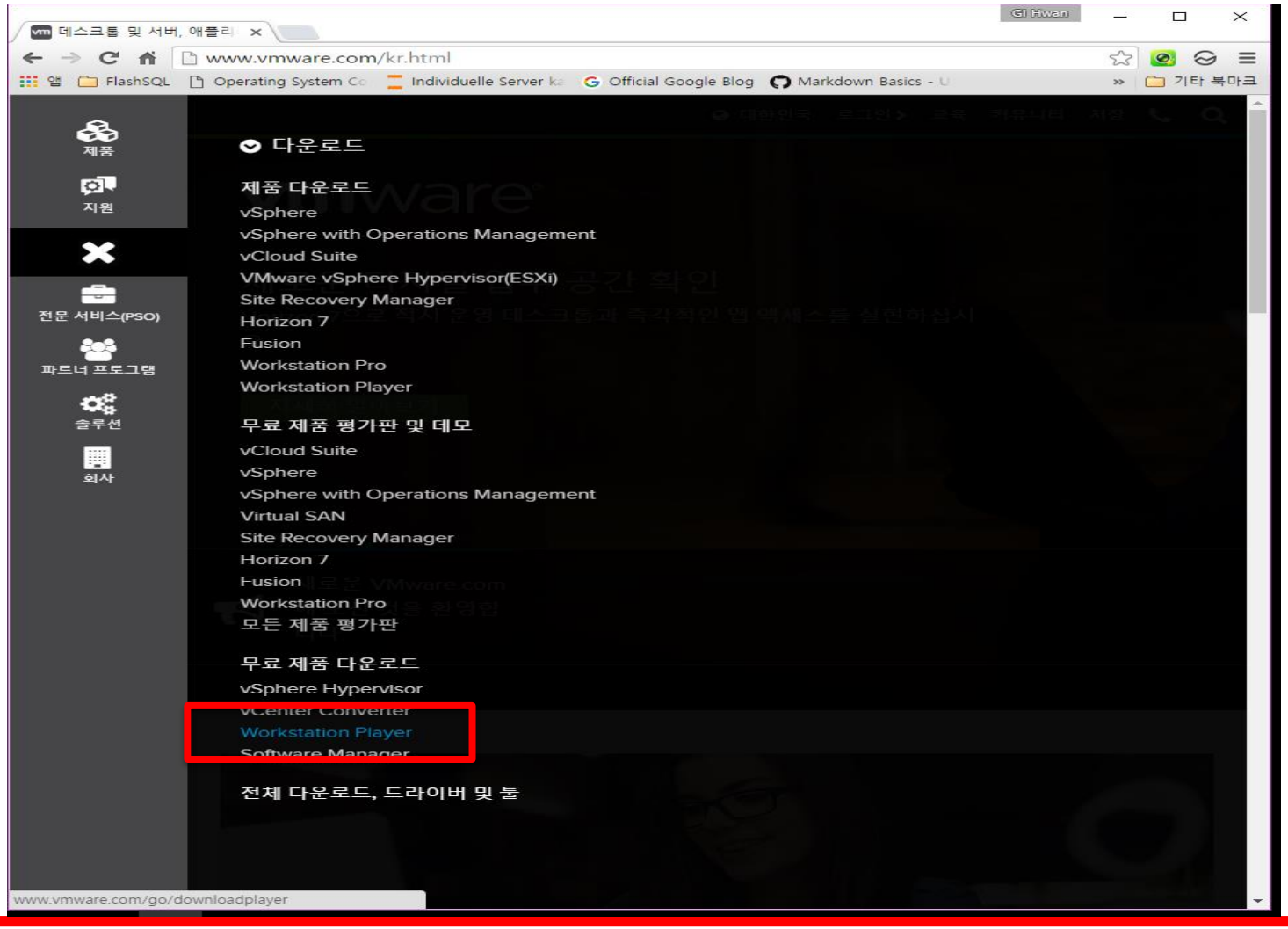
- Install
  - sudo apt-get install fio (Ubuntu Linux)

Install VMware

http://www.vmware.com/



다운로드 -> Workstation Player



자신의 OS환경에 맞게 설치

Try VMware Workstation Player

VMware Workstation Player builds on the industry leading foundation of Workstation Pro, and delivers a streamlined user interface for creating and running operating systems and applications in a virtual machine.

The free version is available for non-commercial, personal and home use. We also encourage students and non-profit organizations to benefit from this offering.

Commercial organizations require paid licenses to use Workstation Player.

Need a more advanced virtualization solution?
Check out Workstation Pro for Windows or Workstation Pro for Linux

VMware Workstation 12.5 Player for Windows 64-bit
Download Now »

