МОСКОВСКИЙ АВИАЦИОННЫЙ ИНСТИТУТ
(НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ)

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Кафедра 806 «Вычислительная математика и программирование»

Лабораторная работа №5
по курсу «Операционные системы»

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Условие

Цель работы:

Приобретение практических навыков диагностики работы программного обеспечения.

Задание:

При выполнении лабораторных работ по курсу ОС необходимо продемонстрировать ключевые системные вызовы, которые в них используются и то, что их использование соответствует варианту ЛР.

По итогам выполнения всех лабораторных работ отчет по данной ЛР должен содержать краткую сводку по исследованию написанных программ.

Средства диагностики:

strace

Метод решения

Программы, реализованные для каждой лабораторной работы, запускаются с использованием strace. Им подаются тестовые входные данные, ожидается завершение их работы, после чего они корректно завершаются. Полученные логи сохраняются в .txt файл, указанный при запуске.

Описание программы

Все stace-выводы содержат общие строки, в которые входит стандартная инициализация программы на c/c++, они могут иметь немного расхожий вид, но логика одинаковая. Происходит инициализация процесса, загрузка библиотек, настройка памяти и потоков, настройка прав доступа. Лабораторная работа 1:

```
execve("./parent", ["./parent"], 0x7ffe5a59fbb0 /* 27 vars */) = 0
write(1, "Enter filename: ", 16) = 16
read(0, "test.txt\n", 1024) = 9
```

Инициализация процесса. Пользователь вводит имя файла test.txt.

```
pipe2([3, 4], 0) = 0
```

Создаётся один неименованный канал

```
clone(child_stack=NULL, flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,
    child_tidptr=0x76f66a82f690) = 1533
```

Создаётся дочерний процесс с PID 1533. SIGCHLD уведомляет родителя о завершении дочернего процесса.

```
close(4) = 0
```

Родительский процесс закрывает конец канала на запись

```
read(3, "30.48\n", 255) = 6
```

Родитель читает из канала и получает ответ.

```
write(1, "Answer: 30.48\n", 14) = 14
write(1, "\n", 1) = 1
close(3) = 0
```

Родитель выводит результат в свой стандартный вывод и закрывает конец канала

Лабораторная работа 2:

```
mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) = 0
    x7a21567ff000
mprotect(0x7a2156800000, 8388608, PROT_READ|PROT_WRITE) = 0
```

Выделение стека для одного потока. mmap резервирует виртуальное адресное пространство,mprotect активирует страницу виртуальной памяти.

```
clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|
    CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID, child_tid=0x7a2156fff910,
    parent_tid=0x7a2156fff910, exit_signal=0, stack=0x7a21567ff000, stack_size=0x7fff00,
    tls=0x7a2156fff640} => {parent_tid=[2385]}, 88) = 2385
rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0
```

Создание потока (CLONE_THREAD). Общая память, файлы, сигналы (CLONE_VM|CLONE_FS|CLO

```
write(1, "000000000000000000000000000000"...,
    157000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000
00000000000000000000000000008Algorithm was done in: 12 ms
) = 157
```

Вывод результата и времени выполнения.

Лабораторная работа 3:

```
openat(AT_FDCWD, "/dev/shm/lab", 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) = 0x75e138f28000
```

Родительский процесс создаёт shared memory-объект.ftruncate(3, 1024) задаёт размер — 1024 байта.mmap отображает сегмент в адресное пространство процесса

```
rt_sigaction(SIGUSR2, {sa_handler=0x6125e174a117, sa_mask=[USR2], sa_flags=SA_RESTORER|
    SA_RESTART, ...}, ...) = 0
```

Родитель регистрирует обработчик сигнала SIGUSR2.

```
clone(child_stack=NULL, flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,
    child_tidptr=0x75e138ec6690) = 940
```

