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Институт №8 “Компьютерные науки и прикладная математика”
Кафедра №806 “Вычислительная математика и программирование”

Лабораторная работа №5 по курсу
«Операционные системы»

Группа: М8О-209БВ-24

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Оценка: _____

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Постановка задачи

Цель работы

Приобретение практических навыков диагностики работы программного обеспечения.

Задание

Продемонстрировать ключевые системные вызовы, которые используются в лабораторных работах и то, что их использование соответствует варианту ЛР.

Общий метод и алгоритм решения

Для демонстрации системных вызовов будем использовать утилиту strace в операционной системе linux. Strace — это диагностическая, отладочная и обучающая утилита пользовательского пространства для Linux. Она используется для мониторинга и вмешательства во взаимодействия между процессами и ядром Linux, включая системные вызовы, доставку сигналов и изменение состояния процесса. Наиболее часто он используется для запуска программы и вывода списка системных вызовов, которые она выполняет. Это особенно полезно, когда программа часто аварийно завершает работу или ведет себя непредсказуемо.

Также в strace с помощью флагов можно вывести дополнительные данные:

- f – отслеживает дочерние процессы, если они будут созданы,
- r - выводить временную метку для каждого системного вызова,
- T - выводит длительность выполнения системного вызова

Протокол работы программы

Лабораторная работа №1

```
mmap(0x7a1528979000, 13952, PROT_READ|PROT_WRITE,  
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7a1528979000  
close(3) = 0  
arch_prctl(ARCH_SET_FS, 0x7a152897e540) = 0  
mprotect(0x7a1528973000, 16384, PROT_READ) = 0  
mprotect(0x63474562c000, 4096, PROT_READ) = 0  
mprotect(0x7a15289af000, 4096, PROT_READ) = 0  
munmap(0x7a152897f000, 21784) = 0  
pipe([3, 4]) = 0  
fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0  
brk(NULL) = 0x6347694a8000  
brk(0x6347694c9000) = 0x6347694c9000  
fstat(0, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0  
write(1, "\321\204\320\260\320\271\320\273:", 9 файл:) = 9  
read(0, input.txt  
"input.txt\n", 1024) = 10  
clone(child_stack=NULL,  
flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,  
child_tidptr=0x7a152897e810) = 1616  
close(4) = 0  
read(3, "44\n6\n", 255) = 5  
read(3, "", 250) = 0  
write(1, "44\n6\n", 544  
6  
) = 5  
close(3) = 0  
wait4(-1, NULL, 0, NULL) = 1616  
--- SIGCHLD {si_signo=SIGHLD, si_code=CLD_EXITED, si_pid=1616,  
si_uid=1000, si_status=0, si_utime=0, si_stime=0} ---  
lseek(0, -1, SEEK_CUR) = -1 ESPIPE (Illegal seek)  
exit_group(0) = ?  
+++ exited with 0 +++  
Лабораторная работа № 2  
strace -f ./lab2 -t 8 -n 999999999  
execve("./lab2", ["./lab2", "-t", "8", "-n", "999999999"], 0x7ffdb1efb978 /* 29 vars */) =
```

