

## CS342 Operating Systems - Fall 2020

### Homework #1

Asuman Aydın

21502604

1. I have decided to setup with Oracle VirtualBox to use the linux on my computer which has Windows 10 as operating system. This virtual machine allows me to create a space on the disk for creating different operating environments to run. I have decided to allocate 5059 MB for the base memory. It is running 2 CPUs as processors. I did not allocate much for the video memory since I assumed I may not use it much.

#### Information

Type (Format): Normal (VDI)

Virtual Size: 20.84 GB

Actual Size: 6.10 GB

Details: Dynamically allocated storage

Location: C:\Users\chary\VirtualBox VMs\Ubuntu 18.04\Ubuntu 18.04.vdi

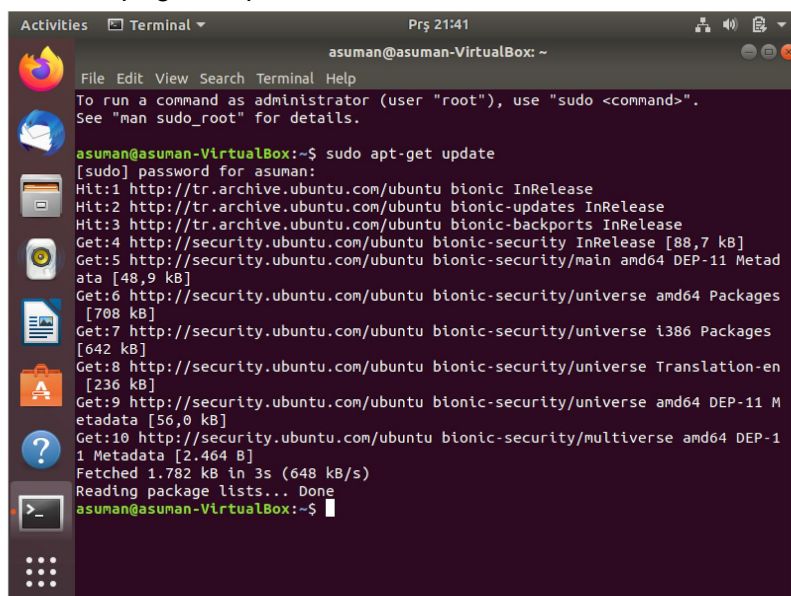
Attached to: Ubuntu 18.04

Encrypted with key: --

While installing the system, I have decided to allocate 20.84 GB for the virtual size. I thought this was a fair amount for the machine since I will not be working on that side more than I work on the windows side.

#### Commands:

- Sudo + apt-get + update



```
asuman@asuman-VirtualBox: ~  
File Edit View Search Terminal Help  
To run a command as administrator (user "root"), use "sudo <command>".  
See "man sudo_root" for details.  
  
asuman@asuman-VirtualBox:~$ sudo apt-get update  
[sudo] password for asuman:  
Hit:1 http://tr.archive.ubuntu.com/ubuntu bionic InRelease  
Hit:2 http://tr.archive.ubuntu.com/ubuntu bionic-updates InRelease  
Hit:3 http://tr.archive.ubuntu.com/ubuntu bionic-backports InRelease  
Get:4 http://security.ubuntu.com/ubuntu bionic-security InRelease [88,7 kB]  
Get:5 http://security.ubuntu.com/ubuntu bionic-security/main amd64 DEP-11 Metad  
ata [48,9 kB]  
Get:6 http://security.ubuntu.com/ubuntu bionic-security/universe amd64 Packages  
[708 kB]  
Get:7 http://security.ubuntu.com/ubuntu bionic-security/universe i386 Packages  
[642 kB]  
Get:8 http://security.ubuntu.com/ubuntu bionic-security/universe Translation-en  
[236 kB]  
Get:9 http://security.ubuntu.com/ubuntu bionic-security/universe amd64 DEP-11 M  
etaddata [56,0 kB]  
Get:10 http://security.ubuntu.com/ubuntu bionic-security/multiverse amd64 DEP-1  
1 Metadata [2,464 B]  
Fetched 1.782 kB in 3s (648 kB/s)  
Reading package lists... Done  
asuman@asuman-VirtualBox:~$
```

It contains 3 commands in it and it is essential to run this command when you open your system each time. It updates the programs and checks for other new stuff going on at the system.