Создаётся дочерний процесс

```
pause() = ? ERESTARTNOHAND (To be restarted if no handler)
--- SIGUSR2 {si_signo=SIGUSR2, si_code=SI_USER, si_pid=940, si_uid=1000} ---
rt_sigreturn({mask=[]}) = -1 EINTR (Interrupted system call)
--- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=940, si_uid=1000, si_status=0,
    si_utime=0, si_stime=0} ---
write(1, "Answer: 30.000000\n", 18) = 18
wait4(940, [{WIFEXITED(s) && WEXITSTATUS(s) == 0}], 0, NULL) = 940
munmap(0x75e138f28000, 1024) = 0
close(3) = 0
unlink("/dev/shm/lab") = 0
```

Родитель блокируется до получения любого сигнала. Сигнал используется именно для синхронизации: он уведомляет родителя, что данные в shared memory готовы к чтению.Родитель читает результат из отображённой памяти.munmap — отвязывает shared memory, close — закрывает файловый дескриптор, unlink — удаляет объект, освобождая ресурс

Лабораторная работа 4: Program1

```
openat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/liblibrary_first.so", O_RDONLY|
    O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0...", 832) = 832
newfstatat(3, "", {st_mode=S_IFREG|0755, st_size=15536, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 16440, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7226b58a3000
mmap(0x7226b58a4000, 4096, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0
    x1000) = 0x7226b58a4000
mmap(0x7226b58a5000, 4096, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0
    x7226b58a5000
```

```
7 mmap(0x7226b58a6000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
      0x2000) = 0x7226b58a6000
8 close(3) = 0
```

Программа автоматически загружает liblibrary_first.so сразу после старта. Вся загрузка библиотек выполняется динамическим загрузчиком ОС до начала выполнения вашего кода main.

Результаты

Были полученны и проанализированы логи системных вызовой ядра linux для программ лабораторных работ 1-4.

Выводы

В ходе выполнения лабораторной работы были получены навыки диагностики работы программного обеспечения,исследованы логи системных вызовов ядра Linux к предыдущим лабораторным работам (strace). Анализ логов strace подтвердил, что все четыре лабораторные работы полностью соответствуют требованиям заданий и корректно реализуют заявленные механизмы межпроцессного взаимодействия и управления ресурсами.

