

Московский Авиационный Институт

(Национальный Исследовательский Университет)

Институт №8 “Компьютерные науки и прикладная математика”

Кафедра №806 “Вычислительная математика и программирование”

Лабораторная работа №5 по курсу

«Операционные системы»

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Оценка: _____

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Постановка задачи

Цель работы

Приобретение практических навыков диагностики работы программного обеспечения.

Задание

Продемонстрировать ключевые системные вызовы, которые используются в лабораторных работах и то, что их использование соответствует варианту ЛР.

Общий метод и алгоритм решения

Для демонстрации системных вызовов будем использовать утилиту `strace` в операционной системе `linux`. `Strace` — это утилита в операционных системах `Linux`, предназначенная для мониторинга и анализа взаимодействия процессов с ядром системы. Она широко применяется для диагностики, отладки и обучения, позволяя отслеживать системные вызовы, получение сигналов и изменения состояния процессов. Чаще всего `strace` используется для запуска программы с одновременным выводом списка выполняемых ею системных вызовов. Это особенно полезно при расследовании причин аварийных завершений программы или её неожиданного поведения.

С помощью дополнительных флагов можно расширить вывод `strace` полезной информацией, например:

`-f` — отслеживать системные вызовы не только основного процесса, но и его дочерних процессов;

`-r` — выводить относительные временные метки для каждого системного вызова;

`-T` — показывать время, затраченное на выполнение каждого системного вызова.

Протокол работы программы

Лабораторная работа №1

```
$ strace -f ./parent
```

```
execve("./parent", ["/parent"], 0x7ffe6bf59de8 /* 29 vars */) = 0
```

```
brk(NULL) = 0x62a0d8d28000
```

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

```
openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
```

```

fstat(3, {st_mode=S_IFREG|0644, st_size=21784, ...}) = 0

mmap(NULL, 21784, PROT_READ, MAP_PRIVATE, 3, 0) = 0x708ec1446000

close(3) = 0

openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) = 3

read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\260>\2\0\0\0\0"..., 832) = 832

fstat(3, {st_mode=S_IFREG|0755, st_size=1901536, ...}) = 0

mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x708ec1444000

mmap(NULL, 1914496, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x708ec1270000

mmap(0x708ec1292000, 1413120, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|
MAP_DENYWRITE, 3, 0x22000) = 0x708ec1292000

mmap(0x708ec13eb000, 323584, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0x17b000) = 0x708ec13eb000

mmap(0x708ec143a000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|
MAP_DENYWRITE, 3, 0x1c9000) = 0x708ec143a000

mmap(0x708ec1440000, 13952, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|
MAP_ANONYMOUS, -1, 0) = 0x708ec1440000

close(3) = 0

arch_prctl(ARCH_SET_FS, 0x708ec1445540) = 0

mprotect(0x708ec143a000, 16384, PROT_READ) = 0

mprotect(0x62a0beb2d000, 4096, PROT_READ) = 0

mprotect(0x708ec1476000, 4096, PROT_READ) = 0

munmap(0x708ec1446000, 21784) = 0

fstat(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0

brk(NULL) = 0x62a0d8d28000

brk(0x62a0d8d49000) = 0x62a0d8d49000

fstat(0, {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}) = 0

write(1, "\320\222\320\262\320\265\320\264\320\270\321\202\320\265 \320\270\320\274\321\217
\321\204\320\260\320\271\320\273\320\260"..., 34Введите имя файла: ) = 34

read(0,
"\n", 1024) = 1

access("", F_OK) = -1 ENOENT (No such file or directory)

write(1, "\320\236\321\210\320\270\320\261\320\272\320\260: \321\204\320\260\320\271\320\273 "
\320\275\320\265 \321"..., 52Ошибка: файл " не существует

) = 52

```

exit_group(1) = ?

+++ exited with 1 +++

Лабораторная работа №2

\$ strace ./a.out 10 4

execve("./a.out", ["/a.out", "10", "4"], 0x7ffe4048eb50 /* 34 vars */) = 0

brk(NULL) = 0x5b44a8f49000

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

openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3

fstat(3, {st_mode=S_IFREG|0644, st_size=21784, ...}) = 0

mmap(NULL, 21784, PROT_READ, MAP_PRIVATE, 3, 0) = 0x78866e522000

close(3) = 0

openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libpthread.so.0", O_RDONLY|O_CLOEXEC) = 3