Лабораторная работа № 2

brk(0x5f6f4cb8c000) = 0x5f6f4cb8c000
mmap(NULL, 8392704, PROT_NONE,
MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) = 0x75ec3ae86000
mprotect(0x75ec3ae87000, 8388608, PROT_READ|PROT_WRITE) = 0
clone(child_stack=0x75ec3b685fb0,
flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREADS|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID
strace: Process 12694 attached
, parent_tid=[12694], tls=0x75ec3b686700, child_tidptr=0x75ec3b6869d0) = 12694
[pid 12694] set_robust_list(0x75ec3b6869e0, 24 <unfinished ...>
[pid 12693] mmap(NULL, 8392704, PROT_NONE,
MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0 <unfinished ...>
[pid 12694] <... set_robust_list resumed>) = 0
[pid 12693] <... mmap resumed> = 0x75ec3a685000
[pid 12693] mprotect(0x75ec3a686000, 8388608, PROT_READ|PROT_WRITE) = 0
[pid 12693] clone(child_stack=0x75ec3ae84fb0,
flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREADS|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID
strace: Process 12695 attached
, parent_tid=[12695], tls=0x75ec3ae85700, child_tidptr=0x75ec3ae859d0) = 12695
[pid 12695] set_robust_list(0x75ec3ae859e0, 24 <unfinished ...>
[pid 12693] mmap(NULL, 8392704, PROT_NONE,
MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0 <unfinished ...>
[pid 12695] <... set_robust_list resumed>) = 0
[pid 12693] <... mmap resumed> = 0x75ec39e84000
[pid 12693] mprotect(0x75ec39e85000, 8388608, PROT_READ|PROT_WRITE) = 0
[pid 12693] clone(child_stack=0x75ec3a683fb0,
flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREADS|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID
strace: Process 12696 attached
, parent_tid=[12696], tls=0x75ec3a684700, child_tidptr=0x75ec3a6849d0) = 12696
[pid 12696] set_robust_list(0x75ec3a6849e0, 24 <unfinished ...>
[pid 12693] mmap(NULL, 8392704, PROT_NONE,
MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0 <unfinished ...>
[pid 12696] <... set_robust_list resumed>) = 0
[pid 12693] <... mmap resumed> = 0x75ec39683000
[pid 12693] mprotect(0x75ec39684000, 8388608, PROT_READ|PROT_WRITE) = 0
[pid 12693] clone(child_stack=0x75ec39e82fb0,
flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREADS|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID
strace: Process 12697 attached
, parent_tid=[12697], tls=0x75ec39e83700, child_tidptr=0x75ec39e839d0) = 12697
[pid 12697] set_robust_list(0x75ec39e839e0, 24 <unfinished ...>
[pid 12693] mmap(NULL, 8392704, PROT_NONE,
MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0 <unfinished ...>
[pid 12697] <... set_robust_list resumed>) = 0
[pid 12693] <... mmap resumed> = 0x75ec38e82000