Strace

Лабораторная работа 1

```
execve("./parent", ["./parent"], 0x7ffe5a59fbb0 /* 27 vars */) = 0
brk(NULL)                               = 0x5c99716f7000
arch_prctl(0x3001 /* ARCH_??? */, 0x7ffd5d856b00) = -1 EINVAL (Invalid argument)
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
↪  0x76f66a93e000
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
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=28532, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 28532, PROT_READ, MAP_PRIVATE, 3, 0) = 0x76f66a937000
close(3)                                = 0
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libstdc++.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
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=2260296, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 2275520, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x76f66a600000
mprotect(0x76f66a69a000, 1576960, PROT_NONE) = 0
mmap(0x76f66a69a000, 1118208, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x9a000) = 0x76f66a69a000
mmap(0x76f66a7ab000, 454656, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x1ab000) = 0x76f66a7ab000
mmap(0x76f66a81b000, 57344, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x21a000) = 0x76f66a81b000
mmap(0x76f66a829000, 10432, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x76f66a829000
close(3)                                = 0
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libgcc_s.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\0\0\0"..., 832)
↪  = 832
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=125488, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 127720, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x76f66a917000
```

```
mmap(0x76f66a91a000, 94208, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x3000) = 0x76f66a91a000
mmap(0x76f66a931000, 16384, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x1a000) = 0x76f66a931000
mmap(0x76f66a935000, 8192, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1d000) = 0x76f66a935000
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\0P\237\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
pread64(3, "\4\0\0\0 \0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0\0"...,
↪  48, 848) = 48
pread64(3, "\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\325\31p\226\367\t\200\30)\261\30\257\3⌋
↪  3|\366c"..., 68, 896) = 68
newfstatat(3, "", {st_mode=S_IFREG|0755, st_size=2220400, ...}, AT_EMPTY_PATH) = 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, 2264656, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x76f66a200000
mprotect(0x76f66a228000, 2023424, PROT_NONE) = 0
mmap(0x76f66a228000, 1658880, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x76f66a228000
mmap(0x76f66a3bd000, 360448, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x1bd000) = 0x76f66a3bd000
mmap(0x76f66a416000, 24576, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x215000) = 0x76f66a416000
mmap(0x76f66a41c000, 52816, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x76f66a41c000
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\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0"..., 832)
↪  = 832
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=940560, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 942344, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x76f66a830000
mmap(0x76f66a83e000, 507904, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe000) = 0x76f66a83e000
mmap(0x76f66a8ba000, 372736, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x8a000) = 0x76f66a8ba000
mmap(0x76f66a915000, 8192, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe4000) = 0x76f66a915000
close(3)                                = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
↪  0x76f66a82e000
arch_prctl(ARCH_SET_FS, 0x76f66a82f3c0) = 0
set_tid_address(0x76f66a82f690)         = 1532
set_robust_list(0x76f66a82f6a0, 24)     = 0
rseq(0x76f66a82fd60, 0x20, 0, 0x53053053) = 0
mprotect(0x76f66a416000, 16384, PROT_READ) = 0
mprotect(0x76f66a915000, 4096, PROT_READ) = 0
mprotect(0x76f66a935000, 4096, PROT_READ) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
↪  0x76f66a82c000
mprotect(0x76f66a81b000, 45056, PROT_READ) = 0
```

```
mprotect(0x5c996ef69000, 4096, PROT_READ) = 0
mprotect(0x76f66a978000, 8192, PROT_READ) = 0
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024, rlim_max=RLIM64_INFINITY}) =
↪  0
munmap(0x76f66a937000, 28532)           = 0
getrandom("\xbd\xe0\xd2\xe9\x4c\xaf\x25\x06", 8, GRND_NONBLOCK) = 8
brk(NULL)                               = 0x5c99716f7000
brk(0x5c9971718000)                     = 0x5c9971718000
futex(0x76f66a82977c, FUTEX_WAKE_PRIVATE, 2147483647) = 0
newfstatat(1, "", {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...},
↪  AT_EMPTY_PATH) = 0
write(1, "Enter filename: ", 16)        = 16
newfstatat(0, "", {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...},
↪  AT_EMPTY_PATH) = 0
read(0, "test.txt\n", 1024)             = 9
pipe2([3, 4], 0)                        = 0
clone(child_stack=NULL, flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,
↪  child_tidptr=0x76f66a82f690) = 1533
close(4)                                = 0
close(4)                                = -1 EBADF (Bad file descriptor)
read(3, "30.48\n", 255)                 = 6
write(1, "Answer: 30.48\n", 14)         = 14
write(1, "\n", 1)                       = 1
close(3)                                = 0
lseek(0, -1, SEEK_CUR)                  = -1 ESPIPE (Illegal seek)
--- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=1533, si_uid=1000,
↪  si_status=0, si_utime=0, si_stime=0} ---
exit_group(0)                           = ?
+++ exited with 0 +++
```

