Московский Авиационный Институт

(Национальный Исследовательский Университет)

Институт №8 “Компьютерные науки и прикладная математика”

Кафедра №806 “Вычислительная математика и программирование”

**Лабораторная работа №8 по курсу**

**«Операционные системы»**

Группа: М8О-215Б-23

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**Постановка задачи**

**Вариант -.**

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.

**Общий метод и алгоритм решения**

Strace — это мощная утилита командной строки для диагностики, отладки и анализа программ в операционных системах семейства Linux. Она позволяет отслеживать взаимодействие между процессами и ядром Linux, перехватывая и отображая системные вызовы, которые делает программа, а также сигналы, которые она получает. Системные вызовы являются основным механизмом, через который программы запрашивают у ядра операционной системы выполнение различных операций, таких как чтение файлов, сетевое взаимодействие или управление процессами.

Использование strace позволяет "заглянуть под капот" работающей программы, даже не имея доступа к её исходному коду. Это делает её незаменимым инструментом для системных администраторов и разработчиков при поиске причин сбоев, анализе производительности и изучении поведения приложений.

В основе работы strace лежит механизм ядра Linux под названием ptrace. Этот механизм позволяет одному процессу контролировать выполнение другого процесса, перехватывая его системные вызовы и сигналы. Когда вы запускаете программу с помощью strace или подключаетесь к уже запущенному процессу, strace "прикрепляется" к этому процессу. После этого, каждый раз, когда отслеживаемый процесс делает системный вызов, ядро приостанавливает его выполнение и уведомляет strace. Strace, в свою очередь, считывает информацию о системном вызове, его аргументах, выводит её в удобном для чтения виде, а затем позволяет процессу продолжить выполнение.

Основные функции и возможности strace:

* Утилита strace предоставляет широкий спектр возможностей для анализа поведения программ:
* Отслеживание системных вызовов: это основная функция strace. Она показывает, какие именно системные вызовы делает программа, с какими параметрами они вызываются и какие значения возвращают.
* Подключение к запущенным процессам: strace может быть "прикреплена" к уже работающему процессу по его идентификатору (PID), что очень удобно для анализа долгоживущих или зависших программ.
* Фильтрация вывода: sывод strace может быть очень объемным. Для удобства анализа предусмотрены опции для фильтрации по имени системного вызова, по пути к файлу, а также по типам системных вызовов (например, только связанные с файловыми операциями или сетевым взаимодействием).
* Статистика по системным вызовам: strace может собирать и отображать статистику по каждому системному вызову, включая количество вызовов, общее время выполнения и количество ошибок.
* Анализ дочерних процессов: с помощью специальной опции strace может отслеживать не только основной процесс, но и все создаваемые им дочерние процессы.
* Запись вывода в файл: для последующего детального анализа вывод strace можно перенаправить в файл.
* Отображение временных меток: strace позволяет добавлять к каждой строке вывода временные метки, что помогает анализировать производительность и выявлять "узкие места" в работе программы.
* Внедрение ошибок: strace позволяет имитировать ошибки системных вызовов. Это мощная функция для тестирования того, как программа будет вести себя в нештатных ситуациях.

Основные флаги:

* -p PID: один из самых полезных флагов, позволяющий подключиться к уже запущенному процессу по его идентификатору (PID) и начать его трассировку.
* -f: отслеживать не только родительский процесс, но и все создаваемые им дочерние процессы.
* -ff: при использовании с флагом -o создает отдельные файлы трассировки для каждого дочернего процесса.
* -o file: перенаправляет вывод strace в указанный файл вместо стандартного потока ошибок. Это удобно для анализа больших объемов данных.

Фильтрация вывода:

-e trace=set: Мощный флаг для фильтрации выводимой информации. В качестве set можно указывать:

* + - Группы вызовов: например, -e trace=file для отслеживания всех вызовов, связанных с файлами, или -e trace=network для сетевых вызовов.
    - -P /путь/к/файлу: показывать только те системные вызовы, которые работают с указанным файлом или путем.
    - Имя системного вызова: например, -e trace=open,read будет отслеживать только системные вызовы open и read

Форматирование вывода:

* -t: добавляет в начало каждой строки время суток.
* -tt: добавляет время суток с точностью до микросекунд.
* -ttt: выводит время в формате UNIX (количество секунд с начала эпохи) с микросекундами.
* -T: показывает время, затраченное на выполнение каждого системного вызова.
* -s strsize: устанавливает максимальный размер строки для вывода. По умолчанию он равен 32 символам, что часто приводит к обрезанию путей к файлам или содержимого буферов.
* -i: выводит указатель инструкции в момент совершения системного вызова.

**Протокол работы программы**

**Лабораторная работа №1**

root@2273a6f3c6af:/workspace/lab1/src# strace -f ./parent

execve("./parent", ["./parent"], 0xffffd4e144b8 /\* 12 vars \*/) = 0

brk(NULL) = 0x1eb96000

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffffb003e000

faccessat(AT\_FDCWD, "/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=25959, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 25959, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0xffffb0037000

close(3) = 0

openat(AT\_FDCWD, "/lib/aarch64-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\267\0\1\0\0\0000y\2\0\0\0\0\0"..., 832) = 832

newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=1651408, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 1826912, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffffafe46000

mmap(0xffffafe50000, 1761376, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffffafe50000

munmap(0xffffafe46000, 40960) = 0

munmap(0xffffaffff000, 20576) = 0

mprotect(0xffffaffd7000, 86016, PROT\_NONE) = 0

mmap(0xffffaffec000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x18c000) = 0xffffaffec000

mmap(0xffffafff2000, 49248, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0xffffafff2000

close(3) = 0

set\_tid\_address(0xffffb003f050) = 38

set\_robust\_list(0xffffb003f060, 24) = 0

rseq(0xffffb003f6a0, 0x20, 0, 0xd428bc00) = 0

mprotect(0xffffaffec000, 16384, PROT\_READ) = 0

mprotect(0x41f000, 4096, PROT\_READ) = 0

mprotect(0xffffb0043000, 8192, PROT\_READ) = 0

prlimit64(0, RLIMIT\_STACK, NULL, {rlim\_cur=8192\*1024, rlim\_max=RLIM64\_INFINITY}) = 0

munmap(0xffffb0037000, 25959) = 0

newfstatat(1, "", {st\_mode=S\_IFCHR|0620, st\_rdev=makedev(0x88, 0), ...}, AT\_EMPTY\_PATH) = 0

getrandom("\x98\xbf\xce\x16\x9b\x3b\x43\xe0", 8, GRND\_NONBLOCK) = 8

brk(NULL) = 0x1eb96000

brk(0x1ebb7000) = 0x1ebb7000

newfstatat(0, "", {st\_mode=S\_IFCHR|0620, st\_rdev=makedev(0x88, 0), ...}, AT\_EMPTY\_PATH) = 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"..., 54Введите имя файла для вывода: ) = 54

read(0, result.txt

"result.txt\n", 1024) = 11

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

clone(child\_stack=NULL, flags=CLONE\_CHILD\_CLEARTID|CLONE\_CHILD\_SETTID|SIGCHLDstrace: Process 39 attached

, child\_tidptr=0xffffb003f050) = 39

[pid 39] set\_robust\_list(0xffffb003f060, 24 <unfinished ...>

[pid 38] close(3 <unfinished ...>

[pid 39] <... set\_robust\_list resumed>) = 0

[pid 38] <... close resumed>) = 0

[pid 39] close(4 <unfinished ...>

[pid 38] 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 \321\201 \321"..., 107 <unfinished ...>

[pid 39] <... close resumed>) = 0

Введите строки с числами (float). Пустая строка — завершение.

