Московский Авиационный Институт

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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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Постановка задачи

Приобретение практических навыков диагностики работы программного обеспечения. Необходимо продемонстрировать ключевые системные вызовы, которые в них используются и то, что их использование соответствует варианту ЛР.

Общий метод и алгоритм решения

Для анализа системных вызовов в ходе лабораторной работы применялась утилита strace в среде Linux. Данный инструмент относится к категории диагностических средств и предназначен для детального отслеживания взаимодействия пользовательских процессов с ядром операционной системы. Его основная функция заключается в перехвате и регистрации системных вызовов, осуществляемых целевой программой, а также в фиксации поступающих к ней сигналов. Такой подход позволяет исследовать низкоуровневое поведение приложений, выявлять причины аварийного завершения, диагностировать проблемы производительности и анализировать логику работы программ.

Принцип действия strace основан на использовании системного вызова ptrace, который предоставляет механизм для наблюдения и управления выполнением другого процесса. Утилита запускает целевую программу в режиме трассировки, перехватывая каждый её запрос к ядру до его фактического выполнения.

Ключевые функциональные возможности strace:

1. Полная трассировка вызовов — запись всех обращений программы к ядру (открытие файлов, чтение/запись, управление процессами, сетевые операции)
2. Детализация параметров — отображение аргументов, передаваемых в каждый системный вызов
3. Контроль результата — фиксация возвращаемых значений, включая коды ошибок
4. Мониторинг сигналов — отслеживание сигналов, отправляемых процессу

Основные ключи командной строки:

`-f` — трассировка дочерних процессов (fork, clone)
`-e trace=<категория>` — фильтрация по типам вызовов (например, file, network, process)
`-c` — сводная статистика по завершении работы
`-T` — вывод времени выполнения каждого вызова
`-s` — ограничение на длину выводимых строк
`-o <файл>` — перенаправление вывода в файл
`-p <PID>` — подключение к уже запущенному процессу

Утилита в основном используется для диагностики ошибок ("Permission denied" или "File not found"), анализа сетевой активности приложения, исследования зависимостей от разделяемых библиотек, профилирования производительности и отладки аварийно-завершающихся программ.

В рамках лабораторной работы strace позволила наглядно проанализировать последовательность системных вызовов, понять, какие ресурсы операционной системы использует программа, и выявить потенциальные проблемы в её взаимодействии с окружением.