Лабораторная работа 2

```
execve("./main", ["./main", "4", "100", "number.hex"], 0x7fffede89ce8 /* 26 vars
↪  */) = 0
brk(NULL)                               = 0x5e908c261000
arch_prctl(0x3001 /* ARCH_??? */, 0x7ffe70625cc0) = -1 EINVAL (Invalid argument)
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
↪  0x7a2157779000
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
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=29000, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 29000, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7a2157771000
close(3)                                = 0
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libstdc++.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
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=2260296, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 2275520, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7a2157400000
mprotect(0x7a215749a000, 1576960, PROT_NONE) = 0
mmap(0x7a215749a000, 1118208, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x9a000) = 0x7a215749a000
mmap(0x7a21575ab000, 454656, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x1ab000) = 0x7a21575ab000
```

```
mmap(0x7a215761b000, 57344, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x21a000) = 0x7a215761b000
mmap(0x7a2157629000, 10432, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7a2157629000
close(3)                                = 0
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libgcc_s.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\0\0\0\0\0\0\0\0"..., 832)
↪  = 832
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=125488, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 127720, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7a2157751000
mmap(0x7a2157754000, 94208, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x3000) = 0x7a2157754000
mmap(0x7a215776b000, 16384, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x1a000) = 0x7a215776b000
mmap(0x7a215776f000, 8192, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1d000) = 0x7a215776f000
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\0P\237\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\0"...,
↪  784, 64) = 784
pread64(3, "\4\0\0\0 \0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0\0"...,
↪  48, 848) = 48
pread64(3, "\4\0\0\0\24\0\0\0\3\0\0\0GNU\0O{\f\225\\=\201\327\312\301P\32\$\230\2」
↪  66\235"..., 68, 896) = 68
newfstatat(3, "", {st_mode=S_IFREG|0755, st_size=2220400, ...}, AT_EMPTY_PATH) = 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\0"...,
↪  784, 64) = 784
mmap(NULL, 2264656, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7a2157000000
mprotect(0x7a2157028000, 2023424, PROT_NONE) = 0
mmap(0x7a2157028000, 1658880, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7a2157028000
mmap(0x7a21571bd000, 360448, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x1bd000) = 0x7a21571bd000
mmap(0x7a2157216000, 24576, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x215000) = 0x7a2157216000
mmap(0x7a215721c000, 52816, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7a215721c000
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
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=940560, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 942344, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7a215766a000
mmap(0x7a2157678000, 507904, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe000) = 0x7a2157678000
mmap(0x7a21576f4000, 372736, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x8a000) = 0x7a21576f4000
