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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

Необходимо продемонстрировать ключевые системные вызовы, которые в них используются и то, что их использование соответствует варианту ЛР.

Общий метод и алгоритм решения

Strace — утилита командной строки для трассировки системных вызовов и сигналов в операционных системах Linux и других Unix-подобных системах. Её основное назначение — перехват и запись взаимодействия между пользовательским процессом и ядром операционной системы в реальном времени, что полезно для отладки, анализа производительности и диагностики ошибок.

Strace работает, используя механизм ядра ptrace (process trace), который позволяет одному процессу наблюдать и контролировать выполнение другого. При запуске с целевой программой strace перехватывает каждый системный вызов (например, открытие файла, запись в сеть, выделение памяти) на границе перехода из пользовательского пространства в пространство ядра и обратно. Это позволяет видеть не только факт вызова, но и его аргументы, возвращаемое значение и код ошибки (errno), если вызов завершился неудачно.

Основные флаги и опции:

-p PID — присоединиться к уже работающему процессу с указанным идентификатором (PID).

-s — подсчитать статистику по системным вызовам (время, количество вызовов, ошибки) и вывести сводку по завершении работы трассируемой программы.

-f — трассировать также все дочерние процессы, созданные с помощью fork(), vfork() и clone().

- e — фильтрация вывода по определенным системным вызовам, группам вызовов или выражениям (например, -e trace=open,read,write или -e trace=file).
- o файл — вывести вывод трассировки в указанный файл вместо стандартного потока ошибок (stderr).
- s размер — увеличить максимальную длину выводимых строк аргументов (по умолчанию часто ограничена 32 символами).
- t — выводить время в формате ЧЧ:ММ:СС при каждом системном вызове.
- T — показывать время, затраченное на выполнение каждого системного вызова.
- y — подробно выводить информацию о файловых дескрипторах (пути к файлам, сокетам).
- v — более подробный (verbose) вывод для некоторых вызовов.
- h — вывести справку по использованию утилиты.

Протокол работы программы

Lab1

```

execve("./parent", ["/parent"], 0x7fff22caf0f0 /* 28 vars */) = 0
brk(NULL)                               = 0x5634d4d20000
arch_prctl(0x3001 /* ARCH_??? */, 0x7ffc0d225640) = -1 EINVAL (Invalid argument)
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7ff018d36000
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=20892, ...}, AT_EMPTY_PATH) = 0
mmap(NULL, 20892, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7ff018d30000
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"..., 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\00{\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"..., 784, 64) = 784

mmap(NULL, 2264656, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7ff018b07000

mprotect(0x7ff018b2f000, 2023424, PROT_NONE) = 0

mmap(0x7ff018b2f000, 1658880, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7ff018b2f000

mmap(0x7ff018cc4000, 360448, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1bd000) = 0x7ff018cc4000

mmap(0x7ff018d1d000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x215000) = 0x7ff018d1d000

mmap(0x7ff018d23000, 52816, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7ff018d23000

close(3) = 0

mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -
1, 0) = 0x7ff018b04000

arch_prctl(ARCH_SET_FS, 0x7ff018b04740) = 0

set_tid_address(0x7ff018b04a10) = 802

set_robust_list(0x7ff018b04a20, 24) = 0

rseq(0x7ff018b050e0, 0x20, 0, 0x53053053) = 0

mprotect(0x7ff018d1d000, 16384, PROT_READ) = 0

mprotect(0x5634cc083000, 4096, PROT_READ) = 0

mprotect(0x7ff018d70000, 8192, PROT_READ) = 0

prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
rlim_max=RLIM64_INFINITY}) = 0

munmap(0x7ff018d30000, 20892) = 0

newfstatat(1, "", {st_mode=S_IFCHR|0600, st_rdev=makedev(0x88, 0x3), ...},
AT_EMPTY_PATH) = 0

getrandom("\xbc\x9e\x90\xf3\xcb\xb0\x40\x91", 8, GRND_NONBLOCK) = 8

brk(NULL) = 0x5634d4d20000

brk(0x5634d4d41000) = 0x5634d4d41000

write(1, "=== Lab 1. Variant 11 ===\n", 26) === Lab 1. Variant 11 ===
) = 26

```

```

write(1, "Chain: Parent -> Child1 -> Child"..., 44Chain: Parent -> Child1 -> Child2 -> Parent
) = 44
write(1, "\n", 1
) = 1
write(1, "=== Creating pipes ===\n", 23=== Creating pipes ===
) = 23
pipe2([3, 4], 0) = 0
pipe2([5, 6], 0) = 0
pipe2([7, 8], 0) = 0
write(1, "=== Creating Child1 ===\n", 24=== Creating Child1 ===
) = 24
clone(child_stack=NULL,
flags=CLONE_CHILD_CLEARPID|CLONE_CHILD_SETTID|SIGCHLD,
child_tidptr=0x7ff018b04a10) = 803
write(1, "Child1 created with PID: 803\n", 29Child1 created with PID: 803
) = 29
write(1, "=== Creating Child2 ===\n", 24=== Creating Child2 ===
) = 24
clone(child_stack=NULL,
flags=CLONE_CHILD_CLEARPID|CLONE_CHILD_SETTID|SIGCHLD,
child_tidptr=0x7ff018b04a10) = 804
write(1, "Child2 created with PID: 804\n", 29Child2 created with PID: 804
) = 29
close(3) = 0
close(5) = 0
close(6) = 0
close(8) = 0
write(1, "\n", 1
) = 1
write(1, "=== Starting data processing ==="..., 33=== Starting data processing ===
) = 33
write(1, "Enter strings for processing (ty"..., 52Enter strings for processing (type 'exit' to quit):
) = 52

```

```

write(1, "> ", 2> )          = 2

newfstatat(0, "", {st_mode=S_IFCHR|0600, st_rdev=makedev(0x88, 0x3), ...},
AT_EMPTY_PATH) = 0

read(0, mew mew mew
"mew mew mew\n", 1024)      = 12

write(1, "[Parent] Sending string #1 to Ch"... , 52[Parent] Sending string #1 to Child1: 'mew mew
mew'
) = 52

write(4, "mew mew mew\n", 12)      = 12

read(7, "MEW_MEW_MEW\n", 1023)    = 12

write(1, "[Parent] Final result from Child"... , 50[Parent] Final result from Child2:
'MEW_MEW_MEW'

) = 50

write(1, "> ", 2> )          = 2

read(0, exit
"exit\n", 1024)            = 5

write(1, "\n", 1
)                          = 1

write(1, "=== Shutting down ===\n", 22=== Shutting down ===
) = 22

write(1, "Closing pipes to signal children"... , 44Closing pipes to signal children to exit...
) = 44

close(4)                   = 0

close(7)                   = 0

write(1, "Waiting for children to exit...\n", 32Waiting for children to exit...
) = 32

wait4(803, [{WIFEXITED(s) && WEXITSTATUS(s) == 0}], 0, NULL) = 803
--- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=803, si_uid=0,
si_status=0, si_etime=0, si_stime=0} ---

wait4(804, [{WIFEXITED(s) && WEXITSTATUS(s) == 0}], 0, NULL) = 804

write(1, "Child processes exited with code"... , 54Child processes exited with codes: Child1=0,
Child2=0

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) = 54

write(1, "Program finished successfully.\n", 31Program finished successfully.

) = 31

exit_group(0) = ?

+++ exited with 0 +++

Lab2

execve("./batcher", [".batcher", "1000", "4"], 0x7ffe28a59c00 /* 28 vars */) = 0

brk(NULL) = 0x55e922e64000

arch_prctl(0x3001 /* ARCH_??? */, 0x7ffc7e1272f0) = -1 EINVAL (Invalid argument)

mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f14a9f3b000

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=20892, ...}, AT_EMPTY_PATH) = 0

mmap(NULL, 20892, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f14a9f35000

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"..., 832) = 832

pread64(3, "\6\0\0\04\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"..., 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\04\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) = 0x7f14a9d0c000

mprotect(0x7f14a9d34000, 2023424, PROT_NONE) = 0

mmap(0x7f14a9d34000, 1658880, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7f14a9d34000

mmap(0x7f14a9ec9000, 360448, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1bd000) = 0x7f14a9ec9000

mmap(0x7f14a9f22000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x215000) = 0x7f14a9f22000