[pid 38] <... write resumed>) = 107

[pid 39] dup3(3, 0, 0 <unfinished ...>

[pid 38] read(0, <unfinished ...>

[pid 39] <... dup3 resumed>) = 0

[pid 39] close(3) = 0

[pid 39] execve("./child", ["child", "result.txt"], 0xffffdacef928 /\* 12 vars \*/) = 0

[pid 39] brk(NULL) = 0x74f3000

[pid 39] mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffff8c093000

[pid 39] faccessat(AT\_FDCWD, "/etc/ld.so.preload", R\_OK) = -1 ENOENT (No such file or directory)

[pid 39] openat(AT\_FDCWD, "/etc/ld.so.cache", O\_RDONLY|O\_CLOEXEC) = 3

[pid 39] newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=25959, ...}, AT\_EMPTY\_PATH) = 0

[pid 39] mmap(NULL, 25959, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0xffff8c08c000

[pid 39] close(3) = 0

[pid 39] openat(AT\_FDCWD, "/lib/aarch64-linux-gnu/libc.so.6", O\_RDONLY|O\_CLOEXEC) = 3

[pid 39] read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0000y\2\0\0\0\0\0"..., 832) = 832

[pid 39] newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=1651408, ...}, AT\_EMPTY\_PATH) = 0

[pid 39] mmap(NULL, 1826912, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffff8be9b000

[pid 39] mmap(0xffff8bea0000, 1761376, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffff8bea0000

[pid 39] munmap(0xffff8be9b000, 20480) = 0

[pid 39] munmap(0xffff8c04f000, 41056) = 0

[pid 39] mprotect(0xffff8c027000, 86016, PROT\_NONE) = 0

[pid 39] mmap(0xffff8c03c000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x18c000) = 0xffff8c03c000

[pid 39] mmap(0xffff8c042000, 49248, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0xffff8c042000

[pid 39] close(3) = 0

[pid 39] set\_tid\_address(0xffff8c094050) = 39

[pid 39] set\_robust\_list(0xffff8c094060, 24) = 0

[pid 39] rseq(0xffff8c0946a0, 0x20, 0, 0xd428bc00) = 0

[pid 39] mprotect(0xffff8c03c000, 16384, PROT\_READ) = 0

[pid 39] mprotect(0x41f000, 4096, PROT\_READ) = 0

[pid 39] mprotect(0xffff8c098000, 8192, PROT\_READ) = 0

[pid 39] prlimit64(0, RLIMIT\_STACK, NULL, {rlim\_cur=8192\*1024, rlim\_max=RLIM64\_INFINITY}) = 0

[pid 39] munmap(0xffff8c08c000, 25959) = 0

[pid 39] getrandom("\x23\x09\xba\xfa\xf8\x1d\x16\xd1", 8, GRND\_NONBLOCK) = 8

[pid 39] brk(NULL) = 0x74f3000

[pid 39] brk(0x7514000) = 0x7514000

[pid 39] openat(AT\_FDCWD, "result.txt", O\_WRONLY|O\_CREAT|O\_TRUNC, 0666) = 3

[pid 39] newfstatat(0, "", {st\_mode=S\_IFIFO|0600, st\_size=0, ...}, AT\_EMPTY\_PATH) = 0

[pid 39] read(0, 1.0 2.0

<unfinished ...>

[pid 38] <... read resumed>"1.0 2.0\n", 1024) = 8

[pid 38] write(4, "1.0 2.0\n", 8) = 8

[pid 39] <... read resumed>"1.0 2.0\n", 4096) = 8

[pid 38] read(0, <unfinished ...>

[pid 39] newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=0, ...}, AT\_EMPTY\_PATH) = 0

[pid 39] read(0, 2.0

<unfinished ...>

[pid 38] <... read resumed>"2.0\n", 1024) = 4

[pid 38] write(4, "2.0\n", 4) = 4

[pid 39] <... read resumed>"2.0\n", 4096) = 4

[pid 38] read(0, <unfinished ...>

[pid 39] read(0,

<unfinished ...>

[pid 38] <... read resumed>"\n", 1024) = 1

[pid 38] close(4) = 0

[pid 39] <... read resumed>"", 4096) = 0

[pid 38] wait4(-1, <unfinished ...>

[pid 39] write(3, "3.000000\n2.000000\n", 18) = 18

[pid 39] close(3) = 0

[pid 39] exit\_group(0) = ?

[pid 39] +++ exited with 0 +++

<... wait4 resumed>NULL, 0, NULL) = 39

--- SIGCHLD {si\_signo=SIGCHLD, si\_code=CLD\_EXITED, si\_pid=39, si\_uid=0, si\_status=0, si\_utime=0, si\_stime=0} ---

exit\_group(0) = ?

+++ exited with 0 +++

**Лабораторная работа №2**

204 execve("./main", ["./main", "200", "200", "5", "1", "2"], 0xfffff3ec3410 /\* 12 vars \*/) = 0

204 brk(NULL) = 0x6b35000

204 mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffffa8a25000

204 faccessat(AT\_FDCWD, "/etc/ld.so.preload", R\_OK) = -1 ENOENT (No such file or directory)

204 openat(AT\_FDCWD, "/etc/ld.so.cache", O\_RDONLY|O\_CLOEXEC) = 3

204 newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=25959, ...}, AT\_EMPTY\_PATH) = 0

204 mmap(NULL, 25959, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0xffffa8a1e000

204 close(3) = 0

204 openat(AT\_FDCWD, "/lib/aarch64-linux-gnu/libc.so.6", O\_RDONLY|O\_CLOEXEC) = 3

204 read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0000y\2\0\0\0\0\0"..., 832) = 832

204 newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=1651408, ...}, AT\_EMPTY\_PATH) = 0

204 mmap(NULL, 1826912, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffffa882d000

204 mmap(0xffffa8830000, 1761376, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffffa8830000

204 munmap(0xffffa882d000, 12288) = 0

204 munmap(0xffffa89df000, 49248) = 0

204 mprotect(0xffffa89b7000, 86016, PROT\_NONE) = 0

204 mmap(0xffffa89cc000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x18c000) = 0xffffa89cc000

204 mmap(0xffffa89d2000, 49248, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0xffffa89d2000

204 close(3) = 0

204 set\_tid\_address(0xffffa8a26050) = 204

204 set\_robust\_list(0xffffa8a26060, 24) = 0

204 rseq(0xffffa8a266a0, 0x20, 0, 0xd428bc00) = 0

204 mprotect(0xffffa89cc000, 16384, PROT\_READ) = 0

204 mprotect(0x41f000, 4096, PROT\_READ) = 0

204 mprotect(0xffffa8a2a000, 8192, PROT\_READ) = 0

204 prlimit64(0, RLIMIT\_STACK, NULL, {rlim\_cur=8192\*1024, rlim\_max=RLIM64\_INFINITY}) = 0

204 munmap(0xffffa8a1e000, 25959) = 0

204 getrandom("\x78\x11\xcf\x13\x63\x2f\x5d\xaa", 8, GRND\_NONBLOCK) = 8

204 brk(NULL) = 0x6b35000

204 brk(0x6b56000) = 0x6b56000

204 mmap(NULL, 163840, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffffa8808000

204 mmap(NULL, 163840, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffffa87e0000

204 rt\_sigaction(SIGRT\_1, {sa\_handler=0xffffa88ac0a0, sa\_mask=[], sa\_flags=SA\_ONSTACK|SA\_RESTART|SA\_SIGINFO}, NULL, 8) = 0

204 rt\_sigprocmask(SIG\_UNBLOCK, [RTMIN RT\_1], NULL, 8) = 0

204 mmap(NULL, 8454144, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS|MAP\_STACK, -1, 0) = 0xffffa7e00000

204 mprotect(0xffffa7e10000, 8388608, PROT\_READ|PROT\_WRITE) = 0

204 rt\_sigprocmask(SIG\_BLOCK, ~[], [], 8) = 0

204 clone(child\_stack=0xffffa860ea60, flags=CLONE\_VM|CLONE\_FS|CLONE\_FILES|CLONE\_SIGHAND|CLONE\_THREAD|CLONE\_SYSVSEM|CLONE\_SETTLS|CLONE\_PARENT\_SETTID|CLONE\_CHILD\_CLEARTID, parent\_tid=[205], tls=0xffffa860f8e0, child\_tidptr=0xffffa860f270) = 205