Проткол работы программы

Лабораторная работа №1

```
execve("./main", ["./main"], 0x7ffd996ab720 /* 26 vars */) = 0
brk(NULL)                               = 0x5f911eaee000
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1,
0) = 0x79f62ae8f000
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=20155, ...}) = 0
mmap(NULL, 20155, PROT_READ, MAP_PRIVATE, 3, 0) = 0x79f62ae8a000
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\0\3\0>\0\1\0\0\0\220\243\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
fstat(3, {st_mode=S_IFREG|0755, st_size=2125328, ...}) = 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
mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x79f62ac00000
mmap(0x79f62ac28000, 1605632, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x79f62ac28000
mmap(0x79f62adb0000, 323584, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1b0000) = 0x79f62adb0000
mmap(0x79f62adff000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000) = 0x79f62adff000
mmap(0x79f62ae05000, 52624, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x79f62ae05000
close(3)                                = 0
mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1,
0) = 0x79f62ae87000
arch_prctl(ARCH_SET_FS, 0x79f62ae87740) = 0
set_tid_address(0x79f62ae87a10)         = 535
set_robust_list(0x79f62ae87a20, 24)     = 0
rseq(0x79f62ae88060, 0x20, 0, 0x53053053) = 0
mprotect(0x79f62adff000, 16384, PROT_READ) = 0
mprotect(0x5f90ea454000, 4096, PROT_READ) = 0
mprotect(0x79f62aec7000, 8192, PROT_READ) = 0
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
rlim_max=RLIM64_INFINITY}) = 0
munmap(0x79f62ae8a000, 20155)           = 0
pipe2([3, 4], 0)                        = 0
pipe2([5, 6], 0)                        = 0
fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0
getrandom("\x4a\x96\x3c\x2a\xc0\x3e\xb8\x69", 8, GRND_NONBLOCK) = 8
brk(NULL)                               = 0x5f911eaee000
brk(0x5f911eb0f000)                     = 0x5f911eb0f000
fstat(0, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0
```

```
write(1, "\320\222\320\262\320\265\320\264\320\270\321\202\320\265
\320\270\320\274\321\217 \321\204\320\260\320\271\320\273\320\260"...,
48Введите имя файла для child1: ) = 48
read(0, short.txt
"short.txt\n", 1024)            = 10
write(1, "\320\222\320\262\320\265\320\264\320\270\321\202\320\265
\320\270\320\274\321\217 \321\204\320\260\320\271\320\273\320\260"...,
48Введите имя файла для child2: ) = 48
read(0, long.txt
"long.txt\n", 1024)             = 9
clone(child_stack=NULL,
flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,
child_tidptr=0x79f62ae87a10) = 539
clone(child_stack=NULL,
flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,
child_tidptr=0x79f62ae87a10) = 540
close(3)                                = 0
close(5)                                = 0
write(1, "\320\222\320\262\320\265\320\264\320\270\321\202\320\265
\321\201\321\202\321\200\320\276\320\272\320\270 (exi"..., 64Введите
строки (exit для завершения):
) = 64
read(0, cat
"cat\n", 1024)                  = 4
write(4, "cat\n", 4)                    = 4
read(0, meowmeowmeowmeow
"meowmeowmeowmeow\n", 1024)     = 17
write(6, "meowmeowmeowmeow\n", 17)      = 17
read(0, dogdog
"dogdog\n", 1024)               = 7
write(4, "dogdog\n", 7)                 = 7
read(0, exit
"exit\n", 1024)                 = 5
close(4)                                = 0
close(6)                                = 0
wait4(-1, NULL, 0, NULL)                = 539
--- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=539,
si_uid=1000, si_status=0, si_utime=0, si_stime=0} ---
wait4(-1, NULL, 0, NULL)                = 540
write(1,
"\320\240\320\276\320\264\320\270\321\202\320\265\320\273\321\214
\320\267\320\260\320\262\320\265\321\200\321\210\320\270\320"...,
48Родитель завершил работу.
) = 48
exit_group(0)                           = ?
+++ exited with 0 +++
```