```

mmap(0x7f14a9f28000, 52816, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f14a9f28000

close(3) = 0

mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -
1, 0) = 0x7f14a9d09000

arch_prctl(ARCH_SET_FS, 0x7f14a9d09740) = 0

set_tid_address(0x7f14a9d09a10) = 841

set_robust_list(0x7f14a9d09a20, 24) = 0

rseq(0x7f14a9d0a0e0, 0x20, 0, 0x53053053) = 0

mprotect(0x7f14a9f22000, 16384, PROT_READ) = 0

mprotect(0x55e8fafda000, 4096, PROT_READ) = 0

mprotect(0x7f14a9f75000, 8192, PROT_READ) = 0

prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
rlim_max=RLIM64_INFINITY}) = 0

munmap(0x7f14a9f35000, 20892) = 0

getrandom("\x5b\xd9\x45\xd6\x4f\x66\x4b\x1b", 8, GRND_NONBLOCK) = 8

brk(NULL) = 0x55e922e64000

brk(0x55e922e85000) = 0x55e922e85000

newfstatat(1, "", {st_mode=S_IFCHR|0600, st_rdev=makedev(0x88, 0x3), ...},
AT_EMPTY_PATH) = 0

write(1, "=== Odd-Even Sort ===\n", 22=== Odd-Even Sort ===
) = 22

write(1, "Array size: 1000\n", 17Array size: 1000
) = 17

write(1, "Maximum threads: 4\n", 19Maximum threads: 4
) = 19

getpid() = 841

write(1, "Thread Information:\n", 20Thread Information:
) = 20

write(1, "Process PID: 841\n", 17Process PID: 841
) = 17

write(1, "Maximum threads: 4\n", 19Maximum threads: 4
) = 19

```



```
write(1, "To view threads execute: ps -T -"... , 38To view threads execute: ps -T -p 841
```

```
) = 38
```

```
write(1, "Or: top -H -p 841\n", 18Or: top -H -p 841
```

```
) = 18
```

```
rt_sigaction(SIGRT_1, {sa_handler=0x7f14a9d9d870, sa_mask=[],  
sa_flags=SA_RESTORER|SA_ONSTACK|SA_RESTART|SA_SIGINFO,  
sa_restorer=0x7f14a9d4e520}, 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) = 0x7f14a9508000
```

```
mprotect(0x7f14a9509000, 8388608, PROT_READ|PROT_WRITE) = 0
```

```
rt_sigprocmask(SIG_BLOCK, ~[], [], 8) = 0
```

```
clone3({ flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THRE  
AD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CL  
EARTID, child_tid=0x7f14a9d08910, parent_tid=0x7f14a9d08910, exit_signal=0,  
stack=0x7f14a9508000, stack_size=0x7fff00, tls=0x7f14a9d08640} => {parent_tid=[842]}, 88)  
= 842
```

```
rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0
```

```
mmap(NULL, 8392704, PROT_NONE,  
MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) = 0x7f14a8d07000
```

```
mprotect(0x7f14a8d08000, 8388608, PROT_READ|PROT_WRITE) = 0
```

```
rt_sigprocmask(SIG_BLOCK, ~[], [], 8) = 0
```

```
clone3({ flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THRE  
AD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CL  
EARTID, child_tid=0x7f14a9507910, parent_tid=0x7f14a9507910, exit_signal=0,  
stack=0x7f14a8d07000, stack_size=0x7fff00, tls=0x7f14a9507640} => {parent_tid=[843]}, 88)  
= 843
```

```
rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0
```

```
mmap(NULL, 8392704, PROT_NONE,  
MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) = 0x7f14a8506000
```

```
mprotect(0x7f14a8507000, 8388608, PROT_READ|PROT_WRITE) = 0
```

```
rt_sigprocmask(SIG_BLOCK, ~[], [], 8) = 0
```

```
clone3({ flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THRE  
AD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CL  
EARTID, child_tid=0x7f14a8d06910, parent_tid=0x7f14a8d06910, exit_signal=0,  
stack=0x7f14a8506000, stack_size=0x7fff00, tls=0x7f14a8d06640} => {parent_tid=[844]}, 88)  
= 844
```

```
rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0
```

```

mmap(NULL, 8392704, PROT_NONE,
MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) = 0x7f14a7d05000

mprotect(0x7f14a7d06000, 8388608, PROT_READ|PROT_WRITE) = 0

rt_sigprocmask(SIG_BLOCK, ~[], [], 8) = 0

clone3({ flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THRE
AD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CL
EARTID, child_tid=0x7f14a8505910, parent_tid=0x7f14a8505910, exit_signal=0,
stack=0x7f14a7d05000, stack_size=0x7fff00, tls=0x7f14a8505640} => {parent_tid=[845]}, 88)
= 845

rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0

futex(0x7f14a9d08910, FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME, 842, NULL,
FUTEX_BITSET_MATCH_ANY) = 0

write(1, "\n", 1
) = 1

write(1, "Sorting completed in 0.095016 se"... , 38Sorting completed in 0.095016 seconds
) = 38

write(1, "Array sorted: YES\n", 18Array sorted: YES
) = 18

exit_group(0) = ?

+++ exited with 0 +++

```

Lab3

```

execve("./parent", ["/parent"], 0x7fff1d3424b8 /* 28 vars */) = 0

brk(NULL) = 0x5641281b3000

arch_prctl(0x3001 /* ARCH_??? */, 0x7ffe9353d1d0) = -1 EINVAL (Invalid argument)

mmap(NULL, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f9e6c486000

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=20892, ...}, AT_EMPTY_PATH) = 0

mmap(NULL, 20892, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f9e6c480000

