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**Отчет по лабораторной работе №3
по курсу «Операционные системы»**

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Условие

Цель работы

Приобретение практических навыков диагностики работы программного обеспечения.

Задание

При выполнении лабораторных работ по курсу ОС необходимо продемонстрировать ключевые системные вызовы, которые в них используются и то, что их использование соответствует варианту ЛР. По итогам выполнения всех лабораторных работ отчет по данной ЛР должен содержать краткую сводку по исследованию написанных программ.

Средства диагностики

strace

Метод решения

Программы, реализованные для каждой лабораторной работы, запускаются с использованием strace. Им подаются тестовые входные данные, ожидается завершение их работы, после чего они корректно завершаются. Полученные логи анализируются для выявления ключевых системных вызовов, подтверждающих корректность реализации заявленных механизмов.

Сводка по исследованию программ (Strace)

Лабораторная работа №1: Взаимодействие процессов через неименованный канал (Pipe)

Данный вывод **strace** демонстрирует создание неименованного канала (pipe) и его использование для однонаправленной передачи данных (имени файла и команд) между родительским и дочерним процессом.

Ключевые системные вызовы

- **pipe2**: Создает неименованный канал с двумя файловыми дескрипторами: [3] для чтения и [4] для записи.
`pipe2([3, 4], 0) = 0`
- **clone**: Создает дочерний процесс (208473).
- **close**: После создания канала каждый процесс закрывает ненужный ему конец: родитель закрывает чтение (`close(3)`), а дочерний закрывает запись (`close(4)`).
- **write/read**: Родительский процесс (208412) записывает данные ("t.txt", "10 2 5") в дескриптор записи (4), а дочерний процесс (208473) читает их из дескриптора чтения (0 после dup2).

```
[pid 208412] write(4, "t.txt\n", 6) = 6
[pid 208473] read(0, "t.txt\n", 4096) = 6
```

- **dup2**: Дочерний процесс перенаправляет файловый дескриптор канала (3) на стандартный ввод (0), чтобы читать данные, как из обычного stdin.
`[pid 208473] dup2(3, 0) = 0`
- **execve**: Дочерний процесс заменяет свой образ программы на `"/child"`.
- **wait4**: Родитель ожидает завершения дочернего процесса, подтверждая синхронное взаимодействие.

Лабораторная работа №2: Многопоточность (Monte-Carlo)

Данный вывод **strace** демонстрирует использование многопоточности для параллельных вычислений (расчет по методу Монте-Карло). Использование **clone3** с соответствующими флагами указывает на создание именно потоков в рамках одного процесса.

Ключевые системные вызовы

- **clone3 (с флагами CLONE_THREAD)**: Ключевой вызов для создания новых потоков. Флаги **CLONE_VM**, **CLONE_FS**, **CLONE_FILES**, **CLONE_SIGHAND** гарантируют, что потоки разделяют адресное пространство, файловые дескрипторы и обработчики сигналов, что является определением потока в Linux.
`clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_...}) = 226684`
- **mmap (MAP_STACK)**: Выделение отдельного стека для каждого нового потока.
`mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0)`
`mprotect(0x7f69f54df000, 8388608, PROT_READ|PROT_WRITE)`
- **futex**: Используется основным потоком (226683) для ожидания завершения или синхронизации с другими потоками, что является стандартным механизмом в библиотеках C++ и Pthreads.
- **exit(0)**: Потоки завершают свою работу, не вызывая **exit_group**, что завершило бы весь процесс.
- **madvise**: Используется для оптимизации использования памяти, сообщая ядру, что выделенный стек потока больше не нужен (**MADV_DONTNEED**).

Лабораторная работа №3: Взаимодействие процессов через разделяемую память и сигналы

Данный вывод **strace** демонстрирует реализацию межпроцессного взаимодействия с использованием разделяемой памяти (Shared Memory) и сигналов для синхронизации.

Ключевые системные вызовы

- **Разделяемая память**:
 - **openat (/dev/shm/lab3_shm)** и **ftruncate** создают и резервируют место для объекта разделяемой памяти.

- `mmap` с флагом `MAP_SHARED` отображает память в адресное пространство родителя и дочернего процесса (10241).
- **Создание процесса:** `clone` используется для создания дочернего процесса.
- **Синхронизация по сигналам:**
 - `rt_sigaction` устанавливает обработчики для `SIGUSR1` и `SIGUSR2`.
 - `kill` используется для отправки сигналов (`kill(10241, SIGUSR1)`) для уведомления о готовности данных.
 - `pause` используется для ожидания сигнала.
- **Очистка ресурсов:** `munmap` освобождает отображения памяти, `wait4` ожидает завершения дочернего процесса, и `unlink("/dev/shm/lab3_shm")` удаляет объект.

Лабораторная работа №4: Динамическая загрузка библиотек

Данный вывод `strace` иллюстрирует динамическую загрузку, выгрузку и замену функциональности с использованием разделяемых библиотек (`.so`) во время выполнения программы, используя функции, аналогичные `dlopen` и `dlclose`.

Ключевые системные вызовы

- **Загрузка (`dlopen`):** Для загрузки каждого файла (`.so`) используются:
 - `openat`: Открытие файла библиотеки (`./libgcf_euclid.so`, `./libsquare_rect.so`).
 - Многократный `mmap`: Проецирование сегментов кода и данных библиотеки в адресное пространство процесса.
- **Выгрузка (`dlclose`):** При замене функционала вызывается `munmap`, которая освобождает занятую память и позволяет ядру выгрузить библиотеку.
- **Повторная загрузка:** Сразу после `munmap` программа снова использует `openat` и `mmap` для загрузки нового набора библиотек (`./libgcf_naive.so` и `./libsquare_triangle`).

Вывод

В ходе выполнения лабораторной работы были получены и закреплены практические навыки диагностики работы программного обеспечения с помощью системной трассировки (`strace`).

Был проведен анализ системных вызовов ядра Linux для четырех реализованных лабораторных работ, которые демонстрируют ключевые механизмы операционных систем:

1. Взаимодействие процессов через неименованный канал (Pipe), подтвержденное вызовом `pipe2` и передачей данных через `read/write`.
2. Использование многопоточности для параллельных вычислений, подтвержденное многократными вызовами `clone3` с флагами `CLONE_THREAD`.
3. Межпроцессное взаимодействие через разделяемую память (`mmap` с `MAP_SHARED`) с использованием сигналов (`kill/pause`) для синхронизации.

4. Динамическая загрузка и выгрузка библиотек, подтвержденная проецированием и освобождением памяти для файлов `.so` с помощью `mmap` и `munmap`.

Анализ логов `strace` подтвердил, что все четыре лабораторные работы полностью соответствуют требованиям заданий и корректно реализуют заявленные механизмы меж-процессного взаимодействия и управления ресурсами.