- Wget

```
asuman@asuman-VirtualBox:~$ wget https://dl.google.com/linux/direct/google-chrome-stable_current_amd64.deb
--2020-09-24 21:47:23-- https://dl.google.com/linux/direct/google-chrome-stable_current_amd64.deb
Resolving dl.google.com (dl.google.com)... 172.217.169.142, 2a00:1450:4017:809::200e
Connecting to dl.google.com (dl.google.com)|172.217.169.142|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 70233788 (67M) [application/x-debian-package]
Saving to: 'google-chrome-stable_current_amd64.deb'
```

This works for downloading the files from their internet sources. Now I have decided to download and install google chrome and the first thing I do is getting the file to my system with wget command.

- dpkg

```
asuman@asuman-VirtualBox:~$ sudo dpkg -i google-chrome-stable_current_amd64.deb
Selecting previously unselected package google-chrome-stable.
(Reading database ... 164108 files and directories currently installed.)
Preparing to unpack google-chrome-stable_current_amd64.deb ...
Unpacking google-chrome-stable (85.0.4183.121-1) ...
```

Dpkg works with sudo command. It is basically a package handler for the ubuntu operating system. Now, it handles the file I download with wget for google chrome.

- Sudo apt -f install

```
asuman@asuman-VirtualBox:~$ sudo apt -f install
Reading package lists... Done
Building dependency tree
Reading state information... Done
0 upgraded, 0 newly installed, 0 to remove and 17 not upgraded.
asuman@asuman-VirtualBox:~$ sudo apt-get update
Hit:1 http://security.ubuntu.com/ubuntu bionic-security InRelease
Hit:2 http://tr.archive.ubuntu.com/ubuntu bionic InRelease
Hit:3 http://tr.archive.ubuntu.com/ubuntu bionic-updates InRelease
Get:4 http://dl.google.com/linux/chrome/deb stable InRelease [1.811 B]
Hit:5 http://tr.archive.ubuntu.com/ubuntu bionic-backports InRelease
Get:6 http://dl.google.com/linux/chrome/deb stable/main amd64 Packages [1.164 B]
Fetched 2.975 B in 1s (3.123 B/s)
Reading package lists... Done
```

So install works with sudo like every other command in ubuntu. From the files the dpkg handled before. And the program is ready to use after this. One thing every Ubuntu user should not forget is to run the “sudo apt-get update” command after such an installment. So that system knows what happened and keeps you updated.

- Ls + pwd + cd

```
asuman@asuman-VirtualBox:~$ ls
Desktop  Documents  Downloads  examples.desktop  google-chrome-stable_current_amd64.deb  Music  Pictures  Public  Templates  Videos
asuman@asuman-VirtualBox:~$ cd Desktop
asuman@asuman-VirtualBox:~/Desktop$ ls
asuman@asuman-VirtualBox:~/Desktop$ pwd
/home/asuman/Desktop
asuman@asuman-VirtualBox:~/Desktop$
```

First I have listed the files that include that directory I am using on the command prompt with “ls” command.

Then, I directed myself to the Desktop with command “cd”. Lastly, I have displayed the path of the current directory with command “pwd”.

2. The location of the kernel executable is /boot. The number of version is 5.4.0-48-generic.

3. Subdirectories are given below:

- Arch
- Block
- Certs
- Crypto
- Documentation
- Drivers
- Fs
- Include
- Init
- Ipc
- Kernel
- Lib
- LICENCES
- Mm
- Net
- Samples
- Scripts
- Security
- Sound
- Tools
- Usr
- virt

4. The path to the system call table: arch/x86/entry/syscalls/syscall\_64.tbl.

- 5 is "common fstat sys\_newfstat"
- 43 is "common accept sys\_accept"
- 123 is "common setfsgid sys\_setfsgid"
- 220 is "common semtimedop sys\_semtimedop"

