

Lab 1

Architecture: x86_64
Byte Order: Little Endian
Address sizes : 39 bits physical, 48 bits virtual
Socket(s): 1
Core(s) per socket: 4
CPU(s): 4
L1d cache: 32K
L1i cache: 32K
L2 cache: 256K
L3 cache: 6144K
MemTotal: 8066284 kB
MemFree: 2682220 kB
SwapTotal: 2097148 kB
SwapFree: 2097148 kB
Processes: 322 total, 1 running, 265 sleeping, 0 stopped, 0 zombie
Context Switches: 50889639

```
labuser@sl1-63:/proc$ cat meminfo
```

```
MemTotal:      8066284 kB
MemFree:       2100260 kB
MemAvailable:  4959640 kB
Buffers:       334408 kB
Cached:        2582184 kB
SwapCached:    0 kB
Active:        3630816 kB
Inactive:      1561628 kB
Active(anon):  2274388 kB
Inactive(anon): 124712 kB
Active(file):  1356428 kB
Inactive(file): 1436916 kB
Unevictable:   14000 kB
Mlocked:       14000 kB
SwapTotal:     2097148 kB
SwapFree:      2097148 kB
```

```
labuser@sl1-63:/proc$ lscpu
```

```
Architecture: x86_64
CPU op-mode(s): 32-bit, 64-bit
Byte Order: Little Endian
CPU(s): 4
On-line CPU(s) list: 0-3
Thread(s) per core: 1
Core(s) per socket: 4
Socket(s): 1
NUMA node(s): 1
Vendor ID: GenuineIntel
CPU family: 6
Model: 60
Model name: Intel(R) Core(TM) i5-4690 CPU @ 3.50GHz
Stepping: 3
CPU MHz: 2086.204
CPU max MHz: 3900.0000
CPU min MHz: 800.0000
BogoMIPS: 6983.82
Virtualization: VT-x
L1d cache: 32K
L1i cache: 32K
L2 cache: 256K
L3 cache: 6144K
```


Memory_2.c :

```
VmSize:    12212 kB
VmLck:      0 kB
VmPin:      0 kB
VmHWM:      724 kB
VmRSS:      724 kB
```

Memory_3.c :

```
VmSize:    8300 kB
VmLck:      0 kB
VmPin:      0 kB
VmHWM:     3240 kB
VmRSS:     3240 kB
```

Memory_4.c :

```
VmSize:    8300 kB
VmLck:      0 kB
VmPin:      0 kB
VmHWM:     5328 kB
VmRSS:     5328 kB
```

The second process uses more VmSize because the array size is 200000, while the others have array size 100000. The 3rd and 4th processes have more VmRSS cause there are more values stored in the arrays than in 1st and 2nd programs.

Q3.

```
labuser@sl1-63:/proc/5163$ ps -ef | grep subprocesses
labuser  5834  5446  0 16:23 pts/3    00:00:00 ./subprocesses 2000501
37
labuser  5835  5834  0 16:23 pts/3    00:00:00 ./subprocesses 2000501
37
labuser  5836  5834  0 16:23 pts/3    00:00:00 ./subprocesses 2000501
37
labuser  5837  5834  0 16:23 pts/3    00:00:00 ./subprocesses 2000501
37
labuser  5843  1358  0 16:23 pts/1    00:00:00 grep --color=auto subp
rocesses
labuser@sl1-63:/proc/5163$ pstree 5834
subprocesses—3*[subprocesses]
labuser@sl1-63:/proc/5163$
```

We first found the PID of the process and then used pstree to obtain the subprocesses corresponding to the PID.

Q4.

The different lines represent the system calls made during the execution of the process.

Empty.c

13 different system calls.

```
labuser@sl1-63:~/Downloads/lab1/lab1$ strace ./empty
execve("./empty", [ "./empty" ], 0x7ffd076ccd10 /* 60 vars */) = 0
brk(NULL) = 0xf57000
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=157926, ...}) = 0
mmap(NULL, 157926, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f0c41484000
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\0\1\0\0\0\240\35\2\0\0\0\0"... , 832) = 832
fstat(3, {st_mode=S_IFREG|0755, st_size=2030928, ...}) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f0c41482000
mmap(NULL, 4131552, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f0c40e91000
mprotect(0x7f0c41078000, 2097152, PROT_NONE) = 0
mmap(0x7f0c41278000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e7000) = 0x7f0c41278000
mmap(0x7f0c4127e000, 15072, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f0c4127e000
close(3) = 0
arch_prctl(ARCH_SET_FS, 0x7f0c414834c0) = 0
mprotect(0x7f0c41278000, 16384, PROT_READ) = 0
mprotect(0x600000, 4096, PROT_READ) = 0
mprotect(0x7f0c414ab000, 4096, PROT_READ) = 0
munmap(0x7f0c41484000, 157926) = 0
exit_group(0) = ?
+++ exited with 0 +++
```