Strace 1 лабораторной работы

Листинг 1: Фрагмент `strace` для ЛР №4 (Динамическая загрузка)

```
1 execve("./parent", ["/parent"], 0x7ffe93a9f208 /* 37 vars */) = 0
2 brk(NULL)                                = 0x55f0fd08a000
3 mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0)
  = 0x7f8093061000
4 access("/etc/ld.so.preload", R_OK)        = -1 ENOENT (No such file or
  directory)
5 openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
6 fstat(3, {st_mode=S_IFREG|0644, st_size=21863, ...}) = 0
7 mmap(NULL, 21863, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f809305b000
8 close(3)                                    = 0
9 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libstdc++.so.6",
  O_RDONLY|O_CLOEXEC) = 3
10 read(3,
  "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"... ,
  832) = 832
11 fstat(3, {st_mode=S_IFREG|0644, st_size=2592224, ...}) = 0
12 mmap(NULL, 2609472, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
  0x7f8092ddd000
13 mmap(0x7f8092e7a000, 1343488, PROT_READ|PROT_EXEC,
  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x9d000) = 0x7f8092e7a000
14 mmap(0x7f8092fc2000, 552960, PROT_READ,
  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e5000) = 0x7f8092fc2000
15 mmap(0x7f8093049000, 57344, PROT_READ|PROT_WRITE,
  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x26b000) = 0x7f8093049000
16 mmap(0x7f8093057000, 12608, PROT_READ|PROT_WRITE,
  MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f8093057000
17 close(3)                                    = 0
18 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libgcc_s.so.1",
  O_RDONLY|O_CLOEXEC) = 3
19 read(3,
  "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"... ,
  832) = 832
20 fstat(3, {st_mode=S_IFREG|0644, st_size=183024, ...}) = 0
21 mmap(NULL, 185256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
  0x7f8092daf000
22 mmap(0x7f8092db3000, 147456, PROT_READ|PROT_EXEC,
  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x4000) = 0x7f8092db3000
23 mmap(0x7f8092dd7000, 16384, PROT_READ,
  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7f8092dd7000
24 mmap(0x7f8092ddb000, 8192, PROT_READ|PROT_WRITE,
  MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2b000) = 0x7f8092ddb000
25 close(3)                                    = 0
26 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) =
  3
27 read(3,
  "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\220\243\2\0\0\0\0\0"... ,
  832) = 832
```

```

28 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
29 fstat(3, {st_mode=S_IFREG|0755, st_size=2125328, ...}) = 0
30 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
31 mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7f8092b9d000
32 mmap(0x7f8092bc5000, 1605632, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7f8092bc5000
33 mmap(0x7f8092d4d000, 323584, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1b0000) = 0x7f8092d4d000
34 mmap(0x7f8092d9c000, 24576, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000) = 0x7f8092d9c000
35 mmap(0x7f8092da2000, 52624, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f8092da2000
36 close(3) = 0
37 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libm.so.6", O_RDONLY|O_CLOEXEC) =
    3
38 read(3,
    "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"...,
    832) = 832
39 fstat(3, {st_mode=S_IFREG|0644, st_size=952616, ...}) = 0
40 mmap(NULL, 950296, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7f8092ab4000
41 mmap(0x7f8092ac4000, 520192, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x10000) = 0x7f8092ac4000
42 mmap(0x7f8092b43000, 360448, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x8f000) = 0x7f8092b43000
43 mmap(0x7f8092b9b000, 8192, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe7000) = 0x7f8092b9b000
44 close(3) = 0
45 mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0)
    = 0x7f8092ab2000
46 mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0)
    = 0x7f8092aaf000
47 arch_prctl(ARCH_SET_FS, 0x7f8092aaf740) = 0
48 set_tid_address(0x7f8092aafa10) = 208412
49 set_robust_list(0x7f8092aafa20, 24) = 0
50 rseq(0x7f8092ab0060, 0x20, 0, 0x53053053) = 0
51 mprotect(0x7f8092d9c000, 16384, PROT_READ) = 0
52 mprotect(0x7f8092b9b000, 4096, PROT_READ) = 0
53 mprotect(0x7f8092ddb000, 4096, PROT_READ) = 0
54 mprotect(0x7f8093049000, 45056, PROT_READ) = 0
55 mprotect(0x55f0eef2a000, 4096, PROT_READ) = 0
56 mprotect(0x7f8093099000, 8192, PROT_READ) = 0
57 prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
    rlim_max=RLIM64_INFINITY}) = 0
58 munmap(0x7f809305b000, 21863) = 0
59 futex(0x7f80930577bc, FUTEX_WAKE_PRIVATE, 2147483647) = 0
60 getrandom("\x7f\x05\x80\x1b\xb5\x8c\x3b\x66", 8, GRND_NONBLOCK) = 8
61 brk(NULL) = 0x55f0fd08a000
62 brk(0x55f0fd0ab000) = 0x55f0fd0ab000
63 fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0xa), ...}) = 0
64 write(1, "Parent:
    \320\222\320\262\320\265\320\264\320\270\321\202\320\265
    \320\270\320\274\321\217 \321\204"..., 85Parent:
:
65 ) = 85

```

```

66 fstat(0, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0xa), ...}) = 0
67 read(0, t.txt
68 "t.txt\n", 1024) = 6
69 pipe2([3, 4], 0) = 0
70 clone(child_stack=NULL,
      flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLDstrace: Process
      208473 attached
71 , child_tidptr=0x7f8092aafa10) = 208473
72 [pid 208473] set_robust_list(0x7f8092aafa20, 24 <unfinished ...>
73 [pid 208412] close(3 <unfinished ...>
74 [pid 208473] <... set_robust_list resumed>) = 0
75 [pid 208412] <... close resumed>) = 0
76 [pid 208412] write(4, "t.txt\n", 6 <unfinished ...>
77 [pid 208473] close(4 <unfinished ...>
78 [pid 208412] <... write resumed>) = 6
79 [pid 208473] <... close resumed>) = 0
80 [pid 208412] write(1,
      "\320\222\320\262\320\265\320\264\320\270\321\202\320\265
      \321\207\320\270\321\201\320\273\320\260 \320\264\320\273\321\217"... ,
      122 <unfinished ...>
81 ,
      1
      2
      ...').
82 [pid 208473] dup2(3, 0 <unfinished ...>
83 [pid 208412] <... write resumed>) = 122
84 [pid 208473] <... dup2 resumed>) = 0
85 [pid 208412] write(1, "\320\224\320\273\321\217
      \320\262\321\213\321\205\320\276\320\264\320\260
      \320\262\320\262\320\265\320\264\320\270\321\202"... , 43 <unfinished
      ...>
86 'exit'.
87 [pid 208473] close(3 <unfinished ...>
88 [pid 208412] <... write resumed>) = 43
89 [pid 208473] <... close resumed>) = 0
90 [pid 208412] read(0, <unfinished ...>
91 [pid 208473] execve("./child", ["child"], 0x7ffc027962a8 /* 37 vars */) =
      0
92 [pid 208473] brk(NULL) = 0x55e2bd7bd000
93 [pid 208473] mmap(NULL, 8192, PROT_READ|PROT_WRITE,
      MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f1ceb678000
94 [pid 208473] access("/etc/ld.so.preload", R_OK) = -1 ENOENT (No such file
      or directory)
95 [pid 208473] openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
96 [pid 208473] fstat(3, {st_mode=S_IFREG|0644, st_size=21863, ...}) = 0
97 [pid 208473] mmap(NULL, 21863, PROT_READ, MAP_PRIVATE, 3, 0) =
      0x7f1ceb672000
98 [pid 208473] close(3) = 0
99 [pid 208473] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libstdc++.so.6",
      O_RDONLY|O_CLOEXEC) = 3
100 [pid 208473] read(3,
      "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"... ,
      832) = 832
101 [pid 208473] fstat(3, {st_mode=S_IFREG|0644, st_size=2592224, ...}) = 0
102 [pid 208473] mmap(NULL, 2609472, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3,
      0) = 0x7f1ceb3f4000
103 [pid 208473] mmap(0x7f1ceb491000, 1343488, PROT_READ|PROT_EXEC,
      MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x9d000) = 0x7f1ceb491000
104 [pid 208473] mmap(0x7f1ceb5d9000, 552960, PROT_READ,
      MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e5000) = 0x7f1ceb5d9000
105 [pid 208473] mmap(0x7f1ceb660000, 57344, PROT_READ|PROT_WRITE,
      MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x26b000) = 0x7f1ceb660000