5. Output of strace with cp:

```
execve("/bin/cp", ["cp", "/home/asuman/.bashrc", "bashrc"], 0x7ffde2075df0 /* 62 vars */)
= 0
brk(NULL)                               = 0x55ff5137a000
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
access("/etc/ld.so.preload", R_OK)     = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=81685, ...}) = 0
mmap(NULL, 81685, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f7019a0a000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)     = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libselinux.so.1", O_RDONLY|O_CLOEXEC)
= 3
```

```

read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\20b\0\0\0\0\0"..., 832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=154832, ...}) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f7019a08000
mmap(NULL, 2259152, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f70195cf000
mprotect(0x7f70195f4000, 2093056, PROT_NONE) = 0
mmap(0x7f70197f3000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x24000) = 0x7f70197f3000
mmap(0x7f70197f5000, 6352, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f70197f5000
close(3) = 0
access("/etc/ld.so.nohwcap", F_OK) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libacl.so.1", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\340\33\0\0\0\0\0"..., 832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=31232, ...}) = 0
mmap(NULL, 2126336, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f70193c7000
mprotect(0x7f70193ce000, 2093056, PROT_NONE) = 0
mmap(0x7f70195cd000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x6000) = 0x7f70195cd000
close(3) = 0
access("/etc/ld.so.nohwcap", F_OK) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libattr.so.1", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\260\20\0\0\0\0\0"..., 832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=18680, ...}) = 0
mmap(NULL, 2113752, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f70191c2000
mprotect(0x7f70191c6000, 2093056, PROT_NONE) = 0
mmap(0x7f70193c5000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x3000) = 0x7f70193c5000
close(3) = 0
access("/etc/ld.so.nohwcap", F_OK) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\260\34\2\0\0\0\0\0"..., 832) = 832
fstat(3, {st_mode=S_IFREG|0755, st_size=2030544, ...}) = 0
mmap(NULL, 4131552, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f7018dd1000
mprotect(0x7f7018fb8000, 2097152, PROT_NONE) = 0
mmap(0x7f70191b8000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e7000) = 0x7f70191b8000
mmap(0x7f70191be000, 15072, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f70191be000
close(3) = 0

```

```

access("/etc/ld.so.nohwcap", F_OK)    = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libpcre.so.3", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0 \25\0\0\0\0\0"... , 832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=464824, ...}) = 0
mmap(NULL, 2560264, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f7018b5f000
mprotect(0x7f7018bcf000, 2097152, PROT_NONE) = 0
mmap(0x7f7018dcf000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x70000) = 0x7f7018dcf000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)    = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libdl.so.2", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0P\16\0\0\0\0\0"... , 832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=14560, ...}) = 0
mmap(NULL, 2109712, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f701895b000
mprotect(0x7f701895e000, 2093056, PROT_NONE) = 0
mmap(0x7f7018b5d000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7f7018b5d000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)    = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libpthread.so.0", O_RDONLY|O_CLOEXEC)
= 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0000b\0\0\0\0\0"... , 832) = 832
fstat(3, {st_mode=S_IFREG|0755, st_size=144976, ...}) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f7019a06000
mmap(NULL, 2221184, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f701873c000
mprotect(0x7f7018756000, 2093056, PROT_NONE) = 0
mmap(0x7f7018955000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x19000) = 0x7f7018955000
mmap(0x7f7018957000, 13440, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f7018957000
close(3)                                = 0
mmap(NULL, 12288, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f7019a03000
arch_prctl(ARCH_SET_FS, 0x7f7019a03800) = 0
mprotect(0x7f70191b8000, 16384, PROT_READ) = 0
mprotect(0x7f7018955000, 4096, PROT_READ) = 0
mprotect(0x7f7018b5d000, 4096, PROT_READ) = 0
mprotect(0x7f7018dcf000, 4096, PROT_READ) = 0
mprotect(0x7f70193c5000, 4096, PROT_READ) = 0
mprotect(0x7f70195cd000, 4096, PROT_READ) = 0

```

```

mprotect(0x7f70197f3000, 4096, PROT_READ) = 0
mprotect(0x55ff4f5a7000, 4096, PROT_READ) = 0
mprotect(0x7f7019a1e000, 4096, PROT_READ) = 0
munmap(0x7f7019a0a000, 81685) = 0
set_tid_address(0x7f7019a03ad0) = 11790
set_robust_list(0x7f7019a03ae0, 24) = 0
rt_sigaction(SIGRTMIN, {sa_handler=0x7f7018741cb0, sa_mask=[],
sa_flags=SA_RESTORER|SA_SIGINFO, sa_restorer=0x7f701874e8a0}, NULL, 8) = 0
rt_sigaction(SIGRT_1, {sa_handler=0x7f7018741d50, sa_mask=[],
sa_flags=SA_RESTORER|SA_RESTART|SA_SIGINFO, sa_restorer=0x7f701874e8a0},
NULL, 8) = 0
rt_sigprocmask(SIG_UNBLOCK, [RTMIN RT_1], NULL, 8) = 0
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
rlim_max=RLIM64_INFINITY}) = 0
statfs("/sys/fs/selinux", 0x7ffd6cefd2f0) = -1 ENOENT (No such file or directory)
statfs("/selinux", 0x7ffd6cefd2f0) = -1 ENOENT (No such file or directory)
brk(NULL) = 0x55ff5137a000
brk(0x55ff5139b000) = 0x55ff5139b000
openat(AT_FDCWD, "/proc/filesystems", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0444, st_size=0, ...}) = 0
read(3, "nodev\tsysfs\nnodev\ttmpfs\nnodev\tbd"..., 1024) = 369
read(3, "", 1024) = 0
close(3) = 0
access("/etc/selinux/config", F_OK) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/lib/locale/locale-archive", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=11731760, ...}) = 0
mmap(NULL, 11731760, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f7017c0b000
close(3) = 0
geteuid() = 1000
stat("bashrc", 0x7ffd6cefd140) = -1 ENOENT (No such file or directory)
stat("/home/asuman/.bashrc", {st_mode=S_IFREG|0644, st_size=3771, ...}) = 0
stat("bashrc", 0x7ffd6cefcec0) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/home/asuman/.bashrc", O_RDONLY) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=3771, ...}) = 0
openat(AT_FDCWD, "bashrc", O_WRONLY|O_CREAT|O_EXCL, 0644) = 4
fstat(4, {st_mode=S_IFREG|0644, st_size=0, ...}) = 0
fadvise64(3, 0, 0, POSIX_FADV_SEQUENTIAL) = 0
mmap(NULL, 139264, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f70199e1000
read(3, "# ~/.bashrc: executed by bash(1)"..., 131072) = 3771
write(4, "# ~/.bashrc: executed by bash(1)"..., 3771) = 3771
read(3, "", 131072) = 0
close(4) = 0
close(3) = 0