mmap(0x7a215774f000, 8192, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe4000) = 0x7a215774f000
close(3)                                = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
↪  0x7a2157668000
```

```
arch_prctl(ARCH_SET_FS, 0x7a21576693c0) = 0
set_tid_address(0x7a2157669690)         = 2384
set_robust_list(0x7a21576696a0, 24)     = 0
rseq(0x7a2157669d60, 0x20, 0, 0x53053053) = 0
mprotect(0x7a2157216000, 16384, PROT_READ) = 0
mprotect(0x7a215774f000, 4096, PROT_READ) = 0
mprotect(0x7a215776f000, 4096, PROT_READ) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
↪  0x7a2157666000
mprotect(0x7a215761b000, 45056, PROT_READ) = 0
mprotect(0x5e9085560000, 4096, PROT_READ) = 0
mprotect(0x7a21577b3000, 8192, PROT_READ) = 0
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024, rlim_max=RLIM64_INFINITY}) =
↪  0
munmap(0x7a2157771000, 29000)           = 0
getrandom("\x1f\xa0\xa4\x16\x77\x33\xeb\x7c", 8, GRND_NONBLOCK) = 8
brk(NULL)                               = 0x5e908c261000
brk(0x5e908c282000)                     = 0x5e908c282000
futex(0x7a215762977c, FUTEX_WAKE_PRIVATE, 2147483647) = 0
openat(AT_FDCWD, "number.hex", O_RDONLY) = 3
read(3, "0000000000000001\r\n00000000000000"..., 8191) = 250
read(3, "", 8191)                       = 0
close(3)                                = 0
rt_sigaction(SIGRT_1, {sa_handler=0x7a2157091870, sa_mask=[],
↪  sa_flags=SA_RESTORER|SA_ONSTACK|SA_RESTART|SA_SIGINFO,
↪  sa_restorer=0x7a2157042520}, 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) =
↪  0x7a21567ff000
mprotect(0x7a2156800000, 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_SYSV⌋
↪  SEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID,
↪  child_tid=0x7a2156fff910, parent_tid=0x7a2156fff910, exit_signal=0,
↪  stack=0x7a21567ff000, stack_size=0x7fff00, tls=0x7a2156fff640} =>
↪  {parent_tid=[2385]}, 88) = 2385
rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0
mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) =
↪  0x7a2155ffe000
mprotect(0x7a2155fff000, 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_SYSV⌋
↪  SEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID,
↪  child_tid=0x7a21567fe910, parent_tid=0x7a21567fe910, exit_signal=0,
↪  stack=0x7a2155ffe000, stack_size=0x7fff00, tls=0x7a21567fe640} =>
↪  {parent_tid=[2386]}, 88) = 2386
rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0
mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) =
↪  0x7a21557fd000
mprotect(0x7a21557fe000, 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_SYSV
↪  SEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID,
↪  child_tid=0x7a2155ffd910, parent_tid=0x7a2155ffd910, exit_signal=0,
↪  stack=0x7a21557fd000, stack_size=0x7fff00, tls=0x7a2155ffd640} =>
↪  {parent_tid=[2387]}, 88) = 2387
rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0
mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) =
↪  0x7a2154ffc000
mprotect(0x7a2154ffd000, 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_SYSV
↪  SEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID,
↪  child_tid=0x7a21557fc910, parent_tid=0x7a21557fc910, exit_signal=0,
↪  stack=0x7a2154ffc000, stack_size=0x7fff00, tls=0x7a21557fc640} =>
↪  {parent_tid=[0]}, 88) = 2388
rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0
newfstatat(1, "", {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0x3), ...},
↪  AT_EMPTY_PATH) = 0
write(1, "00000000000000000000000000000000"...,
↪  157000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
↪  00000000000000000000000000000000000000000000000008Algorithm was done in:
↪  12 ms
) = 157
exit_group(0)                           = ?
+++ exited with 0 +++
```

