

CS342 Operating Systems - Homework 1

1. First, from virtualbox.org, I have downloaded and installed Oracle VM VirtualBox. Then I have downloaded the ISO file of Ubuntu 20.04 from ubuntu.org. By following a tutorial on youtube[1], I had Ubuntu Linux on the virtual machine. It was a smooth and comparably less risky process of installation. The only problem I got during installation was my choice of the user password. I have set a valid password, but when I tried to log in to my Linux machine, I got an invalid password error. I have followed another tutorial[2] and opened Recovery Menu to reset my password in the root. I have set another password that does not contain any Turkish characters, and now I have a smooth Linux experience.

- 10 Linux Commands I Have Learned:
 - a. cd Command
 - b. ls Command
 - c. mount Command
 - d. tar Command
 - e. gzip Command
 - f. uname Command
 - g. man Command
 - h. cp Command
 - i. mkdir Command
 - j. sudo Command

2. I found it in /boot directory with version 5.11.0-36-generic.

3. The names of directories:

- arch
- block
- certs
- crypto
- documentation
- drivers
- fs
- include
- init
- ipc
- kernel
- lib
- LICENSES
- mm
- net
- samples
- scripts

- security
- sound
- tools
- usr
- virt

4. I have found the system call table in the directory /arch/x86/entry/syscalls. The file name is syscall_64.tbl

| | |
|-------------|-----------|
| Syscall 3 | close |
| Syscall 35 | nanosleep |
| Syscall 110 | getppid |
| Syscall 210 | io_cancel |