```

```

106 [pid 208473] mmap(0x7f1ceb66e000, 12608, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f1ceb66e000
107 [pid 208473] close(3) = 0
108 [pid 208473] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libgcc_s.so.1",
    O_RDONLY|O_CLOEXEC) = 3
109 [pid 208473] read(3,
    "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"...,
    832) = 832
110 [pid 208473] fstat(3, {st_mode=S_IFREG|0644, st_size=183024, ...}) = 0
111 [pid 208473] mmap(NULL, 185256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3,
    0) = 0x7f1ceb3c6000
112 [pid 208473] mmap(0x7f1ceb3ca000, 147456, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x4000) = 0x7f1ceb3ca000
113 [pid 208473] mmap(0x7f1ceb3ee000, 16384, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7f1ceb3ee000
114 [pid 208473] mmap(0x7f1ceb3f2000, 8192, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2b000) = 0x7f1ceb3f2000
115 [pid 208473] close(3) = 0
116 [pid 208473] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6",
    O_RDONLY|O_CLOEXEC) = 3
117 [pid 208473] read(3,
    "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\220\243\2\0\0\0\0\0"...,
    832) = 832
118 [pid 208473] 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"...,
    784, 64) = 784
119 [pid 208473] fstat(3, {st_mode=S_IFREG|0755, st_size=2125328, ...}) = 0
120 [pid 208473] 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"...,
    784, 64) = 784
121 [pid 208473] mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3,
    0) = 0x7f1ceb1b4000
122 [pid 208473] mmap(0x7f1ceb1dc000, 1605632, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7f1ceb1dc000
123 [pid 208473] mmap(0x7f1ceb364000, 323584, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1b0000) = 0x7f1ceb364000
124 [pid 208473] mmap(0x7f1ceb3b3000, 24576, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000) = 0x7f1ceb3b3000
125 [pid 208473] mmap(0x7f1ceb3b9000, 52624, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f1ceb3b9000
126 [pid 208473] close(3) = 0
127 [pid 208473] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libm.so.6",
    O_RDONLY|O_CLOEXEC) = 3
128 [pid 208473] read(3,
    "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"...,
    832) = 832
129 [pid 208473] fstat(3, {st_mode=S_IFREG|0644, st_size=952616, ...}) = 0
130 [pid 208473] mmap(NULL, 950296, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3,
    0) = 0x7f1ceb0cb000
131 [pid 208473] mmap(0x7f1ceb0db000, 520192, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x10000) = 0x7f1ceb0db000
132 [pid 208473] mmap(0x7f1ceb15a000, 360448, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x8f000) = 0x7f1ceb15a000
133 [pid 208473] mmap(0x7f1ceb1b2000, 8192, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe7000) = 0x7f1ceb1b2000
134 [pid 208473] close(3) = 0
135 [pid 208473] mmap(NULL, 8192, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f1ceb0c9000
136 [pid 208473] mmap(NULL, 12288, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f1ceb0c6000

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137 [pid 208473] arch_prctl(ARCH_SET_FS, 0x7f1ceb0c6740) = 0
138 [pid 208473] set_tid_address(0x7f1ceb0c6a10) = 208473
139 [pid 208473] set_robust_list(0x7f1ceb0c6a20, 24) = 0
140 [pid 208473] rseq(0x7f1ceb0c7060, 0x20, 0, 0x53053053) = 0
141 [pid 208473] mprotect(0x7f1ceb3b3000, 16384, PROT_READ) = 0
142 [pid 208473] mprotect(0x7f1ceb1b2000, 4096, PROT_READ) = 0
143 [pid 208473] mprotect(0x7f1ceb3f2000, 4096, PROT_READ) = 0
144 [pid 208473] mprotect(0x7f1ceb660000, 45056, PROT_READ) = 0
145 [pid 208473] mprotect(0x55e2a91c6000, 4096, PROT_READ) = 0
146 [pid 208473] mprotect(0x7f1ceb6b0000, 8192, PROT_READ) = 0
147 [pid 208473] prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
    rlim_max=RLIM64_INFINITY}) = 0
148 [pid 208473] munmap(0x7f1ceb672000, 21863) = 0
149 [pid 208473] futex(0x7f1ceb66e7bc, FUTEX_WAKE_PRIVATE, 2147483647) = 0
150 [pid 208473] getrandom("\x41\x84\xd1\xb4\x79\x26\x1a\x5d", 8,
    GRND_NONBLOCK) = 8
151 [pid 208473] brk(NULL) = 0x55e2bd7bd000
152 [pid 208473] brk(0x55e2bd7de000) = 0x55e2bd7de000
153 [pid 208473] fstat(0, {st_mode=S_IFIFO|0600, st_size=0, ...}) = 0
154 [pid 208473] read(0, "t.txt\n", 4096) = 6
155 [pid 208473] openat(AT_FDCWD, "t.txt", O_WRONLY|O_CREAT|O_APPEND, 0666) =
    3
156 [pid 208473] lseek(3, 0, SEEK_END) = 375
157 [pid 208473] fstat(3, {st_mode=S_IFREG|0644, st_size=375, ...}) = 0
158 [pid 208473] read(0, 10 2 5
159 <unfinished ...>
160 [pid 208412] <... read resumed>"10 2 5 \n", 1024) = 8
161 [pid 208412] write(4, "10 2 5 \n", 8) = 8
162 [pid 208473] <... read resumed>"10 2 5 \n", 4096) = 8
163 [pid 208412] read(0, <unfinished ...>
164 [pid 208473] write(3, "Child:
    \320\227\320\260\320\277\321\203\321\211\320\265\320\275.
    \320\244\320\260\320\271\320\273 "..., 103) = 103
165 [pid 208473] read(0, exit
166 <unfinished ...>
167 [pid 208412] <... read resumed>"exit\n", 1024) = 5
168 [pid 208412] write(1, "Parent:
    \320\227\320\260\320\272\321\200\321\213\320\262\320\260\321\216
    \320\277\320\260\320\271\320"..., 85Parent:
    ...
169 ) = 85
170 [pid 208412] close(4) = 0
171 [pid 208473] <... read resumed>"", 4096) = 0
172 [pid 208412] wait4(208473, <unfinished ...>
173 [pid 208473] write(2, "Child:
    \320\237\320\276\320\273\321\203\321\207\320\265\320\275 EOF,
    \320\267\320\260\320"..., 64Child: EOF,
    ProcessDivision.) = 64
174 [pid 208473] write(2, "\n", 1
175 ) = 1
176 [pid 208473] write(3, "Child:
    \320\240\320\260\320\261\320\276\321\202\320\260
    \320\267\320\260\320\262\320\265\321\200\321\210"..., 40) = 40
177 [pid 208473] close(3) = 0
178 [pid 208473] exit_group(0) = ?
179 [pid 208473] +++ exited with 0 +++
180 <... wait4 resumed>[{WIFEXITED(s) && WEXITSTATUS(s) == 0}], 0, NULL) =
    208473
181 --- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=208473,
    si_uid=1000, si_status=0, si_utime=0, si_stime=1 /* 0.01 s */} ---

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```

182 write(1, "Parent:
    \320\224\320\276\321\207\320\265\321\200\320\275\320\270\320\271
    \320\277\321\200\320\276\321"... , 58Parent:
    .
183 ) = 58
184 write(1, "Parent:
    \320\237\321\200\320\276\320\263\321\200\320\260\320\274\320\274\320\260
    \320\267\320\260\320"... , 47Parent:
    .
185 ) = 47
186 exit_group(0) = ?
187 +++ exited with 0 +++