Лабораторная работа №2

```
execve("./main", ["./main", "2", "5", "5", "2", "1"], 0x7ffd67d2dd88
/* 26 vars */) = 0
brk(NULL)                               = 0x61f351ed5000
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1,
0) = 0x7c4ee7999000
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=32319, ...}) = 0
mmap(NULL, 32319, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7c4ee7991000
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\0\3\0>\0\1\0\0\0\220\243\2\0\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
fstat(3, {st_mode=S_IFREG|0755, st_size=2125328, ...}) = 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
mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7c4ee7600000
mmap(0x7c4ee7628000, 1605632, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7c4ee7628000
mmap(0x7c4ee77b0000, 323584, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1b0000) = 0x7c4ee77b0000
mmap(0x7c4ee77ff000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000) = 0x7c4ee77ff000
mmap(0x7c4ee7805000, 52624, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7c4ee7805000
close(3)                                = 0
mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1,
0) = 0x7c4ee798e000
arch_prctl(ARCH_SET_FS, 0x7c4ee798e740) = 0
set_tid_address(0x7c4ee798ea10)         = 1542
set_robust_list(0x7c4ee798ea20, 24)     = 0
rseq(0x7c4ee798f060, 0x20, 0, 0x53053053) = 0
mprotect(0x7c4ee77ff000, 16384, PROT_READ) = 0
mprotect(0x61f34c568000, 4096, PROT_READ) = 0
mprotect(0x7c4ee79d1000, 8192, PROT_READ) = 0
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
rlim_max=RLIM64_INFINITY}) = 0
munmap(0x7c4ee7991000, 32319)           = 0
getrandom("\x48\x17\x2d\x65\x6b\xb0\xf3\xdc", 8, GRND_NONBLOCK) = 8
brk(NULL)                               = 0x61f351ed5000
brk(0x61f351ef6000)                     = 0x61f351ef6000
fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0
write(1,
"\320\230\321\201\321\205\320\276\320\264\320\275\320\260\321\217
\320\274\320\260\321\202\321\200\320\270\321\206\320\260:"...,
33Исходная матрица:
) = 33
write(1, "52.90 40.67 11.51 92.90 14.04 \n", 3152.90 40.67 11.51 92.90
14.04
) = 31
write(1, "14.75 57.80 43.72 40.47 54.27 \n", 3114.75 57.80 43.72 40.47
54.27
) = 31
write(1, "91.70 40.61 96.62 26.01 91.17 \n", 3191.70 40.61 96.62 26.01
91.17
) = 31
```

```
write(1, "49.98 73.45 88.44 92.27 85.74 \n", 3149.98 73.45 88.44 92.27
85.74
) = 31
write(1, "4.97 42.51 85.90 37.27 2.79 \n", 294.97 42.51 85.90 37.27
2.79
) = 29
write(1, "\n", 1
)                       = 1
clock_gettime(CLOCK_PROCESS_CPUTIME_ID, {tv_sec=0, tv_nsec=2560207}) =
0
rt_sigaction(SIGRT_1, {sa_handler=0x7c4ee7699530, sa_mask=[],
sa_flags=SA_RESTORER|SA_ONSTACK|SA_RESTART|SA_SIGINFO,
sa_restorer=0x7c4ee7645330}, NULL, 8) = 0
rt_sigprocmask(SIG_UNBLOCK, [RTMIN RT_1], NULL, 8) = 0
mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -
1, 0) = 0x7c4ee6dff000
mprotect(0x7c4ee6e00000, 8388608, PROT_READ|PROT_WRITE) = 0
rt_sigprocmask(SIG_BLOCK, ~[], [], 8)   = 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD
|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID,
child_tid=0x7c4ee75ff990, parent_tid=0x7c4ee75ff990, exit_signal=0,
stack=0x7c4ee6dff000, stack_size=0x7fff80, tls=0x7c4ee75ff6c0} =>
{parent_tid=[1543]}, 88) = 1543
rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0
mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -
1, 0) = 0x7c4ee65fe000
mprotect(0x7c4ee65ff000, 8388608, PROT_READ|PROT_WRITE) = 0
rt_sigprocmask(SIG_BLOCK, ~[], [], 8)   = 0
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD
|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID,
child_tid=0x7c4ee6dfe990, parent_tid=0x7c4ee6dfe990, exit_signal=0,
stack=0x7c4ee65fe000, stack_size=0x7fff80, tls=0x7c4ee6dfe6c0} =>
{parent_tid=[1544]}, 88) = 1544
rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0
futex(0x7c4ee75ff990, FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME, 1543,
NULL, FUTEX_BITSET_MATCH_ANY) = 0
clock_gettime(CLOCK_PROCESS_CPUTIME_ID, {tv_sec=0, tv_nsec=4444128}) =
0
write(1,
"\320\240\320\265\320\267\321\203\320\273\321\214\321\202\320\260\321\
202 \321\215\321\200\320\276\320\267\320\270\320\270:"..., 33Результат
эрозии:
) = 33
write(1, "11.51 11.51 11.51 11.51 11.51 \n", 3111.51 11.51 11.51 11.51
11.51
) = 31
write(1, "11.51 11.51 11.51 11.51 11.51 \n", 3111.51 11.51 11.51 11.51
11.51
) = 31
write(1, "4.97 4.97 2.79 2.79 2.79 \n", 264.97 4.97 2.79 2.79 2.79
) = 26
write(1, "4.97 4.97 2.79 2.79 2.79 \n", 264.97 4.97 2.79 2.79 2.79
) = 26
write(1, "4.97 4.97 2.79 2.79 2.79 \n", 264.97 4.97 2.79 2.79 2.79
) = 26
write(1, "\n", 1
)                       = 1
```

```
write(1,
"\320\240\320\265\320\267\321\203\320\273\321\214\321\202\320\260\321\
202 \320\264\320\270\320\273\320\260\321\202\320\260\321"...,
39Результат дилатации:
) = 39
write(1, "96.62 96.62 96.62 96.62 96.62 \n", 3196.62 96.62 96.62 96.62
96.62
) = 31
write(1, "96.62 96.62 96.62 96.62 96.62 \n", 3196.62 96.62 96.62 96.62
96.62
) = 31
write(1, "96.62 96.62 96.62 96.62 96.62 \n", 3196.62 96.62 96.62 96.62
96.62
) = 31
write(1, "96.62 96.62 96.62 96.62 96.62 \n", 3196.62 96.62 96.62 96.62
96.62
) = 31
write(1, "96.62 96.62 96.62 96.62 96.62 \n", 3196.62 96.62 96.62 96.62
96.62
) = 31
write(1, "\n", 1
)                       = 1
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\2
70\321\217:"..., 55Время выполнения: 0.001884 секунд
) = 55
write(1,
"\320\236\320\261\321\200\320\260\320\261\320\276\321\202\320\260\320\
275\320\276 \321\215\320\273\320\265\320\274\320\265\320"...,
45Обработано элементов: 100
) = 45
write(1,
"\320\237\321\200\320\276\320\270\320\267\320\262\320\276\320\264\320\
270\321\202\320\265\320\273\321\214\320\275\320\276\321\201"...,
73Производительность: 53078.56 элементов/сек
) = 73
exit_group(0)                           = ?
+++ exited with 0 +++
```