204 rt\_sigprocmask(SIG\_SETMASK, [], NULL, 8) = 0

205 rseq(0xffffa860f8c0, 0x20, 0, 0xd428bc00 <unfinished ...>

204 mmap(NULL, 8454144, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS|MAP\_STACK, -1, 0) = 0xffffa7400000

205 <... rseq resumed>) = 0

204 mprotect(0xffffa7410000, 8388608, PROT\_READ|PROT\_WRITE <unfinished ...>

205 set\_robust\_list(0xffffa860f280, 24 <unfinished ...>

204 <... mprotect resumed>) = 0

205 <... set\_robust\_list resumed>) = 0

204 rt\_sigprocmask(SIG\_BLOCK, ~[], <unfinished ...>

205 rt\_sigprocmask(SIG\_SETMASK, [], <unfinished ...>

204 <... rt\_sigprocmask resumed>[], 8) = 0

205 <... rt\_sigprocmask resumed>NULL, 8) = 0

204 clone(child\_stack=0xffffa7c0ea60, flags=CLONE\_VM|CLONE\_FS|CLONE\_FILES|CLONE\_SIGHAND|CLONE\_THREAD|CLONE\_SYSVSEM|CLONE\_SETTLS|CLONE\_PARENT\_SETTID|CLONE\_CHILD\_CLEARTID, parent\_tid=[206], tls=0xffffa7c0f8e0, child\_tidptr=0xffffa7c0f270) = 206

204 rt\_sigprocmask(SIG\_SETMASK, [], NULL, 8) = 0

204 futex(0xffffa860f270, FUTEX\_WAIT\_BITSET|FUTEX\_CLOCK\_REALTIME, 205, NULL, FUTEX\_BITSET\_MATCH\_ANY <unfinished ...>

206 rseq(0xffffa7c0f8c0, 0x20, 0, 0xd428bc00) = 0

206 set\_robust\_list(0xffffa7c0f280, 24) = 0

206 rt\_sigprocmask(SIG\_SETMASK, [], NULL, 8) = 0

205 rt\_sigprocmask(SIG\_BLOCK, ~[RT\_1], NULL, 8) = 0

205 madvise(0xffffa7e00000, 8314880, MADV\_DONTNEED) = 0

205 exit(0) = ?

204 <... futex resumed>) = 0

205 +++ exited with 0 +++

204 futex(0xffffa7c0f270, FUTEX\_WAIT\_BITSET|FUTEX\_CLOCK\_REALTIME, 206, NULL, FUTEX\_BITSET\_MATCH\_ANY <unfinished ...>

206 rt\_sigprocmask(SIG\_BLOCK, ~[RT\_1], NULL, 8) = 0

206 madvise(0xffffa7400000, 8314880, MADV\_DONTNEED) = 0

206 exit(0) = ?

204 <... futex resumed>) = 0

204 newfstatat(1, "", <unfinished ...>

206 +++ exited with 0 +++

204 <... newfstatat resumed>{st\_mode=S\_IFCHR|0620, st\_rdev=makedev(0x88, 0), ...}, AT\_EMPTY\_PATH) = 0

204 write(1, "Time taken: 6.772 ms\n", 21) = 21

204 munmap(0xffffa8808000, 163840) = 0

204 munmap(0xffffa87e0000, 163840) = 0

204 exit\_group(0) = ?

204 +++ exited with 0 +++

**Лабораторная работа №3**

execve("./parent", ["./parent"], 0xffffd75a0228 /\* 12 vars \*/) = 0

brk(NULL) = 0x35959000

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffffa36f0000

faccessat(AT\_FDCWD, "/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=25959, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 25959, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0xffffa36e9000

close(3) = 0

openat(AT\_FDCWD, "/lib/aarch64-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\267\0\1\0\0\0000y\2\0\0\0\0\0"..., 832) = 832

newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=1651408, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 1826912, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffffa34f8000

mmap(0xffffa3500000, 1761376, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffffa3500000

munmap(0xffffa34f8000, 32768) = 0

munmap(0xffffa36af000, 28768) = 0

mprotect(0xffffa3687000, 86016, PROT\_NONE) = 0

mmap(0xffffa369c000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x18c000) = 0xffffa369c000

mmap(0xffffa36a2000, 49248, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0xffffa36a2000

close(3) = 0

set\_tid\_address(0xffffa36f1050) = 31

set\_robust\_list(0xffffa36f1060, 24) = 0

rseq(0xffffa36f16a0, 0x20, 0, 0xd428bc00) = 0

mprotect(0xffffa369c000, 16384, PROT\_READ) = 0

mprotect(0x41f000, 4096, PROT\_READ) = 0

mprotect(0xffffa36f5000, 8192, PROT\_READ) = 0

prlimit64(0, RLIMIT\_STACK, NULL, {rlim\_cur=8192\*1024, rlim\_max=RLIM64\_INFINITY}) = 0

munmap(0xffffa36e9000, 25959) = 0

newfstatat(1, "", {st\_mode=S\_IFREG|0644, st\_size=1819, ...}, AT\_EMPTY\_PATH) = 0

getrandom("\xac\x55\x86\x13\x2c\x2f\x48\x5a", 8, GRND\_NONBLOCK) = 8

brk(NULL) = 0x35959000

brk(0x3597a000) = 0x3597a000

newfstatat(0, "", {st\_mode=S\_IFCHR|0620, st\_rdev=makedev(0x88, 0), ...}, AT\_EMPTY\_PATH) = 0

read(0, "result.txt\n", 1024) = 11

openat(AT\_FDCWD, "/dev/shm/my\_shared\_memory", 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) = 0xffffa36ef000

close(3) = 0

unlinkat(AT\_FDCWD, "/dev/shm/sem.my\_sem\_write", 0) = -1 ENOENT (No such file or directory)

unlinkat(AT\_FDCWD, "/dev/shm/sem.my\_sem\_read", 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/dev/shm/sem.my\_sem\_write", O\_RDWR|O\_NOFOLLOW) = -1 ENOENT (No such file or directory)

getrandom("\x54\x94\xab\x3e\x1a\x5f\x51\x80", 8, GRND\_NONBLOCK) = 8

newfstatat(AT\_FDCWD, "/dev/shm/sem.q6oG8C", 0xffffdf02c638, AT\_SYMLINK\_NOFOLLOW) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/dev/shm/sem.q6oG8C", O\_RDWR|O\_CREAT|O\_EXCL, 0666) = 3

write(3, "\1\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\0", 32) = 32

mmap(NULL, 32, PROT\_READ|PROT\_WRITE, MAP\_SHARED, 3, 0) = 0xffffa36ee000

linkat(AT\_FDCWD, "/dev/shm/sem.q6oG8C", AT\_FDCWD, "/dev/shm/sem.my\_sem\_write", 0) = 0

newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=32, ...}, AT\_EMPTY\_PATH) = 0

unlinkat(AT\_FDCWD, "/dev/shm/sem.q6oG8C", 0) = 0

close(3) = 0

openat(AT\_FDCWD, "/dev/shm/sem.my\_sem\_read", O\_RDWR|O\_NOFOLLOW) = -1 ENOENT (No such file or directory)

getrandom("\x60\x79\xd4\x93\x9f\xa9\xc1\x98", 8, GRND\_NONBLOCK) = 8

newfstatat(AT\_FDCWD, "/dev/shm/sem.ofnd2n", 0xffffdf02c638, AT\_SYMLINK\_NOFOLLOW) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/dev/shm/sem.ofnd2n", O\_RDWR|O\_CREAT|O\_EXCL, 0666) = 3

write(3, "\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\0", 32) = 32

mmap(NULL, 32, PROT\_READ|PROT\_WRITE, MAP\_SHARED, 3, 0) = 0xffffa36ed000

linkat(AT\_FDCWD, "/dev/shm/sem.ofnd2n", AT\_FDCWD, "/dev/shm/sem.my\_sem\_read", 0) = 0

newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=32, ...}, AT\_EMPTY\_PATH) = 0

unlinkat(AT\_FDCWD, "/dev/shm/sem.ofnd2n", 0) = 0

close(3) = 0

clone(child\_stack=NULL, flags=CLONE\_CHILD\_CLEARTID|CLONE\_CHILD\_SETTID|SIGCHLD, child\_tidptr=0xffffa36f1050) = 32

strace: Process 32 attached

[pid 31] read(0, <unfinished ...>

[pid 32] set\_robust\_list(0xffffa36f1060, 24) = 0

[pid 32] execve("./child", ["child", "result.txt"], 0xffffdf02d068 /\* 12 vars \*/) = 0