Hello.c

16 system calls.

```
labuser@sl1-63:~/Downloads/lab1/lab1/strace$ strace ./hello
execve("./hello", ["/hello"], 0x7fffa436d1b0 /* 60 vars */) = 0
brk(NULL)                               = 0x201f000
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=157926, ...}) = 0
mmap(NULL, 157926, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f35f26b6000
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\240\35\2\0\0\0\0"... , 832) = 832
fstat(3, {st_mode=S_IFREG|0755, st_size=2030928, ...}) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f35f26b4000
mmap(NULL, 4131552, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f35f20c3000
mprotect(0x7f35f22aa000, 2097152, PROT_NONE) = 0
mmap(0x7f35f24aa000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e7000) = 0x7f35f24aa000
mmap(0x7f35f24b0000, 15072, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f35f24b0000
close(3)                                = 0
arch_prctl(ARCH_SET_FS, 0x7f35f26b5500) = 0
mprotect(0x7f35f24aa000, 16384, PROT_READ) = 0
mprotect(0x600000, 4096, PROT_READ)    = 0
mprotect(0x7f35f26dd000, 4096, PROT_READ) = 0
munmap(0x7f35f26b6000, 157926)         = 0
getpid()                               = 7415

getpid()                               = 7415
fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(136, 3), ...}) = 0
brk(NULL)                               = 0x201f000
brk(0x20400000)                         = 0x20400000
write(1, "\n", 1
)                                         = 1
write(1, "Process ID : 7415 \n", 19Process ID : 7415
)                                         = 19
write(1, "\n", 1
)                                         = 1
fstat(0, {st_mode=S_IFCHR|0620, st_rdev=makedev(136, 3), ...}) = 0
write(1, "Enter your name : ", 18Enter your name : ) = 18
read(0, 2
"2\n", 1024)                             = 2
write(1, "\n", 1
)                                         = 1
write(1, "Welcome 2\n", 10Welcome 2
)                                         = 10
lseek(0, -1, SEEK_CUR)                  = -1 ESPIPE (Illegal seek)
exit_group(0)                           = ?
+++ exited with 0 +++
labuser@sl1-63:~/Downloads/lab1/lab1/strace$
```

Most of the system calls are same for the two processes except the 'write' system call that is there in the hello.c strace.

Q5.

There were 6 files opened by the program : 0,1,2,3,4,5.

```

labuser@sl1-63:/proc$ ps -ef | grep openfiles
labuser  7783  7759  0 16:50 pts/3    00:00:00 ./openfiles
labuser  7841  1358  0 16:51 pts/1    00:00:00 grep --color=auto open
files
labuser@sl1-63:/proc$ cd 7783
labuser@sl1-63:/proc/7783$ ls
attr          fdinfo        numa_maps     smaps
autogroup     gid_map       oom_adj       smaps_rollup
auxv          io            oom_score     stack
cgroup        limits        oom_score_adj stat
clear_refs    loginuid      pagemap       statm
cmdline       map_files     patch_state   status
comm          maps          personality    syscall
coredump_filter mem           projid_map    task
cpuset        mountinfo     root          timers
cwd           mounts        sched          timerslack_ns
environ       mountstats    schedstat     uid_map
exe           net           sessionid     wchan
fd            ns            setgroups
labuser@sl1-63:/proc/7783$ cd fd
labuser@sl1-63:/proc/7783/fd$ ls
0  1  2  3  4  5
labuser@sl1-63:/proc/7783/fd$ █

```

Object Files

```

2000 01000200 50617373 776f7264 31323300 ....Password123.
2010 436f7272 65637421 00496e63 6f727265 Correct!.Incorre
2020 63742e20 3a280a29 00          ct. :(.).
poojan@poojan:~/Downloads/lab1/lab1/object$ ./password.out Password123
Correct!
poojan@poojan:~/Downloads/lab1/lab1/object$ ./password.out Password12
Incorrect. :(
)poojan@poojan:~/Downloads/lab1/lab1/object$ █

```

Password : Password123