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"... , 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"..., 48, 848) = 48

pread64(3,
"\4\0\0\0\24\0\0\0\3\0\0\0GNU\0O{\f225\|=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) =
0x7f9e6c257000

mprotect(0x7f9e6c27f000, 2023424, PROT_NONE) = 0

mmap(0x7f9e6c27f000, 1658880, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7f9e6c27f000

mmap(0x7f9e6c414000, 360448, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1bd000) = 0x7f9e6c414000

mmap(0x7f9e6c46d000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x215000) = 0x7f9e6c46d000

mmap(0x7f9e6c473000, 52816, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f9e6c473000

close(3) = 0

mmap(NULL, 12288, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f9e6c254000

arch_prctl(ARCH_SET_FS, 0x7f9e6c254740) = 0

set_tid_address(0x7f9e6c254a10) = 10066

set_robust_list(0x7f9e6c254a20, 24) = 0

rseq(0x7f9e6c2550e0, 0x20, 0, 0x53053053) = 0

mprotect(0x7f9e6c46d000, 16384, PROT_READ) = 0

mprotect(0x56411ab46000, 4096, PROT_READ) = 0

mprotect(0x7f9e6c4c0000, 8192, PROT_READ) = 0

prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
rlim_max=RLIM64_INFINITY}) = 0

munmap(0x7f9e6c480000, 20892) = 0

newfstatat(1, "", {st_mode=S_IFCHR|0600, st_rdev=makedev(0x88, 0x2), ...},
AT_EMPTY_PATH) = 0

getrandom("\xcc\x91\x4d\x0b\x15\x78\xb5\x28", 8, GRND_NONBLOCK) = 8

```

```

brk(NULL) = 0x5641281b3000

brk(0x5641281d4000) = 0x5641281d4000

write(1, "=== Lab 3. Variant 11 ===\n", 26) == Lab 3. Variant 11 ==

) = 26

write(1, "Chain: Parent -> Child1 -> Child"... , 72Chain: Parent -> Child1 -> Child2 -> Parent
(using Memory-Mapped Files)

) = 72

write(1, "\n", 1

) = 1

openat(AT_FDCWD, "/dev/shm/shm_parent_child1",
O_RDWR|O_CREAT|O_NOFOLLOW|O_CLOEXEC, 0666) = 3

openat(AT_FDCWD, "/dev/shm/shm_child1_child2",
O_RDWR|O_CREAT|O_NOFOLLOW|O_CLOEXEC, 0666) = 4

openat(AT_FDCWD, "/dev/shm/shm_child2_parent",
O_RDWR|O_CREAT|O_NOFOLLOW|O_CLOEXEC, 0666) = 5

ftruncate(3, 4096) = 0

ftruncate(4, 4096) = 0

ftruncate(5, 4096) = 0

mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 3, 0) =
0x7f9e6c4bf000

mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 4, 0) =
0x7f9e6c485000

mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 5, 0) =
0x7f9e6c484000

openat(AT_FDCWD, "/dev/shm/sem.sem_pc1", O_RDWR|O_NOFOLLOW) = -1 ENOENT
(No such file or directory)

getrandom("\x92\xb5\xdb\xe8\x00\x1c\x97\x63", 8, GRND_NONBLOCK) = 8

newfstatat(AT_FDCWD, "/dev/shm/sem.W5J1Fi", 0x7ffe9353cac0,
AT_SYMLINK_NOFOLLOW) = -1 ENOENT (No such file or directory)

openat(AT_FDCWD, "/dev/shm/sem.W5J1Fi", O_RDWR|O_CREAT|O_EXCL, 0666) = 6

write(6, "\0\0\0\0\0\0\0\0\200\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0", 32) = 32

mmap(NULL, 32, PROT_READ|PROT_WRITE, MAP_SHARED, 6, 0) = 0x7f9e6c483000

link("/dev/shm/sem.W5J1Fi", "/dev/shm/sem.sem_pc1") = 0

newfstatat(6, "", {st_mode=S_IFREG|0644, st_size=32, ...}, AT_EMPTY_PATH) = 0

```

```

unlink("/dev/shm/sem.W5J1Fi")      = 0

close(6)                            = 0

openat(AT_FDCWD, "/dev/shm/sem.sem_c1c2", O_RDWR|O_NOFOLLOW) = -1
ENOENT (No such file or directory)

getrandom("\xe3\x64\x13\x42\x52\x54\xa9\x8a", 8, GRND_NONBLOCK) = 8

newfstatat(AT_FDCWD, "/dev/shm/sem.hAI5hD", 0x7ffe9353cac0,
AT_SYMLINK_NOFOLLOW) = -1 ENOENT (No such file or directory)

openat(AT_FDCWD, "/dev/shm/sem.hAI5hD", O_RDWR|O_CREAT|O_EXCL, 0666) = 6

write(6, "\0\0\0\0\0\0\0\0\200\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0", 32) = 32

mmap(NULL, 32, PROT_READ|PROT_WRITE, MAP_SHARED, 6, 0) = 0x7f9e6c482000

link("/dev/shm/sem.hAI5hD", "/dev/shm/sem.sem_c1c2") = 0

newfstatat(6, "", {st_mode=S_IFREG|0644, st_size=32, ...}, AT_EMPTY_PATH) = 0

unlink("/dev/shm/sem.hAI5hD")      = 0

close(6)                            = 0

openat(AT_FDCWD, "/dev/shm/sem.sem_c2p", O_RDWR|O_NOFOLLOW) = -1 ENOENT
(No such file or directory)

getrandom("\x79\xc7\x8c\x0a\xbe\xa3\x3e\x19", 8, GRND_NONBLOCK) = 8

newfstatat(AT_FDCWD, "/dev/shm/sem.5QPMA8", 0x7ffe9353cac0,
AT_SYMLINK_NOFOLLOW) = -1 ENOENT (No such file or directory)

openat(AT_FDCWD, "/dev/shm/sem.5QPMA8", O_RDWR|O_CREAT|O_EXCL, 0666) = 6

write(6, "\0\0\0\0\0\0\0\0\200\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0", 32) = 32

mmap(NULL, 32, PROT_READ|PROT_WRITE, MAP_SHARED, 6, 0) = 0x7f9e6c481000

link("/dev/shm/sem.5QPMA8", "/dev/shm/sem.sem_c2p") = 0

newfstatat(6, "", {st_mode=S_IFREG|0644, st_size=32, ...}, AT_EMPTY_PATH) = 0

unlink("/dev/shm/sem.5QPMA8")      = 0

close(6)                            = 0

write(1, "=== Creating Child1 ===\n", 24) === Creating Child1 ===

) = 24

clone(child_stack=NULL,
flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLDstrace: Process
10067 attached