[pid 32] brk(NULL) = 0x294dd000

[pid 32] mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffff9933d000

[pid 32] faccessat(AT\_FDCWD, "/etc/ld.so.preload", R\_OK) = -1 ENOENT (No such file or directory)

[pid 32] openat(AT\_FDCWD, "/etc/ld.so.cache", O\_RDONLY|O\_CLOEXEC) = 3

[pid 32] newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=25959, ...}, AT\_EMPTY\_PATH) = 0

[pid 32] mmap(NULL, 25959, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0xffff99336000

[pid 32] close(3) = 0

[pid 32] openat(AT\_FDCWD, "/lib/aarch64-linux-gnu/libc.so.6", O\_RDONLY|O\_CLOEXEC) = 3

[pid 32] read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0000y\2\0\0\0\0\0"..., 832) = 832

[pid 32] newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=1651408, ...}, AT\_EMPTY\_PATH) = 0

[pid 32] mmap(NULL, 1826912, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffff99145000

[pid 32] mmap(0xffff99150000, 1761376, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffff99150000

[pid 32] munmap(0xffff99145000, 45056) = 0

[pid 32] munmap(0xffff992ff000, 16480) = 0

[pid 32] mprotect(0xffff992d7000, 86016, PROT\_NONE) = 0

[pid 32] mmap(0xffff992ec000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x18c000) = 0xffff992ec000

[pid 32] mmap(0xffff992f2000, 49248, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0xffff992f2000

[pid 32] close(3) = 0

[pid 32] set\_tid\_address(0xffff9933e050) = 32

[pid 32] set\_robust\_list(0xffff9933e060, 24) = 0

[pid 32] rseq(0xffff9933e6a0, 0x20, 0, 0xd428bc00) = 0

[pid 32] mprotect(0xffff992ec000, 16384, PROT\_READ) = 0

[pid 32] mprotect(0x41f000, 4096, PROT\_READ) = 0

[pid 32] mprotect(0xffff99342000, 8192, PROT\_READ) = 0

[pid 32] prlimit64(0, RLIMIT\_STACK, NULL, {rlim\_cur=8192\*1024, rlim\_max=RLIM64\_INFINITY}) = 0

[pid 32] munmap(0xffff99336000, 25959) = 0

[pid 32] getrandom("\xf7\x50\xe0\x1a\x1f\x50\x15\x5e", 8, GRND\_NONBLOCK) = 8

[pid 32] brk(NULL) = 0x294dd000

[pid 32] brk(0x294fe000) = 0x294fe000

[pid 32] openat(AT\_FDCWD, "result.txt", O\_WRONLY|O\_CREAT|O\_TRUNC, 0666) = 3

[pid 32] openat(AT\_FDCWD, "/dev/shm/my\_shared\_memory", O\_RDWR|O\_NOFOLLOW|O\_CLOEXEC) = 4

[pid 32] mmap(NULL, 1024, PROT\_READ|PROT\_WRITE, MAP\_SHARED, 4, 0) = 0xffff9933c000

[pid 32] close(4) = 0

[pid 32] openat(AT\_FDCWD, "/dev/shm/sem.my\_sem\_write", O\_RDWR|O\_NOFOLLOW) = 4

[pid 32] newfstatat(4, "", {st\_mode=S\_IFREG|0644, st\_size=32, ...}, AT\_EMPTY\_PATH) = 0

[pid 32] mmap(NULL, 32, PROT\_READ|PROT\_WRITE, MAP\_SHARED, 4, 0) = 0xffff9933b000

[pid 32] close(4) = 0

[pid 32] openat(AT\_FDCWD, "/dev/shm/sem.my\_sem\_read", O\_RDWR|O\_NOFOLLOW) = 4

[pid 32] newfstatat(4, "", {st\_mode=S\_IFREG|0644, st\_size=32, ...}, AT\_EMPTY\_PATH) = 0

[pid 32] mmap(NULL, 32, PROT\_READ|PROT\_WRITE, MAP\_SHARED, 4, 0) = 0xffff9933a000

[pid 32] close(4) = 0

[pid 32] futex(0xffff9933a000, FUTEX\_WAIT\_BITSET|FUTEX\_CLOCK\_REALTIME, 0, NULL, FUTEX\_BITSET\_MATCH\_ANY <unfinished ...>

[pid 31] <... read resumed>"1.0 2.0\n", 1024) = 8

[pid 31] futex(0xffffa36ed000, FUTEX\_WAKE, 1) = 1

[pid 32] <... futex resumed>) = 0

[pid 31] read(0, <unfinished ...>

[pid 32] newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=0, ...}, AT\_EMPTY\_PATH) = 0

[pid 32] write(3, "3.000000\n", 9) = 9

[pid 32] futex(0xffff9933a000, FUTEX\_WAIT\_BITSET|FUTEX\_CLOCK\_REALTIME, 0, NULL, FUTEX\_BITSET\_MATCH\_ANY <unfinished ...>

[pid 31] <... read resumed>"0.0\n", 1024) = 4

[pid 31] futex(0xffffa36ed000, FUTEX\_WAKE, 1) = 1

[pid 31] read(0, <unfinished ...>

[pid 32] <... futex resumed>) = 0

[pid 32] write(3, "0.000000\n", 9) = 9

[pid 32] futex(0xffff9933a000, FUTEX\_WAIT\_BITSET|FUTEX\_CLOCK\_REALTIME, 0, NULL, FUTEX\_BITSET\_MATCH\_ANY <unfinished ...>

[pid 31] <... read resumed>"\n", 1024) = 1

[pid 31] futex(0xffffa36ed000, FUTEX\_WAKE, 1) = 1

[pid 31] wait4(-1, <unfinished ...>

[pid 32] <... futex resumed>) = 0

[pid 32] munmap(0xffff9933b000, 32) = 0

[pid 32] munmap(0xffff9933a000, 32) = 0

[pid 32] close(3) = 0

[pid 32] munmap(0xffff9933c000, 1024) = 0

[pid 32] exit\_group(0) = ?

[pid 32] +++ exited with 0 +++

<... wait4 resumed>NULL, 0, NULL) = 32

--- SIGCHLD {si\_signo=SIGCHLD, si\_code=CLD\_EXITED, si\_pid=32, si\_uid=0, si\_status=0, si\_utime=0, si\_stime=0} ---

munmap(0xffffa36ee000, 32) = 0

munmap(0xffffa36ed000, 32) = 0

unlinkat(AT\_FDCWD, "/dev/shm/sem.my\_sem\_write", 0) = 0

unlinkat(AT\_FDCWD, "/dev/shm/sem.my\_sem\_read", 0) = 0

munmap(0xffffa36ef000, 1024) = 0

unlinkat(AT\_FDCWD, "/dev/shm/my\_shared\_memory", 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"..., 161Введите имя файла для вывода: Введите строки с числами (float). Пустая строка — завершение.

) = 161

exit\_group(0) = ?