5. Some uses of strace command:

- **strace ls:**

```

execve("/usr/bin/ls", ["ls"], 0x7ffe39a95e90 /* 58 vars */) = 0
brk(NULL)                                = 0x55d81d118000
arch_prctl(0x3001 /* ARCH_??? */, 0x7fff0e2b78b0) = -1 EINVAL (Invalid argument)
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=73778, ...}) = 0
mmap(NULL, 73778, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7ff80d96a000
close(3)                                = 0
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\0\3\0>\0\1\0\0\0@p\0\0\0\0\0\0"... , 832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=163200, ...}) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7ff80d968000
mmap(NULL, 174600, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7ff80d93d000
mprotect(0x7ff80d943000, 135168, PROT_NONE) = 0
mmap(0x7ff80d943000, 102400, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x6000) = 0x7ff80d943000
mmap(0x7ff80d95c000, 28672, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1f000) = 0x7ff80d95c000
mmap(0x7ff80d964000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x26000) = 0x7ff80d964000
mmap(0x7ff80d966000, 6664, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7ff80d966000
close(3)                                = 0
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\360q\2\0\0\0\0"..., 832) =
832
pread64(3, "\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0"..., 784,
64) = 784
pread64(3, "\4\0\0\0\20\0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0", 32,
848) = 32
pread64(3,
"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\t\233\222%\274\260\320\31\331\326\10\204\276X>\
263"..., 68, 880) = 68
fstat(3, {st_mode=S_IFREG|0755, st_size=2029224, ...}) = 0
pread64(3, "\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0"..., 784,
64) = 784
pread64(3, "\4\0\0\0\20\0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0", 32,
848) = 32
pread64(3,
"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\t\233\222%\274\260\320\31\331\326\10\204\276X>\
263"..., 68, 880) = 68
mmap(NULL, 2036952, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7ff80d74b000
mprotect(0x7ff80d770000, 1847296, PROT_NONE) = 0
mmap(0x7ff80d770000, 1540096, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x25000) = 0x7ff80d770000
mmap(0x7ff80d8e8000, 303104, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x19d000) = 0x7ff80d8e8000
mmap(0x7ff80d933000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e7000) = 0x7ff80d933000
mmap(0x7ff80d939000, 13528, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7ff80d939000
close(3) = 0
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libpcre2-8.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\0\340\0\0\0\0\0\0"..., 832) =
832
fstat(3, {st_mode=S_IFREG|0644, st_size=584392, ...}) = 0
mmap(NULL, 586536, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7ff80d6bb000
mmap(0x7ff80d6bd000, 409600, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7ff80d6bd000
mmap(0x7ff80d721000, 163840, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x66000) = 0x7ff80d721000
mmap(0x7ff80d749000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x8d000) = 0x7ff80d749000
close(3) = 0
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\0\22\0\0\0\0\0\0"..., 832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=18816, ...}) = 0

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mmap(NULL, 20752, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7ff80d6b5000
mmap(0x7ff80d6b6000, 8192, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x7ff80d6b6000
mmap(0x7ff80d6b8000, 4096, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x3000) = 0x7ff80d6b8000
mmap(0x7ff80d6b9000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x3000) = 0x7ff80d6b9000
close(3) = 0
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\0\220\201\0\0\0\0\0"..., 832) =
832
pread64(3,
"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\345Ga\367\265T\320\374\301V)Yfj\223\337"..., 68,
824) = 68
fstat(3, {st_mode=S_IFREG|0755, st_size=157224, ...}) = 0
pread64(3,
"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\345Ga\367\265T\320\374\301V)Yfj\223\337"..., 68,
824) = 68
mmap(NULL, 140408, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7ff80d692000
mmap(0x7ff80d699000, 69632, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x7000) = 0x7ff80d699000
mmap(0x7ff80d6aa000, 20480, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x18000) = 0x7ff80d6aa000
mmap(0x7ff80d6af000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1c000) = 0x7ff80d6af000
mmap(0x7ff80d6b1000, 13432, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7ff80d6b1000
close(3) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7ff80d690000
arch_prctl(ARCH_SET_FS, 0x7ff80d691400) = 0
mprotect(0x7ff80d933000, 12288, PROT_READ) = 0
mprotect(0x7ff80d6af000, 4096, PROT_READ) = 0
mprotect(0x7ff80d6b9000, 4096, PROT_READ) = 0
mprotect(0x7ff80d749000, 4096, PROT_READ) = 0
mprotect(0x7ff80d964000, 4096, PROT_READ) = 0
mprotect(0x55d81b598000, 4096, PROT_READ) = 0
mprotect(0x7ff80d9aa000, 4096, PROT_READ) = 0
munmap(0x7ff80d96a000, 73778) = 0
set_tid_address(0x7ff80d6916d0) = 4152
set_robust_list(0x7ff80d6916e0, 24) = 0
rt_sigaction(SIGRTMIN, {sa_handler=0x7ff80d699bf0, sa_mask=[],
sa_flags=SA_RESTORER|SA_SIGINFO, sa_restorer=0x7ff80d6a73c0}, NULL, 8) =
0

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rt_sigaction(SIGRT_1, {sa_handler=0x7ff80d699c90, sa_mask=[],
sa_flags=SA_RESTORER|SA_RESTART|SA_SIGINFO,
sa_restorer=0x7ff80d6a73c0}, 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", 0x7fff0e2b7800) = -1 ENOENT (No such file or directory)
statfs("/selinux", 0x7fff0e2b7800) = -1 ENOENT (No such file or directory)
brk(NULL) = 0x55d81d118000
brk(0x55d81d139000) = 0x55d81d139000
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=17469824, ...}) = 0
mmap(NULL, 17469824, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7ff80c5e6000
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
getdents64(3, /* 19 entries */, 32768) = 744
getdents64(3, /* 0 entries */, 32768) = 0
close(3) = 0
fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0
write(1, "config-5.11.0-27-generic me"..., 45config-5.11.0-27-generic
memtest86+.elf
) = 45
write(1, "config-5.11.0-36-generic me"..., 55config-5.11.0-36-generic
memtest86+_multiboot.bin
) = 55
write(1, "efi\t\t\t System.map-5.11.0-27"..., 41efi
System.map-5.11.0-27-generic
) = 41
write(1, "grub\t\t\t System.map-5.11.0-3"..., 42grub
System.map-5.11.0-36-generic
) = 42
write(1, "initrd.img\t\t\t vmlinuz\n", 26initrd.img vmlinuz
) = 26
write(1, "initrd.img-5.11.0-27-generic vm"..., 56initrd.img-5.11.0-27-generic
vmlinuz-5.11.0-27-generic
) = 56
write(1, "initrd.img-5.11.0-36-generic vm"..., 56initrd.img-5.11.0-36-generic
vmlinuz-5.11.0-36-generic

```

```
) = 56  
write(1, "initrd.img.old\t\t\t\t\tvmlinuz.ol"... , 34initrd.img.old\t\t\t\t\tvmlinuz.ol  
) = 34  
write(1, "memtest86+.bin\n", 15memtest86+.bin  
) = 15  
close(1) = 0  
close(2) = 0  
exit_group(0) = ?  
+++ exited with 0 +++
```

