**CS342**

**HOMEWORK 1**

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**Section 1**

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**INSTALLATION CHOICES AND EXPERIENCES:**

I chose installing Ubuntu Desktop 64-bit 18.04 LTS on a virtual machine using VirtualBox 6.1 for MacOS. The reason for this decision was that I rarely use Ubuntu (due to the availability of Bash terminal in MacOS) and wanted this installation to be a temporary thing. Also, I have had trouble with the boot order in a dual-boot installation previously and didn’t want to risk such a scenario again. I chose VirtualBox because I was acquainted to its usage. I chose to make a virtual hard drive of 50GB size (not dynamic) because I thought that would be the necessary size.

As far as the experience is concerned, I had a pretty straightforward experience installing the OS and setting it up to run. Contrary to what I believed, virtual machines, given enough RAM (4GB in my case), perform quite well.

**10 LINUX COMMANDS:**

1. cat
2. cd
3. ls
4. chmod
5. curl
6. echo
7. exit
8. grep
9. gzip
10. mkdir

**PATH/ VERSION OF KERNEL EXECUTABLE:**

Location: /boot

Version: 5.3.0-28-generic

**SUBDIRECTORIES IN KERNEL SOURCE CODE:**

COPYING MAINTAINERS crypto kernel security

CREDITS Makefile drivers lib sound

Documentation README fs mm tools

Kbuild arch include net usr

Kconfig block init samples virt

LICENSES certs ipc scripts

**DEFINITION OF SYSTEM CALL TABLE:**

Location: arch/x86/entry/syscalls/syscall\_64.tbl

5: fstat

43: accept

123: setfsgid

220: semtimedop

**STRACE COMMAND:**

ls: strace ls

execve("/bin/ls", ["ls"], 0x7ffda365b1e0 /\* 64 vars \*/) = 0

brk(NULL) = 0x55737ed99000

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=84201, ...}) = 0

mmap(NULL, 84201, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0x7f372903a000

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\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) = 0x7f3729038000

mmap(NULL, 2259152, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7f3728c00000

mprotect(0x7f3728c25000, 2093056, PROT\_NONE) = 0

mmap(0x7f3728e24000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x24000) = 0x7f3728e24000

mmap(0x7f3728e26000, 6352, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f3728e26000

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\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) = 0x7f372880f000

mprotect(0x7f37289f6000, 2097152, PROT\_NONE) = 0

mmap(0x7f3728bf6000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1e7000) = 0x7f3728bf6000

mmap(0x7f3728bfc000, 15072, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f3728bfc000

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\0\3\0>\0\1\0\0\0 \25\0\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) = 0x7f372859d000

mprotect(0x7f372860d000, 2097152, PROT\_NONE) = 0

mmap(0x7f372880d000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x70000) = 0x7f372880d000

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\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) = 0x7f3728399000

mprotect(0x7f372839c000, 2093056, PROT\_NONE) = 0

mmap(0x7f372859b000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x2000) = 0x7f372859b000

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\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) = 0x7f372817a000

mprotect(0x7f3728194000, 2093056, PROT\_NONE) = 0

mmap(0x7f3728393000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x19000) = 0x7f3728393000

mmap(0x7f3728395000, 13440, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f3728395000

close(3) = 0

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f3729036000

arch\_prctl(ARCH\_SET\_FS, 0x7f3729037040) = 0

mprotect(0x7f3728bf6000, 16384, PROT\_READ) = 0

mprotect(0x7f3728393000, 4096, PROT\_READ) = 0

mprotect(0x7f372859b000, 4096, PROT\_READ) = 0

mprotect(0x7f372880d000, 4096, PROT\_READ) = 0

mprotect(0x7f3728e24000, 4096, PROT\_READ) = 0

mprotect(0x55737e7d8000, 8192, PROT\_READ) = 0

mprotect(0x7f372904f000, 4096, PROT\_READ) = 0

munmap(0x7f372903a000, 84201) = 0

set\_tid\_address(0x7f3729037310) = 18718

set\_robust\_list(0x7f3729037320, 24) = 0

rt\_sigaction(SIGRTMIN, {sa\_handler=0x7f372817fcb0, sa\_mask=[], sa\_flags=SA\_RESTORER|SA\_SIGINFO, sa\_restorer=0x7f372818c890}, NULL, 8) = 0

rt\_sigaction(SIGRT\_1, {sa\_handler=0x7f372817fd50, sa\_mask=[], sa\_flags=SA\_RESTORER|SA\_RESTART|SA\_SIGINFO, sa\_restorer=0x7f372818c890}, 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", 0x7fff3db6ec70) = -1 ENOENT (No such file or directory)

statfs("/selinux", 0x7fff3db6ec70) = -1 ENOENT (No such file or directory)

brk(NULL) = 0x55737ed99000

brk(0x55737edba000) = 0x55737edba000

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) = 360

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) = 0x7f3727649000

close(3) = 0

ioctl(1, TCGETS, {B38400 opost isig icanon echo ...}) = 0

ioctl(1, TIOCGWINSZ, {ws\_row=24, ws\_col=80, ws\_xpixel=0, ws\_ypixel=0}) = 0

openat(AT\_FDCWD, ".", O\_RDONLY|O\_NONBLOCK|O\_CLOEXEC|O\_DIRECTORY) = 3

fstat(3, {st\_mode=S\_IFDIR|0755, st\_size=4096, ...}) = 0

getdents(3, /\* 28 entries \*/, 32768) = 960

getdents(3, /\* 0 entries \*/, 32768) = 0

close(3) = 0

fstat(1, {st\_mode=S\_IFCHR|0620, st\_rdev=makedev(136, 1), ...}) = 0

write(1, "cs342hw1.c Documents examples."..., 69cs342hw1.c Documents examples.desktop Music Public Templates