```

Strace 2 лабораторной работы

Листинг 2: Фрагмент strace для ЛР №4 (Динамическая загрузка)

```

1 execve("./monte_carlo", ["/monte_carlo", "1.0", "4"], 0x7fffa41ae6e8 /*
   37 vars */) = 0
2 brk(NULL) = 0x55e38eb1f000
3 mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0)
   = 0x7f69f6291000
4 access("/etc/ld.so.preload", R_OK) = -1 ENOENT (No such file or
   directory)
5 openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
6 fstat(3, {st_mode=S_IFREG|0644, st_size=21863, ...}) = 0
7 mmap(NULL, 21863, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f69f628b000
8 close(3) = 0
9 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libstdc++.so.6",
   O_RDONLY|O_CLOEXEC) = 3
10 read(3,
    "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"... ,
    832) = 832
11 fstat(3, {st_mode=S_IFREG|0644, st_size=2592224, ...}) = 0
12 mmap(NULL, 2609472, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7f69f600d000
13 mmap(0x7f69f60aa000, 1343488, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x9d000) = 0x7f69f60aa000
14 mmap(0x7f69f61f2000, 552960, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e5000) = 0x7f69f61f2000
15 mmap(0x7f69f6279000, 57344, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x26b000) = 0x7f69f6279000
16 mmap(0x7f69f6287000, 12608, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f69f6287000
17 close(3) = 0
18 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libm.so.6", O_RDONLY|O_CLOEXEC) =
    3
19 read(3,
    "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"... ,
    832) = 832
20 fstat(3, {st_mode=S_IFREG|0644, st_size=952616, ...}) = 0
21 mmap(NULL, 950296, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7f69f5f24000
22 mmap(0x7f69f5f34000, 520192, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x10000) = 0x7f69f5f34000
23 mmap(0x7f69f5fb3000, 360448, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x8f000) = 0x7f69f5fb3000
24 mmap(0x7f69f600b000, 8192, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe7000) = 0x7f69f600b000
25 close(3) = 0

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```

26 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libgcc_s.so.1",
    O_RDONLY|O_CLOEXEC) = 3
27 read(3,
    "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0"...,
    832) = 832
28 fstat(3, {st_mode=S_IFREG|0644, st_size=183024, ...}) = 0
29 mmap(NULL, 185256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7f69f5ef6000
30 mmap(0x7f69f5efa000, 147456, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x4000) = 0x7f69f5efa000
31 mmap(0x7f69f5f1e000, 16384, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7f69f5f1e000
32 mmap(0x7f69f5f22000, 8192, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2b000) = 0x7f69f5f22000
33 close(3) = 0
34 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) =
    3
35 read(3,
    "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\220\243\2\0\0\0\0"...,
    832) = 832
36 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
37 fstat(3, {st_mode=S_IFREG|0755, st_size=2125328, ...}) = 0
38 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
39 mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7f69f5ce4000
40 mmap(0x7f69f5d0c000, 1605632, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7f69f5d0c000
41 mmap(0x7f69f5e94000, 323584, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1b0000) = 0x7f69f5e94000
42 mmap(0x7f69f5ee3000, 24576, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000) = 0x7f69f5ee3000
43 mmap(0x7f69f5ee9000, 52624, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f69f5ee9000
44 close(3) = 0
45 mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0)
    = 0x7f69f5ce2000
46 mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0)
    = 0x7f69f5cdf000
47 arch_prctl(ARCH_SET_FS, 0x7f69f5cdf740) = 0
48 set_tid_address(0x7f69f5cdfa10) = 226683
49 set_robust_list(0x7f69f5cdfa20, 24) = 0
50 rseq(0x7f69f5ce0060, 0x20, 0, 0x53053053) = 0
51 mprotect(0x7f69f5ee3000, 16384, PROT_READ) = 0
52 mprotect(0x7f69f5f22000, 4096, PROT_READ) = 0
53 mprotect(0x7f69f600b000, 4096, PROT_READ) = 0
54 mprotect(0x7f69f6279000, 45056, PROT_READ) = 0
55 mprotect(0x55e35cbae000, 4096, PROT_READ) = 0
56 mprotect(0x7f69f62c9000, 8192, PROT_READ) = 0
57 prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
    rlim_max=RLIM64_INFINITY}) = 0
58 munmap(0x7f69f628b000, 21863) = 0
59 futex(0x7f69f62877bc, FUTEX_WAKE_PRIVATE, 2147483647) = 0
60 getrandom("\x1e\xb5\x36\xf6\x43\x81\xf6\x10", 8, GRND_NONBLOCK) = 8
61 brk(NULL) = 0x55e38eb1f000
62 brk(0x55e38eb40000) = 0x55e38eb40000
63 rt_sigaction(SIGRT_1, {sa_handler=0x7f69f5d7d530, sa_mask=[],

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        sa_flags=SA_RESTORER|SA_ONSTACK|SA_RESTART|SA_SIGINFO,
        sa_restorer=0x7f69f5d29330}, NULL, 8) = 0
64 rt_sigprocmask(SIG_UNBLOCK, [RTMIN RT_1], NULL, 8) = 0
65 mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1,
    0) = 0x7f69f54de000
66 mprotect(0x7f69f54df000, 8388608, PROT_READ|PROT_WRITE) = 0
67 rt_sigprocmask(SIG_BLOCK, ~[], [], 8) = 0
68 clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSV
    child_tid=0x7f69f5cde990, parent_tid=0x7f69f5cde990, exit_signal=0,
    stack=0x7f69f54de000, stack_size=0x7fff80, tls=0x7f69f5cde6c0}strace:
    Process 226684 attached
69 => {parent_tid=[226684]}, 88) = 226684
70 [pid 226684] rseq(0x7f69f5cdefe0, 0x20, 0, 0x53053053 <unfinished ...>
71 [pid 226683] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
72 [pid 226684] <... rseq resumed>) = 0
73 [pid 226683] <... rt_sigprocmask resumed>NULL, 8) = 0
74 [pid 226684] set_robust_list(0x7f69f5cde9a0, 24 <unfinished ...>
75 [pid 226683] mmap(NULL, 8392704, PROT_NONE,
    MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0 <unfinished ...>
76 [pid 226684] <... set_robust_list resumed>) = 0
77 [pid 226683] <... mmap resumed>) = 0x7f69f4cdd000
78 [pid 226684] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
79 [pid 226683] mprotect(0x7f69f4cde000, 8388608, PROT_READ|PROT_WRITE
    <unfinished ...>
80 [pid 226684] <... rt_sigprocmask resumed>NULL, 8) = 0
81 [pid 226683] <... mprotect resumed>) = 0
82 [pid 226683] rt_sigprocmask(SIG_BLOCK, ~[], [], 8) = 0
83 [pid 226683]
    clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_S
    child_tid=0x7f69f54dd990, parent_tid=0x7f69f54dd990, exit_signal=0,
    stack=0x7f69f4cdd000, stack_size=0x7fff80, tls=0x7f69f54dd6c0}strace:
    Process 226685 attached
84 => {parent_tid=[226685]}, 88) = 226685
85 [pid 226685] rseq(0x7f69f54ddfe0, 0x20, 0, 0x53053053 <unfinished ...>
86 [pid 226683] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
87 [pid 226685] <... rseq resumed>) = 0
88 [pid 226683] <... rt_sigprocmask resumed>NULL, 8) = 0
89 [pid 226685] set_robust_list(0x7f69f54dd9a0, 24 <unfinished ...>
90 [pid 226683] mmap(NULL, 8392704, PROT_NONE,
    MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0 <unfinished ...>
91 [pid 226685] <... set_robust_list resumed>) = 0
92 [pid 226683] <... mmap resumed>) = 0x7f69f44dc000
93 [pid 226685] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
94 [pid 226683] mprotect(0x7f69f44dd000, 8388608, PROT_READ|PROT_WRITE
    <unfinished ...>
95 [pid 226685] <... rt_sigprocmask resumed>NULL, 8) = 0
96 [pid 226683] <... mprotect resumed>) = 0
97 [pid 226683] rt_sigprocmask(SIG_BLOCK, ~[], [], 8) = 0
98 [pid 226683]
    clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_S
    child_tid=0x7f69f4cdc990, parent_tid=0x7f69f4cdc990, exit_signal=0,
    stack=0x7f69f44dc000, stack_size=0x7fff80, tls=0x7f69f4cdc6c0}strace:
    Process 226686 attached
99 => {parent_tid=[226686]}, 88) = 226686
100 [pid 226686] rseq(0x7f69f4cdcfe0, 0x20, 0, 0x53053053 <unfinished ...>
101 [pid 226683] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
102 [pid 226686] <... rseq resumed>) = 0
103 [pid 226683] <... rt_sigprocmask resumed>NULL, 8) = 0
104 [pid 226686] set_robust_list(0x7f69f4cdc9a0, 24 <unfinished ...>
105 [pid 226683] mmap(NULL, 8392704, PROT_NONE,