- **strace cp:**

```
execve("/usr/bin/cp", ["cp"], 0x7fff870a1760 /* 58 vars */) = 0
brk(NULL) = 0x56513c097000
arch_prctl(0x3001 /* ARCH_??? */, 0x7fff03b9470) = -1 EINVAL (Invalid argument)
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=73778, ...}) = 0
mmap(NULL, 73778, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7efe2b99a000
close(3) = 0
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@p\0\0\0\0\0"... , 832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=163200, ...}) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7efe2b998000
mmap(NULL, 174600, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7efe2b96d000
mprotect(0x7efe2b973000, 135168, PROT_NONE) = 0
mmap(0x7efe2b973000, 102400, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x6000) = 0x7efe2b973000
mmap(0x7efe2b98c000, 28672, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1f000) = 0x7efe2b98c000
mmap(0x7efe2b994000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x26000) = 0x7efe2b994000
mmap(0x7efe2b996000, 6664, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7efe2b996000
close(3) = 0
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\360$\0\0\0\0\0"... , 832) =
832
fstat(3, {st_mode=S_IFREG|0644, st_size=39088, ...}) = 0
mmap(NULL, 41120, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7efe2b962000
mmap(0x7efe2b964000, 20480, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7efe2b964000
```

```

mmap(0x7efe2b969000, 8192, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x7000) = 0x7efe2b969000
mmap(0x7efe2b96b000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x8000) = 0x7efe2b96b000
close(3) = 0
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 $\0\0\0\0\0"..., 832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=26696, ...}) = 0
mmap(NULL, 28696, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7efe2b95a000
mmap(0x7efe2b95c000, 12288, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7efe2b95c000
mmap(0x7efe2b95f000, 4096, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x5000) = 0x7efe2b95f000
mmap(0x7efe2b960000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x5000) = 0x7efe2b960000
close(3) = 0
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\360q\2\0\0\0\0"..., 832) =
832
pread64(3, "\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0"..., 784,
64) = 784
pread64(3, "\4\0\0\0\20\0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0", 32,
848) = 32
pread64(3,
"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\t\233\222%\274\260\320\31\331\326\10\204\276X>\
263"..., 68, 880) = 68
fstat(3, {st_mode=S_IFREG|0755, st_size=2029224, ...}) = 0
pread64(3, "\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0"..., 784,
64) = 784
pread64(3, "\4\0\0\0\20\0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0", 32,
848) = 32
pread64(3,
"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\t\233\222%\274\260\320\31\331\326\10\204\276X>\
263"..., 68, 880) = 68
mmap(NULL, 2036952, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7efe2b768000
mprotect(0x7efe2b78d000, 1847296, PROT_NONE) = 0
mmap(0x7efe2b78d000, 1540096, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x25000) = 0x7efe2b78d000
mmap(0x7efe2b905000, 303104, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x19d000) = 0x7efe2b905000
mmap(0x7efe2b950000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e7000) = 0x7efe2b950000
mmap(0x7efe2b956000, 13528, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7efe2b956000
close(3) = 0

```

```

openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libpcre2-8.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\0\340\0\0\0\0\0"..., 832) =
832
fstat(3, {st_mode=S_IFREG|0644, st_size=584392, ...}) = 0
mmap(NULL, 586536, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7efe2b6d8000
mmap(0x7efe2b6da000, 409600, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7efe2b6da000
mmap(0x7efe2b73e000, 163840, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x66000) = 0x7efe2b73e000
mmap(0x7efe2b766000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x8d000) = 0x7efe2b766000
close(3) = 0
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\0 \22\0\0\0\0\0"..., 832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=18816, ...}) = 0
mmap(NULL, 20752, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7efe2b6d2000
mmap(0x7efe2b6d3000, 8192, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x7efe2b6d3000
mmap(0x7efe2b6d5000, 4096, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x3000) = 0x7efe2b6d5000
mmap(0x7efe2b6d6000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x3000) = 0x7efe2b6d6000
close(3) = 0
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\0\220\201\0\0\0\0\0"..., 832) =
832
pread64(3,
"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\345Ga\367\265T\320\374\301V)Yfj\223\337"..., 68,
824) = 68
fstat(3, {st_mode=S_IFREG|0755, st_size=157224, ...}) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7efe2b6d0000
pread64(3,
"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\345Ga\367\265T\320\374\301V)Yfj\223\337"..., 68,
824) = 68
mmap(NULL, 140408, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7efe2b6ad000
mmap(0x7efe2b6b4000, 69632, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x7000) = 0x7efe2b6b4000
mmap(0x7efe2b6c5000, 20480, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x18000) = 0x7efe2b6c5000
mmap(0x7efe2b6ca000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1c000) = 0x7efe2b6ca000