VMware Workstation 12.5 Player for Linux 64-bit
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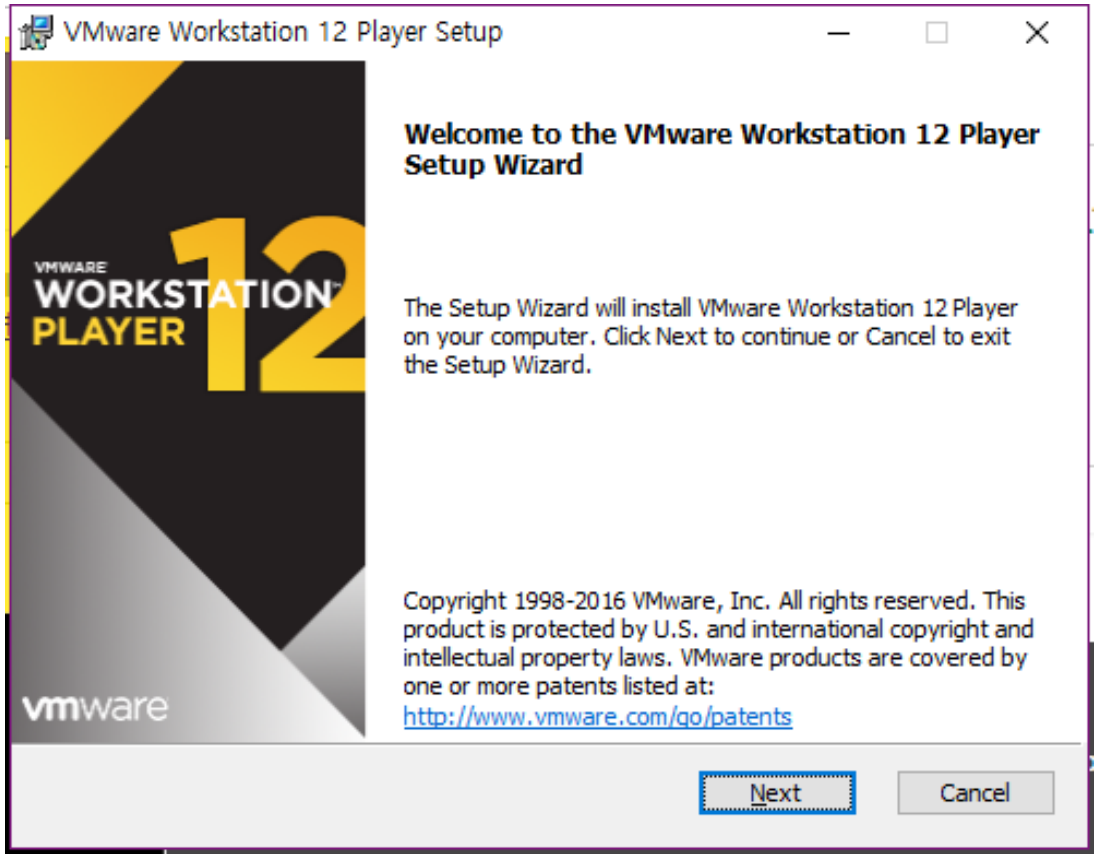
설치 (Next 계속 클릭)


VMware Workstation 12 Player Setup
VMWARE
WORKSTATION
PLAYER
12
vmware
Welcome to the VMware Workstation 12 Player Setup Wizard