Лабораторная работа №3

```
execve("./main", ["./main"], 0x7fff72176f10 /* 26 vars */) = 0
brk(NULL)                               = 0x591ed8471000
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1,
0) = 0x7c5208acc000
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=32319, ...}) = 0
mmap(NULL, 32319, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7c5208ac4000
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\0\3\0>\0\1\0\0\0\220\243\2\0\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
fstat(3, {st_mode=S_IFREG|0755, st_size=2125328, ...}) = 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
mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7c5208800000
mmap(0x7c5208828000, 1605632, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7c5208828000
mmap(0x7c52089b0000, 323584, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1b0000) = 0x7c52089b0000
mmap(0x7c52089ff000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000) = 0x7c52089ff000
mmap(0x7c5208a05000, 52624, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7c5208a05000
close(3)                                = 0
mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1,
0) = 0x7c5208ac1000
arch_prctl(ARCH_SET_FS, 0x7c5208ac1740) = 0
set_tid_address(0x7c5208ac1a10)         = 535
set_robust_list(0x7c5208ac1a20, 24)     = 0
rseq(0x7c5208ac2060, 0x20, 0, 0x53053053) = 0
mprotect(0x7c52089ff000, 16384, PROT_READ) = 0
mprotect(0x591e98c0f000, 4096, PROT_READ) = 0
mprotect(0x7c5208b04000, 8192, PROT_READ) = 0
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
rlim_max=RLIM64_INFINITY}) = 0
munmap(0x7c5208ac4000, 32319)           = 0
pipe2([3, 4], 0)                        = 0
pipe2([5, 6], 0)                        = 0
fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0
getrandom("\x30\x4f\xee\x04\xc7\x61\x94\xd4", 8, GRND_NONBLOCK) = 8
brk(NULL)                               = 0x591ed8471000
brk(0x591ed8492000)                     = 0x591ed8492000
fstat(0, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0
write(1, "\320\222\320\262\320\265\320\264\320\270\321\202\320\265
\320\270\320\274\321\217 \321\204\320\260\320\271\320\273\320\260"...,
48Введите имя файла для child1: ) = 48
read(0, short.txt
"short.txt\n", 1024)            = 10
write(1, "\320\222\320\262\320\265\320\264\320\270\321\202\320\265
\320\270\320\274\321\217 \321\204\320\260\320\271\320\273\320\260"...,
48Введите имя файла для child2: ) = 48
read(0, long.txt
"long.txt\n", 1024)             = 9
clone(child_stack=NULL,
flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,
child_tidptr=0x7c5208ac1a10) = 538
clone(child_stack=NULL,
flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,
child_tidptr=0x7c5208ac1a10) = 539
close(3)                                = 0
close(5)                                = 0
write(1, "\320\222\320\262\320\265\320\264\320\270\321\202\320\265
\321\201\321\202\321\200\320\276\320\272\320\270 (exi"..., 64Введите
строки (exit для завершения):
```

```
) = 64
read(0, cat
"cat\n", 1024)                  = 4
write(4, "cat\n", 4)                     = 4
read(0, longlonglonglonglong
"longlonglonglonglong\n", 1024) = 21
write(6, "longlonglonglonglong\n", 21)  = 21
read(0, short
"short\n", 1024)                = 6
write(4, "short\n", 6)                   = 6
read(0, dog
"dog\n", 1024)                  = 4
write(4, "dog\n", 4)                     = 4
read(0, dogdogdogdogdog
"dogdogdogdogdog\n", 1024)      = 16
write(6, "dogdogdogdogdog\n", 16)       = 16
read(0, exit
"exit\n", 1024)                 = 5
close(4)                                = 0
close(6)                                = 0
wait4(-1, NULL, 0, NULL)                = 538
--- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=539,
si_uid=1000, si_status=0, si_utime=0, si_stime=0} ---
wait4(-1, NULL, 0, NULL)                = 539
exit_group(0)                           = ?
+++ exited with 0 +++
```