```



```

mmap(0x7efe2b6cc000, 13432, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7efe2b6cc000
close(3) = 0
mmap(NULL, 12288, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7efe2b6aa000
arch_prctl(ARCH_SET_FS, 0x7efe2b6aa800) = 0
mprotect(0x7efe2b950000, 12288, PROT_READ) = 0
mprotect(0x7efe2b6ca000, 4096, PROT_READ) = 0
mprotect(0x7efe2b6d6000, 4096, PROT_READ) = 0
mprotect(0x7efe2b766000, 4096, PROT_READ) = 0
mprotect(0x7efe2b960000, 4096, PROT_READ) = 0
mprotect(0x7efe2b96b000, 4096, PROT_READ) = 0
mprotect(0x7efe2b994000, 4096, PROT_READ) = 0
mprotect(0x56513b823000, 4096, PROT_READ) = 0
mprotect(0x7efe2b9da000, 4096, PROT_READ) = 0
munmap(0x7efe2b99a000, 73778) = 0
set_tid_address(0x7efe2b6aaad0) = 4161
set_robust_list(0x7efe2b6aaae0, 24) = 0
rt_sigaction(SIGRTMIN, {sa_handler=0x7efe2b6b4bf0, sa_mask=[],
sa_flags=SA_RESTORER|SA_SIGINFO, sa_restorer=0x7efe2b6c23c0}, NULL, 8) =
0
rt_sigaction(SIGRT_1, {sa_handler=0x7efe2b6b4c90, sa_mask=[],
sa_flags=SA_RESTORER|SA_RESTART|SA_SIGINFO,
sa_restorer=0x7efe2b6c23c0}, 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", 0x7ffc03b93c0) = -1 ENOENT (No such file or directory)
statfs("/selinux", 0x7ffc03b93c0) = -1 ENOENT (No such file or directory)
brk(NULL) = 0x56513c097000
brk(0x56513c0b8000) = 0x56513c0b8000
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=17469824, ...}) = 0
mmap(NULL, 17469824, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7efe2a600000
close(3) = 0
geteuid() = 1000
openat(AT_FDCWD, "/usr/share/locale/locale.alias", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=2996, ...}) = 0
read(3, "# Locale name alias data base.\n#"..., 4096) = 2996
read(3, "", 4096) = 0
close(3) = 0

```

```

openat(AT_FDCWD, "/usr/share/locale/en_US.UTF-8/LC_MESSAGES/coreutils.mo",
O_RDONLY) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/share/locale/en_US.utf8/LC_MESSAGES/coreutils.mo",
O_RDONLY) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/share/locale/en_US/LC_MESSAGES/coreutils.mo",
O_RDONLY) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/share/locale/en.UTF-8/LC_MESSAGES/coreutils.mo",
O_RDONLY) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/share/locale/en.utf8/LC_MESSAGES/coreutils.mo",
O_RDONLY) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/share/locale/en/LC_MESSAGES/coreutils.mo",
O_RDONLY) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD,
"/usr/share/locale-langpack/en_US.UTF-8/LC_MESSAGES/coreutils.mo",
O_RDONLY) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD,
"/usr/share/locale-langpack/en_US.utf8/LC_MESSAGES/coreutils.mo", O_RDONLY)
= -1 ENOENT (No such file or directory)
openat(AT_FDCWD,
"/usr/share/locale-langpack/en_US/LC_MESSAGES/coreutils.mo", O_RDONLY) = -1
ENOENT (No such file or directory)
openat(AT_FDCWD,
"/usr/share/locale-langpack/en.UTF-8/LC_MESSAGES/coreutils.mo", O_RDONLY) =
-1 ENOENT (No such file or directory)
openat(AT_FDCWD,
"/usr/share/locale-langpack/en.utf8/LC_MESSAGES/coreutils.mo", O_RDONLY) = -1
ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/share/locale-langpack/en/LC_MESSAGES/coreutils.mo",
O_RDONLY) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=613, ...}) = 0
mmap(NULL, 613, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7efe2b9d9000
close(3) = 0
write(2, "cp: ", 4cp: ) = 4
write(2, "missing file operand", 20missing file operand) = 20
write(2, "\n", 1
) = 1
write(2, "Try 'cp --help' for more informa"..., 38Try 'cp --help' for more information.
) = 38
lseek(0, 0, SEEK_CUR) = -1 ESPIPE (Illegal seek)
close(0) = 0
close(1) = 0
close(2) = 0
exit_group(1) = ?
+++ exited with 1 +++

```

- **strace pwd:**

```

execve("/usr/bin/pwd", ["pwd"], 0x7ffda326f250 /* 58 vars */) = 0
brk(NULL) = 0x558090ca6000