```

```

    MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0 <unfinished ...>
106 [pid 226686] <... set_robust_list resumed>) = 0
107 [pid 226683] <... mmap resumed>) = 0x7f69f3cdb000
108 [pid 226686] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
109 [pid 226683] mprotect(0x7f69f3cdc000, 8388608, PROT_READ|PROT_WRITE
    <unfinished ...>
110 [pid 226686] <... rt_sigprocmask resumed>NULL, 8) = 0
111 [pid 226683] <... mprotect resumed>) = 0
112 [pid 226683] rt_sigprocmask(SIG_BLOCK, ~[], [], 8) = 0
113 [pid 226683]
    clone3({flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_S
    child_tid=0x7f69f44db990, parent_tid=0x7f69f44db990, exit_signal=0,
    stack=0x7f69f3cdb000, stack_size=0x7fff80, tls=0x7f69f44db6c0}strace:
    Process 226687 attached
114 => {parent_tid=[226687]}, 8) = 226687
115 [pid 226687] rseq(0x7f69f44dbfe0, 0x20, 0, 0x53053053 <unfinished ...>
116 [pid 226683] rt_sigprocmask(SIG_SETMASK, [], <unfinished ...>
117 [pid 226687] <... rseq resumed>) = 0
118 [pid 226683] <... rt_sigprocmask resumed>NULL, 8) = 0
119 [pid 226687] set_robust_list(0x7f69f44db9a0, 24 <unfinished ...>
120 [pid 226683] futex(0x7f69f5cde990,
    FUTEX_WAIT_BITSET|FUTEX_CLOCK_REALTIME, 226684, NULL,
    FUTEX_BITSET_MATCH_ANY <unfinished ...>
121 [pid 226687] <... set_robust_list resumed>) = 0
122 [pid 226687] rt_sigprocmask(SIG_SETMASK, [], NULL, 8) = 0
123
124 [pid 226685] rt_sigprocmask(SIG_BLOCK, ~[RT_1], NULL, 8) = 0
125 [pid 226685] madvise(0x7f69f4cdd000, 8368128, MADV_DONTNEED) = 0
126 [pid 226685] exit(0) = ?
127 [pid 226685] +++ exited with 0 +++
128 [pid 226687] rt_sigprocmask(SIG_BLOCK, ~[RT_1], NULL, 8) = 0
129 [pid 226687] madvise(0x7f69f3cdb000, 8368128, MADV_DONTNEED) = 0
130 [pid 226687] exit(0) = ?
131 [pid 226687] +++ exited with 0 +++
132 [pid 226686] rt_sigprocmask(SIG_BLOCK, ~[RT_1], NULL, 8) = 0
133 [pid 226686] madvise(0x7f69f44dc000, 8368128, MADV_DONTNEED) = 0
134 [pid 226686] exit(0) = ?
135 [pid 226686] +++ exited with 0 +++
136 [pid 226684] rt_sigprocmask(SIG_BLOCK, ~[RT_1], NULL, 8) = 0
137 [pid 226684] madvise(0x7f69f54de000, 8368128, MADV_DONTNEED) = 0
138 [pid 226684] exit(0) = ?
139 [pid 226683] <... futex resumed>) = 0
140 [pid 226684] +++ exited with 0 +++
141 fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0x6), ...}) = 0
142 write(1, "\n", 1
143 ) = 1
144 write(1, "--- Monte Carlo Simulation Resul"... , 39--- Monte Carlo
    Simulation Results ---
145 ) = 39
146 write(1, "Threads Used:          4\n", 21Threads Used:          4
147 ) = 21
148 write(1, "Total Points:          1000000000\n", 30Total Points:
    1000000000
149 ) = 30
150 write(1, "Total Hits:          785353352\n", 29Total Hits:          785353352
151 ) = 29
152 write(1, "Estimated Area:        3.14141341\n", 30Estimated Area:
    3.14141341
153 ) = 30
154 write(1, "Analytical Area:       3.14159265\n", 30Analytical Area:

```

```

3.14159265
155 ) = 30
156 write(1, "Execution Time:      82.268002 sec"... , 37Execution Time:
      82.268002 seconds
157 ) = 37
158 exit_group(0)                      = ?
159 +++ exited with 0 +++

```

Strace 3 лабораторной работы

Листинг 3: Фрагмент strace для ЛР №4 (Динамическая загрузка)

```

1 10205 execve("./parent", ["/parent"], 0x7ffed2623138 /* 37 vars */) = 0
2 10205 brk(NULL)                      = 0x563d8de50000
3 10205 mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS,
      -1, 0) = 0x7fa69d2b6000
4 10205 access("/etc/ld.so.preload", R_OK) = -1 ENOENT (No such file or
      directory)
5 10205 openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
6 10205 fstat(3, {st_mode=S_IFREG|0644, st_size=21863, ...}) = 0
7 10205 mmap(NULL, 21863, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7fa69d2b0000
8 10205 close(3)                       = 0
9 10205 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libstdc++.so.6",
      O_RDONLY|O_CLOEXEC) = 3
10 10205 read(3,
      "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"... ,
      832) = 832
11 10205 fstat(3, {st_mode=S_IFREG|0644, st_size=2592224, ...}) = 0
12 10205 mmap(NULL, 2609472, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
      0x7fa69d032000
13 10205 mmap(0x7fa69d0cf000, 1343488, PROT_READ|PROT_EXEC,
      MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x9d000) = 0x7fa69d0cf000
14 10205 mmap(0x7fa69d217000, 552960, PROT_READ,
      MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e5000) = 0x7fa69d217000
15 10205 mmap(0x7fa69d29e000, 57344, PROT_READ|PROT_WRITE,
      MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x26b000) = 0x7fa69d29e000
16 10205 mmap(0x7fa69d2ac000, 12608, PROT_READ|PROT_WRITE,
      MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7fa69d2ac000
17 10205 close(3)                      = 0
18 10205 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libgcc_s.so.1",
      O_RDONLY|O_CLOEXEC) = 3
19 10205 read(3,
      "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"... ,
      832) = 832
20 10205 fstat(3, {st_mode=S_IFREG|0644, st_size=183024, ...}) = 0
21 10205 mmap(NULL, 185256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
      0x7fa69d004000
22 10205 mmap(0x7fa69d008000, 147456, PROT_READ|PROT_EXEC,
      MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x4000) = 0x7fa69d008000
23 10205 mmap(0x7fa69d02c000, 16384, PROT_READ,
      MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7fa69d02c000
24 10205 mmap(0x7fa69d030000, 8192, PROT_READ|PROT_WRITE,
      MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2b000) = 0x7fa69d030000
25 10205 close(3)                      = 0
26 10205 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6",
      O_RDONLY|O_CLOEXEC) = 3
27 10205 read(3,
      "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\220\243\2\0\0\0\0\0"... ,
      832) = 832