, child_tidptr=0x7f9e6c254a10) = 10067

[pid 10067] set_robust_list(0x7f9e6c254a20, 24) = 0

```

```

[pid 10066] write(1, "Child1 created with PID: 10067\n", 31 <unfinished ...>
Child1 created with PID: 10067
[pid 10067] close(3 <unfinished ...>
[pid 10066] <... write resumed>    = 31
[pid 10067] <... close resumed>    = 0
[pid 10066] write(1, "=== Creating Child2 ===\n", 24 <unfinished ...>
=== Creating Child2 ===
[pid 10067] close(4 <unfinished ...>
[pid 10066] <... write resumed>    = 24
[pid 10067] <... close resumed>    = 0
[pid 10066] clone(child_stack=NULL,
flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD <unfinished ...>
[pid 10067] close(5)              = 0
[pid 10067] execve("./child1", ["child1"], 0x7ffe9353d3a8 /* 28 vars */strace: Process 10068
attached
<unfinished ...>
[pid 10066] <... clone resumed>, child_tidptr=0x7f9e6c254a10) = 10068
[pid 10068] set_robust_list(0x7f9e6c254a20, 24 <unfinished ...>
[pid 10066] write(1, "Child2 created with PID: 10068\n", 31 <unfinished ...>
Child2 created with PID: 10068
[pid 10068] <... set_robust_list resumed>) = 0
[pid 10066] <... write resumed>    = 31
[pid 10066] close(3)              = 0
[pid 10068] close(3 <unfinished ...>
[pid 10066] close(4 <unfinished ...>
[pid 10068] <... close resumed>    = 0
[pid 10066] <... close resumed>    = 0
[pid 10068] close(4 <unfinished ...>
[pid 10066] close(5 <unfinished ...>
[pid 10068] <... close resumed>    = 0
[pid 10066] <... close resumed>    = 0

```

[pid 10068] close(5 <unfinished ...>

[pid 10066] write(1, "\n", 1 <unfinished ...>

[pid 10068] <... close resumed> = 0

[pid 10066] <... write resumed> = 1

[pid 10068] execve("./child2", ["child2"], 0x7ffe9353d3a8 /* 28 vars */ <unfinished ...>

[pid 10066] write(1, "=== Starting data processing ==="..., 33=== Starting data processing
===

) = 33

[pid 10066] write(1, "Enter strings for processing (ty"..., 52Enter strings for processing (type
'exit' to quit):

) = 52

[pid 10066] write(1, "> ", 2>) = 2

[pid 10066] newfstatat(0, "", {st_mode=S_IFCHR|0600, st_rdev=makedev(0x88, 0x2), ...},
AT_EMPTY_PATH) = 0

[pid 10066] read(0, <unfinished ...>

[pid 10067] <... execve resumed> = 0

[pid 10067] brk(NULL) = 0x56441dcb8000

[pid 10067] arch_prctl(0x3001 /* ARCH_??? */, 0x7ffed886b7c0) = -1 EINVAL (Invalid
argument)

[pid 10068] <... execve resumed> = 0

[pid 10067] mmap(NULL, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0 <unfinished ...>

[pid 10068] brk(NULL <unfinished ...>

[pid 10067] <... mmap resumed> = 0x7f2dcb9cd000

[pid 10068] <... brk resumed> = 0x55f66a612000

[pid 10067] access("/etc/ld.so.preload", R_OK <unfinished ...>

[pid 10068] arch_prctl(0x3001 /* ARCH_??? */, 0x7ffd8bc21010 <unfinished ...>

[pid 10067] <... access resumed> = -1 ENOENT (No such file or directory)

[pid 10068] <... arch_prctl resumed> = -1 EINVAL (Invalid argument)

[pid 10067] openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC
<unfinished ...>

```

[pid 10068] mmap(NULL, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0 <unfinished ...>

[pid 10067] <... openat resumed>    = 3

[pid 10068] <... mmap resumed>      = 0x7fd0f152d000

[pid 10067] newfstatat(3, "", <unfinished ...>

[pid 10068] access("/etc/ld.so.preload", R_OK <unfinished ...>

[pid 10067] <... newfstatat resumed>{st_mode=S_IFREG|0644, st_size=20892, ...},
AT_EMPTY_PATH) = 0

[pid 10068] <... access resumed>    = -1 ENOENT (No such file or directory)

[pid 10067] mmap(NULL, 20892, PROT_READ, MAP_PRIVATE, 3, 0 <unfinished ...>

[pid 10068] openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC
<unfinished ...>

[pid 10067] <... mmap resumed>      = 0x7f2dcb9c7000

[pid 10068] <... openat resumed>    = 3

[pid 10067] close(3 <unfinished ...>

[pid 10068] newfstatat(3, "", <unfinished ...>

[pid 10067] <... close resumed>     = 0

[pid 10068] <... newfstatat resumed>{st_mode=S_IFREG|0644, st_size=20892, ...},
AT_EMPTY_PATH) = 0

[pid 10067] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6",
O_RDONLY|O_CLOEXEC <unfinished ...>

[pid 10068] mmap(NULL, 20892, PROT_READ, MAP_PRIVATE, 3, 0 <unfinished ...>

[pid 10067] <... openat resumed>    = 3

[pid 10068] <... mmap resumed>      = 0x7fd0f1527000

[pid 10067] read(3, <unfinished ...>

[pid 10068] close(3 <unfinished ...>

[pid 10067] <... read
resumed>"\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

[pid 10068] <... close resumed>     = 0

[pid 10067] pread64(3, <unfinished ...>

[pid 10068] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6",
O_RDONLY|O_CLOEXEC <unfinished ...>

[pid 10067] <... pread64
resumed>"\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"..., 784, 64) = 784

```



```

[pid 10068] <... openat resumed>      = 3

[pid 10067] pread64(3, <unfinished ...>

[pid 10068] read(3, <unfinished ...>

[pid 10067] <... pread64 resumed>"\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"..., 48, 848) = 48

[pid 10068] <... read
resumed>"\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"..., 832) = 832

[pid 10067] pread64(3, <unfinished ...>

[pid 10068] pread64(3, <unfinished ...>

[pid 10067] <... pread64
resumed>"\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

[pid 10068] <... pread64
resumed>"\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

[pid 10067] newfstatat(3, "", <unfinished ...>

[pid 10068] pread64(3, <unfinished ...>

[pid 10067] <... newfstatat resumed>{st_mode=S_IFREG|0755, st_size=2220400, ...},
AT_EMPTY_PATH) = 0

[pid 10068] <... pread64 resumed>"\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"..., 48, 848) = 48

[pid 10067] pread64(3, <unfinished ...>

[pid 10068] pread64(3, <unfinished ...>

[pid 10067] <... pread64
resumed>"\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

[pid 10068] <... pread64
resumed>"\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

[pid 10067] mmap(NULL, 2264656, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE,
3, 0 <unfinished ...>

[pid 10068] newfstatat(3, "", <unfinished ...>

[pid 10067] <... mmap resumed>      = 0x7f2dcb79e000

[pid 10068] <... newfstatat resumed>{st_mode=S_IFREG|0755, st_size=2220400, ...},
AT_EMPTY_PATH) = 0

[pid 10067] mprotect(0x7f2dcb7c6000, 2023424, PROT_NONE <unfinished ...>

[pid 10068] pread64(3, <unfinished ...>

[pid 10067] <... mprotect resumed>    = 0

```

```

[pid 10068] <... pread64
resumed>"\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

[pid 10067] mmap(0x7f2dcb7c6000, 1658880, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000 <unfinished ...>

[pid 10068] mmap(NULL, 2264656, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE,
3, 0 <unfinished ...>

[pid 10067] <... mmap resumed>)      = 0x7f2dcb7c6000

[pid 10068] <... mmap resumed>)      = 0x7fd0f12fe000

[pid 10067] mmap(0x7f2dcb95b000, 360448, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1bd000 <unfinished ...>

[pid 10068] mprotect(0x7fd0f1326000, 2023424, PROT_NONE <unfinished ...>

[pid 10067] <... mmap resumed>)      = 0x7f2dcb95b000

[pid 10068] <... mprotect resumed>)   = 0

[pid 10067] mmap(0x7f2dcb9b4000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x215000 <unfinished ...>

[pid 10068] mmap(0x7fd0f1326000, 1658880, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000 <unfinished ...>