) = 69

write(1, "Desktop Downloads hw1\t\t Pic"..., 55Desktop Downloads hw1 Pictures tempDir Videos

) = 55

close(1) = 0

close(2) = 0

exit\_group(0) = ?

+++ exited with 0 +++

mkdir: strace mkdir tempDir

execve("/bin/mkdir", ["mkdir", "tempDir"], 0x7ffd559c5508 /\* 64 vars \*/) = 0

brk(NULL) = 0x55c969b36000

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=84201, ...}) = 0

mmap(NULL, 84201, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0x7f52bd12d000

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\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) = 0x7f52bd12b000

mmap(NULL, 2259152, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7f52bccf3000

mprotect(0x7f52bcd18000, 2093056, PROT\_NONE) = 0

mmap(0x7f52bcf17000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x24000) = 0x7f52bcf17000

mmap(0x7f52bcf19000, 6352, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f52bcf19000

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\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) = 0x7f52bc902000

mprotect(0x7f52bcae9000, 2097152, PROT\_NONE) = 0

mmap(0x7f52bcce9000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1e7000) = 0x7f52bcce9000

mmap(0x7f52bccef000, 15072, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f52bccef000

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\0\3\0>\0\1\0\0\0 \25\0\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) = 0x7f52bc690000

mprotect(0x7f52bc700000, 2097152, PROT\_NONE) = 0

mmap(0x7f52bc900000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x70000) = 0x7f52bc900000

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\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) = 0x7f52bc48c000

mprotect(0x7f52bc48f000, 2093056, PROT\_NONE) = 0

mmap(0x7f52bc68e000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x2000) = 0x7f52bc68e000

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\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) = 0x7f52bc26d000

mprotect(0x7f52bc287000, 2093056, PROT\_NONE) = 0

mmap(0x7f52bc486000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x19000) = 0x7f52bc486000

mmap(0x7f52bc488000, 13440, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f52bc488000

close(3) = 0

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f52bd129000

arch\_prctl(ARCH\_SET\_FS, 0x7f52bd12a040) = 0

mprotect(0x7f52bcce9000, 16384, PROT\_READ) = 0

mprotect(0x7f52bc486000, 4096, PROT\_READ) = 0

mprotect(0x7f52bc68e000, 4096, PROT\_READ) = 0

mprotect(0x7f52bc900000, 4096, PROT\_READ) = 0

mprotect(0x7f52bcf17000, 4096, PROT\_READ) = 0

mprotect(0x55c9698f6000, 4096, PROT\_READ) = 0

mprotect(0x7f52bd142000, 4096, PROT\_READ) = 0

munmap(0x7f52bd12d000, 84201) = 0

set\_tid\_address(0x7f52bd12a310) = 18710

set\_robust\_list(0x7f52bd12a320, 24) = 0

rt\_sigaction(SIGRTMIN, {sa\_handler=0x7f52bc272cb0, sa\_mask=[], sa\_flags=SA\_RESTORER|SA\_SIGINFO, sa\_restorer=0x7f52bc27f890}, NULL, 8) = 0

rt\_sigaction(SIGRT\_1, {sa\_handler=0x7f52bc272d50, sa\_mask=[], sa\_flags=SA\_RESTORER|SA\_RESTART|SA\_SIGINFO, sa\_restorer=0x7f52bc27f890}, 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", 0x7ffef3226c00) = -1 ENOENT (No such file or directory)

statfs("/selinux", 0x7ffef3226c00) = -1 ENOENT (No such file or directory)

brk(NULL) = 0x55c969b36000

brk(0x55c969b57000) = 0x55c969b57000

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) = 360

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) = 0x7f52bb73c000

close(3) = 0

mkdir("tempDir", 0777) = 0

close(1) = 0

close(2) = 0

exit\_group(0) = ?

+++ exited with 0 +++

**TIME COMMAND:**

Command: time cp test.txt test2.txt

Output:

real 0m0,003s

user 0m0,002s

sys 0m0,000

Explanation:

Time command outputs the timings statistics to run a command in three different ways. The “real” values means the real time between when the command was invoked and when it terminated. The “user” values refers to the CPU time difference (ie: sum of tms\_utime and tms\_cutime values in the struct tms as the value that is returned by times(2). Finally, the “sys” time refers to the system CPU time difference values (ie: sum of tms\_stime and tms\_cstime values in the struct tms as the value that is returned by times(2).

**COST.C OUTPUT:**

erofnnewooc