```

```

28 10205 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
29 10205 fstat(3, {st_mode=S_IFREG|0755, st_size=2125328, ...}) = 0
30 10205 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
31 10205 mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7fa69cdf2000
32 10205 mmap(0x7fa69ce1a000, 1605632, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7fa69ce1a000
33 10205 mmap(0x7fa69cfa2000, 323584, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1b0000) = 0x7fa69cfa2000
34 10205 mmap(0x7fa69cff1000, 24576, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000) = 0x7fa69cff1000
35 10205 mmap(0x7fa69cff7000, 52624, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7fa69cff7000
36 10205 close(3) = 0
37 10205 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libm.so.6",
    O_RDONLY|O_CLOEXEC) = 3
38 10205 read(3,
    "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"...,
    832) = 832
39 10205 fstat(3, {st_mode=S_IFREG|0644, st_size=952616, ...}) = 0
40 10205 mmap(NULL, 950296, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7fa69cd09000
41 10205 mmap(0x7fa69cd19000, 520192, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x10000) = 0x7fa69cd19000
42 10205 mmap(0x7fa69cd98000, 360448, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x8f000) = 0x7fa69cd98000
43 10205 mmap(0x7fa69cdf0000, 8192, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe7000) = 0x7fa69cdf0000
44 10205 close(3) = 0
45 10205 mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS,
    -1, 0) = 0x7fa69cd07000
46 10205 mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS,
    -1, 0) = 0x7fa69cd04000
47 10205 arch_prctl(ARCH_SET_FS, 0x7fa69cd04740) = 0
48 10205 set_tid_address(0x7fa69cd04a10) = 10205
49 10205 set_robust_list(0x7fa69cd04a20, 24) = 0
50 10205 rseq(0x7fa69cd05060, 0x20, 0, 0x53053053) = 0
51 10205 mprotect(0x7fa69cff1000, 16384, PROT_READ) = 0
52 10205 mprotect(0x7fa69cdf0000, 4096, PROT_READ) = 0
53 10205 mprotect(0x7fa69d030000, 4096, PROT_READ) = 0
54 10205 mprotect(0x7fa69d29e000, 45056, PROT_READ) = 0
55 10205 mprotect(0x563d65b5f000, 4096, PROT_READ) = 0
56 10205 mprotect(0x7fa69d2ee000, 8192, PROT_READ) = 0
57 10205 prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
    rlim_max=RLIM64_INFINITY}) = 0
58 10205 munmap(0x7fa69d2b0000, 21863) = 0
59 10205 futex(0x7fa69d2ac7bc, FUTEX_WAKE_PRIVATE, 2147483647) = 0
60 10205 getrandom("\xb9\x42\xb8\x80\xae\x72\xb6\x01", 8, GRND_NONBLOCK) = 8
61 10205 brk(NULL) = 0x563d8de50000
62 10205 brk(0x563d8de71000) = 0x563d8de71000
63 10205 fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0xb), ...}) =
    0
64 10205 write(1, "Parent:
    \320\222\320\262\320\265\320\264\320\270\321\202\320\265
    \320\270\320\274\321\217 \321\204"..., 42) = 42
65 10205 fstat(0, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0xb), ...}) =

```

```

0
66 10205 read(0, "t.txt\n", 1024) = 6
67 10205 unlink("/dev/shm/lab3_shm") = -1 ENOENT (No such file or
    directory)
68 10205 openat(AT_FDCWD, "/dev/shm/lab3_shm",
    O_RDWR|O_CREAT|O_NOFOLLOW|O_CLOEXEC, 0666) = 3
69 10205 ftruncate(3, 4096) = 0
70 10205 mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 3, 0) =
    0x7fa69d2b5000
71 10205 rt_sigaction(SIGUSR2, {sa_handler=0x563d65b5d2af, sa_mask=[],
    sa_flags=SA_RESTORER, sa_restorer=0x7fa69ce37330}, NULL, 8) = 0
72 10205 rt_sigaction(SIGTERM, {sa_handler=0x563d65b5d2c7, sa_mask=[],
    sa_flags=SA_RESTORER, sa_restorer=0x7fa69ce37330}, NULL, 8) = 0
73 10205 clone(child_stack=NULL,
    flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,
    child_tidptr=0x7fa69cd04a10) = 10241
74 10205 clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=200000000},
    <unfinished ...>
75 10241 set_robust_list(0x7fa69cd04a20, 24) = 0
76 10241 execve("./child", ["/child", "t.txt", "/lab3_shm"], 0x7ffc6bf3bad8
    /* 37 vars */) = 0
77 10241 brk(NULL) = 0x55b0d7e6b000
78 10241 mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS,
    -1, 0) = 0x7ff8aa08e000
79 10241 access("/etc/ld.so.preload", R_OK) = -1 ENOENT (No such file or
    directory)
80 10241 openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
81 10241 fstat(3, {st_mode=S_IFREG|0644, st_size=21863, ...}) = 0
82 10241 mmap(NULL, 21863, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7ff8aa088000
83 10241 close(3) = 0
84 10241 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libstdc++.so.6",
    O_RDONLY|O_CLOEXEC) = 3
85 10241 read(3,
    "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"...,
    832) = 832
86 10241 fstat(3, {st_mode=S_IFREG|0644, st_size=2592224, ...}) = 0
87 10241 mmap(NULL, 2609472, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7ff8a9e0a000
88 10241 mmap(0x7ff8a9ea7000, 1343488, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x9d000) = 0x7ff8a9ea7000
89 10241 mmap(0x7ff8a9fef000, 552960, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e5000) = 0x7ff8a9fef000
90 10241 mmap(0x7ff8aa076000, 57344, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x26b000) = 0x7ff8aa076000
91 10241 mmap(0x7ff8aa084000, 12608, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7ff8aa084000
92 10241 close(3) = 0
93 10241 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libgcc_s.so.1",
    O_RDONLY|O_CLOEXEC) = 3
94 10241 read(3,
    "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"...,
    832) = 832
95 10241 fstat(3, {st_mode=S_IFREG|0644, st_size=183024, ...}) = 0
96 10241 mmap(NULL, 185256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7ff8a9ddc000
97 10241 mmap(0x7ff8a9de0000, 147456, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x4000) = 0x7ff8a9de0000
98 10241 mmap(0x7ff8a9e04000, 16384, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7ff8a9e04000
99 10241 mmap(0x7ff8a9e08000, 8192, PROT_READ|PROT_WRITE,