+++ exited with 0 +++

**Лабораторная работа №4**

**strace\_program1.txt**

211 execve("./program1", ["./program1"], 0xffffced24f98 /\* 13 vars \*/) = 0

211 brk(NULL) = 0x19e3e000

211 mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffff8e640000

211 faccessat(AT\_FDCWD, "/etc/ld.so.preload", R\_OK) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "/workspace/lab4/src/build/tls/aarch64/atomics/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 newfstatat(AT\_FDCWD, "/workspace/lab4/src/build/tls/aarch64/atomics", 0xffffc2c6bad0, 0) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "/workspace/lab4/src/build/tls/aarch64/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 newfstatat(AT\_FDCWD, "/workspace/lab4/src/build/tls/aarch64", 0xffffc2c6bad0, 0) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "/workspace/lab4/src/build/tls/atomics/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 newfstatat(AT\_FDCWD, "/workspace/lab4/src/build/tls/atomics", 0xffffc2c6bad0, 0) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "/workspace/lab4/src/build/tls/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 newfstatat(AT\_FDCWD, "/workspace/lab4/src/build/tls", 0xffffc2c6bad0, 0) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "/workspace/lab4/src/build/aarch64/atomics/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 newfstatat(AT\_FDCWD, "/workspace/lab4/src/build/aarch64/atomics", 0xffffc2c6bad0, 0) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "/workspace/lab4/src/build/aarch64/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 newfstatat(AT\_FDCWD, "/workspace/lab4/src/build/aarch64", 0xffffc2c6bad0, 0) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "/workspace/lab4/src/build/atomics/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 newfstatat(AT\_FDCWD, "/workspace/lab4/src/build/atomics", 0xffffc2c6bad0, 0) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "/workspace/lab4/src/build/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = 3

211 read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

211 newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=69536, ...}, AT\_EMPTY\_PATH) = 0

211 mmap(NULL, 196656, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffff8e5d6000

211 mmap(0xffff8e5e0000, 131120, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffff8e5e0000

211 munmap(0xffff8e5d6000, 40960) = 0

211 munmap(0xffff8e601000, 20528) = 0

211 mprotect(0xffff8e5e1000, 122880, PROT\_NONE) = 0

211 mmap(0xffff8e5ff000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0xf000) = 0xffff8e5ff000

211 close(3) = 0

211 openat(AT\_FDCWD, "/workspace/lab4/src/build/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/aarch64/atomics/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/aarch64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/atomics/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/aarch64/atomics/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/aarch64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/atomics/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "/etc/ld.so.cache", O\_RDONLY|O\_CLOEXEC) = 3

211 newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=25959, ...}, AT\_EMPTY\_PATH) = 0

211 mmap(NULL, 25959, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0xffff8e639000

211 close(3) = 0

211 openat(AT\_FDCWD, "/usr/local/lib64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = 3

211 read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

211 newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=2436000, ...}, AT\_EMPTY\_PATH) = 0

211 mmap(NULL, 2583688, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffff8e200000

211 mmap(0xffff8e200000, 2518152, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffff8e200000

211 munmap(0xffff8e467000, 64648) = 0

211 mprotect(0xffff8e445000, 65536, PROT\_NONE) = 0

211 mmap(0xffff8e455000, 57344, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x245000) = 0xffff8e455000

211 mmap(0xffff8e463000, 15496, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0xffff8e463000

211 close(3) = 0

211 openat(AT\_FDCWD, "/workspace/lab4/src/build/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/aarch64/atomics/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/aarch64/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/atomics/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/aarch64/atomics/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/aarch64/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/atomics/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "/lib/aarch64-linux-gnu/libm.so.6", O\_RDONLY|O\_CLOEXEC) = 3

211 read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

211 newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=591960, ...}, AT\_EMPTY\_PATH) = 0

211 mmap(NULL, 655472, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffff8e53f000

211 mmap(0xffff8e540000, 589936, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffff8e540000

211 munmap(0xffff8e53f000, 4096) = 0

211 munmap(0xffff8e5d1000, 57456) = 0

211 mprotect(0xffff8e5c0000, 61440, PROT\_NONE) = 0

211 mmap(0xffff8e5cf000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x8f000) = 0xffff8e5cf000

211 close(3) = 0

211 openat(AT\_FDCWD, "/workspace/lab4/src/build/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/aarch64/atomics/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/aarch64/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/atomics/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/aarch64/atomics/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/aarch64/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/atomics/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "/usr/local/lib64/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = 3

211 read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

211 newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=726416, ...}, AT\_EMPTY\_PATH) = 0

211 mmap(NULL, 263104, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffff8e4ff000

211 mmap(0xffff8e500000, 197568, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffff8e500000

211 munmap(0xffff8e4ff000, 4096) = 0

211 munmap(0xffff8e531000, 58304) = 0

211 mprotect(0xffff8e51f000, 65536, PROT\_NONE) = 0

211 mmap(0xffff8e52f000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1f000) = 0xffff8e52f000

211 close(3) = 0

211 openat(AT\_FDCWD, "/workspace/lab4/src/build/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/aarch64/atomics/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/aarch64/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/atomics/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/tls/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/aarch64/atomics/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/aarch64/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/atomics/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "build/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

211 openat(AT\_FDCWD, "/lib/aarch64-linux-gnu/libc.so.6", O\_RDONLY|O\_CLOEXEC) = 3

211 read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0000y\2\0\0\0\0\0"..., 832) = 832

211 newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=1651408, ...}, AT\_EMPTY\_PATH) = 0

211 mmap(NULL, 1826912, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffff8e041000

211 mmap(0xffff8e050000, 1761376, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffff8e050000

211 munmap(0xffff8e041000, 61440) = 0

211 munmap(0xffff8e1ff000, 96) = 0

211 mprotect(0xffff8e1d7000, 86016, PROT\_NONE) = 0

211 mmap(0xffff8e1ec000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x18c000) = 0xffff8e1ec000

211 mmap(0xffff8e1f2000, 49248, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0xffff8e1f2000

211 close(3) = 0

211 mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffff8e637000

211 mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffff8e635000

211 set\_tid\_address(0xffff8e6350f0) = 211

211 set\_robust\_list(0xffff8e635100, 24) = 0

211 rseq(0xffff8e635740, 0x20, 0, 0xd428bc00) = 0

211 mprotect(0xffff8e1ec000, 16384, PROT\_READ) = 0

211 mprotect(0xffff8e52f000, 4096, PROT\_READ) = 0

211 mprotect(0xffff8e5cf000, 4096, PROT\_READ) = 0

211 mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffff8e633000

211 mprotect(0xffff8e455000, 45056, PROT\_READ) = 0

211 mprotect(0xffff8e5ff000, 4096, PROT\_READ) = 0

211 mprotect(0x41f000, 4096, PROT\_READ) = 0

211 mprotect(0xffff8e645000, 8192, PROT\_READ) = 0

211 prlimit64(0, RLIMIT\_STACK, NULL, {rlim\_cur=8192\*1024, rlim\_max=RLIM64\_INFINITY}) = 0

211 munmap(0xffff8e639000, 25959) = 0

211 futex(0xffff8e4637ec, FUTEX\_WAKE\_PRIVATE, 2147483647) = 0

211 getrandom("\x06\x68\xec\x53\x75\xca\xf1\x8b", 8, GRND\_NONBLOCK) = 8

211 brk(NULL) = 0x19e3e000

211 brk(0x19e5f000) = 0x19e5f000

211 newfstatat(1, "", {st\_mode=S\_IFCHR|0620, st\_rdev=makedev(0x88, 0), ...}, AT\_EMPTY\_PATH) = 0

211 write(1, "\320\237\321\200\320\276\320\263\321\200\320\260\320\274\320\274\320\260 1 (\320\241\321\202\320\260\321\202\320\270"..., 95) = 95

211 write(1, "\320\230\321\201\320\277\320\276\320\273\321\214\320\267\320\276\320\262\320\260\320\275\320\270\320\265 \320\277\321\200\320"..., 47) = 47

211 write(1, "1 <A> <B> - \320\237\320\276\320\264\321\201\321\207\321\221\321\202 \320\277\321"..., 65) = 65

211 write(1, "2 <X> - \320\222\321\213\321\207\320\270\321\201\320\273\320\270\321\202\321\214"..., 59) = 59

211 write(1, "exit - \320\222\321\213\321\205\320\276\320\264\n", 25) = 25

211 newfstatat(0, "", {st\_mode=S\_IFCHR|0620, st\_rdev=makedev(0x88, 0), ...}, AT\_EMPTY\_PATH) = 0

211 read(0, "1 10 100\n", 1024) = 9

211 write(1, "\320\240\320\265\320\267\321\203\320\273\321\214\321\202\320\260\321\202: 21\n", 23) = 23

211 read(0, "2 10\n", 1024) = 5

211 write(1, "\320\240\320\265\320\267\321\203\320\273\321\214\321\202\320\260\321\202: 2.59374\n", 28) = 28

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

211 lseek(0, -5, SEEK\_CUR) = -1 ESPIPE (Illegal seek)

211 exit\_group(0) = ?