[pid 12693] mprotect(0x75ec38e83000, 8388608, PROT_READ|PROT_WRITE) = 0
[pid 12693] clone(child_stack=0x75ec39681fb0,
flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREADS|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID
strace: Process 12698 attached
, parent_tid=[12698], tls=0x75ec39682700, child_tidptr=0x75ec396829d0) = 12698
[pid 12698] set_robust_list(0x75ec396829e0, 24 <unfinished ...>
[pid 12693] mmap(NULL, 8392704, PROT_NONE,
MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0 <unfinished ...>
[pid 12698] <... set_robust_list resumed>) = 0
[pid 12693] <... mmap resumed> = 0x75ec38681000
[pid 12693] mprotect(0x75ec38682000, 8388608, PROT_READ|PROT_WRITE) = 0
[pid 12693] clone(child_stack=0x75ec38e80fb0,
flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREADS|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID
strace: Process 12699 attached
, parent_tid=[12699], tls=0x75ec38e81700, child_tidptr=0x75ec38e819d0) = 12699
[pid 12693] mmap(NULL, 8392704, PROT_NONE,
MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0 <unfinished ...>
[pid 12699] set_robust_list(0x75ec38e819e0, 24 <unfinished ...>
[pid 12693] <... mmap resumed> = 0x75ec37e80000
[pid 12699] <... set_robust_list resumed>) = 0
[pid 12693] mprotect(0x75ec37e81000, 8388608, PROT_READ|PROT_WRITE) = 0
[pid 12693] clone(child_stack=0x75ec3867ffb0,
flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREADS|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID
strace: Process 12700 attached
, parent_tid=[12700], tls=0x75ec38680700, child_tidptr=0x75ec386809d0) = 12700
[pid 12700] set_robust_list(0x75ec386809e0, 24 <unfinished ...>
[pid 12693] mmap(NULL, 8392704, PROT_NONE,
MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0 <unfinished ...>
[pid 12700] <... set_robust_list resumed>) = 0
[pid 12693] <... mmap resumed> = 0x75ec3767f000
[pid 12693] mprotect(0x75ec37680000, 8388608, PROT_READ|PROT_WRITE) = 0
[pid 12693] clone(child_stack=0x75ec37e7efb0,
flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREADS|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID
strace: Process 12701 attached
, parent_tid=[12701], tls=0x75ec37e7f700, child_tidptr=0x75ec37e7f9d0) = 12701
[pid 12701] set_robust_list(0x75ec37e7f9e0, 24 <unfinished ...>
[pid 12693] futex(0x75ec3b6869d0, FUTEX_WAIT, 12694, NULL <unfinished ...>
[pid 12701] <... set_robust_list resumed>) = 0
[pid 12698] madvise(0x75ec38e82000, 8368128, MADV_DONTNEED) = 0
[pid 12698] exit(0) = ?
[pid 12698] +++ exited with 0 +++
[pid 12700] madvise(0x75ec37e80000, 8368128, MADV_DONTNEED) = 0
[pid 12700] exit(0) = ?

```
[pid 12700] +++ exited with 0 +++
[pid 12694] madvise(0x75ec3ae86000, 8368128, MADV_DONTNEED) = 0
[pid 12694] exit(0)      = ?
[pid 12693] <... futex resumed> = 0
[pid 12694] +++ exited with 0 +++
[pid 12693] futex(0x75ec3ae859d0, FUTEX_WAIT, 12695, NULL <unfinished ...>
[pid 12695] madvise(0x75ec3a685000, 8368128, MADV_DONTNEED) = 0
[pid 12695] exit(0)      = ?
[pid 12693] <... futex resumed> = 0
[pid 12695] +++ exited with 0 +++
[pid 12693] futex(0x75ec3a6849d0, FUTEX_WAIT, 12696, NULL <unfinished ...>
[pid 12697] madvise(0x75ec39683000, 8368128, MADV_DONTNEED) = 0
[pid 12697] exit(0)      = ?
[pid 12697] +++ exited with 0 +++
[pid 12696] madvise(0x75ec39e84000, 8368128, MADV_DONTNEED) = 0
[pid 12696] exit(0)      = ?
[pid 12693] <... futex resumed> = 0
[pid 12696] +++ exited with 0 +++
[pid 12693] munmap(0x75ec3ae86000, 8392704) = 0
[pid 12693] futex(0x75ec38e819d0, FUTEX_WAIT, 12699, NULL <unfinished ...>
[pid 12699] madvise(0x75ec38681000, 8368128, MADV_DONTNEED) = 0
[pid 12699] exit(0)      = ?
[pid 12693] <... futex resumed> = 0
[pid 12699] +++ exited with 0 +++
[pid 12693] munmap(0x75ec3a685000, 8392704) = 0
[pid 12693] munmap(0x75ec39e84000, 8392704) = 0
[pid 12693] futex(0x75ec37e7f9d0, FUTEX_WAIT, 12701, NULL <unfinished ...>
[pid 12701] madvise(0x75ec3767f000, 8368128, MADV_DONTNEED) = 0
[pid 12701] exit(0)      = ?
[pid 12693] <... futex resumed> = 0
[pid 12701] +++ exited with 0 +++
munmap(0x75ec39683000, 8392704) = 0
fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0x2), ...}) = 0
write(1, "\320\237\320\276\321\202\320\276\320\272\320\276\320\262: 8\n",
     8\n",
18Потоков: 8
) = 18
write(1, "\320\240\320\260\321\203\320\275\320\264\320\276\320\262: 999999999\n",
26Раундов: 99999999
) = 26
write(1,
"\320\222\320\265\321\200\320\276\321\217\321\202\320\275\320\276\321\201\321\202\32
1\214 \321\201\320\276\320\262\320\277\320"..., 54Вероятность совпадения: 0.058809
) = 54
write(1,
"\320\222\321\200\320\265\320\274\321\217
\320\262\321\213\320\277\320\276\320\273\320\275\320\265\320\275\320\270\321\217:"...,
```