Лабораторная работа №4

```
strace ./prog1
execve("./prog1", ["./prog1"], 0x7fff82209e10 /* 27 vars */) = 0
brk(NULL)                               = 0x57876edcf000
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1,
0) = 0x790b7dd8a000
access("/etc/ld.so.preload", R_OK)      = -1 ENOENT (No such file or
directory)
openat(AT_FDCWD, "./glibc-hwcaps/x86-64-v3/libimplA.so",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "./glibc-hwcaps/x86-64-v2/libimplA.so",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "./libimplA.so", 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\0\0\0\0\0\0\0\0"...,
832) = 832
fstat(3, {st_mode=S_IFREG|0777, st_size=15496, ...}) = 0
getcwd("/mnt/c/Users/apush/Desktop/lab_OS/lab4_OS/src", 128) = 46
mmap(NULL, 16408, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x790b7dd85000
mmap(0x790b7dd86000, 4096, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x790b7dd86000
mmap(0x790b7dd87000, 4096, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x790b7dd87000
mmap(0x790b7dd88000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x790b7dd88000
close(3)                                = 0
```

```
openat(AT_FDCWD, "./glibc-hwcaps/x86-64-v3/libc.so.6",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "./glibc-hwcaps/x86-64-v2/libc.so.6",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "./libc.so.6", O_RDONLY|O_CLOEXEC) = -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=32319, ...}) = 0
mmap(NULL, 32319, PROT_READ, MAP_PRIVATE, 3, 0) = 0x790b7dd7d000
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\0\3\0>\0\1\0\0\0\220\243\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
fstat(3, {st_mode=S_IFREG|0755, st_size=2125328, ...}) = 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
mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x790b7da00000
mmap(0x790b7da28000, 1605632, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x790b7da28000
mmap(0x790b7dbb0000, 323584, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1b0000) = 0x790b7dbb0000
mmap(0x790b7dbff000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000) = 0x790b7dbff000
mmap(0x790b7dc05000, 52624, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x790b7dc05000
close(3)                                = 0
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libm.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\0\0\0\0\0\0\0\0\0"...,
832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=952616, ...}) = 0
mmap(NULL, 950296, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x790b7dc94000
mmap(0x790b7dca4000, 520192, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x10000) = 0x790b7dca4000
mmap(0x790b7dd23000, 360448, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x8f000) = 0x790b7dd23000
mmap(0x790b7dd7b000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe7000) = 0x790b7dd7b000
close(3)                                = 0
mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1,
0) = 0x790b7dc91000
arch_prctl(ARCH_SET_FS, 0x790b7dc91740) = 0
set_tid_address(0x790b7dc91a10)         = 1519
set_robust_list(0x790b7dc91a20, 24)     = 0
rseq(0x790b7dc92060, 0x20, 0, 0x53053053) = 0
mprotect(0x790b7dbff000, 16384, PROT_READ) = 0
mprotect(0x790b7dd7b000, 4096, PROT_READ) = 0
mprotect(0x790b7dd88000, 4096, PROT_READ) = 0
mprotect(0x578760de0000, 4096, PROT_READ) = 0
```

```
mprotect(0x790b7ddc2000, 8192, PROT_READ) = 0
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
rlim_max=RLIM64_INFINITY}) = 0
munmap(0x790b7dd7d000, 32319)           = 0
fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0
getrandom("\x6c\x1e\x37\x59\x59\x80\xf7\x47", 8, GRND_NONBLOCK) = 8
brk(NULL)                               = 0x57876edcf000
brk(0x57876edf0000)                     = 0x57876edf0000
write(1, "Current lib: A\n", 15Current lib: A
)        = 15
write(1, "1 A B - PrimeCount(A,B)\n", 241 A B - PrimeCount(A,B)
) = 24
write(1, "2 A B - GCF(A,B)\n", 172 A B - GCF(A,B)
)      = 17
fstat(0, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0
read(0, 1 10 30
"1 10 30\n", 1024)              = 8
write(1, "PrimeCount(10,30) = 6\n", 22PrimeCount(10,30) = 6
) = 22
read(0, 2 10 30
"2 10 30\n", 1024)              = 8
write(1, "GCF(10,30) = 10\n", 16GCF(10,30) = 10
)       = 16
read(0, q
"q\n", 1024)                    = 2
lseek(0, -1, SEEK_CUR)                  = -1 ESPIPE (Illegal seek)
exit_group(0)                           = ?
+++ exited with 0 +++
```