Лабораторная работа 3

```
execve("./parent", ["./parent"], 0x7ffef5265970 /* 27 vars */) = 0
brk(NULL)                               = 0x61261ca8e000
arch_prctl(0x3001 /* ARCH_??? */, 0x7ffdc2325030) = -1 EINVAL (Invalid argument)
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
↪  0x75e138eef000
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
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=29000, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 29000, PROT_READ, MAP_PRIVATE, 3, 0) = 0x75e138ee7000
close(3)                                = 0
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libstdc++.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
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=2260296, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 2275520, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x75e138c00000
mprotect(0x75e138c9a000, 1576960, PROT_NONE) = 0
mmap(0x75e138c9a000, 1118208, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x9a000) = 0x75e138c9a000
mmap(0x75e138dab000, 454656, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x1ab000) = 0x75e138dab000
mmap(0x75e138e1b000, 57344, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x21a000) = 0x75e138e1b000
mmap(0x75e138e29000, 10432, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x75e138e29000
close(3)                                = 0
```

```
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libgcc_s.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\0\0\0\0\0\0\0"..., 832)
↪  = 832
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=125488, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 127720, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x75e138ec7000
mmap(0x75e138eca000, 94208, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x3000) = 0x75e138eca000
mmap(0x75e138ee1000, 16384, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x1a000) = 0x75e138ee1000
mmap(0x75e138ee5000, 8192, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1d000) = 0x75e138ee5000
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\0P\237\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
pread64(3, "\4\0\0\0 \0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0\0"...,
↪  48, 848) = 48
pread64(3, "\4\0\0\0\24\0\0\0\3\0\0\0GNU\0O{\f\225\\=\201\327\312\301P\32$\230\26⌋
↪  6\235"..., 68, 896) = 68
newfstatat(3, "", {st_mode=S_IFREG|0755, st_size=2220400, ...}, AT_EMPTY_PATH) = 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, 2264656, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x75e138800000
mprotect(0x75e138828000, 2023424, PROT_NONE) = 0
mmap(0x75e138828000, 1658880, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x75e138828000
mmap(0x75e1389bd000, 360448, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x1bd000) = 0x75e1389bd000
mmap(0x75e138a16000, 24576, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x215000) = 0x75e138a16000
mmap(0x75e138a1c000, 52816, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x75e138a1c000
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"..., 832)
↪  = 832
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=940560, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 942344, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x75e138b19000
mmap(0x75e138b27000, 507904, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe000) = 0x75e138b27000
mmap(0x75e138ba3000, 372736, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x8a000) = 0x75e138ba3000
mmap(0x75e138bfe000, 8192, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe4000) = 0x75e138bfe000
close(3)                                = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
↪  0x75e138ec5000
arch_prctl(ARCH_SET_FS, 0x75e138ec63c0) = 0
set_tid_address(0x75e138ec6690)         = 939
set_robust_list(0x75e138ec66a0, 24)     = 0
rseq(0x75e138ec6d60, 0x20, 0, 0x53053053) = 0
mprotect(0x75e138a16000, 16384, PROT_READ) = 0
```

```
mprotect(0x75e138bfe000, 4096, PROT_READ) = 0
mprotect(0x75e138ee5000, 4096, PROT_READ) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
↪  0x75e138ec3000
mprotect(0x75e138e1b000, 45056, PROT_READ) = 0
mprotect(0x6125e174d000, 4096, PROT_READ) = 0
mprotect(0x75e138f29000, 8192, PROT_READ) = 0
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024, rlim_max=RLIM64_INFINITY}) =
↪  0
munmap(0x75e138ee7000, 29000)           = 0
getrandom("\xa5\x0f\x58\xe6\x85\x95\x21\x0d", 8, GRND_NONBLOCK) = 8
brk(NULL)                               = 0x61261ca8e000
brk(0x61261caaf000)                     = 0x61261caaf000
futex(0x75e138e2977c, FUTEX_WAKE_PRIVATE, 2147483647) = 0
newfstatat(1, "", {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...},
↪  AT_EMPTY_PATH) = 0
write(1, "Enter filename: ", 16)        = 16
newfstatat(0, "", {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...},
↪  AT_EMPTY_PATH) = 0
read(0, "\n", 1024)                     = 1
read(0, "test.txt\n", 1024)             = 9
openat(AT_FDCWD, "/dev/shm/lab", 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) = 0x75e138f28000
rt_sigaction(SIGUSR2, {sa_handler=0x6125e174a117, sa_mask=[USR2],
↪  sa_flags=SA_RESTORER|SA_RESTART, sa_restorer=0x75e138842520},
↪  {sa_handler=SIG_DFL, sa_mask=[], sa_flags=0}, 8) = 0
clone(child_stack=NULL, flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,
↪  child_tidptr=0x75e138ec6690) = 940
pause()                                 = ? ERESTARTNOHAND (To be restarted if no
↪  handler)
--- SIGUSR2 {si_signo=SIGUSR2, si_code=SI_USER, si_pid=940, si_uid=1000} ---
rt_sigreturn({mask=[]})                 = -1 EINTR (Interrupted system call)
--- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=940, si_uid=1000,
↪  si_status=0, si_utime=0, si_stime=0} ---
write(1, "Answer: 30.000000\n", 18)     = 18
wait4(940, [{WIFEXITED(s) && WEXITSTATUS(s) == 0}], 0, NULL) = 940
munmap(0x75e138f28000, 1024)            = 0
close(3)                                = 0
unlink("/dev/shm/lab")                  = 0
lseek(0, -1, SEEK_CUR)                  = -1 ESPIPE (Illegal seek)
exit_group(0)                           = ?
+++ exited with 0 +++
```