```

```

arch_prctl(0x3001 /* ARCH_??? */, 0x7ffc06b5f0f0) = -1 EINVAL (Invalid argument)
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=73778, ...}) = 0
mmap(NULL, 73778, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7fd91eb25000
close(3) = 0
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\360q\2\0\0\0\0"... , 832) =
832
pread64(3, "\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0"... , 784,
64) = 784
pread64(3, "\4\0\0\0\20\0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0", 32,
848) = 32
pread64(3,
"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\t\233\222%\274\260\320\31\331\326\10\204\276X>\263"... , 68, 880) = 68
fstat(3, {st_mode=S_IFREG|0755, st_size=2029224, ...}) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7fd91eb23000
pread64(3, "\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0"... , 784,
64) = 784
pread64(3, "\4\0\0\0\20\0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0", 32,
848) = 32
pread64(3,
"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\t\233\222%\274\260\320\31\331\326\10\204\276X>\263"... , 68, 880) = 68
mmap(NULL, 2036952, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7fd91e931000
mprotect(0x7fd91e956000, 1847296, PROT_NONE) = 0
mmap(0x7fd91e956000, 1540096, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x25000) = 0x7fd91e956000
mmap(0x7fd91eace000, 303104, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x19d000) = 0x7fd91eace000
mmap(0x7fd91eb19000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e7000) = 0x7fd91eb19000
mmap(0x7fd91eb1f000, 13528, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7fd91eb1f000
close(3) = 0
arch_prctl(ARCH_SET_FS, 0x7fd91eb24580) = 0
mprotect(0x7fd91eb19000, 12288, PROT_READ) = 0
mprotect(0x55809002d000, 4096, PROT_READ) = 0
mprotect(0x7fd91eb65000, 4096, PROT_READ) = 0
munmap(0x7fd91eb25000, 73778) = 0
brk(NULL) = 0x558090ca6000
brk(0x558090cc7000) = 0x558090cc7000
openat(AT_FDCWD, "/usr/lib/locale/locale-archive", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=17469824, ...}) = 0
mmap(NULL, 17469824, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7fd91d887000

```

```

close(3)                = 0
getcwd("/boot", 4096)    = 6
fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0
write(1, "/boot\n", 6/boot
)                        = 6
close(1)                = 0
close(2)                = 0
exit_group(0)           = ?
+++ exited with 0 +++

```

6.

real: can be summarized as the total time the call takes. Real is the time passed between the beginning and the ending of the call. It also includes the interrupts such as input and output processes.

user: is the time that the CPU spent for the user interactions outside the OS or kernel.

sys: is the time that the CPU spent inside kernel or OS.

- Time required to execute some programs:

for "man cp" command:

```

real    0m6,923s
user    0m0,048s
sys     0m0,045s

```

for ls command:

```

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

```

for "mkdir berksaltuk" command:

```

real    0m0,002s
user    0m0,001s
sys     0m0,000s

```

7. Source code of list.c:

```
#include <stdlib.h>
```

```
#include <stdio.h>
```

```
#include <time.h>
```

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

```

struct listNode{
    int val;
    struct listNode *next;
};

```

```
struct listNode *head = NULL;
```

```

void addToHead(int val){
    struct listNode *newNode = (struct listNode*)malloc(sizeof(struct listNode));

    newNode->val = val;

    newNode->next = head;
    head = newNode;
}

void printList(){
    struct listNode* cur = head;

    while( cur != NULL){
        printf(" %d ", cur->val);
        cur = cur->next;
    }
}

void deallocateList(){

    while( head != NULL)
    {
        struct listNode *temp = head;
        head = head->next;
        free(temp);
    }
}

int main(){
    struct timeval beginning;
    struct timeval ending;
    srand(time(NULL));

    gettimeofday(&beginning, 0);

    for( int i = 0; i < 10000; i++)
    {
        addToHead(rand());
    }

    gettimeofday(&ending, 0);

    double timeTaken = ((ending.tv_sec-beginning.tv_sec) * 1000.0) + ((ending.tv_usec -
beginning.tv_usec) / 1000.0);
    printf("%f milliseconds passed for inserting 10000 integers.\n", timeTaken);
}

```

```
//printList();
deallocateList();

return 0;
}
```

Make file for list.c:

```
all: list.c
    gcc -g -Wall -o list list.c
clean:
    rm -fr list list.o *~
```

8. I have read the first two chapters of our mandatory textbook, and I am ready for lectures!

References

1. How to Install Ubuntu 20.04 LTS on VirtualBox in Windows 10?.

ProgrammingKnowledge. Youtube.

<https://www.youtube.com/watch?v=x5MhydjWmc&t=3s>

2. How to Reset Your Forgotten Password in Ubuntu 18.04 LTS?. TechMeSpot. Youtube.

<https://www.youtube.com/watch?v=yqL9IIWT2dw>