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1.
I chose to use a virtual machine because installing Linux on hardware required too much space for my computer. I chose to use Oracle VirtualBox over VMware because it is free and I used it before.I did not want any mistakes during set up,so I downloaded ubuntu and VB from their official websites and decided to go with default settings.Here is a list of the commands that I learned.

- pwd : prints your current directory
- ls : lists your work directory
- cd : changes your current directory
- cd .. : takes you back to the previous directory
- cd / : takes you to the root directory
- cp : used to copy files
- rm : used to remove files
- mkdir : used to create a new directory
- rmdir : used to remove a directory
- clear : clears the all terminal

2.Kernel executable file resides in /boot .And my version number is 5.4.0.47
3.Subdirectories**:**
- arch
- block
- certs
- crypto
- Documentation
- drivers
- fs
- include
- init ipc
- kernel
- lib
- LICENCES
- mm
- net
- samples
- scripts
- security
- sound
- tools
- usr
- virt

4.The pathname is
linux-5.4.66/arch/x86/entry/syscalls/syscall_64.tbl
5:fstat
43:accept
123:setfsgid

220:semtimedop

5.Sample output for strace ls :
execve("/bin/ls", ["ls"], 0x7ffc5ad81ff0 /* 61 vars */) = 0
brk(NULL)   = 0x55742609f000
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=84091, ...}) = 0
mmap(NULL, 84091, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f061fde8000
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) = 0x7f061fde6000
mmap(NULL, 2259152, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f061f9ae000
mprotect(0x7f061f9d3000, 2093056, PROT_NONE) = 0
mmap(0x7f061fbd2000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x24000) = 0x7f061fbd2000
mmap(0x7f061fbd4000, 6352, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f061fbd4000
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\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) = 0x7f061f5bd000
mprotect(0x7f061f7a4000, 2097152, PROT_NONE) = 0
mmap(0x7f061f9a4000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e7000) = 0x7f061f9a4000
mmap(0x7f061f9aa000, 15072, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f061f9aa000
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) = 0x7f061f34b000
mprotect(0x7f061f3bb000, 2097152, PROT_NONE) = 0
mmap(0x7f061f5bb000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x70000) = 0x7f061f5bb000

```
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) = 0x7f061f147000
mprotect(0x7f061f14a000, 2093056, PROT_NONE) = 0
mmap(0x7f061f349000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7f061f349000
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) = 0x7f061ef28000
mprotect(0x7f061ef42000, 2093056, PROT_NONE) = 0
mmap(0x7f061f141000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x19000) = 0x7f061f141000
mmap(0x7f061f143000, 13440, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f061f143000
close(3)                            = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1,
0) = 0x7f061fde4000
arch_prctl(ARCH_SET_FS, 0x7f061fde5040) = 0
mprotect(0x7f061f9a4000, 16384, PROT_READ) = 0
mprotect(0x7f061f141000, 4096, PROT_READ) = 0
mprotect(0x7f061f349000, 4096, PROT_READ) = 0
mprotect(0x7f061f5bb000, 4096, PROT_READ) = 0
mprotect(0x7f061fbd2000, 4096, PROT_READ) = 0
mprotect(0x557424b1a000, 8192, PROT_READ) = 0
mprotect(0x7f061fdfd000, 4096, PROT_READ) = 0
munmap(0x7f061fde8000, 84091)           = 0
set_tid_address(0x7f061fde5310)         = 10901
set_robust_list(0x7f061fde5320, 24)     = 0
rt_sigaction(SIGRTMIN, {sa_handler=0x7f061ef2dcb0, sa_mask=[],
sa_flags=SA_RESTORER|SA_SIGINFO, sa_restorer=0x7f061ef3a8a0}, NULL, 8) = 0
rt_sigaction(SIGRT_1, {sa_handler=0x7f061ef2dd50, sa_mask=[],
sa_flags=SA_RESTORER|SA_RESTART|SA_SIGINFO, sa_restorer=0x7f061ef3a8a0},
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", 0x7ffcc2328210) = -1 ENOENT (No such file or directory)
statfs("/selinux", 0x7ffcc2328210)      = -1 ENOENT (No such file or directory)
```

```
brk(NULL)                        = 0x55742609f000
brk(0x5574260c0000)              = 0x5574260c0000
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) = 0x7f061e3f7000
close(3)                         = 0
ioctl(1, TCGETS, {B38400 opost isig icanon echo ...}) = 0
ioctl(1, TIOCGWINSZ, {ws_row=22, ws_col=62, 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, /* 29 entries */, 32768)    = 1024
getdents(3, /* 0 entries */, 32768)     = 0
close(3)                         = 0
fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(136, 0), ...}) = 0
write(1, "Desktop    examples.desktop\tPict"..., 46Desktop    examples.desktop    Pictures
Videos
) = 46
write(1, "Documents  linux-4.19.9.tar.xz\tP"..., 38Documents  linux-4.19.9.tar.xz    Public
) = 38
write(1, "Downloads  Music\t\tTemplates\n", 28Downloads  MusicTemplates
) = 28
close(1)                         = 0
close(2)                         = 0
exit_group(0)                    = ?
+++ exited with 0 +++
```

6.
real time:time elapsed between the start and finish of the call
user time : cpu time spent in user mode
sys time: cpu time spent in kernel mode

```
 time cd Desktop
real    0m0,000s
user    0m0,000s
sys     0m0,000s


time ls
real    0m0,001s
user    0m0,001s
sys     0m0,000s
```

```
time strace ls
real    0m0,006s
user    0m0,001s
sys     0m0,003s
```

7.
My source code

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

struct Element
{
   int value;
   struct Element * next;

};
int main()
{
   long int before;
   long int next;
   long int before2;
   long int next2;
   struct timeval cur_time;
   struct Element * head = NULL;
   srand(time(0));
   gettimeofday(&cur_time, NULL);
   printf("Time before the insertion is \n seconds : %ld\nmicro seconds : %ld \n",before2 =
cur_time.tv_sec, before = cur_time.tv_usec);
for(int i = 0; i < 10000;i++)
{
        if(i == 0)
        {
          head = (struct Element*)malloc(sizeof(struct Element));
          head->value = rand()%10000;
        }
        else
        {
          struct Element * element = (struct Element*)malloc(sizeof(struct Element));
          element->value = rand()%10000;
          element->next = head;
          head = element;
```

```
        }
}
   gettimeofday(&cur_time, NULL);
   printf("Time after the insertion is \n seconds : %ld\nmicro seconds : %ld",next2 =
cur_time.tv_sec, next = cur_time.tv_usec);
   printf("\nTime elapsed to make insertion is \n");
   printf("%ld seconds and %ld miliseconds \n",next2-before2,next-before);
   return 0;
}
```