strace ./prog2

```
execve("./prog2", ["./prog2"], 0x7ffe59045390 /* 27 vars */) = 0
brk(NULL)                               = 0x5e6884580000
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1,
0) = 0x771f5ec47000
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=32319, ...}) = 0
mmap(NULL, 32319, PROT_READ, MAP_PRIVATE, 3, 0) = 0x771f5ec3f000
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\0\3\0>\0\1\0\0\0\220\243\2\0\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
fstat(3, {st_mode=S_IFREG|0755, st_size=2125328, ...}) = 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
mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x771f5ea00000
mmap(0x771f5ea28000, 1605632, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x771f5ea28000
mmap(0x771f5ebb0000, 323584, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1b0000) = 0x771f5ebb0000
```

```
mmap(0x771f5ebff000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000) = 0x771f5ebff000
mmap(0x771f5ec05000, 52624, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x771f5ec05000
close(3)                                = 0
mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1,
0) = 0x771f5ec3c000
arch_prctl(ARCH_SET_FS, 0x771f5ec3c740) = 0
set_tid_address(0x771f5ec3ca10)         = 1525
set_robust_list(0x771f5ec3ca20, 24)     = 0
rseq(0x771f5ec3d060, 0x20, 0, 0x53053053) = 0
mprotect(0x771f5ebff000, 16384, PROT_READ) = 0
mprotect(0x5e6849264000, 4096, PROT_READ) = 0
mprotect(0x771f5ec7f000, 8192, PROT_READ) = 0
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
rlim_max=RLIM64_INFINITY}) = 0
munmap(0x771f5ec3f000, 32319)           = 0
getrandom("\x2e\xa0\x65\x8d\x93\x43\x8f\x7c", 8, GRND_NONBLOCK) = 8
brk(NULL)                               = 0x5e6884580000
brk(0x5e68845a1000)                     = 0x5e68845a1000
openat(AT_FDCWD, "./libimplA.so", 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\0\0\0\0\0\0\0\0"...,
832) = 832
fstat(3, {st_mode=S_IFREG|0777, st_size=15496, ...}) = 0
getcwd("/mnt/c/Users/apush/Desktop/lab_OS/lab4_OS/src", 128) = 46
mmap(NULL, 16408, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x771f5ec42000
mmap(0x771f5ec43000, 4096, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x771f5ec43000
mmap(0x771f5ec44000, 4096, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x771f5ec44000
mmap(0x771f5ec45000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x771f5ec45000
close(3)                                = 0
openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=32319, ...}) = 0
mmap(NULL, 32319, PROT_READ, MAP_PRIVATE, 3, 0) = 0x771f5ec34000
close(3)                                = 0
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libm.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\0\0\0\0\0\0\0\0"...,
832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=952616, ...}) = 0
mmap(NULL, 950296, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x771f5e917000
mmap(0x771f5e927000, 520192, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x10000) = 0x771f5e927000
mmap(0x771f5e9a6000, 360448, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x8f000) = 0x771f5e9a6000
mmap(0x771f5e9fe000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe7000) = 0x771f5e9fe000
close(3)                                = 0
mprotect(0x771f5e9fe000, 4096, PROT_READ) = 0
mprotect(0x771f5ec45000, 4096, PROT_READ) = 0
munmap(0x771f5ec34000, 32319)           = 0
fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0
```

```
write(1, "Current lib: A\n", 15Current lib: A
)        = 15
write(1, "0 - switch lib\n", 150 - switch lib
)        = 15
write(1, "1 A B - PrimeCount(A,B)\n", 241 A B - PrimeCount(A,B)
) = 24
write(1, "2 A B - GCF(A,B)\n", 172 A B - GCF(A,B)
)      = 17
fstat(0, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0
read(0, 1 10 30
"1 10 30\n", 1024)               = 8
write(1, "PrimeCount(10,30) = 6\n", 22PrimeCount(10,30) = 6