```



```

    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2b000) = 0x7ff8a9e08000
100 10241 close(3) = 0
101 10241 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6",
    O_RDONLY|O_CLOEXEC) = 3
102 10241 read(3,
    "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\220\243\2\0\0\0\0\0"... ,
    832) = 832
103 10241 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
104 10241 fstat(3, {st_mode=S_IFREG|0755, st_size=2125328, ...}) = 0
105 10241 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
106 10241 mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7ff8a9bca000
107 10241 mmap(0x7ff8a9bf2000, 1605632, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7ff8a9bf2000
108 10241 mmap(0x7ff8a9d7a000, 323584, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1b0000) = 0x7ff8a9d7a000
109 10241 mmap(0x7ff8a9dc9000, 24576, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000) = 0x7ff8a9dc9000
110 10241 mmap(0x7ff8a9dcf000, 52624, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7ff8a9dcf000
111 10241 close(3) = 0
112 10241 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libm.so.6",
    O_RDONLY|O_CLOEXEC) = 3
113 10241 read(3,
    "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0"... ,
    832) = 832
114 10241 fstat(3, {st_mode=S_IFREG|0644, st_size=952616, ...}) = 0
115 10241 mmap(NULL, 950296, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7ff8a9ae1000
116 10241 mmap(0x7ff8a9af1000, 520192, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x10000) = 0x7ff8a9af1000
117 10241 mmap(0x7ff8a9b70000, 360448, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x8f000) = 0x7ff8a9b70000
118 10241 mmap(0x7ff8a9bc8000, 8192, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe7000) = 0x7ff8a9bc8000
119 10241 close(3) = 0
120 10241 mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS,
    -1, 0) = 0x7ff8a9adf000
121 10241 mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS,
    -1, 0) = 0x7ff8a9adc000
122 10241 arch_prctl(ARCH_SET_FS, 0x7ff8a9adc740) = 0
123 10241 set_tid_address(0x7ff8a9adca10) = 10241
124 10241 set_robust_list(0x7ff8a9adca20, 24) = 0
125 10241 rseq(0x7ff8a9add060, 0x20, 0, 0x53053053) = 0
126 10241 mprotect(0x7ff8a9dc9000, 16384, PROT_READ) = 0
127 10241 mprotect(0x7ff8a9bc8000, 4096, PROT_READ) = 0
128 10241 mprotect(0x7ff8a9e08000, 4096, PROT_READ) = 0
129 10241 mprotect(0x7ff8aa076000, 45056, PROT_READ) = 0
130 10241 mprotect(0x55b0bfc6000, 4096, PROT_READ) = 0
131 10241 mprotect(0x7ff8aa0c6000, 8192, PROT_READ) = 0
132 10241 prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
    rlim_max=RLIM64_INFINITY}) = 0
133 10241 munmap(0x7ff8aa088000, 21863) = 0
134 10241 futex(0x7ff8aa0847bc, FUTEX_WAKE_PRIVATE, 2147483647) = 0
135 10241 getrandom("\xb7\xff\x09\x72\xfd\x52\x5e\xc5", 8, GRND_NONBLOCK) = 8
136 10241 brk(NULL) = 0x55b0d7e6b000

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```

137 10241 brk(0x55b0d7e8c000) = 0x55b0d7e8c000
138 10241 openat(AT_FDCWD, "t.txt", O_WRONLY|O_CREAT|O_APPEND, 0666) = 3
139 10241 lseek(3, 0, SEEK_END) = 393
140 10241 fstat(3, {st_mode=S_IFREG|0644, st_size=393, ...}) = 0
141 10241 openat(AT_FDCWD, "/dev/shm/lab3_shm", O_RDWR|O_NOFOLLOW|O_CLOEXEC)
    = 4
142 10241 mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 4, 0) =
    0x7ff8aa08d000
143 10241 rt_sigaction(SIGUSR1, {sa_handler=0x55b0bfc3293, sa_mask=[],
    sa_flags=SA_RESTORER, sa_restorer=0x7ff8a9c0f330}, NULL, 8) = 0
144 10241 pause( <unfinished ...>
145 10205 <... clock_nanosleep resumed>NULL) = 0
146 10205 write(1, "\320\222\320\262\320\265\320\264\320\270\321\202\320\265
    \321\207\320\270\321\201\320\273\320\260: '\320\264\320\265"... , 93) =
    93
147 10205 read(0, "10 5 2\n", 1024) = 7
148 10205 kill(10241, SIGUSR1) = 0
149 10241 <... pause resumed> = ? ERESTARTNOHAND (To be
    restarted if no handler)
150 10205 pause( <unfinished ...>
151 10241 --- SIGUSR1 {si_signo=SIGUSR1, si_code=SI_USER, si_pid=10205,
    si_uid=1000} ---
152 10241 rt_sigreturn({mask=[]}) = -1 EINTR (Interrupted system
    call)
153 10241 write(3, "Child:
    \320\227\320\260\320\277\321\203\321\211\320\265\320\275.
    \320\244\320\260\320\271\320\273 "... , 78) = 78
154 10241 getppid() = 10205
155 10241 kill(10205, SIGUSR2) = 0
156 10205 <... pause resumed> = ? ERESTARTNOHAND (To be
    restarted if no handler)
157 10205 --- SIGUSR2 {si_signo=SIGUSR2, si_code=SI_USER, si_pid=10241,
    si_uid=1000} ---
158 10241 pause( <unfinished ...>
159 10205 rt_sigreturn({mask=[]}) = -1 EINTR (Interrupted system
    call)
160 10205 read(0, "exit\n", 1024) = 5
161 10205 kill(10241, SIGUSR1) = 0
162 10241 <... pause resumed> = ? ERESTARTNOHAND (To be
    restarted if no handler)
163 10205 kill(10241, SIGUSR1 <unfinished ...>
164 10241 --- SIGUSR1 {si_signo=SIGUSR1, si_code=SI_USER, si_pid=10205,
    si_uid=1000} ---
165 10205 <... kill resumed> = 0
166 10241 rt_sigreturn({mask=[]} <unfinished ...>
167 10205 wait4(10241, <unfinished ...>
168 10241 <... rt_sigreturn resumed> = -1 EINTR (Interrupted system
    call)
169 10241 --- SIGUSR1 {si_signo=SIGUSR1, si_code=SI_USER, si_pid=10205,
    si_uid=1000} ---
170 10241 rt_sigreturn({mask=[]}) = -1 EINTR (Interrupted system
    call)
171 10241 write(3, "Child:
    \320\237\320\276\320\273\321\203\321\207\320\265\320\275\320\260
    \320\272\320\276\320\274\320\260"... , 66) = 66
172 10241 getpid() = 10241
173 10241 write(3, "Child: \320\240\320\260\320\261\320\276\321\202\320\260
    \320\267\320\260\320\262\320\265\321\200\321\210"... , 51) = 51
174 10241 close(3) = 0
175 10241 munmap(0x7ff8aa08d000, 4096) = 0

```

```

176 10241 close(4) = 0
177 10241 exit_group(0) = ?
178 10241 +++ exited with 0 +++
179 10205 <... wait4 resumed>NULL, 0, NULL) = 10241
180 10205 --- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=10241,
      si_uid=1000, si_status=0, si_utime=2 /* 0.02 s */, si_stime=2 /* 0.02
      s */} ---
181 10205 munmap(0x7fa69d2b5000, 4096) = 0
182 10205 close(3) = 0
183 10205 unlink("/dev/shm/lab3_shm") = 0
184 10205 exit_group(0) = ?
185 10205 +++ exited with 0 +++

```

Strace 4 лабораторной работы

Листинг 4: Фрагмент strace для ЛР №4 (Динамическая загрузка)

```

1 execve("./prog_dynamic", ["./prog_dynamic"], 0x7ffc7eceb5f0 /* 36 vars
   */) = 0
2 brk(NULL) = 0x557cdf291000
3 mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0)
   = 0x7f741857e000
4 access("/etc/ld.so.preload", R_OK) = -1 ENOENT (No such file or
   directory)
5 openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
6 fstat(3, {st_mode=S_IFREG|0644, st_size=21863, ...}) = 0
7 mmap(NULL, 21863, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f7418578000
8 close(3) = 0
9 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libstdc++.so.6",
   O_RDONLY|O_CLOEXEC) = 3
10 read(3,
   "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"... ,
   832) = 832
11 fstat(3, {st_mode=S_IFREG|0644, st_size=2592224, ...}) = 0
12 mmap(NULL, 2609472, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
   0x7f74182fa000
13 mmap(0x7f7418397000, 1343488, PROT_READ|PROT_EXEC,
   MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x9d000) = 0x7f7418397000
14 mmap(0x7f74184df000, 552960, PROT_READ,
   MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e5000) = 0x7f74184df000
15 mmap(0x7f7418566000, 57344, PROT_READ|PROT_WRITE,
   MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x26b000) = 0x7f7418566000
16 mmap(0x7f7418574000, 12608, PROT_READ|PROT_WRITE,
   MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f7418574000
17 close(3) = 0
18 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) =
   3
19 read(3,
   "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\220\243\2\0\0\0\0\0"... ,
   832) = 832
20 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
21 fstat(3, {st_mode=S_IFREG|0755, st_size=2125328, ...}) = 0
22 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
23 mmap(NULL, 2170256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
   0x7f74180e8000