211 +++ exited with 0 +++

**strace\_program2.txt**

216 execve("./program2", ["./program2"], 0xffffed959a28 /\* 13 vars \*/) = 0

216 brk(NULL) = 0x40337000

216 mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xfffface3b000

216 faccessat(AT\_FDCWD, "/etc/ld.so.preload", R\_OK) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "/workspace/lab4/src/build/tls/aarch64/atomics/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 newfstatat(AT\_FDCWD, "/workspace/lab4/src/build/tls/aarch64/atomics", 0xffffe49c2ad0, 0) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "/workspace/lab4/src/build/tls/aarch64/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 newfstatat(AT\_FDCWD, "/workspace/lab4/src/build/tls/aarch64", 0xffffe49c2ad0, 0) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "/workspace/lab4/src/build/tls/atomics/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 newfstatat(AT\_FDCWD, "/workspace/lab4/src/build/tls/atomics", 0xffffe49c2ad0, 0) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "/workspace/lab4/src/build/tls/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 newfstatat(AT\_FDCWD, "/workspace/lab4/src/build/tls", 0xffffe49c2ad0, 0) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "/workspace/lab4/src/build/aarch64/atomics/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 newfstatat(AT\_FDCWD, "/workspace/lab4/src/build/aarch64/atomics", 0xffffe49c2ad0, 0) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "/workspace/lab4/src/build/aarch64/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 newfstatat(AT\_FDCWD, "/workspace/lab4/src/build/aarch64", 0xffffe49c2ad0, 0) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "/workspace/lab4/src/build/atomics/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 newfstatat(AT\_FDCWD, "/workspace/lab4/src/build/atomics", 0xffffe49c2ad0, 0) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "/workspace/lab4/src/build/libimpl1.so", O\_RDONLY|O\_CLOEXEC) = 3

216 read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

216 newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=69536, ...}, AT\_EMPTY\_PATH) = 0

216 mmap(NULL, 196656, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffffacdd1000

216 mmap(0xffffacde0000, 131120, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffffacde0000

216 munmap(0xffffacdd1000, 61440) = 0

216 munmap(0xfffface01000, 48) = 0

216 mprotect(0xffffacde1000, 122880, PROT\_NONE) = 0

216 mmap(0xffffacdff000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0xf000) = 0xffffacdff000

216 close(3) = 0

216 openat(AT\_FDCWD, "/workspace/lab4/src/build/libimpl2.so", O\_RDONLY|O\_CLOEXEC) = 3

216 read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

216 newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=74400, ...}, AT\_EMPTY\_PATH) = 0

216 mmap(NULL, 197032, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffffacdaf000

216 mmap(0xffffacdb0000, 131496, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffffacdb0000

216 munmap(0xffffacdaf000, 4096) = 0

216 munmap(0xffffacdd1000, 57768) = 0

216 mprotect(0xffffacdb4000, 110592, PROT\_NONE) = 0

216 mmap(0xffffacdcf000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0xf000) = 0xffffacdcf000

216 close(3) = 0

216 openat(AT\_FDCWD, "/workspace/lab4/src/build/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/aarch64/atomics/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/aarch64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/atomics/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/aarch64/atomics/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/aarch64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/atomics/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "/etc/ld.so.cache", O\_RDONLY|O\_CLOEXEC) = 3

216 newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=25959, ...}, AT\_EMPTY\_PATH) = 0

216 mmap(NULL, 25959, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0xfffface34000

216 close(3) = 0

216 openat(AT\_FDCWD, "/usr/local/lib64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = 3

216 read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

216 newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=2436000, ...}, AT\_EMPTY\_PATH) = 0

216 mmap(NULL, 2583688, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffffaca00000

216 mmap(0xffffaca00000, 2518152, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffffaca00000

216 munmap(0xffffacc67000, 64648) = 0

216 mprotect(0xffffacc45000, 65536, PROT\_NONE) = 0

216 mmap(0xffffacc55000, 57344, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x245000) = 0xffffacc55000

216 mmap(0xffffacc63000, 15496, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0xffffacc63000

216 close(3) = 0

216 openat(AT\_FDCWD, "/workspace/lab4/src/build/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/aarch64/atomics/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/aarch64/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/atomics/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/aarch64/atomics/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/aarch64/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/atomics/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/libm.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "/lib/aarch64-linux-gnu/libm.so.6", O\_RDONLY|O\_CLOEXEC) = 3

216 read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

216 newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=591960, ...}, AT\_EMPTY\_PATH) = 0

216 mmap(NULL, 655472, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffffacd0f000

216 mmap(0xffffacd10000, 589936, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffffacd10000

216 munmap(0xffffacd0f000, 4096) = 0

216 munmap(0xffffacda1000, 57456) = 0

216 mprotect(0xffffacd90000, 61440, PROT\_NONE) = 0

216 mmap(0xffffacd9f000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x8f000) = 0xffffacd9f000

216 close(3) = 0

216 openat(AT\_FDCWD, "/workspace/lab4/src/build/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/aarch64/atomics/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/aarch64/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/atomics/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/aarch64/atomics/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/aarch64/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/atomics/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "/usr/local/lib64/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = 3

216 read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

216 newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=726416, ...}, AT\_EMPTY\_PATH) = 0

216 mmap(NULL, 263104, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffffacccf000

216 mmap(0xffffaccd0000, 197568, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffffaccd0000

216 munmap(0xffffacccf000, 4096) = 0

216 munmap(0xffffacd01000, 58304) = 0

216 mprotect(0xffffaccef000, 65536, PROT\_NONE) = 0

216 mmap(0xffffaccff000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1f000) = 0xffffaccff000

216 close(3) = 0

216 openat(AT\_FDCWD, "/workspace/lab4/src/build/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/aarch64/atomics/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/aarch64/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/atomics/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/tls/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/aarch64/atomics/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/aarch64/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/atomics/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "build/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

216 openat(AT\_FDCWD, "/lib/aarch64-linux-gnu/libc.so.6", O\_RDONLY|O\_CLOEXEC) = 3

216 read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0000y\2\0\0\0\0\0"..., 832) = 832

216 newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=1651408, ...}, AT\_EMPTY\_PATH) = 0

216 mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xfffface32000

216 mmap(NULL, 1826912, PROT\_NONE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffffac841000

216 mmap(0xffffac850000, 1761376, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0) = 0xffffac850000

216 munmap(0xffffac841000, 61440) = 0

216 munmap(0xffffac9ff000, 96) = 0

216 mprotect(0xffffac9d7000, 86016, PROT\_NONE) = 0

216 mmap(0xffffac9ec000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x18c000) = 0xffffac9ec000

216 mmap(0xffffac9f2000, 49248, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0xffffac9f2000