) = 22
read(0, 2 10 30
"2 10 30\n", 1024)               = 8
write(1, "GCF(10,30) = 10\n", 16GCF(10,30) = 10
)       = 16
read(0, 0
"0\n", 1024)                     = 2
munmap(0x771f5ec42000, 16408)           = 0
munmap(0x771f5e917000, 950296)          = 0
openat(AT_FDCWD, "./libimplB.so", 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\0\0\0\0\0\0\0\0"...,
832) = 832
fstat(3, {st_mode=S_IFREG|0777, st_size=15616, ...}) = 0
getcwd("/mnt/c/Users/apush/Desktop/lab_OS/lab4_OS/src", 128) = 46
mmap(NULL, 16424, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x771f5ec42000
mmap(0x771f5ec43000, 4096, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x771f5ec43000
mmap(0x771f5ec44000, 4096, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x771f5ec44000
mmap(0x771f5ec45000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x771f5ec45000
close(3)                                = 0
mprotect(0x771f5ec45000, 4096, PROT_READ) = 0
write(1, "Switched to ./libimplB.so\n", 26Switched to ./libimplB.so
) = 26
read(0, 1 10 30
"1 10 30\n", 1024)               = 8
write(1, "PrimeCount(10,30) = 6\n", 22PrimeCount(10,30) = 6
) = 22
read(0, 2 10 30
"2 10 30\n", 1024)               = 8
write(1, "GCF(10,30) = 10\n", 16GCF(10,30) = 10
)       = 16
read(0, 0
"0\n", 1024)                     = 2
munmap(0x771f5ec42000, 16424)           = 0
openat(AT_FDCWD, "./libimplA.so", 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\0\0\0\0\0\0\0\0"...,
832) = 832
fstat(3, {st_mode=S_IFREG|0777, st_size=15496, ...}) = 0
getcwd("/mnt/c/Users/apush/Desktop/lab_OS/lab4_OS/src", 128) = 46
mmap(NULL, 16408, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x771f5ec42000
```

```
mmap(0x771f5ec43000, 4096, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x771f5ec43000
mmap(0x771f5ec44000, 4096, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x771f5ec44000
mmap(0x771f5ec45000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x771f5ec45000
close(3)                                = 0
openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=32319, ...}) = 0
mmap(NULL, 32319, PROT_READ, MAP_PRIVATE, 3, 0) = 0x771f5ec34000
close(3)                                = 0
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libm.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\0\0\0\0\0\0\0\0"...,
832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=952616, ...}) = 0
mmap(NULL, 950296, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x771f5e917000
mmap(0x771f5e927000, 520192, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x10000) = 0x771f5e927000
mmap(0x771f5e9a6000, 360448, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x8f000) = 0x771f5e9a6000
mmap(0x771f5e9fe000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe7000) = 0x771f5e9fe000
close(3)                                = 0
mprotect(0x771f5e9fe000, 4096, PROT_READ) = 0
mprotect(0x771f5ec45000, 4096, PROT_READ) = 0
munmap(0x771f5ec34000, 32319)           = 0
write(1, "Switched to ./libimplA.so\n", 26Switched to ./libimplA.so
) = 26
read(0, q
"q\n", 1024)                    = 2
munmap(0x771f5ec42000, 16408)           = 0
munmap(0x771f5e917000, 950296)          = 0
lseek(0, -1, SEEK_CUR)                  = -1 ESPIPE (Illegal seek)
exit_group(0)                           = ?
+++ exited with 0 +++
```

Вывод

В ходе работы был освоен практический инструмент анализа поведения программ — утилита strace. Она позволяет наблюдать все взаимодействия приложения с ядром операционной системы через системные вызовы, что является ключевым для низкоуровневой диагностики. Умение применять фильтрацию вывода, трассировку дочерних процессов и анализ статистики даёт возможность быстро локализовать проблемы — будь то ошибки доступа к файлам, сетевые сбои или аварийные завершения. Полученный навык работы с strace является важным для любой деятельности, связанной с отладкой и администрированием в Linux-средах.