[pid 10067] <... mmap resumed>)      = 0x7f2dcb9b4000

[pid 10068] <... mmap resumed>)      = 0x7fd0f1326000

[pid 10067] mmap(0x7f2dcb9ba000, 52816, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0 <unfinished ...>

[pid 10068] mmap(0x7fd0f14bb000, 360448, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1bd000 <unfinished ...>

[pid 10067] <... mmap resumed>)      = 0x7f2dcb9ba000

[pid 10068] <... mmap resumed>)      = 0x7fd0f14bb000

[pid 10068] mmap(0x7fd0f1514000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x215000 <unfinished ...>

[pid 10067] close(3 <unfinished ...>

[pid 10068] <... mmap resumed>)      = 0x7fd0f1514000

[pid 10067] <... close resumed>)     = 0

[pid 10068] mmap(0x7fd0f151a000, 52816, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0 <unfinished ...>

[pid 10067] mmap(NULL, 12288, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0 <unfinished ...>

[pid 10068] <... mmap resumed>)      = 0x7fd0f151a000

```

[pid 10067] <... mmap resumed>) = 0x7f2dcb79b000

[pid 10068] close(3 <unfinished ...>

[pid 10067] arch_prctl(ARCH_SET_FS, 0x7f2dcb79b740 <unfinished ...>

[pid 10068] <... close resumed>) = 0

[pid 10067] <... arch_prctl resumed>) = 0

[pid 10068] mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0 <unfinished ...>

[pid 10067] set_tid_address(0x7f2dcb79ba10 <unfinished ...>

[pid 10068] <... mmap resumed>) = 0x7fd0f12fb000

[pid 10067] <... set_tid_address resumed>) = 10067

[pid 10068] arch_prctl(ARCH_SET_FS, 0x7fd0f12fb740 <unfinished ...>

[pid 10067] set_robust_list(0x7f2dcb79ba20, 24 <unfinished ...>

[pid 10068] <... arch_prctl resumed>) = 0

[pid 10067] <... set_robust_list resumed>) = 0

[pid 10068] set_tid_address(0x7fd0f12fba10 <unfinished ...>

[pid 10067] rseq(0x7f2dcb79c0e0, 0x20, 0, 0x53053053 <unfinished ...>

[pid 10068] <... set_tid_address resumed>) = 10068

[pid 10067] <... rseq resumed>) = 0

[pid 10068] set_robust_list(0x7fd0f12fba20, 24) = 0

[pid 10067] mprotect(0x7f2dcb9b4000, 16384, PROT_READ <unfinished ...>

[pid 10068] rseq(0x7fd0f12fc0e0, 0x20, 0, 0x53053053 <unfinished ...>

[pid 10067] <... mprotect resumed>) = 0

[pid 10068] <... rseq resumed>) = 0

[pid 10067] mprotect(0x564404b43000, 4096, PROT_READ) = 0

[pid 10068] mprotect(0x7fd0f1514000, 16384, PROT_READ <unfinished ...>

[pid 10067] mprotect(0x7f2dcba07000, 8192, PROT_READ <unfinished ...>

[pid 10068] <... mprotect resumed>) = 0

[pid 10067] <... mprotect resumed>) = 0

[pid 10068] mprotect(0x55f63fa0e000, 4096, PROT_READ <unfinished ...>

[pid 10067] prlimit64(0, RLIMIT_STACK, NULL, <unfinished ...>

[pid 10068] <... mprotect resumed>) = 0

```

[pid 10067] <... prlimit64 resumed>{rlim_cur=8192*1024, rlim_max=RLIM64_INFINITY})
= 0

[pid 10068] mprotect(0x7fd0f1567000, 8192, PROT_READ <unfinished ...>

[pid 10067] munmap(0x7f2dcb9c7000, 20892 <unfinished ...>

[pid 10068] <... mprotect resumed>)    = 0

[pid 10067] <... munmap resumed>)      = 0

[pid 10068] prlimit64(0, RLIMIT_STACK, NULL, <unfinished ...>

[pid 10067] openat(AT_FDCWD, "/dev/shm/shm_parent_child1",
O_RDWR|O_NOFOLLOW|O_CLOEXEC <unfinished ...>

[pid 10068] <... prlimit64 resumed>{rlim_cur=8192*1024, rlim_max=RLIM64_INFINITY})
= 0

[pid 10067] <... openat resumed>)      = 3

[pid 10068] munmap(0x7fd0f1527000, 20892 <unfinished ...>

[pid 10067] openat(AT_FDCWD, "/dev/shm/shm_child1_child2",
O_RDWR|O_NOFOLLOW|O_CLOEXEC <unfinished ...>

[pid 10068] <... munmap resumed>)      = 0

[pid 10067] <... openat resumed>)      = 4

[pid 10068] openat(AT_FDCWD, "/dev/shm/shm_child1_child2",
O_RDWR|O_NOFOLLOW|O_CLOEXEC <unfinished ...>

[pid 10067] mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 3, 0
<unfinished ...>

[pid 10068] <... openat resumed>)      = 3

[pid 10067] <... mmap resumed>)        = 0x7f2dcba06000

[pid 10068] openat(AT_FDCWD, "/dev/shm/shm_child2_parent",
O_RDWR|O_NOFOLLOW|O_CLOEXEC <unfinished ...>

[pid 10067] mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 4, 0
<unfinished ...>

[pid 10068] <... openat resumed>)      = 4

[pid 10067] <... mmap resumed>)        = 0x7f2dcb9cc000

[pid 10068] mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 3, 0
<unfinished ...>

[pid 10067] openat(AT_FDCWD, "/dev/shm/sem.sem_pc1", O_RDWR|O_NOFOLLOW
<unfinished ...>

[pid 10068] <... mmap resumed>)        = 0x7fd0f1566000

[pid 10067] <... openat resumed>)      = 5

```

```

[pid 10068] mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 4, 0
<unfinished ...>

[pid 10067] newfstatat(5, "", <unfinished ...>

[pid 10068] <... mmap resumed>)      = 0x7fd0f152c000

[pid 10067] <... newfstatat resumed>{st_mode=S_IFREG|0644, st_size=32, ...},
AT_EMPTY_PATH) = 0

[pid 10068] openat(AT_FDCWD, "/dev/shm/sem.sem_c1c2", O_RDWR|O_NOFOLLOW
<unfinished ...>

[pid 10067] getrandom(<unfinished ...>

[pid 10068] <... openat resumed>)      = 5

[pid 10068] newfstatat(5, "", <unfinished ...>

[pid 10067] <... getrandom resumed>"\xd1\xc2\x53\x2b\xa9\x13\x1b\xf3", 8,
GRND_NONBLOCK) = 8

[pid 10068] <... newfstatat resumed>{st_mode=S_IFREG|0644, st_size=32, ...},
AT_EMPTY_PATH) = 0

[pid 10067] brk(NULL <unfinished ...>

[pid 10068] getrandom(<unfinished ...>

[pid 10067] <... brk resumed>)      = 0x56441dcb8000

[pid 10068] <... getrandom resumed>"\xf3\xb4\xae\x7f\xcf\x4a\xbe\xb4", 8,
GRND_NONBLOCK) = 8

[pid 10067] brk(0x56441dcd9000 <unfinished ...>

[pid 10068] brk(NULL <unfinished ...>

[pid 10067] <... brk resumed>)      = 0x56441dcd9000

[pid 10068] <... brk resumed>)      = 0x55f66a612000

[pid 10067] mmap(NULL, 32, PROT_READ|PROT_WRITE, MAP_SHARED, 5, 0
<unfinished ...>