The Setup Wizard will install VMware Workstation 12 Player on your computer. Click Next to continue or Cancel to exit the Setup Wizard.
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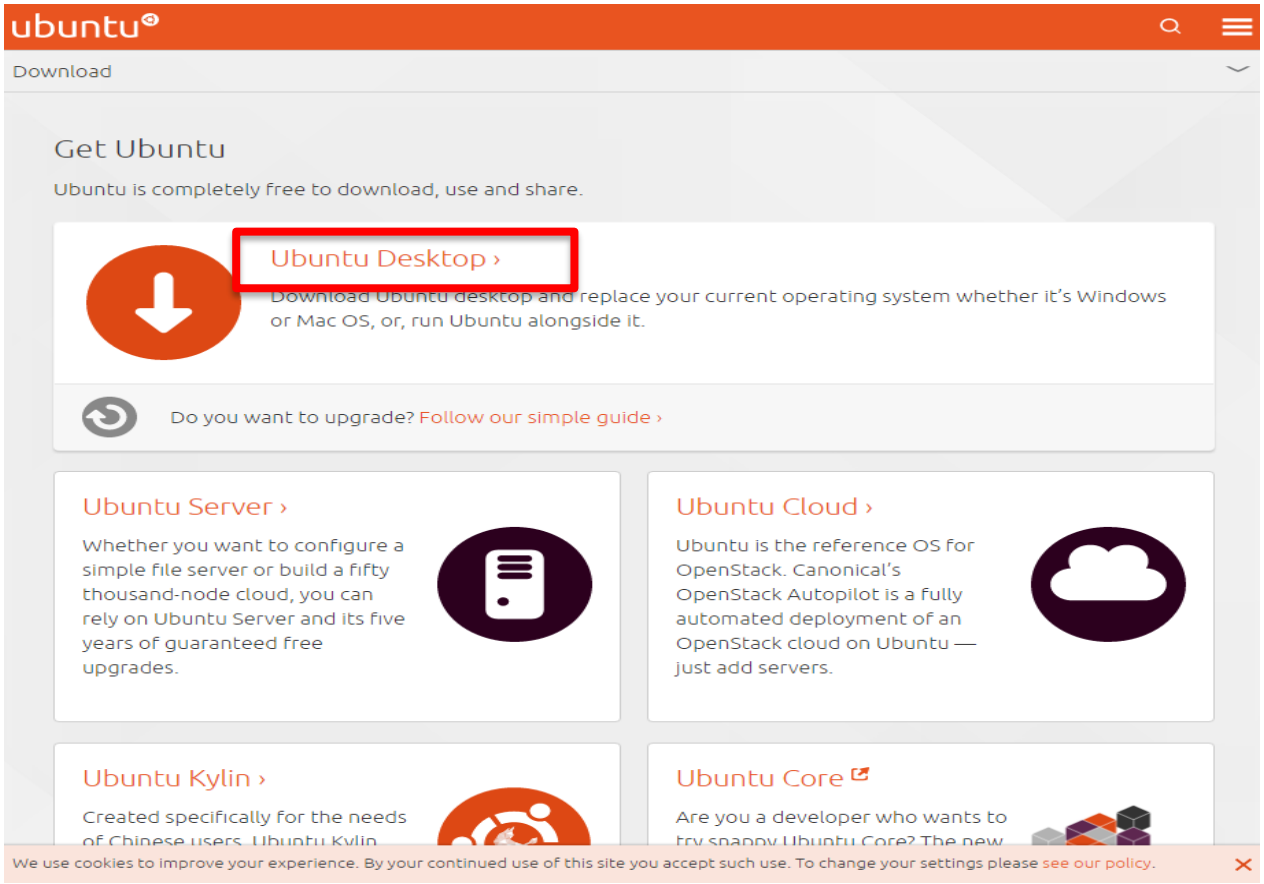
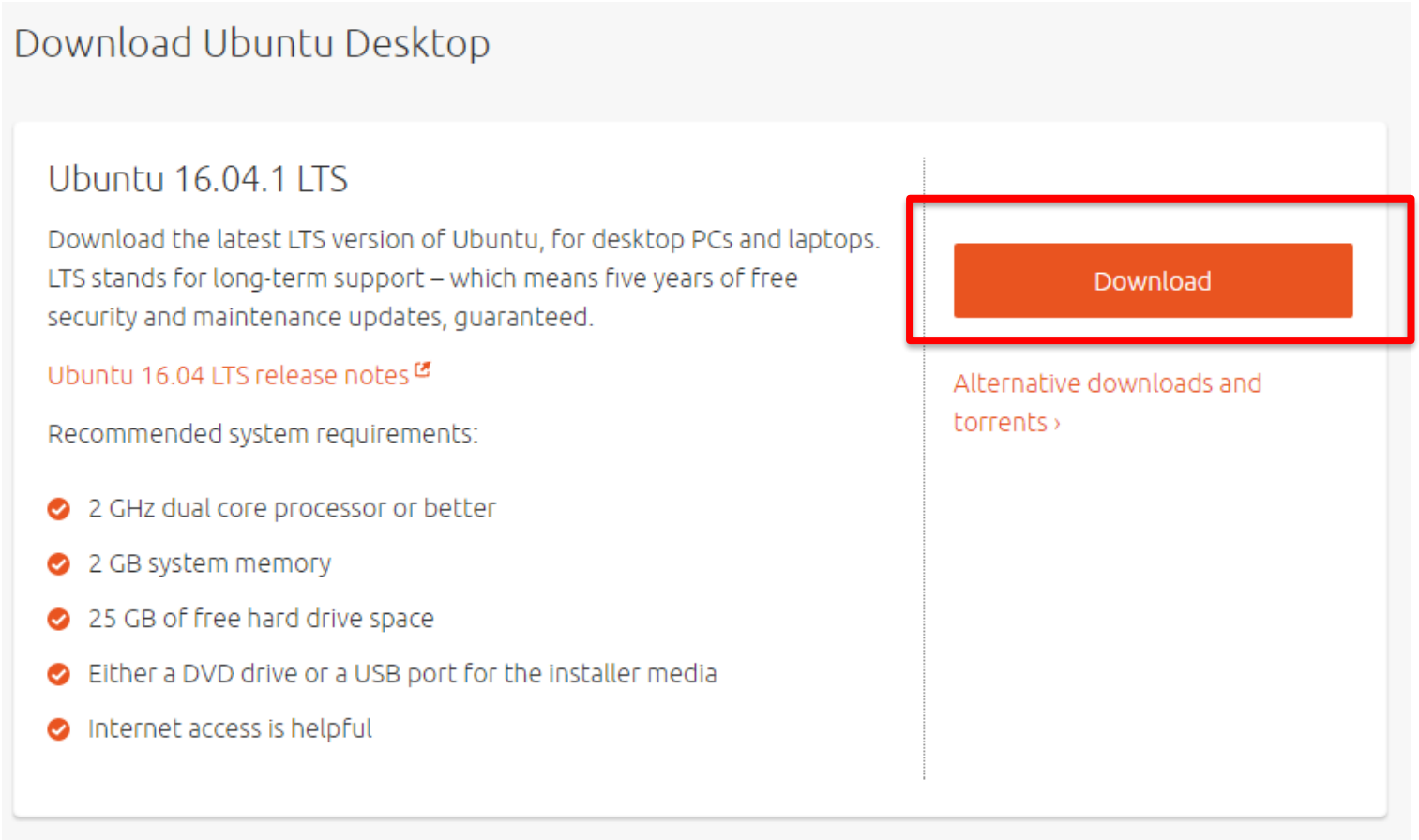
Next
Cancel