Лабораторная работа 4. Prog1

```
execve("./program1", ["./program1"], 0x7ffdd516afd0 /* 26 vars */) = 0
brk(NULL)                               = 0x650c19e7e000
arch_prctl(0x3001 /* ARCH_??? */, 0x7ffcafabade0) = -1 EINVAL (Invalid argument)
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
↪  0x7226b58a8000
access("/etc/ld.so.preload", R_OK)      = -1 ENOENT (No such file or directory)
```

```
openat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/glibc-hwcaps/x86-64-v3/l⌋
↪  iblibrary_first.so", O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or
↪  directory)
newfstatat(AT_FDCWD,
↪  "/home/guuuzova_v/oslab/LabsOS/lab4/lib/glibc-hwcaps/x86-64-v3",
↪  0x7ffcafaba000, 0) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/glibc-hwcaps/x86-64-v2/l⌋
↪  iblibrary_first.so", O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or
↪  directory)
newfstatat(AT_FDCWD,
↪  "/home/guuuzova_v/oslab/LabsOS/lab4/lib/glibc-hwcaps/x86-64-v2",
↪  0x7ffcafaba000, 0) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/tls/x86_64/x86_64/liblib⌋
↪  rary_first.so", O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
newfstatat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/tls/x86_64/x86_64",
↪  0x7ffcafaba000, 0) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD,
↪  "/home/guuuzova_v/oslab/LabsOS/lab4/lib/tls/x86_64/liblibrary_first.so",
↪  O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
newfstatat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/tls/x86_64",
↪  0x7ffcafaba000, 0) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD,
↪  "/home/guuuzova_v/oslab/LabsOS/lab4/lib/tls/x86_64/liblibrary_first.so",
↪  O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
newfstatat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/tls/x86_64",
↪  0x7ffcafaba000, 0) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/tls/liblibrary_first.so",
↪  O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
newfstatat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/tls", 0x7ffcafaba000,
↪  0) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD,
↪  "/home/guuuzova_v/oslab/LabsOS/lab4/lib/x86_64/x86_64/liblibrary_first.so",
↪  O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
newfstatat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/x86_64/x86_64",
↪  0x7ffcafaba000, 0) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD,
↪  "/home/guuuzova_v/oslab/LabsOS/lab4/lib/x86_64/liblibrary_first.so",
↪  O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
newfstatat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/x86_64",
↪  0x7ffcafaba000, 0) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD,
↪  "/home/guuuzova_v/oslab/LabsOS/lab4/lib/x86_64/liblibrary_first.so",
↪  O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
newfstatat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/x86_64",
↪  0x7ffcafaba000, 0) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/liblibrary_first.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
newfstatat(3, "", {st_mode=S_IFREG|0755, st_size=15536, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 16440, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7226b58a3000
mmap(0x7226b58a4000, 4096, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x7226b58a4000
```

```
mmap(0x7226b58a5000, 4096, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x2000) = 0x7226b58a5000
mmap(0x7226b58a6000, 8192, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7226b58a6000
close(3)                                = 0
openat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/liblibrary_leibniz.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
newfstatat(3, "", {st_mode=S_IFREG|0755, st_size=15208, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 16424, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7226b589e000
mmap(0x7226b589f000, 4096, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x7226b589f000
mmap(0x7226b58a0000, 4096, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x2000) = 0x7226b58a0000
mmap(0x7226b58a1000, 8192, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7226b58a1000
close(3)                                = 0
openat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/libstdc++.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
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=29000, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 29000, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7226b5896000
close(3)                                = 0
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libstdc++.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