```

```

munmap(0x7f70199e1000, 139264)      = 0
lseek(0, 0, SEEK_CUR)                = -1 ESPIPE (Illegal seek)
close(0)                             = 0
close(1)                             = 0
close(2)                             = 0
exit_group(0)                        = ?
+++ exited with 0 +++

```

Output of strace with ls:

```

execve("/bin/ls", ["ls", "/home/asuman/.bashrc", "bashrc"], 0x7ffed72d7f20 /* 62 vars */) = 0
brk(NULL)                             = 0x563540837000
access("/etc/ld.so.nohwcap", F_OK)    = -1 ENOENT (No such file or directory)
access("/etc/ld.so.preload", R_OK)    = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=81685, ...}) = 0
mmap(NULL, 81685, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7fc3d5a8d000
close(3)                             = 0
access("/etc/ld.so.nohwcap", F_OK)    = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libselinux.so.1", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\20b\0\0\0\0\0"..., 832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=154832, ...}) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7fc3d5a8b000
mmap(NULL, 2259152, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7fc3d5652000
mprotect(0x7fc3d5677000, 2093056, PROT_NONE) = 0
mmap(0x7fc3d5876000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x24000) = 0x7fc3d5876000
mmap(0x7fc3d5878000, 6352, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7fc3d5878000
close(3)                             = 0
access("/etc/ld.so.nohwcap", F_OK)    = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\260\34\2\0\0\0\0"..., 832) = 832
fstat(3, {st_mode=S_IFREG|0755, st_size=2030544, ...}) = 0
mmap(NULL, 4131552, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7fc3d5261000
mprotect(0x7fc3d5448000, 2097152, PROT_NONE) = 0
mmap(0x7fc3d5648000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e7000) = 0x7fc3d5648000
mmap(0x7fc3d564e000, 15072, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7fc3d564e000

```

```

close(3) = 0
access("/etc/ld.so.nohwcap", F_OK) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libpcr.so.3", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0 \25\0\0\0\0\0"... , 832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=464824, ...}) = 0
mmap(NULL, 2560264, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7fc3d4fef000
mprotect(0x7fc3d505f000, 2097152, PROT_NONE) = 0
mmap(0x7fc3d525f000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x70000) = 0x7fc3d525f000
close(3) = 0
access("/etc/ld.so.nohwcap", F_OK) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libdl.so.2", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0P\16\0\0\0\0\0"... , 832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=14560, ...}) = 0
mmap(NULL, 2109712, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7fc3d4deb000
mprotect(0x7fc3d4dee000, 2093056, PROT_NONE) = 0
mmap(0x7fc3d4fed000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7fc3d4fed000
close(3) = 0
access("/etc/ld.so.nohwcap", F_OK) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libpthread.so.0", O_RDONLY|O_CLOEXEC)
= 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0000b\0\0\0\0\0"... , 832) = 832
fstat(3, {st_mode=S_IFREG|0755, st_size=144976, ...}) = 0
mmap(NULL, 2221184, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7fc3d4bcc000
mprotect(0x7fc3d4be6000, 2093056, PROT_NONE) = 0
mmap(0x7fc3d4de5000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x19000) = 0x7fc3d4de5000
mmap(0x7fc3d4de7000, 13440, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7fc3d4de7000
close(3) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7fc3d5a89000
arch_prctl(ARCH_SET_FS, 0x7fc3d5a8a040) = 0
mprotect(0x7fc3d5648000, 16384, PROT_READ) = 0
mprotect(0x7fc3d4de5000, 4096, PROT_READ) = 0
mprotect(0x7fc3d4fed000, 4096, PROT_READ) = 0
mprotect(0x7fc3d525f000, 4096, PROT_READ) = 0
mprotect(0x7fc3d5876000, 4096, PROT_READ) = 0
mprotect(0x56353f5d1000, 8192, PROT_READ) = 0
mprotect(0x7fc3d5aa1000, 4096, PROT_READ) = 0