Ubuntu 설치

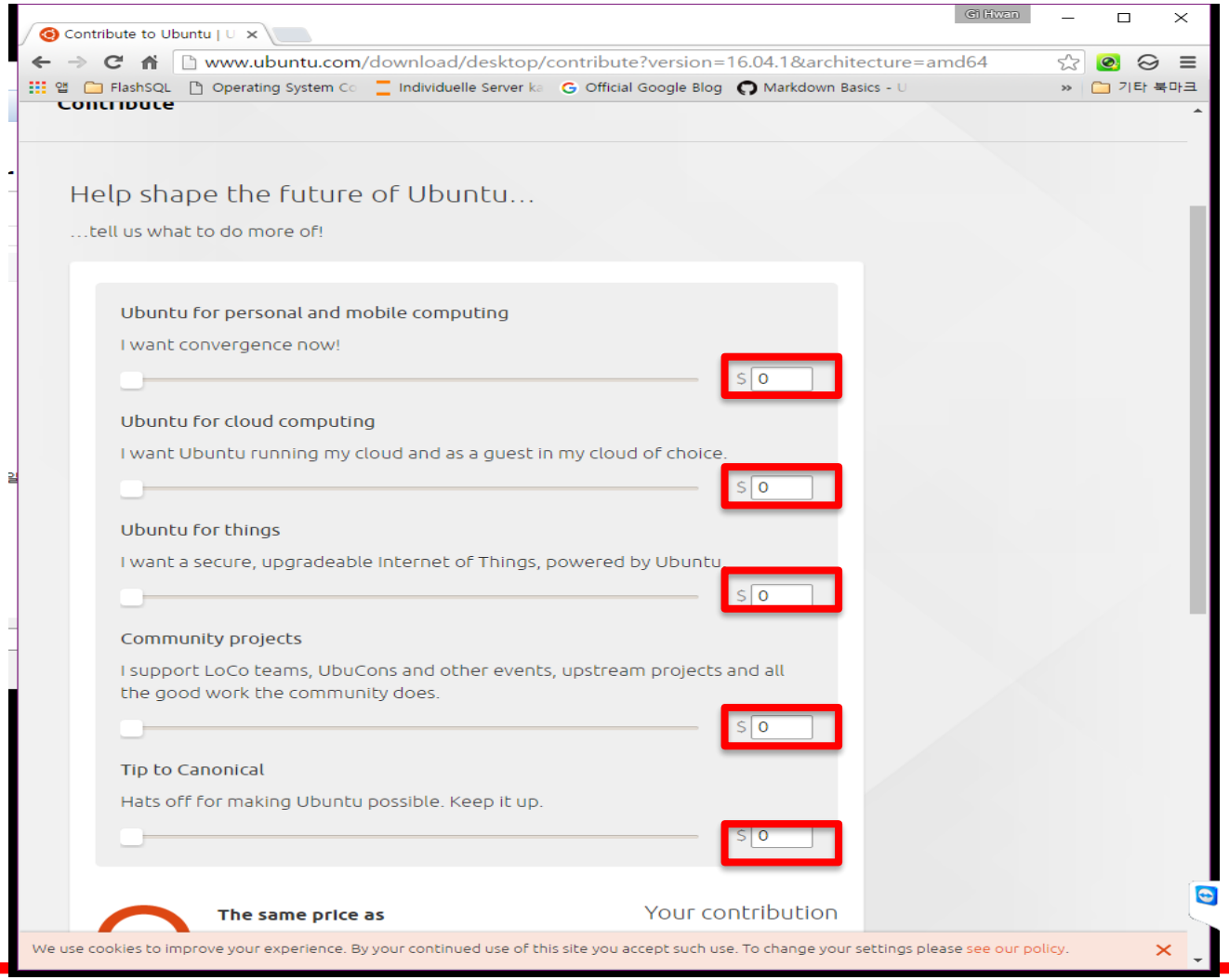
https://www.ubuntu.com/download



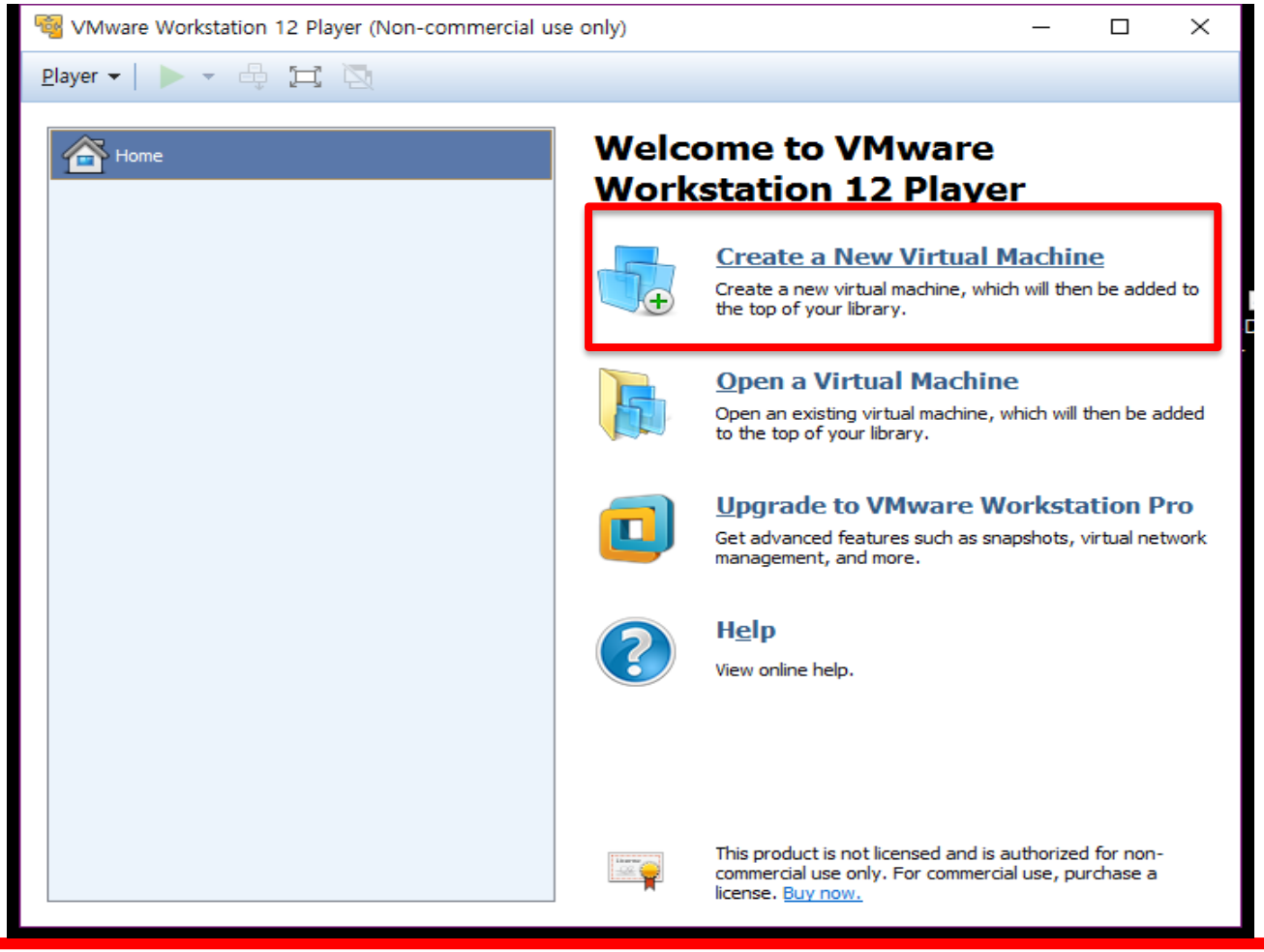
다운로드


Download Ubuntu Desktop
Ubuntu 16.04.1 LTS
Download the latest LTS 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 ›