[pid 10068] brk(0x55f66a633000 <unfinished ...>

[pid 10067] <... mmap resumed>)      = 0x7f2dcb9cb000

[pid 10068] <... brk resumed>)      = 0x55f66a633000

[pid 10067] close(5 <unfinished ...>

[pid 10068] mmap(NULL, 32, PROT_READ|PROT_WRITE, MAP_SHARED, 5, 0) =
0x7fd0f152b000

[pid 10067] <... close resumed>)      = 0

[pid 10068] close(5 <unfinished ...>

```

```

[pid 10067] openat(AT_FDCWD, "/dev/shm/sem.sem_c1c2", O_RDWR|O_NOFOLLOW
<unfinished ...>

[pid 10068] <... close resumed>)      = 0

[pid 10067] <... openat resumed>)      = 5

[pid 10068] openat(AT_FDCWD, "/dev/shm/sem.sem_c2p", O_RDWR|O_NOFOLLOW
<unfinished ...>

[pid 10067] newfstatat(5, "", <unfinished ...>

[pid 10068] <... openat resumed>)      = 5

[pid 10067] <... newfstatat resumed>{st_mode=S_IFREG|0644, st_size=32, ...},
AT_EMPTY_PATH) = 0

[pid 10068] newfstatat(5, "", <unfinished ...>

[pid 10067] mmap(NULL, 32, PROT_READ|PROT_WRITE, MAP_SHARED, 5, 0
<unfinished ...>

[pid 10068] <... newfstatat resumed>{st_mode=S_IFREG|0644, st_size=32, ...},
AT_EMPTY_PATH) = 0

[pid 10067] <... mmap resumed>)        = 0x7f2dcb9ca000

[pid 10068] mmap(NULL, 32, PROT_READ|PROT_WRITE, MAP_SHARED, 5, 0
<unfinished ...>

[pid 10067] close(5 <unfinished ...>

[pid 10068] <... mmap resumed>)        = 0x7fd0f152a000

[pid 10067] <... close resumed>)       = 0

[pid 10068] close(5 <unfinished ...>

[pid 10067] close(3 <unfinished ...>

[pid 10068] <... close resumed>)       = 0

[pid 10067] <... close resumed>)       = 0

[pid 10068] close(3 <unfinished ...>

[pid 10067] close(4 <unfinished ...>

[pid 10068] <... close resumed>)       = 0

[pid 10067] <... close resumed>)       = 0

[pid 10068] close(4 <unfinished ...>

[pid 10067] futex(0x7f2dcb9cb000,
FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME, 0, NULL,
FUTEX_BITSET_MATCH_ANY <unfinished ...>

[pid 10068] <... close resumed>)       = 0

```

```
[pid 10068] futex(0x7fd0f152b000,  
FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME, 0, NULL,  
FUTEX_BITSET_MATCH_ANYmew hello world
```

<unfinished ...>

```
[pid 10066] <... read resumed>"mew hello world\n", 1024) = 16
```

```
[pid 10066] write(1, "[Parent] Sending string #1 to Ch"..., 56[Parent] Sending string #1 to  
Child1: 'mew hello world'
```

```
) = 56
```

```
[pid 10066] futex(0x7f9e6c483000, FUTEX_WAKE, 1) = 1
```

```
[pid 10067] <... futex resumed>) = 0
```

```
[pid 10066] futex(0x7f9e6c481000,  
FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME, 0, NULL,  
FUTEX_BITSET_MATCH_ANY <unfinished ...>
```

```
[pid 10067] futex(0x7f2dcb9ca000, FUTEX_WAKE, 1 <unfinished ...>
```

```
[pid 10068] <... futex resumed>) = 0
```

```
[pid 10067] <... futex resumed>) = 1
```

```
[pid 10068] futex(0x7fd0f152a000, FUTEX_WAKE, 1 <unfinished ...>
```

```
[pid 10067] futex(0x7f2dcb9cb000,  
FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME, 0, NULL,  
FUTEX_BITSET_MATCH_ANY <unfinished ...>
```

```
[pid 10066] <... futex resumed>) = 0
```

```
[pid 10068] <... futex resumed>) = 1
```

```
[pid 10066] write(1, "[Parent] Final result from Child"..., 54 <unfinished ...>
```

```
[pid 10068] futex(0x7fd0f152b000,  
FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME, 0, NULL,  
FUTEX_BITSET_MATCH_ANY[Parent] Final result from Child2:  
'MEW_HELLO_WORLD'
```

<unfinished ...>

```
[pid 10066] <... write resumed>) = 54
```

```
[pid 10066] write(1, "> ", 2>) = 2
```

```
[pid 10066] read(0, mew mew
```

```
"mew mew\n", 1024) = 8
```

```
[pid 10066] write(1, "[Parent] Sending string #2 to Ch"..., 48[Parent] Sending string #2 to  
Child1: 'mew mew'
```

) = 48

[pid 10066] futex(0x7f9e6c483000, FUTEX_WAKE, 1) = 1

[pid 10067] <... futex resumed> = 0

[pid 10066] futex(0x7f9e6c481000,
FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME, 0, NULL,
FUTEX_BITSET_MATCH_ANY <unfinished ...>

[pid 10067] futex(0x7f2dcb9ca000, FUTEX_WAKE, 1 <unfinished ...>

[pid 10068] <... futex resumed> = 0

[pid 10067] <... futex resumed> = 1

[pid 10068] futex(0x7fd0f152a000, FUTEX_WAKE, 1 <unfinished ...>

[pid 10067] futex(0x7f2dcb9cb000,
FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME, 0, NULL,
FUTEX_BITSET_MATCH_ANY <unfinished ...>

[pid 10066] <... futex resumed> = 0

[pid 10068] <... futex resumed> = 1

[pid 10066] write(1, "[Parent] Final result from Child"..., 46 <unfinished ...>

[pid 10068] futex(0x7fd0f152b000,
FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME, 0, NULL,
FUTEX_BITSET_MATCH_ANY[Parent] Final result from Child2: 'MEW_MEW'

<unfinished ...>

[pid 10066] <... write resumed> = 46

[pid 10066] write(1, "> ", 2) = 2

[pid 10066] read(0, exit

"exit\n", 1024) = 5

[pid 10066] futex(0x7f9e6c483000, FUTEX_WAKE, 1) = 1

[pid 10067] <... futex resumed> = 0

[pid 10066] write(1, "\n", 1 <unfinished ...>

[pid 10067] futex(0x7f2dcb9ca000, FUTEX_WAKE, 1

<unfinished ...>

[pid 10066] <... write resumed> = 1

[pid 10067] <... futex resumed> = 1

[pid 10066] write(1, "=== Shutting down ===\n", 22 <unfinished ...>