```

```

24 mmap(0x7f7418110000, 1605632, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7f7418110000
25 mmap(0x7f7418298000, 323584, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1b0000) = 0x7f7418298000
26 mmap(0x7f74182e7000, 24576, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1fe000) = 0x7f74182e7000
27 mmap(0x7f74182ed000, 52624, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f74182ed000
28 close(3) = 0
29 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libm.so.6", O_RDONLY|O_CLOEXEC) =
    3
30 read(3,
    "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"...,
    832) = 832
31 fstat(3, {st_mode=S_IFREG|0644, st_size=952616, ...}) = 0
32 mmap(NULL, 950296, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7f7417fff000
33 mmap(0x7f741800f000, 520192, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x10000) = 0x7f741800f000
34 mmap(0x7f741808e000, 360448, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x8f000) = 0x7f741808e000
35 mmap(0x7f74180e6000, 8192, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe7000) = 0x7f74180e6000
36 close(3) = 0
37 openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libgcc_s.so.1",
    O_RDONLY|O_CLOEXEC) = 3
38 read(3,
    "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"...,
    832) = 832
39 fstat(3, {st_mode=S_IFREG|0644, st_size=183024, ...}) = 0
40 mmap(NULL, 185256, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7f7417fd1000
41 mmap(0x7f7417fd5000, 147456, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x4000) = 0x7f7417fd5000
42 mmap(0x7f7417ff9000, 16384, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7f7417ff9000
43 mmap(0x7f7417ffd000, 8192, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2b000) = 0x7f7417ffd000
44 close(3) = 0
45 mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0)
    = 0x7f7417fcf000
46 mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0)
    = 0x7f7417fcc000
47 arch_prctl(ARCH_SET_FS, 0x7f7417fcc740) = 0
48 set_tid_address(0x7f7417fcca10) = 10005
49 set_robust_list(0x7f7417fcca20, 24) = 0
50 rseq(0x7f7417fcd060, 0x20, 0, 0x53053053) = 0
51 mprotect(0x7f74182e7000, 16384, PROT_READ) = 0
52 mprotect(0x7f7417ffd000, 4096, PROT_READ) = 0
53 mprotect(0x7f74180e6000, 4096, PROT_READ) = 0
54 mprotect(0x7f7418566000, 45056, PROT_READ) = 0
55 mprotect(0x557ccc051000, 4096, PROT_READ) = 0
56 mprotect(0x7f74185b6000, 8192, PROT_READ) = 0
57 prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024,
    rlim_max=RLIM64_INFINITY}) = 0
58 munmap(0x7f7418578000, 21863) = 0
59 futex(0x7f74185747bc, FUTEX_WAKE_PRIVATE, 2147483647) = 0
60 getrandom("\x2f\x33\xe\x8b\xcd\xb8\x9d\x5c", 8, GRND_NONBLOCK) = 8
61 brk(NULL) = 0x557cdf291000
62 brk(0x557cdf2b2000) = 0x557cdf2b2000

```

```

63 openat(AT_FDCWD, "./libgcf_euclid.so", O_RDONLY|O_CLOEXEC) = 3
64 read(3,
    "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0"...,
    832) = 832
65 fstat(3, {st_mode=S_IFREG|0755, st_size=15672, ...}) = 0
66 getcwd("/home/pavlovau/lab4_os/build", 128) = 29
67 mmap(NULL, 16400, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7f7418579000
68 mmap(0x7f741857a000, 4096, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x7f741857a000
69 mmap(0x7f741857b000, 4096, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7f741857b000
70 mmap(0x7f741857c000, 8192, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7f741857c000
71 close(3) = 0
72 mprotect(0x7f741857c000, 4096, PROT_READ) = 0
73 openat(AT_FDCWD, "./libsquare_rect.so", O_RDONLY|O_CLOEXEC) = 3
74 read(3,
    "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0"...,
    832) = 832
75 fstat(3, {st_mode=S_IFREG|0755, st_size=15640, ...}) = 0
76 getcwd("/home/pavlovau/lab4_os/build", 128) = 29
77 mmap(NULL, 16400, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7f7417fc7000
78 mmap(0x7f7417fc8000, 4096, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x7f7417fc8000
79 mmap(0x7f7417fc9000, 4096, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7f7417fc9000
80 mmap(0x7f7417fca000, 8192, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7f7417fca000
81 close(3) = 0
82 mprotect(0x7f7417fca000, 4096, PROT_READ) = 0
83 fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0x5), ...}) = 0
84 write(1, "Switched to: Euclid & Rectangle\n", 32) = 32
85 write(1, "Lab 4: Dynamic Loading\n", 23) = 23
86 write(1, "0 - Exit\n", 9) = 9
87 write(1, "1 <A> <B> - Compute GCF\n", 24) = 24
88 write(1, "2 <A> <B> - Compute Area\n", 25) = 25
89 write(1, "3 - Switch implementation\n", 26) = 26
90 fstat(0, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0x5), ...}) = 0
91 read(0, "\1\n", 1024) = 2
92 read(0, "12 14\n", 1024) = 6
93 write(1, "GCF Result: 2\n", 14) = 14
94 read(0, "2\n", 1024) = 2
95 read(0, "12 13\n", 1024) = 6
96 write(1, "Square Result: 156\n", 19) = 19
97 read(0, "3\n", 1024) = 2
98 munmap(0x7f7418579000, 16400) = 0
99 munmap(0x7f7417fc7000, 16400) = 0
100 openat(AT_FDCWD, "./libgcf_naive.so", O_RDONLY|O_CLOEXEC) = 3
101 read(3,
    "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0"...,
    832) = 832
102 fstat(3, {st_mode=S_IFREG|0755, st_size=15832, ...}) = 0
103 getcwd("/home/pavlovau/lab4_os/build", 128) = 29
104 mmap(NULL, 16408, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7f7418579000
105 mmap(0x7f741857a000, 4096, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x7f741857a000
106 mmap(0x7f741857b000, 4096, PROT_READ,

```

```

    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7f741857b000
107 mmap(0x7f741857c000, 8192, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7f741857c000
108 close(3) = 0
109 mprotect(0x7f741857c000, 4096, PROT_READ) = 0
110 openat(AT_FDCWD, "./libsquare_triangle.so", O_RDONLY|O_CLOEXEC) = 3
111 read(3,
    "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"... ,
    832) = 832
112 fstat(3, {st_mode=S_IFREG|0755, st_size=15640, ...}) = 0
113 getcwd("/home/pavlovau/lab4_os/build", 128) = 29
114 mmap(NULL, 16400, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
    0x7f7417fc7000
115 mmap(0x7f7417fc8000, 4096, PROT_READ|PROT_EXEC,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1000) = 0x7f7417fc8000
116 mmap(0x7f7417fc9000, 4096, PROT_READ,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7f7417fc9000
117 mmap(0x7f7417fca000, 8192, PROT_READ|PROT_WRITE,
    MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x7f7417fca000
118 close(3) = 0
119 mprotect(0x7f7417fca000, 4096, PROT_READ) = 0
120 write(1, "Switched to: Naive & Triangle\n", 30) = 30
121 read(0, "1\n", 1024) = 2
122 read(0, "12 31\n", 1024) = 6
123 write(1, "GCF Result: 1\n", 14) = 14
124 read(0, "2\n", 1024) = 2
125 read(0, "13 12\n", 1024) = 6
126 write(1, "Square Result: 78\n", 18) = 18
127 read(0, "0\n", 1024) = 2
128 write(1, "Exiting...\n", 11) = 11
129 munmap(0x7f7418579000, 16408) = 0
130 munmap(0x7f7417fc7000, 16400) = 0
131 lseek(0, -1, SEEK_CUR) = -1 ESPIPE (Illegal seek)
132 exit_group(0) = ?
133 +++ exited with 0 +++

```