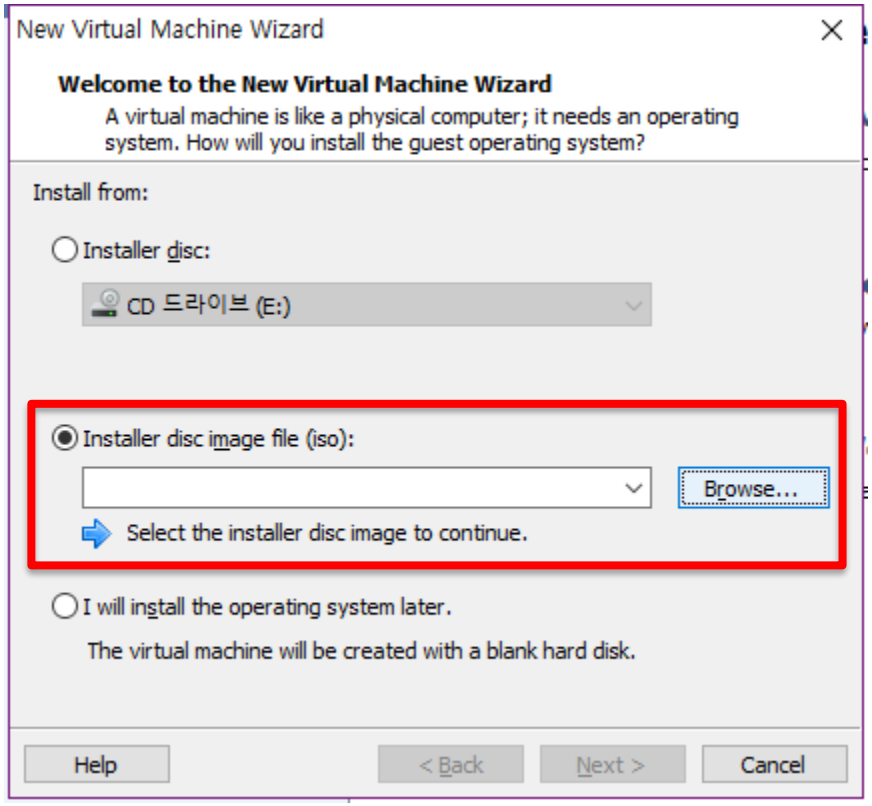
기부금액 설정 후 다운로드



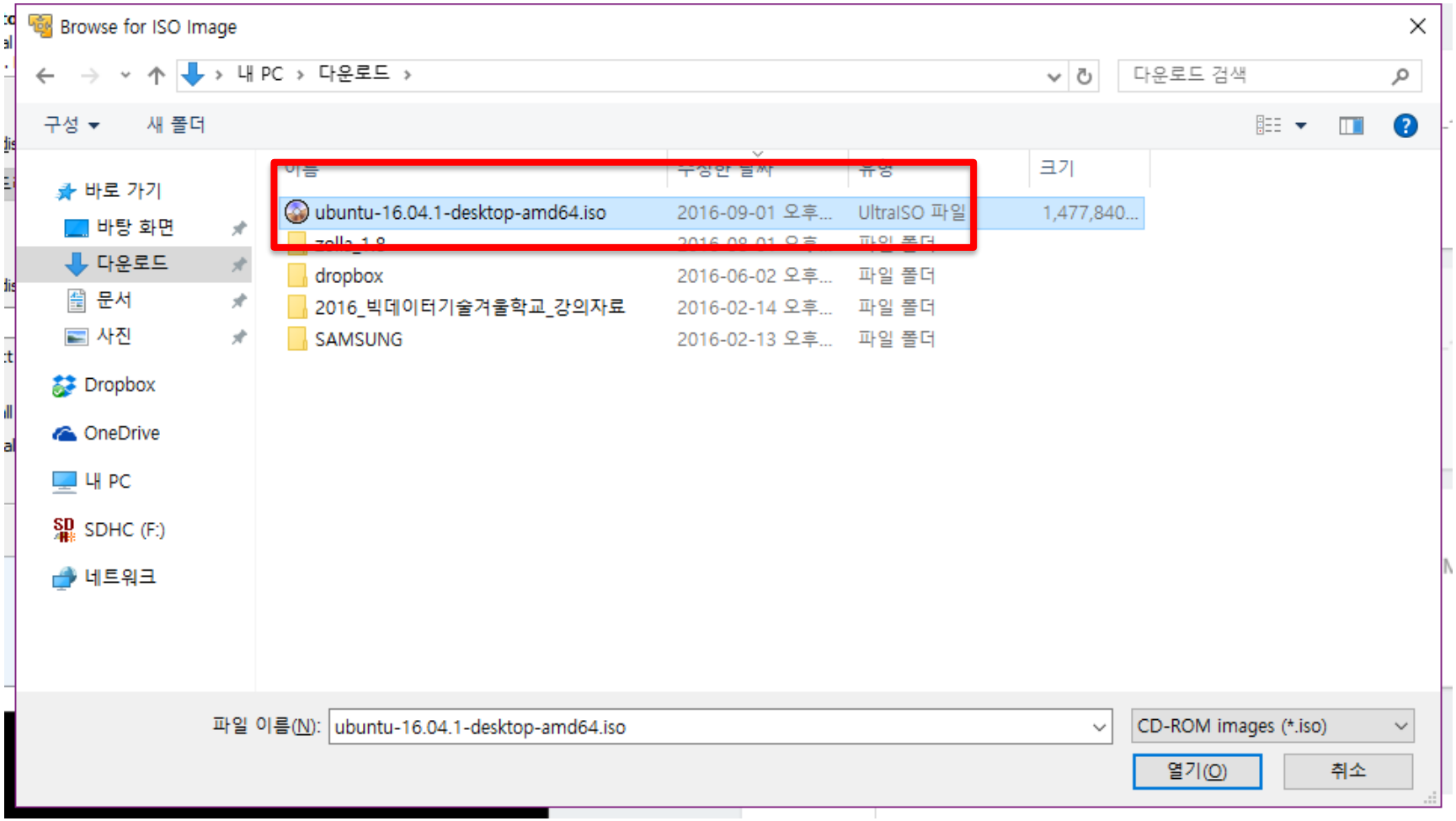
Vmware 실행 후, Create a New Virtual 실행