```

[pid 10068] <... futex resumed>    = 0
=== Shutting down ===
[pid 10066] <... write resumed>    = 22
[pid 10067] munmap(0x7f2dcba06000, 4096 <unfinished ...>
[pid 10066] write(1, "Waiting for children to exit...\n", 32 <unfinished ...>
Waiting for children to exit...
[pid 10068] munmap(0x7fd0f1566000, 4096 <unfinished ...>
[pid 10066] <... write resumed>    = 32
[pid 10067] <... munmap resumed>   = 0
[pid 10066] wait4(10067, <unfinished ...>
[pid 10068] <... munmap resumed>   = 0
[pid 10067] munmap(0x7f2dcb9cc000, 4096 <unfinished ...>
[pid 10068] munmap(0x7fd0f152c000, 4096 <unfinished ...>
[pid 10067] <... munmap resumed>   = 0
[pid 10068] <... munmap resumed>   = 0
[pid 10067] munmap(0x7f2dcb9cb000, 32 <unfinished ...>
[pid 10068] munmap(0x7fd0f152b000, 32 <unfinished ...>
[pid 10067] <... munmap resumed>   = 0
[pid 10068] <... munmap resumed>   = 0
[pid 10067] munmap(0x7f2dcb9ca000, 32 <unfinished ...>
[pid 10068] munmap(0x7fd0f152a000, 32 <unfinished ...>
[pid 10067] <... munmap resumed>   = 0
[pid 10068] <... munmap resumed>   = 0
[pid 10068] exit_group(0 <unfinished ...>
[pid 10067] exit_group(0 <unfinished ...>
[pid 10068] <... exit_group resumed> = ?
[pid 10067] <... exit_group resumed> = ?
[pid 10068] +++ exited with 0 +++
[pid 10067] +++ exited with 0 +++
<... wait4 resumed>[{ WIFEXITED(s) && WEXITSTATUS(s) == 0}], 0, NULL) = 10067

```

```

--- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=10068, si_uid=0,
si_status=0, si_utime=0, si_stime=0} ---

wait4(10068, [{WIFEXITED(s) && WEXITSTATUS(s) == 0}], 0, NULL) = 10068

munmap(0x7f9e6c4bf000, 4096)      = 0
munmap(0x7f9e6c485000, 4096)      = 0
munmap(0x7f9e6c484000, 4096)      = 0
unlink("/dev/shm/shm_parent_child1") = 0
unlink("/dev/shm/shm_child1_child2") = 0
unlink("/dev/shm/shm_child2_parent") = 0
munmap(0x7f9e6c483000, 32)        = 0
munmap(0x7f9e6c482000, 32)        = 0
munmap(0x7f9e6c481000, 32)        = 0
unlink("/dev/shm/sem.sem_pc1")    = 0
unlink("/dev/shm/sem.sem_c1c2")   = 0
unlink("/dev/shm/sem.sem_c2p")    = 0

write(1, "Child processes exited with code"..., 54Child processes exited with codes:
Child1=0, Child2=0

) = 54

write(1, "Program finished successfully.\n", 31Program finished successfully.

) = 31

exit_group(0)                    = ?

+++ exited with 0 +++

```

Lab4

Program1 (статистическая линковка)

```

execve("./program1", ["/program1"], 0x7ffdb8491a60 /* 28 vars */) = 0

brk(NULL) = 0x55cc646aa000

arch_prctl(0x3001 /* ARCH_??? */, 0x7fff232fc350) = -1 EINVAL (Invalid argument)

mmap(NULL, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7fa0f0241000

access("/etc/ld.so.preload", R_OK) = -1 ENOENT (No such file or directory)

```

```

    openat(AT_FDCWD, "./glibc-hwcaps/x86-64-v3/libfuncs1.so",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)

    openat(AT_FDCWD, "./glibc-hwcaps/x86-64-v2/libfuncs1.so",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)

    openat(AT_FDCWD, "./tls/haswell/x86_64/libfuncs1.so",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)

    openat(AT_FDCWD, "./tls/haswell/libfuncs1.so", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)

    openat(AT_FDCWD, "./tls/x86_64/libfuncs1.so", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)

    openat(AT_FDCWD, "./tls/libfuncs1.so", O_RDONLY|O_CLOEXEC) = -1 ENOENT
(No such file or directory)

    openat(AT_FDCWD, "./haswell/x86_64/libfuncs1.so", O_RDONLY|O_CLOEXEC) =
-1 ENOENT (No such file or directory)

    openat(AT_FDCWD, "./haswell/libfuncs1.so", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)

    openat(AT_FDCWD, "./x86_64/libfuncs1.so", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)

    openat(AT_FDCWD, "./libfuncs1.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\0\0\0\0\0\0\0\0"...
, 832) = 832

    newfstatat(3, "", {st_mode=S_IFREG|0777, st_size=15528, ...}, AT_EMPTY_PATH)
= 0

    getcwd("/mnt/c/Users/mkoti/os_laba1/lab4", 128) = 33

    mmap(NULL, 16432, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7fa0f023c000

    mmap(0x7fa0f023d000, 4096, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x7fa0f023d000

    mmap(0x7fa0f023e000, 4096, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7fa0f023e000

    mmap(0x7fa0f023f000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7fa0f023f000

    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, "./tls/haswell/x86_64/libc.so.6", O_RDONLY|O_CLOEXEC) = -
1 ENOENT (No such file or directory)

```

openat(AT_FDCWD, "/tls/haswell/libc.so.6", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)

openat(AT_FDCWD, "/tls/x86_64/libc.so.6", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)

openat(AT_FDCWD, "/tls/libc.so.6", O_RDONLY|O_CLOEXEC) = -1 ENOENT (No
such file or directory)

openat(AT_FDCWD, "/haswell/x86_64/libc.so.6", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)

openat(AT_FDCWD, "/haswell/libc.so.6", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)

openat(AT_FDCWD, "/x86_64/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
newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=20892, ...}, AT_EMPTY_PATH)
= 0

mmap(NULL, 20892, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7fa0f0236000

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"..., 832) =
832

pread64(3, "\6\0\0\04\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\05\0\0\0GNU\0\2\0\0300\4\0\0\03\0\0\0\0\0\0"..., 48, 848)
= 48

pread64(3,
"\4\0\0\024\0\0\03\0\0\0GNU\0O{\f225\|=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

mmap(NULL, 2264656, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7fa0f000d000

mprotect(0x7fa0f0035000, 2023424, PROT_NONE) = 0

mmap(0x7fa0f0035000, 1658880, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7fa0f0035000

```
mmap(0x7fa0f01ca000, 360448, PROT_READ,  
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1bd000) = 0x7fa0f01ca000
```

```
mmap(0x7fa0f0223000, 24576, PROT_READ|PROT_WRITE,  
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x215000) = 0x7fa0f0223000
```

```
mmap(0x7fa0f0229000, 52816, PROT_READ|PROT_WRITE,  
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7fa0f0229000
```

```
close(3) = 0
```

```
mmap(NULL, 12288, PROT_READ|PROT_WRITE,  
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7fa0f000a000
```

```
arch_prctl(ARCH_SET_FS, 0x7fa0f000a740) = 0
```

```
set_tid_address(0x7fa0f000aa10) = 1455
```

```
set_robust_list(0x7fa0f000aa20, 24) = 0
```

```
rseq(0x7fa0f000b0e0, 0x20, 0, 0x53053053) = 0
```

```
mprotect(0x7fa0f0223000, 16384, PROT_READ) = 0
```

```
mprotect(0x7fa0f023f000, 4096, PROT_READ) = 0
```

```
mprotect(0x55cc60fb5000, 4096, PROT_READ) = 0
```

```
mprotect(0x7fa0f027b000, 8192, PROT_READ) = 0
```

```
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,  
rlim_max=RLIM64_INFINITY}) = 0
```