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=2260296, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 2275520, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7226b5600000
mprotect(0x7226b569a000, 1576960, PROT_NONE) = 0
mmap(0x7226b569a000, 1118208, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x9a000) = 0x7226b569a000
mmap(0x7226b57ab000, 454656, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x1ab000) = 0x7226b57ab000
mmap(0x7226b581b000, 57344, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x21a000) = 0x7226b581b000
mmap(0x7226b5829000, 10432, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7226b5829000
close(3)                                = 0
openat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/libgcc_s.so.1",
↪  O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libgcc_s.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\0\0\0\0\0\0\0\0"..., 832)
↪  = 832
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=125488, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 127720, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7226b5876000
mmap(0x7226b5879000, 94208, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x3000) = 0x7226b5879000
mmap(0x7226b5890000, 16384, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x1a000) = 0x7226b5890000
mmap(0x7226b5894000, 8192, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1d000) = 0x7226b5894000
close(3)                                = 0
```

```
openat(AT_FDCWD, "/home/guuuzova_v/oslab/LabsOS/lab4/lib/libc.so.6",
↪  O_RDONLY|O_CLOEXEC) = -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\0P\237\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
pread64(3, "\4\0\0\0 \0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0\0"...,
↪  48, 848) = 48
pread64(3, "\4\0\0\0\24\0\0\0\3\0\0\0GNU\0O{\f\225\\=\201\327\312\301P\32\230\266
↪  \235"..., 68, 896) = 68
newfstatat(3, "", {st_mode=S_IFREG|0755, st_size=2220400, ...}, AT_EMPTY_PATH) = 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, 2264656, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7226b5200000
mprotect(0x7226b5228000, 2023424, PROT_NONE) = 0
mmap(0x7226b5228000, 1658880, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7226b5228000
mmap(0x7226b53bd000, 360448, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x1bd000) = 0x7226b53bd000
mmap(0x7226b5416000, 24576, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x215000) = 0x7226b5416000
mmap(0x7226b541c000, 52816, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7226b541c000
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
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=940560, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
↪  0x7226b5874000
mmap(NULL, 942344, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7226b5519000
mmap(0x7226b5527000, 507904, PROT_READ|PROT_EXEC,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe000) = 0x7226b5527000
mmap(0x7226b55a3000, 372736, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
↪  0x8a000) = 0x7226b55a3000
mmap(0x7226b55fe000, 8192, PROT_READ|PROT_WRITE,
↪  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe4000) = 0x7226b55fe000
close(3)                                = 0
mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
↪  0x7226b5871000
arch_prctl(ARCH_SET_FS, 0x7226b5871740) = 0
set_tid_address(0x7226b5871a10)         = 3949
set_robust_list(0x7226b5871a20, 24)     = 0
rseq(0x7226b58720e0, 0x20, 0, 0x53053053) = 0
mprotect(0x7226b5416000, 16384, PROT_READ) = 0
mprotect(0x7226b55fe000, 4096, PROT_READ) = 0
mprotect(0x7226b5894000, 4096, PROT_READ) = 0
mprotect(0x7226b581b000, 45056, PROT_READ) = 0
mprotect(0x7226b58a1000, 4096, PROT_READ) = 0
mprotect(0x7226b58a6000, 4096, PROT_READ) = 0
mprotect(0x650be98e3000, 4096, PROT_READ) = 0
mprotect(0x7226b58e2000, 8192, PROT_READ) = 0
```

```
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024, rlim_max=RLIM64_INFINITY}) =
↪  0
munmap(0x7226b5896000, 29000)           = 0
getrandom("\x04\x85\x9f\x30\x1a\x37\x89\x12", 8, GRND_NONBLOCK) = 8
brk(NULL)                               = 0x650c19e7e000
brk(0x650c19e9f000)                     = 0x650c19e9f000
futex(0x7226b582977c, FUTEX_WAKE_PRIVATE, 2147483647) = 0
newfstatat(1, "", {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0x2), ...},
↪  AT_EMPTY_PATH) = 0
write(1, "Program 1: First derivative + Le"..., 55) = 55
newfstatat(0, "", {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0x2), ...},
↪  AT_EMPTY_PATH) = 0
read(0, "2 1000000000\n", 1024)         = 13
write(1, "Pi: 3.1416\n", 11)            = 11
read(0, 0x650c19e902c0, 1024)           = ? ERESTARTSYS (To be restarted if
↪  SA_RESTART is set)
--- SIGINT {si_signo=SIGINT, si_code=SI_KERNEL} ---
+++ killed by SIGINT +++
```