Ubuntu 이미지 선택

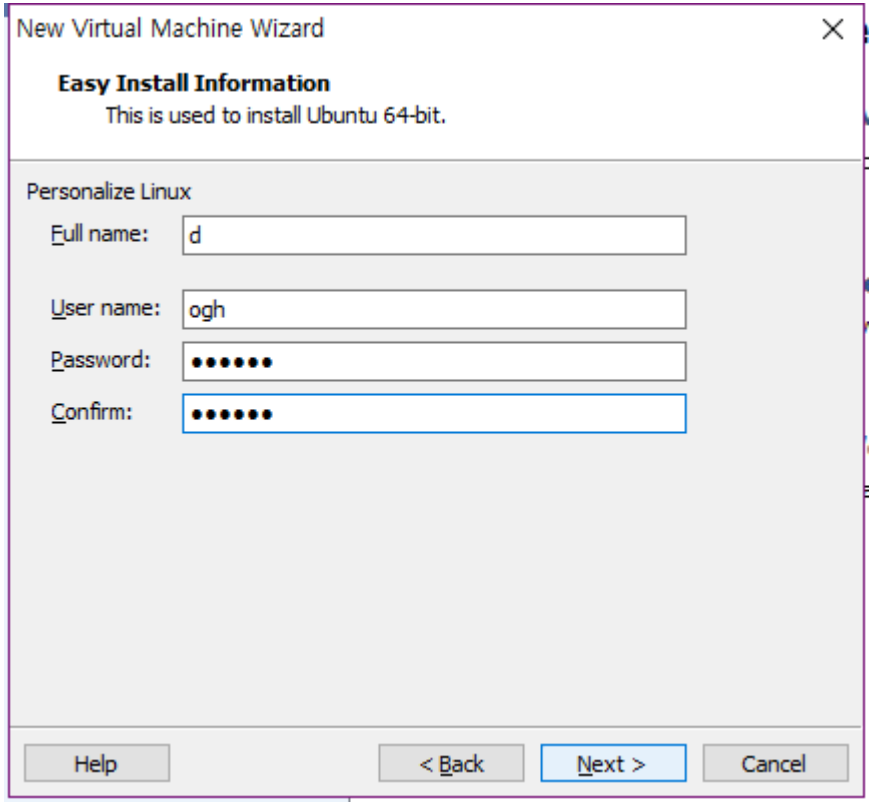


Ubuntu 이미지 선택

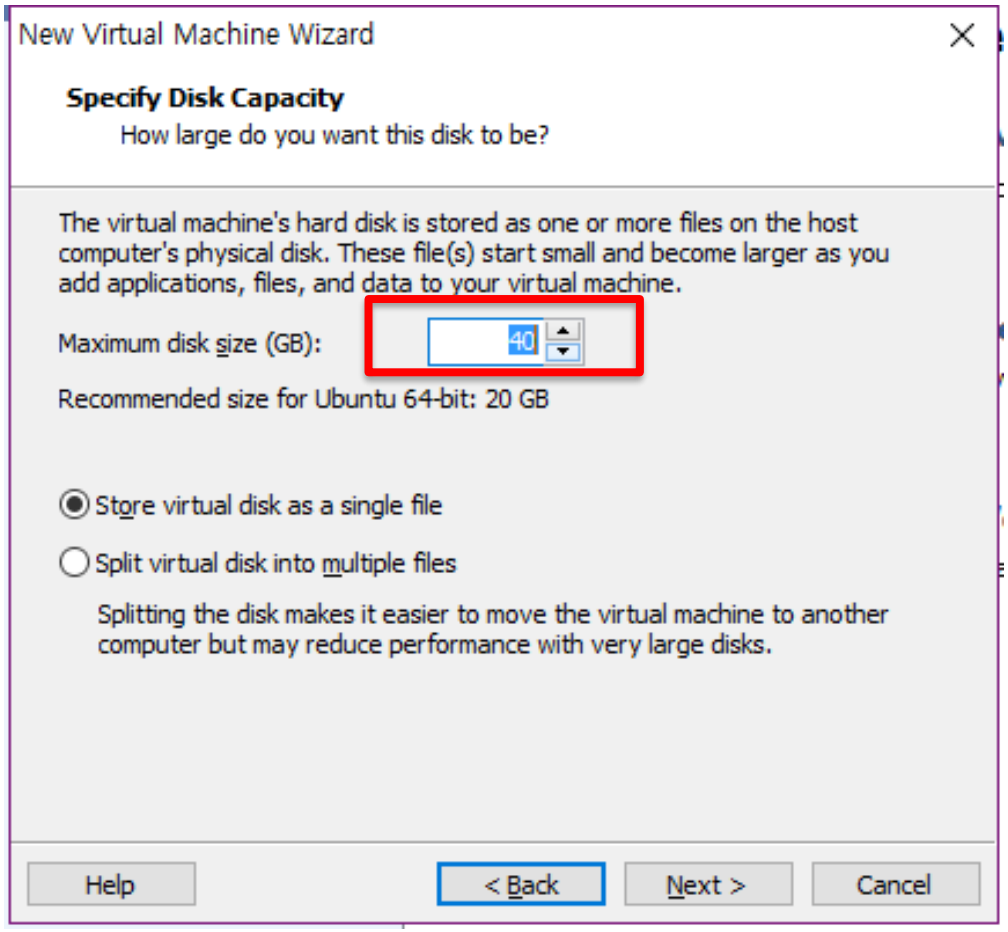