```



```

munmap(0x7fc3d5a8d000, 81685)      = 0
set_tid_address(0x7fc3d5a8a310)   = 11794
set_robust_list(0x7fc3d5a8a320, 24) = 0
rt_sigaction(SIGRTMIN, {sa_handler=0x7fc3d4bd1cb0, sa_mask=[],
sa_flags=SA_RESTORER|SA_SIGINFO, sa_restorer=0x7fc3d4bde8a0}, NULL, 8) = 0
rt_sigaction(SIGRT_1, {sa_handler=0x7fc3d4bd1d50, sa_mask=[],
sa_flags=SA_RESTORER|SA_RESTART|SA_SIGINFO, sa_restorer=0x7fc3d4bde8a0},
NULL, 8) = 0
rt_sigprocmask(SIG_UNBLOCK, [RTMIN RT_1], NULL, 8) = 0
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
rlim_max=RLIM64_INFINITY}) = 0
statfs("/sys/fs/selinux", 0x7ffd16ae4690) = -1 ENOENT (No such file or directory)
statfs("/selinux", 0x7ffd16ae4690) = -1 ENOENT (No such file or directory)
brk(NULL) = 0x563540837000
brk(0x563540858000) = 0x563540858000
openat(AT_FDCWD, "/proc/filesystems", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0444, st_size=0, ...}) = 0
read(3, "nodev\tsysfs\nnodev\ttmpfs\nnodev\tbdf", 1024) = 369
read(3, "", 1024) = 0
close(3) = 0
access("/etc/selinux/config", F_OK) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/lib/locale/locale-archive", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=11731760, ...}) = 0
mmap(NULL, 11731760, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7fc3d409b000
close(3) = 0
ioctl(1, TCGETS, {B38400 opost isig icanon echo ...}) = 0
ioctl(1, TIOCGWINSZ, {ws_row=39, ws_col=168, ws_xpixel=0, ws_ypixel=0}) = 0
stat("/home/asuman/.bashrc", {st_mode=S_IFREG|0644, st_size=3771, ...}) = 0
lstat("/home/asuman/.bashrc", {st_mode=S_IFREG|0644, st_size=3771, ...}) = 0
stat("bashrc", {st_mode=S_IFREG|0644, st_size=3771, ...}) = 0
lstat("bashrc", {st_mode=S_IFREG|0644, st_size=3771, ...}) = 0
fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(136, 0), ...}) = 0
write(1, "bashrc\t/home/asuman/.bashrc\n", 28bashrc      /home/asuman/.bashrc
) = 28
close(1) = 0
close(2) = 0
exit_group(0) = ?
+++ exited with 0 +++

```

6. For command: `time ls -a:`

```

real    0m0,002s → total time took to execute
user    0m0,002s → total time took to execute in user mode
sys     0m0,000s → total time took to execute in kernel mode

```

For command: time wc /etc/hosts

```
real    0m0,002s
user    0m0,002s
sys     0m0,000s
```

7.

```
#include <stdio.h>
#include <stdlib.h>
#include <sys/time.h>

struct Node {
    int insertedData;
    struct Node* nextData;
};

int main()
{
    struct timeval start_time;
    gettimeofday(&start_time, NULL);
    struct Node* head = (struct Node*)malloc(sizeof(struct
Node));
    //does it constructed right?
    if(head == NULL)
    {
        perror( "malloc for for node failed" );
        exit( EXIT_FAILURE );
    }
    //first head inserted
    head->nextData = NULL;
    head->insertedData = rand()%100;
    //copy the head to create others
    struct Node *root = head;

    for (int i=1; i<1000; i++)
    {
        root->nextData = malloc( sizeof( struct Node ) );
        if( !(root->nextData) )
        {
            perror( "malloc failed" );
            exit( EXIT_FAILURE );
        }

        root = root->nextData;
        root->insertedData = rand()%100;
```

```
    }  
    struct timeval finish_time;  
    gettimeofday(&finish_time, NULL);  
    printf("it took %ld micro seconds.\n",  
finish_time.tv_usec-start_time.tv_usec);  
    return 0;  
}
```