216 close(3) = 0

216 mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xfffface30000

216 set\_tid\_address(0xfffface300f0) = 216

216 set\_robust\_list(0xfffface30100, 24) = 0

216 rseq(0xfffface30740, 0x20, 0, 0xd428bc00) = 0

216 mprotect(0xffffac9ec000, 16384, PROT\_READ) = 0

216 mprotect(0xffffaccff000, 4096, PROT\_READ) = 0

216 mprotect(0xffffacd9f000, 4096, PROT\_READ) = 0

216 mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xfffface2e000

216 mprotect(0xffffacc55000, 45056, PROT\_READ) = 0

216 mprotect(0xffffacdcf000, 4096, PROT\_READ) = 0

216 mprotect(0xffffacdff000, 4096, PROT\_READ) = 0

216 mprotect(0x41f000, 4096, PROT\_READ) = 0

216 mprotect(0xfffface40000, 8192, PROT\_READ) = 0

216 prlimit64(0, RLIMIT\_STACK, NULL, {rlim\_cur=8192\*1024, rlim\_max=RLIM64\_INFINITY}) = 0

216 munmap(0xfffface34000, 25959) = 0

216 futex(0xffffacc637ec, FUTEX\_WAKE\_PRIVATE, 2147483647) = 0

216 getrandom("\x7b\x84\xa6\xee\xfb\x08\x25\x13", 8, GRND\_NONBLOCK) = 8

216 brk(NULL) = 0x40337000

216 brk(0x40358000) = 0x40358000

216 openat(AT\_FDCWD, "./libimpl1.so", O\_RDONLY|O\_CLOEXEC) = 3

216 read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

216 newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=69536, ...}, AT\_EMPTY\_PATH) = 0

216 close(3) = 0

216 newfstatat(1, "", {st\_mode=S\_IFCHR|0620, st\_rdev=makedev(0x88, 0), ...}, AT\_EMPTY\_PATH) = 0

216 write(1, "\320\237\321\200\320\276\320\263\321\200\320\260\320\274\320\274\320\260 2 (\320\224\320\270\320\275\320\260\320\274"..., 105) = 105

216 write(1, "\320\230\321\201\320\277\320\276\320\273\321\214\320\267\320\276\320\262\320\260\320\275\320\270\320\265 \320\277\321\200\320"..., 47) = 47

216 write(1, "0 - \320\237\320\265\321\200\320\265\320\272\320\273\321\216\321\207\320\265"..., 60) = 60

216 write(1, "1 <A> <B> - \320\237\320\276\320\264\321\201\321\207\321\221\321\202 \320\277\321"..., 65) = 65

216 write(1, "2 <X> - \320\222\321\213\321\207\320\270\321\201\320\273\320\270\321\202\321\214"..., 59) = 59

216 write(1, "exit - \320\222\321\213\321\205\320\276\320\264\n", 25) = 25

216 newfstatat(0, "", {st\_mode=S\_IFCHR|0620, st\_rdev=makedev(0x88, 0), ...}, AT\_EMPTY\_PATH) = 0

216 read(0, "1 10 100\n", 1024) = 9

216 write(1, "\320\240\320\265\320\267\321\203\320\273\321\214\321\202\320\260\321\202: 21\n", 23) = 23

216 read(0, "2 10\n", 1024) = 5

216 write(1, "\320\240\320\265\320\267\321\203\320\273\321\214\321\202\320\260\321\202: 2.59374\n", 28) = 28

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

216 openat(AT\_FDCWD, "./libimpl2.so", O\_RDONLY|O\_CLOEXEC) = 3

216 read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0\267\0\1\0\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

216 newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=74400, ...}, AT\_EMPTY\_PATH) = 0

216 close(3) = 0

216 write(1, "\320\237\320\265\321\200\320\265\321\210\321\221\320\273 \320\272 \321\200\320\265\320\260\320\273\320\270\320\267\320\260"..., 41) = 41

216 read(0, "1 10 100\n", 1024) = 9

216 write(1, "\320\240\320\265\320\267\321\203\320\273\321\214\321\202\320\260\321\202: 21\n", 23) = 23

216 read(0, "2 10\n", 1024) = 5

216 write(1, "\320\240\320\265\320\267\321\203\320\273\321\214\321\202\320\260\321\202: 2.71828\n", 28) = 28

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

216 lseek(0, -5, SEEK\_CUR) = -1 ESPIPE (Illegal seek)

216 exit\_group(0) = ?

216 +++ exited with 0 +++

**Лабораторная работа №5-7**

386 execve("./control\_node", ["./control\_node"], 0xffffd017f518 /\* 12 vars \*/) = 0

386 brk(NULL) = 0x18a2f000

386 mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0xffff8709b000

# Настройка сокета для связи

- 386 socket(AF\_INET, SOCK\_STREAM|SOCK\_CLOEXEC, IPPROTO\_TCP) = 9

386 setsockopt(9, SOL\_SOCKET, SO\_REUSEADDR, [1], 4) = 0

# Управляющий узел создает сокет. AF\_INET указывает на использование семейства адресов IPv4.

# SOCK\_STREAM означает, что это будет TCP-сокет, обеспечивающий надежную потоковую передачу данных. ZeroMQ будет использовать этот сокет для своего REQ-REP паттерна.

- 386 bind(9, {sa\_family=AF\_INET, sin\_port=htons(4040), sin\_addr=inet\_addr("127.0.0.1")}, 16) = 0

# Процесс привязывает созданный сокет (файловый дескриптор 9) к конкретному адресу: 127.0.0.1 (localhost) и порту 4040.

# Теперь он может принимать входящие подключения на этот адрес.

- 386 listen(9, 100) = 0

386 getsockname(9, {sa\_family=AF\_INET, sin\_port=htons(4040), sin\_addr=inet\_addr("127.0.0.1")}, [128 => 16]) = 0

386 getsockname(9, {sa\_family=AF\_INET, sin\_port=htons(4040), sin\_addr=inet\_addr("127.0.0.1")}, [128 => 16]) = 0

386 getpid() = 386

386 write(6, "\1\0\0\0\0\0\0\0", 8) = 8

- 388 <... epoll\_pwait resumed>[{events=EPOLLIN, data={u32=413428128, u64=413428128}}], 256, -1, NULL, 8) = 1

386 getpid( <unfinished ...>

388 ppoll([{fd=6, events=POLLIN}], 1, {tv\_sec=0, tv\_nsec=0}, NULL, 0) = 0 (Timeout)

388 epoll\_pwait(7, <unfinished ...>

# Кманда для создания узла.

- 386 <... read resumed>"create 10 5\n", 1024) = 12

386 futex(0xffff86e637f8, FUTEX\_WAKE\_PRIVATE, 2147483647) = 0

# Управляющий узел (PID 386) прочитал команду create 10 5 из стандартного ввода

- 386 clone(child\_stack=NULL, flags=CLONE\_CHILD\_CLEARTID|CLONE\_CHILD\_SETTID|SIGCHLD, child\_tidptr=0xffff870890f0) = 389

389 set\_robust\_list(0xffff87089100, 24 <unfinished ...>

386 getpid( <unfinished ...>

389 <... set\_robust\_list resumed>) = 0

386 <... getpid resumed>) = 386

386 ppoll([{fd=8, events=POLLIN}], 1, NULL, NULL, 0 <unfinished ...>

# Системный вызов

- 389 execve("./computing\_node", ["computing\_node", "10", "tcp://127.0.0.1:4040"], 0xffffeb5f9f28 /\* 12 vars \*/ <unfinished ...>

- 386 <... ppoll resumed>) = 1 ([{fd=8, revents=POLLIN}])

- 386 getpid() = 386

- 389 <... execve resumed>) = 0

386 read(8, <unfinished ...>

389 brk(NULL <unfinished ...>

389 <... mmap resumed>) = 0xffffba672000

386 ppoll([{fd=8, events=POLLIN}], 1, {tv\_sec=0, tv\_nsec=0}, NULL, 0 <unfinished ...>

389 faccessat(AT\_FDCWD, "/etc/ld.so.preload", R\_OK <unfinished ...>

# огда выполняется pingall, управляющий узел в цикле пытается подключиться и отправить сообщение ping каждому известному ему вычислительному узлу.