우분투 ID / PW 설정

SUDO 명령어
비밀번호

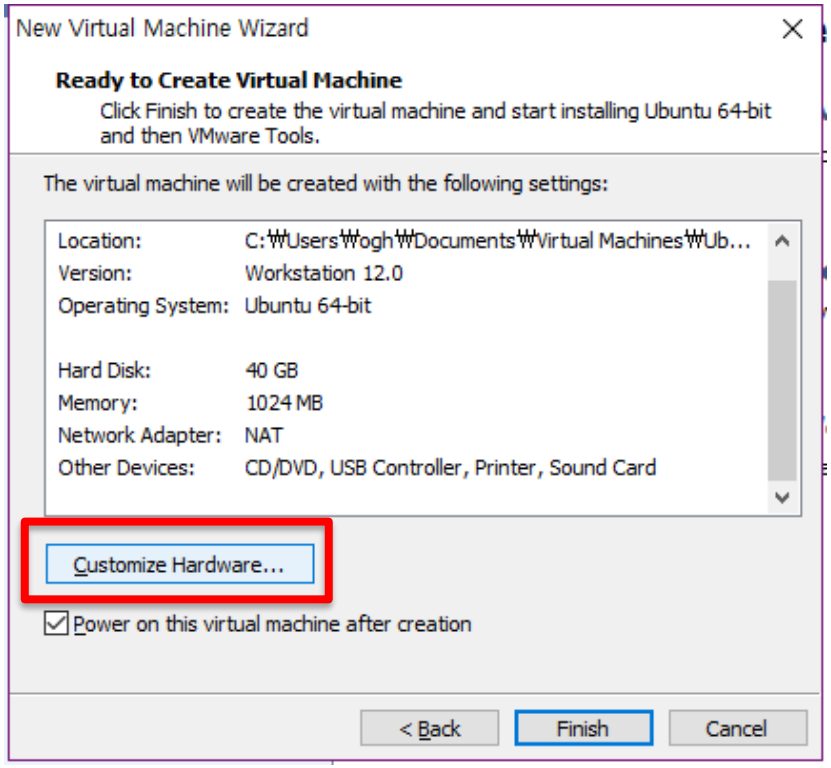


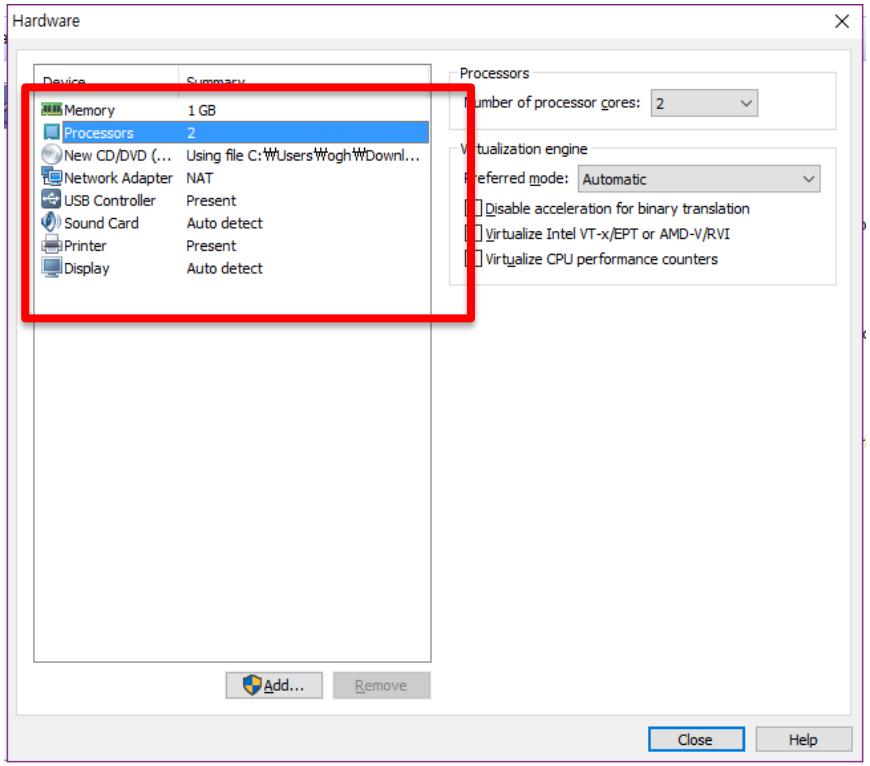
용량 넉넉히 설정 (20G 이상)