```
munmap(0x7fa0f0236000, 20892) = 0
```

```
newfstatat(1, "", {st_mode=S_IFCHR|0600, st_rdev=makedev(0x88, 0), ...},  
AT_EMPTY_PATH) = 0
```

```
getrandom("\xe7\xc3\xb8\xf2\xfa\xb3\xe7\xf3", 8, GRND_NONBLOCK) = 8
```

```
brk(NULL) = 0x55cc646aa000
```

```
brk(0x55cc646cb000) = 0x55cc646cb000
```

```
write(1, "Программа 1: Использование библиотеки при линковке\n", 94) = 94
```

```
write(1, "Команды:\n", 16) = 16
```

```
write(1, " 0 - справка\n", 21) = 21
```

```
write(1, " 1 A B - НОД чисел A и B\n", 35) = 35
```

```
write(1, " 2 size n1 n2 ... - сортировка массива\n", 57) = 57
```

```
write(1, " q - выход\n", 17) = 17
```

```
write(1, "\n", 1) = 1
```

```

newfstatat(0, "", {st_mode=S_IFCHR|0600, st_rdev=makedev(0x88, 0), ...},
AT_EMPTY_PATH) = 0

write(1, "> ", 2) = 2

read(0, "1 15 6\n", 1024) = 7

write(1, "НОД(15, 6) = 3\n", 18) = 18

write(1, "> ", 2) = 2

read(0, "2 3 109 98 4\n", 1024) = 13

write(1, "Исходный массив: [109, 98, 4]\n", 44) = 44

write(1, "Отсортированный массив: [4, 98, 109]\n", 58) = 58

write(1, "> ", 2) = 2

read(0, "q\n", 1024) = 2

exit_group(0) = ?

+++ exited with 0 +++

```

Program2 (динамическая загрузка)

```

execve("./program2", [ "./program2" ], 0x7fff1ad3cba0 /* 28 vars */) = 0

brk(NULL) = 0x560d81fe7000

arch_prctl(0x3001 /* ARCH_??? */, 0x7ffd7916fe20) = -1 EINVAL (Invalid
argument)

mmap(NULL, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7ffbef170000

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=20892, ...}, AT_EMPTY_PATH)
= 0

mmap(NULL, 20892, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7ffbef16a000

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"..., 832) =
832

pread64(3, "\6\0\0\04\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"..., 48, 848)
= 48

pread64(3,
"\\4\\0\\0\\0\\24\\0\\0\\0\\3\\0\\0\\0GNU\\0O{\\f225\\|=\\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

mmap(NULL, 2264656, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7ffbeef41000

mprotect(0x7ffbeef69000, 2023424, PROT_NONE) = 0

mmap(0x7ffbeef69000, 1658880, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7ffbeef69000

mmap(0x7ffbef0fe000, 360448, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1bd000) = 0x7ffbef0fe000

mmap(0x7ffbef157000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x215000) = 0x7ffbef157000

mmap(0x7ffbef15d000, 52816, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7ffbef15d000

close(3) = 0

mmap(NULL, 12288, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7ffbeef3e000

arch_prctl(ARCH_SET_FS, 0x7ffbeef3e740) = 0

set_tid_address(0x7ffbeef3ea10) = 1459

set_robust_list(0x7ffbeef3ea20, 24) = 0

rseq(0x7ffbeef3f0e0, 0x20, 0, 0x53053053) = 0

mprotect(0x7ffbef157000, 16384, PROT_READ) = 0

mprotect(0x560d61e48000, 4096, PROT_READ) = 0

mprotect(0x7ffbef1aa000, 8192, PROT_READ) = 0

prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
rlim_max=RLIM64_INFINITY}) = 0

munmap(0x7ffbef16a000, 20892) = 0

getrandom("\\x13\\x5c\\xd8\\xb4\\x6b\\x96\\xdb\\x2f", 8, GRND_NONBLOCK) = 8

brk(NULL) = 0x560d81fe7000

brk(0x560d82008000) = 0x560d82008000

openat(AT_FDCWD, "./libfuncs1.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\\0\\0\\0\\0\\0\\0\\0\\0\"..., 832) = 832
newfstatat(3, "", {st_mode=S_IFREG|0777, st_size=15528, ...}, AT_EMPTY_PATH)
= 0

getcwd("/mnt/c/Users/mkoti/os_laba1/lab4", 128) = 33

mmap(NULL, 16432, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7ffbef16b000

mmap(0x7ffbef16c000, 4096, PROT_READ|PROT_EXEC,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x7ffbef16c000

mmap(0x7ffbef16d000, 4096, PROT_READ,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7ffbef16d000

mmap(0x7ffbef16e000, 8192, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7ffbef16e000

close(3) = 0

mprotect(0x7ffbef16e000, 4096, PROT_READ) = 0

newfstatat(1, "", {st_mode=S_IFCHR|0600, st_rdev=makedev(0x88, 0), ...},
AT_EMPTY_PATH) = 0

write(1, "Загружена библиотека: ./libfuncs1.so\\n", 56) = 56

write(1, "Программа 2: Динамическая загрузка библиотек\\n", 83) = 83

write(1, "Команды:\\n", 16) = 16

write(1, " 0 - переключить библиотеку (1/2)\\n", 56) = 56

write(1, " 1 A B - НОД чисел A и B\\n", 35) = 35

write(1, " 2 size n1 n2 ... - сортировка массива\\n", 57) = 57

write(1, " q - выход\\n", 17) = 17

write(1, "\\n", 1) = 1

newfstatat(0, "", {st_mode=S_IFCHR|0600, st_rdev=makedev(0x88, 0), ...},
AT_EMPTY_PATH) = 0

write(1, "> ", 2) = 2

read(0, "1 15 6\\n", 1024) = 7

write(1, "НОД(15, 6) = 3\\n", 18) = 18

write(1, "> ", 2) = 2

read(0, "2 3 109 98 4\\n", 1024) = 13

write(1, "Исходный массив: [109, 98, 4]\\n", 44) = 44

write(1, "Отсортированный массив: [4, 98, 109]\\n", 58) = 58

```



```
write(1, "> ", 2) = 2
read(0, "q\n", 1024) = 2
munmap(0x7ffbef16b000, 16432) = 0
exit_group(0) = ?
+++ exited with 0 +++
```

Вывод

В рамках лабораторной работы №5 был выполнен углублённый анализ системных вызовов, порождаемых программами, созданными в ходе четырёх предыдущих лабораторных работ. Использование утилиты `strace` дало возможность проследить, каким образом операции, написанные на языке Си — создание процессов, взаимодействие через каналы, использование разделяемой памяти, работа с потоками и динамическими библиотеками — преобразуются в низкоуровневые обращения к ядру операционной системы, таким как `clone`, `pipe2`, `mmap`, `openat` и `mummap`. Проведённый анализ не только подтвердил корректность реализации механизмов межпроцессного взаимодействия и управления ресурсами в каждой из рассмотренных программ, но и позволил выявить характерные шаблоны применения системных вызовов при использовании различных средств коммуникации (каналов и разделяемой памяти), а также при организации параллельных вычислений через процессы и потоки.