49Время выполнения: 2.852213 сек
) = 49

mmap(0x7dd0d8003000, 65536, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x6000) = 0x7dd0d8003000
mmap(0x7dd0d8013000, 24576, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x16000) = 0x7dd0d8013000
mmap(0x7dd0d8019000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1b000) = 0x7dd0d8019000
mmap(0x7dd0d801b000, 13424, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7dd0d801b000
close(3) = 0
mmap(NULL, 12288, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7dd0d7ffa000
arch_prctl(ARCH_SET_FS, 0x7dd0d7ffa740) = 0
mprotect(0x7dd0d81e9000, 16384, PROT_READ) = 0
mprotect(0x7dd0d8019000, 4096, PROT_READ) = 0
mprotect(0x7dd0d81fb000, 4096, PROT_READ) = 0
mprotect(0x5705da866000, 4096, PROT_READ) = 0
mprotect(0x7dd0d822f000, 4096, PROT_READ) = 0
munmap(0x7dd0d81ff000, 21784) = 0
set_tid_address(0x7dd0d7ffaa10) = 5772
set_robust_list(0x7dd0d7ffaa20, 24) = 0
rt_sigaction(SIGRTMIN, {sa_handler=0x7dd0d8003690, sa_mask=[],
sa_flags=SA_RESTORER|SA_SIGINFO, sa_restorer=0x7dd0d8010140}, NULL, 8) = 0
rt_sigaction(SIGRT_1, {sa_handler=0x7dd0d8003730, sa_mask=[],
sa_flags=SA_RESTORER|SA_RESTART|SA_SIGINFO, sa_restorer=0x7dd0d8010140},
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
fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0
brk(NULL) = 0x57060324d000
brk(0x57060326e000) = 0x57060326e000
fstat(0, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0
write(1, "\321\204\320\260\320\271\320\273:", 10файл:) = 10
read(0, inpput.txt
"inpput.txt\n", 1024) = 11
statfs("/dev/shm/", {f_type=TMPFS_MAGIC, f_bsize=4096, f_blocks=16384,
f_bfree=16384, f_bavail=16384, f_files=973465, f_ffree=973464, f_fsid={val=[969116940,
50866251]}, f_namelen=255, f_frsize=4096,
f_flags=ST_VALID|ST_NOSUID|ST_NODEV|ST_NOEXEC|ST_RELATIME}) = 0
futex(0x7dd0d801e410, FUTEX_WAKE_PRIVATE, 2147483647) = 0
openat(AT_FDCWD, "/dev/shm/prime_shm",
O_RDWR|O_CREAT|O_NOFOLLOW|O_CLOEXEC, 0666) = 3
ftruncate(3, 1024) = 0
mmap(NULL, 1024, PROT_READ|PROT_WRITE, MAP_SHARED, 3, 0) =
0x7dd0d822e000


```

[pid 5858] +++ exited with 1 +++
<... wait4 resumed>NULL, 0, NULL)      = 5858
--- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=5858,
si_uid=1000, si_status=1, si_utime=0, si_stime=1} ---
write(1,
"\\"320\240\320\265\320\267\321\203\320\273\321\214\321\202\320\260\321\202
\320\276\321\202  \320\264\320\276\321\207\320\265"..., 61Результат от дочернего
процесса:
) = 61
munmap(0x7dd0d822e000, 1024)      = 0
close(3)                          = 0
unlink("/dev/shm/prime_shm")       = 0
lseek(0, -1, SEEK_CUR)            = -1 ESPIPE (Illegal seek)
exit_group(0)                     = ?
+++ exited with 0 +++

```

Лабораторная работа №4

Static.c

```

vscode → /workspaces/OS_LABS/lab4/src (main) $ strace -f ./static
execve("./static", ["../static"], 0x7ffe58c101c8 /* 33 vars */) = 0
brk(NULL)                         = 0x6096b9ea2000
access("/etc/ld.so.preload", R_OK)  = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "./tls/x86_64/x86_64/lib1.so", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
openat(AT_FDCWD, "./tls/x86_64/lib1.so", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
openat(AT_FDCWD, "./tls/x86_64/lib1.so", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
openat(AT_FDCWD, "./tls/lib1.so", O_RDONLY|O_CLOEXEC) = -1 ENOENT (No
such file or directory)
openat(AT_FDCWD, "./x86_64/x86_64/lib1.so", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
openat(AT_FDCWD, "./x86_64/lib1.so", O_RDONLY|O_CLOEXEC) = -1 ENOENT
(No such file or directory)
openat(AT_FDCWD, "./x86_64/lib1.so", O_RDONLY|O_CLOEXEC) = -1 ENOENT
(No such file or directory)
openat(AT_FDCWD, "./lib1.so", 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\20\0\0\0\0\0\0"..., 832) =
832
fstat(3, {st_mode=S_IFREG|0755, st_size=15992, ...}) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7e066cb55000
getcwd("/workspaces/OS_LABS/lab4/src", 128) = 29
mmap(NULL, 16432, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7e066cb50000
mmap(0x7e066cb51000, 4096, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x7e066cb51000