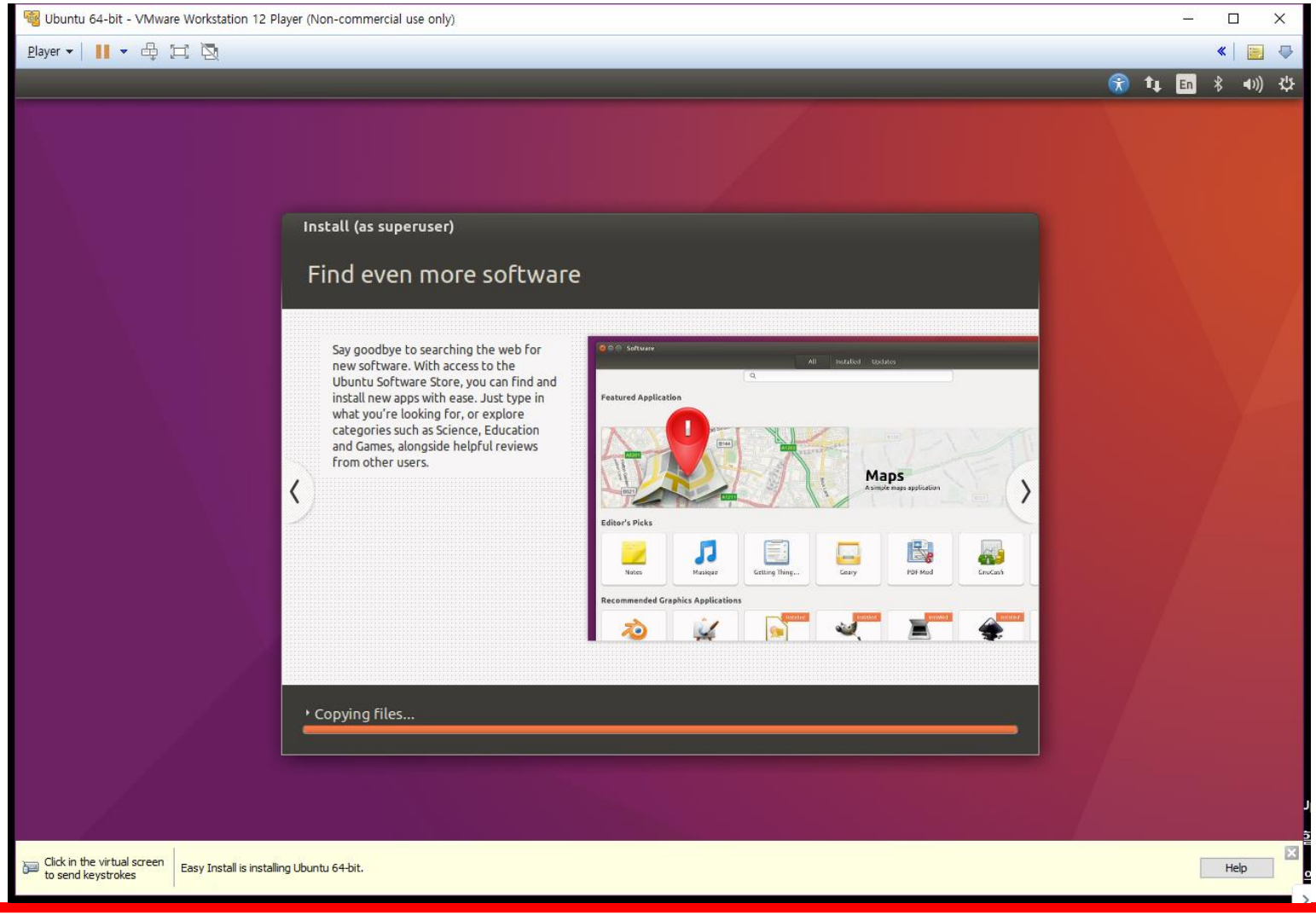
필요한 경우, 하드웨어 설정 변경

우분투에서 사용할 CPU 개수, 메모리 등

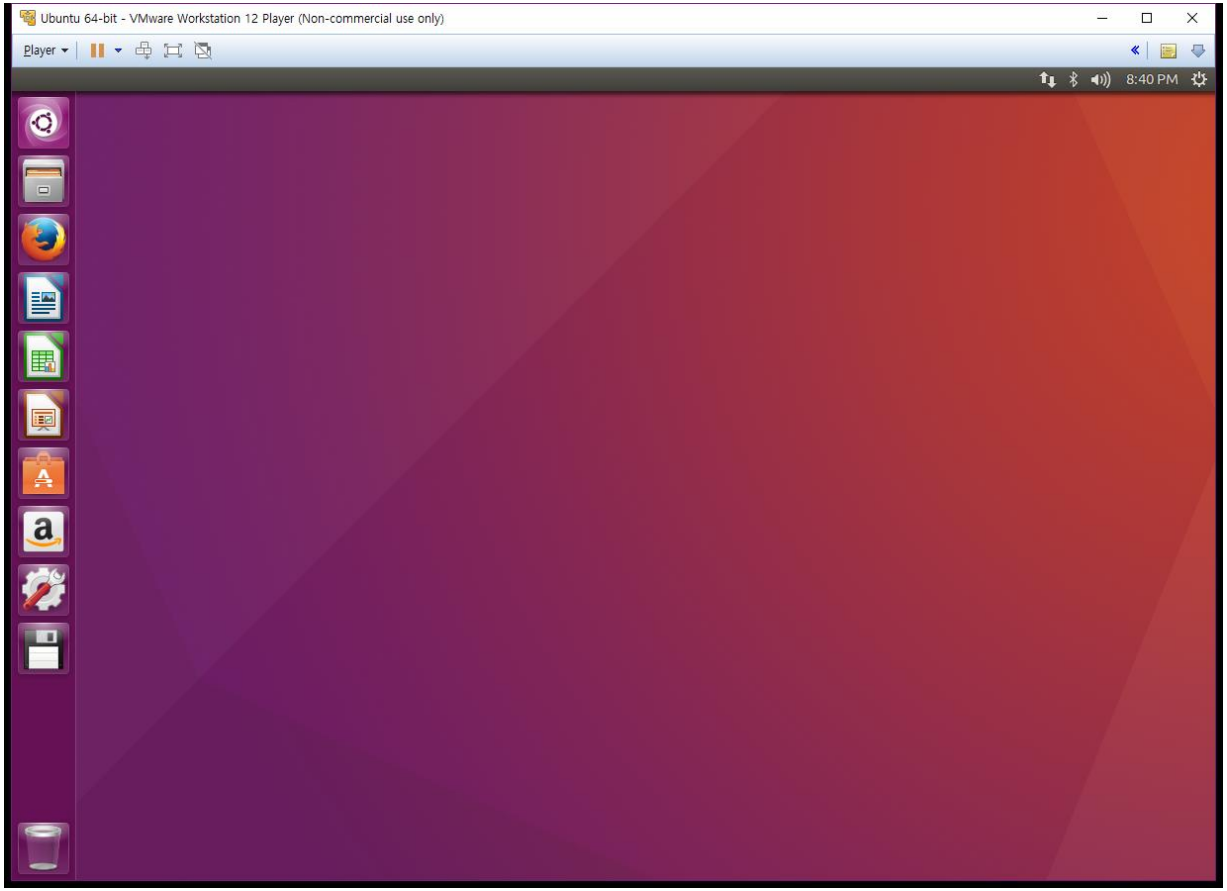




자동으로 설치 진행됨 (시간 소요됨)



설치 완료 화면


Ubuntu 64-bit - VMware Workstation 12 Player (Non-commercial use only)
Player
8:40 PM

Q&A

Create issue in Github

https://github.com/JonghyeokPark/SWE3003/issues

Q&A

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