- 386 <... ppoll resumed>) = 0 (Timeout)

- 389 <... faccessat resumed>) = -1 ENOENT (No such file or directory)

386 getpid( <unfinished ...>

<... ppoll resumed>) = 0 (Timeout)

391 <... mprotect resumed>) = 0

389 getpid( <unfinished ...>

- 391 socket(AF\_INET, SOCK\_STREAM|SOCK\_CLOEXEC, IPPROTO\_TCP <unfinished ...>

- 389 <... getpid resumed>) = 389

- 391 <... socket resumed>) = 9

389 ppoll([{fd=8, events=POLLIN}], 1, NULL, NULL, 0 <unfinished ...>

391 fcntl(9, F\_GETFL) = 0x2 (flags O\_RDWR)

391 fcntl(9, F\_SETFL, O\_RDWR|O\_NONBLOCK) = 0

# Новый узел должен сообщить, что он готов к работе.

- 391 connect(9, {sa\_family=AF\_INET, sin\_port=htons(4040), sin\_addr=inet\_addr("127.0.0.1")}, 16) = -1 EINPROGRESS (Operation now in progress)

388 <... epoll\_pwait resumed>[{events=EPOLLIN, data={u32=2147486576, u64=281472829229936}}], 256, -1, NULL, 8) = 1

391 epoll\_ctl(7, EPOLL\_CTL\_ADD, 9, {events=0, data={u32=3019904048, u64=281473701647408}} <unfinished ...>

388 accept4(9, <unfinished ...>

391 <... epoll\_ctl resumed>) = 0

# Вычислительный узел (здесь его PID 391, в вашем логе он 389) пытается подключиться к управляющему узлу по адресу, который ему передали при запуске.

# Это его сокет типа REQ.

- 388 <... accept4 resumed>{sa\_family=AF\_INET, sin\_port=htons(34684), sin\_addr=inet\_addr("127.0.0.1")}, [128 => 16], SOCK\_CLOEXEC) = 10

391 epoll\_ctl(7, EPOLL\_CTL\_MOD, 9, {events=EPOLLOUT, data={u32=3019904048, u64=281473701647408}} <unfinished ...>

388 setsockopt(10, SOL\_TCP, TCP\_NODELAY, [1], 4 <unfinished ...>

391 <... write resumed>) = 8

389 <... ppoll resumed>) = 1 ([{fd=8, revents=POLLIN}])

# Управляющий узел принял входящее соединение от вычислительного узла.

# Теперь для общения с этим конкретным узлом создан новый файловый дескриптор.

- 391 sendto(9, "\1\0\0\10Ready 10", 12, 0, NULL, 0 <unfinished ...>

- 388 <... getpid resumed>) = 386

- 391 <... sendto resumed>) = 12

389 getpid( <unfinished ...>

391 epoll\_pwait(7, <unfinished ...>

poll resumed>) = 0 (Timeout)

389 ppoll([{fd=8, events=POLLIN}], 1, NULL, NULL, 0 <unfinished ...>

388 epoll\_pwait(7, [{events=EPOLLIN, data={u32=2147490256, u64=281472829233616}}], 256, -1, NULL, 8) = 1

- 388 recvfrom(10, "\1\0\0\10Ready 10", 8192, 0, NULL, NULL) = 12

388 getpid() = 386

388 getpid() = 386

388 write(8, "\1\0\0\0\0\0\0\0", 8) = 8

# Управляющий узел получил сообщение.

# Теперь он знает, что узел готов, и может отправить подтверждение.

- 388 sendto(10, "\1\0\0\3OK\0", 7, 0, NULL, 0 <unfinished ...>

- 391 <... epoll\_pwait resumed>[{events=EPOLLIN, data={u32=3019904048, u64=281473701647408}}], 256, -1, NULL, 8) = 1

- 388 <... sendto resumed>) = 7

391 recvfrom(9, <unfinished ...>

# Выполнение команды exec

- 386 <... read resumed>"exec 10 MyVar\n", 1024) = 14

386 eventfd2(0, EFD\_CLOEXEC) = 11

386 fcntl(11, F\_GETFL) = 0x2 (flags O\_RDWR)

386 fcntl(11, F\_SETFL, O\_RDWR|O\_NONBLOCK) = 0

388 <... read resumed>"\1\0\0\0\0\0\0\0", 8) = 8

386 getpid( <unfinished ...>

- 388 socket(AF\_INET, SOCK\_STREAM|SOCK\_CLOEXEC, IPPROTO\_TCP <unfinished ...>

- 386 <... getpid resumed>) = 386

- 388 <... socket resumed>) = 12

386 read(11, <unfinished ...>

388 <... fcntl resumed>) = 0

386 ppoll([{fd=11, events=POLLIN}], 1, {tv\_sec=0, tv\_nsec=0}, NULL, 0 <unfinished ...>

- 388 connect(12, {sa\_family=AF\_INET, sin\_port=htons(4050), sin\_addr=inet\_addr("127.0.0.1")}, 16 <unfinished ...>

- 386 <... ppoll resumed>) = 0 (Timeout)

- 386 getpid( <unfinished ...>

391 <... epoll\_pwait resumed>[{events=EPOLLIN, data={u32=3019903840, u64=281473701647200}}], 256, -1, NULL, 8) = 1

386 <... getpid resumed>) = 386

391 getpid( <unfinished ...>

- 388 sendto(12, "\1\0\0\6MyVar ", 10, 0, NULL, 0 <unfinished ...>

- 386 read(11, <unfinished ...>

- 391 <... getpid resumed>) = 389

- 389 ppoll([{fd=10, events=POLLIN}], 1, {tv\_sec=0, tv\_nsec=0}, NULL, 0 <unfinished ...>

- 386 <... read resumed>"\1\0\0\0\0\0\0\0", 8) = 8

- 391 read(6, <unfinished ...>

- 388 <... sendto resumed>) = 10

386 getpid( <unfinished ...>

391 <... read resumed>"\1\0\0\0\0\0\0\0", 8) = 8

391 <... ppoll resumed>) = 0 (Timeout)

- 388 <... recvfrom resumed>"\1\0\0\30Ok:10: 'MyVar' not found", 8192, 0, NULL, NULL) = 28

391 epoll\_pwait(7, <unfinished ...>

389 getpid( <unfinished ...>

386 getpid() = 386

386 write(6, "\1\0\0\0\0\0\0\0", 8) = 8

# poll\_pwait (или ppoll). Это сердце асинхронного I/O, которое использует ZeroMQ

388 <... epoll\_pwait resumed>[{events=EPOLLIN, data={u32=413428128, u64=413428128}}], 256, -1, NULL, 8) = 1

- 386 write(1, "Ok:10: 'MyVar' not found\n", 25 <unfinished ...>

388 getpid( <unfinished ...>

386 <... write resumed>) = 25

386 write(1, "Error:12: Not found\n", 20) = 20

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

386 read(0, "pingall\n", 1024) = 8

389 getpid() = 389

389 ppoll([{fd=10, events=POLLIN}], 1, {tv\_sec=0, tv\_nsec=0}, NULL, 0) = 0 (Timeout)

389 getpid() = 389

389 ppoll([{fd=10, events=POLLIN}], 1, NULL, NULL, 0 <unfinished ...>

# Завершение работы (exit)

- 386 <... read resumed>"exit\n", 1024) = 5

- 386 kill(389, SIGTERM) = 0

389 <... ppoll resumed>) = ? ERESTARTNOHAND (To be restarted if no handler)

386 getpid( <unfinished ...>

**Вывод**

В результате выполнения лабораторной работы были освоены практические навыки диагностики программного обеспечения с использованием утилиты strace в среде Linux. Применение данной утилиты позволило наглядно продемонстрировать ключевые системные вызовы, используемые программой, и подтвердить, что их использование соответствует логике работы, описанной в варианте лабораторной работы.