```



```

mmap(NULL, 1323280, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7e066c832000
    mmap(0x7e066c83f000,           630784,          PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xd000) = 0x7e066c83f000
    mmap(0x7e066c8d9000,           634880,          PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xa7000) = 0x7e066c8d9000
    mmap(0x7e066c974000,           8192,            PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x141000) = 0x7e066c974000
close(3)                      = 0
mmap(NULL,           12288,          PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7e066c82f000
arch_prctl(ARCH_SET_FS, 0x7e066c82f740) = 0
mprotect(0x7e066cb40000, 16384, PROT_READ) = 0
mprotect(0x7e066c974000, 4096, PROT_READ) = 0
mprotect(0x7e066cb53000, 4096, PROT_READ) = 0
mprotect(0x6096a45f7000, 4096, PROT_READ) = 0
mprotect(0x7e066cb81000, 4096, PROT_READ) = 0
munmap(0x7e066cb4a000, 21784)      = 0
fstat(0, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0x1), ...}) = 0
brk(NULL)                      = 0x6096b9ea2000
brk(0x6096b9ec3000)            = 0x6096b9ec3000
read(0, 1 100
"1 100\n", 1024)      = 6
fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0x1), ...}) = 0
write(1, "Pi = 3.131593\n", 14Pi = 3.131593
)      = 14
read(0, 2 100
"2 100\n", 1024)      = 6
write(1, "E = 2.704811\n", 13E = 2.704811
)      = 13
read(0, -1
"-1\n", 1024)      = 3
write(1, "Exit\n", 5Exit
)      = 5
lseek(0, -1, SEEK_CUR)        = -1 ESPIPE (Illegal seek)
exit_group(0)                = ?
+++ exited with 0 +++
Dynamic.c
vscode → /workspaces/OS_LABS/lab4/src (main) $ strace -f ./dynamic
execve("./dynamic", ["/./dynamic"], 0x7ffc04713d18 /* 33 vars */) = 0
brk(NULL)                      = 0x5766ac0d0000
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=21784, ...}) = 0
mmap(NULL, 21784, PROT_READ, MAP_PRIVATE, 3, 0) = 0x79ea0d520000
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\0\3\0>\0\1\0\0\0000\21\0\0\0\0\0\0"..., 832) =
832
fstat(3, {st_mode=S_IFREG|0644, st_size=18688, ...}) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x79ea0d51e000
mmap(NULL, 20752, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x79ea0d518000
mmap(0x79ea0d519000, 8192, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x79ea0d519000
mmap(0x79ea0d51b000, 4096, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x3000) = 0x79ea0d51b000
mmap(0x79ea0d51c000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x3000) = 0x79ea0d51c000
close(3) = 0
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) =
3
read(3, "\177ELF\2\1\3\0\0\0\0\0\0\0\3\0>\0\1\0\0\260>\2\0\0\0\0"..., 832) = 832
fstat(3, {st_mode=S_IFREG|0755, st_size=1901536, ...}) = 0
mmap(NULL, 1914496, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x79ea0d344000
mmap(0x79ea0d366000, 1413120, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x22000) = 0x79ea0d366000
mmap(0x79ea0d4bf000, 323584, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x17b000) = 0x79ea0d4bf000
mmap(0x79ea0d50e000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1c9000) = 0x79ea0d50e000
mmap(0x79ea0d514000, 13952, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x79ea0d514000
close(3) = 0
mmap(NULL, 12288, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x79ea0d341000
arch_prctl(ARCH_SET_FS, 0x79ea0d341740) = 0
mprotect(0x79ea0d50e000, 16384, PROT_READ) = 0
mprotect(0x79ea0d51c000, 4096, PROT_READ) = 0
mprotect(0x576693e61000, 4096, PROT_READ) = 0
mprotect(0x79ea0d550000, 4096, PROT_READ) = 0
munmap(0x79ea0d520000, 21784) = 0
brk(NULL) = 0x5766ac0d0000
brk(0x5766ac0f1000) = 0x5766ac0f1000
openat(AT_FDCWD, "./lib1.so", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\3\0>\0\1\0\0\0P\20\0\0\0\0\0\0"..., 832) =
832
fstat(3, {st_mode=S_IFREG|0755, st_size=15992, ...}) = 0
getcwd("/workspaces/OS_LABS/lab4/src", 128) = 29

```



```
mmap(0x79ea0d522000,           4096,          PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x79ea0d522000
mmap(0x79ea0d523000,           4096,          PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x79ea0d523000
mmap(0x79ea0d524000,           8192,          PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x79ea0d524000
close(3)                      = 0
mprotect(0x79ea0d524000, 4096, PROT_READ) = 0
write(1, "Library swapped\n", 16Library swapped
)    = 16
read(0, 1 100
"1 100\n", 1024)      = 6
write(1, "Pi = 3.133788\n", 14Pi = 3.133788
)    = 14
read(0, -1
"-1\n", 1024)      = 3
write(1, "Exit\n", 5Exit
)    = 5
munmap(0x79ea0d521000, 16424)    = 0
lseek(0, -1, SEEK_CUR)      = -1 ESPIPE (Illegal seek)
exit_group(0)                = ?
+++ exited with 0 +++
```

Вывод

В ходе выполнения лабораторной работы были получены навыки по диагностике работы программного обеспечения. Это было рассмотрено на примере команды strace. Полученные навыки помогают лучше понять, как программы взаимодействуют с операционной системой.