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

fstat(3, {st_mode=S_IFREG|0755, st_size=149520, ...}) = 0

mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x78866e520000

mmap(NULL, 136304, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x78866e4fe000

mmap(0x78866e504000, 65536, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x6000) = 0x78866e504000

mmap(0x78866e514000, 24576, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x16000) = 0x78866e514000

mmap(0x78866e51a000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1b000) = 0x78866e51a000

mmap(0x78866e51c000, 13424, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x78866e51c000

close(3) = 0

openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) = 3

read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\260>\2\0\0\0\0"..., 832) = 832

fstat(3, {st_mode=S_IFREG|0755, st_size=1901536, ...}) = 0

mmap(NULL, 1914496, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x78866e32a000

mmap(0x78866e34c000, 1413120, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x22000) = 0x78866e34c000

mmap(0x78866e4a5000, 323584, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x17b000) = 0x78866e4a5000

mmap(0x78866e4f4000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1c9000) = 0x78866e4f4000

mmap(0x78866e4fa000, 13952, PROT_READ | PROT_WRITE, MAP_PRIVATE | MAP_FIXED | MAP_ANONYMOUS, -1, 0) = 0x78866e4fa000

close(3) = 0

mmap(NULL, 12288, PROT_READ | PROT_WRITE, MAP_PRIVATE | MAP_ANONYMOUS, -1, 0) = 0x78866e327000

arch_prctl(ARCH_SET_FS, 0x78866e327740) = 0

mprotect(0x78866e4f4000, 16384, PROT_READ) = 0

mprotect(0x78866e51a000, 4096, PROT_READ) = 0

mprotect(0x5b44a6e90000, 4096, PROT_READ) = 0

mprotect(0x78866e552000, 4096, PROT_READ) = 0

munmap(0x78866e522000, 21784) = 0

set_tid_address(0x78866e327a10) = 55406

set_robust_list(0x78866e327a20, 24) = 0

rt_sigaction(SIGRTMIN, {sa_handler=0x78866e504690, sa_mask=[], sa_flags=SA_RESTORER | SA_SIGINFO, sa_restorer=0x78866e511140}, NULL, 8) = 0

rt_sigaction(SIGRT_1, {sa_handler=0x78866e504730, sa_mask=[], sa_flags=SA_RESTORER | SA_RESTART | SA_SIGINFO, sa_restorer=0x78866e511140}, NULL, 8) = 0

rt_sigprocmask(SIG_UNBLOCK, [RTMIN RT_1], NULL, 8) = 0

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

brk(NULL) = 0x5b44a8f49000

brk(0x5b44a8f6a000) = 0x5b44a8f6a000

fstat(1, {st_mode=S_IFCHR | 0620, st_rdev=makedev(0x88, 0), ...}) = 0

write(1, "=== \320\247\321\221\321\202\320\275\320\276-\320\275\320\265\321\207\321\221\321\202\320\275\320\260\321\217 "..., 72=== Чётно-нечётная сортировка Бетчера ===

) = 72

write(1, "\320\240\320\260\320\267\320\274\320\265\321\200\320\274\320\260\321\201\321\201\320\270\320\262\320\260: 10,"..., 52Размер массива: 10, Поток:

) = 52

write(1, "\320\235\320\265\320\276\321\202\321\201\320\276\321\200\321\202\320\270\321\200\320\276\320\262\320\260\320\275\320\275\321\213"..., 78Неотсортированный массив: 19 68 43 13 53 12 58 55 65 8

) = 78

mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE | MAP_ANONYMOUS | MAP_STACK, -1, 0) = 0x78866db26000

mprotect(0x78866db27000, 8388608, PROT_READ | PROT_WRITE) = 0

clone(child_stack=0x78866e325fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[55407], tls=0x78866e326700, child_tidptr=0x78866e3269d0) = 55407

mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) = 0x78866d325000

mprotect(0x78866d326000, 8388608, PROT_READ|PROT_WRITE) = 0

clone(child_stack=0x78866db24fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866db25700, child_tidptr=0x78866db259d0) = 55408

mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) = 0x78866cb24000

mprotect(0x78866cb25000, 8388608, PROT_READ|PROT_WRITE) = 0

clone(child_stack=0x78866d323fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866d324700, child_tidptr=0x78866d3249d0) = 55409

mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) = 0x78866c323000

mprotect(0x78866c324000, 8388608, PROT_READ|PROT_WRITE) = 0

clone(child_stack=0x78866cb22fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[55410], tls=0x78866cb23700, child_tidptr=0x78866cb239d0) = 55410

clone(child_stack=0x78866cb22fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866cb23700, child_tidptr=0x78866cb239d0) = 55411

clone(child_stack=0x78866d323fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[55412], tls=0x78866d324700, child_tidptr=0x78866d3249d0) = 55412

clone(child_stack=0x78866db24fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866db25700, child_tidptr=0x78866db259d0) = 55413

clone(child_stack=0x78866e325fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866e326700, child_tidptr=0x78866e3269d0) = 55414

clone(child_stack=0x78866e325fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866e326700, child_tidptr=0x78866e3269d0) = 55415

clone(child_stack=0x78866db24fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|

CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866db25700, child_tidptr=0x78866db259d0) = 55416

clone(child_stack=0x78866d323fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866d324700, child_tidptr=0x78866d3249d0) = 55417

clone(child_stack=0x78866cb22fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866cb23700, child_tidptr=0x78866cb239d0) = 55418

clone(child_stack=0x78866cb22fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866cb23700, child_tidptr=0x78866cb239d0) = 55419

clone(child_stack=0x78866d323fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866d324700, child_tidptr=0x78866d3249d0) = 55420

clone(child_stack=0x78866db24fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[55421], tls=0x78866db25700, child_tidptr=0x78866db259d0) = 55421

clone(child_stack=0x78866e325fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[55422], tls=0x78866e326700, child_tidptr=0x78866e3269d0) = 55422

clone(child_stack=0x78866e325fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866e326700, child_tidptr=0x78866e3269d0) = 55423

clone(child_stack=0x78866db24fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866db25700, child_tidptr=0x78866db259d0) = 55424

clone(child_stack=0x78866d323fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866d324700, child_tidptr=0x78866d3249d0) = 55425

clone(child_stack=0x78866cb22fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866cb23700, child_tidptr=0x78866cb239d0) = 55426

clone(child_stack=0x78866cb22fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866cb23700, child_tidptr=0x78866cb239d0) = 55427

clone(child_stack=0x78866d323fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866d324700, child_tidptr=0x78866d3249d0) = 55428

clone(child_stack=0x78866db24fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866db25700, child_tidptr=0x78866db259d0) =
55429

clone(child_stack=0x78866e325fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866e326700, child_tidptr=0x78866e3269d0) = 55430

clone(child_stack=0x78866e325fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866e326700, child_tidptr=0x78866e3269d0) = 55431

clone(child_stack=0x78866db24fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866db25700, child_tidptr=0x78866db259d0) =
55432

clone(child_stack=0x78866d323fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866d324700, child_tidptr=0x78866d3249d0) =
55433

clone(child_stack=0x78866cb22fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEARARTID, parent_tid=[55434], tls=0x78866cb23700, child_tidptr=0x78866cb239d0) =
55434

clone(child_stack=0x78866cb22fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866cb23700, child_tidptr=0x78866cb239d0) = 55435

clone(child_stack=0x78866d323fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866d324700, child_tidptr=0x78866d3249d0) =
55436

clone(child_stack=0x78866db24fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEARARTID, parent_tid=[55437], tls=0x78866db25700, child_tidptr=0x78866db259d0) =
55437

clone(child_stack=0x78866e325fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866e326700, child_tidptr=0x78866e3269d0) = 55438

clone(child_stack=0x78866e325fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866e326700, child_tidptr=0x78866e3269d0) = 55439

clone(child_stack=0x78866db24fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866db25700, child_tidptr=0x78866db259d0) =
55440

clone(child_stack=0x78866d323fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEARARTID, parent_tid=[0], tls=0x78866d324700, child_tidptr=0x78866d3249d0) =
55441


```
clone(child_stack=0x78866cb22fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEAR_TID, parent_tid=[0], tls=0x78866cb23700, child_tidptr=0x78866cb239d0) = 55442
```

```
clone(child_stack=0x78866cb22fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEAR_TID, parent_tid=[55443], tls=0x78866cb23700, child_tidptr=0x78866cb239d0) =
55443
```

```
clone(child_stack=0x78866d323fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEAR_TID, parent_tid=[0], tls=0x78866d324700, child_tidptr=0x78866d3249d0) =
55444
```

```
clone(child_stack=0x78866db24fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEAR_TID, parent_tid=[0], tls=0x78866db25700, child_tidptr=0x78866db259d0) =
55445
```

```
clone(child_stack=0x78866e325fb0, flags=CLONE_VM|CLONE_FS|CLONE_FILES|
CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SETTLS|CLONE_PARENT_SETTID|
CLONE_CHILD_CLEAR_TID, parent_tid=[0], tls=0x78866e326700, child_tidptr=0x78866e3269d0) = 55446
```

```
write(1, "\320\241\320\276\321\200\321\202\320\270\321\200\320\276\320\262\320\272\320\260
\320\267\320\260\320\262\320\265\321\200\321"..., 64Сортировка завершена за 5 итераций
) = 64
```

```
write(1,
"\320\236\321\202\321\201\320\276\321\200\321\202\320\270\321\200\320\276\320\262\320\260\320\275\320\2
75\321\213\320\271 \320"..., 74Отсортированный массив: 8 12 13 19 43 53 55 58 65 68
) = 74
```

```
write(1, "\320\237\321\200\320\276\320\262\320\265\321\200\320\272\320\260:
\320\236\320\242\320\241\320\236\320\240\320\242\320\230"..., 64Проверка: ОТСОРТИРОВАНО
КОРРЕКТНО
) = 64
```

```
exit_group(0) = ?
```

```
+++ exited with 0 +++
```

Лабораторная работа №3

```
strace ./parent commands.txt
```

```
execve("./parent", ["/parent", "commands.txt"], 0x7ffc38fda038 /* 27 vars */) = 0
```

```
brk(NULL) = 0x635e575d6000
```

```
arch_prctl(0x3001 /* ARCH_??? */, 0x7fff97bd2820) = -1 EINVAL (Invalid argument)
```

```
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x7a7ea3a85000
```

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

```
openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
```

newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=61360, ...}, AT_EMPTY_PATH) = 0

mmap(NULL, 61360, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7a7ea3a76000

close(3) = 0

openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) = 3

read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\3\0>\0\1\0\0\0P\237\2\0\0\0\0"..., 832) = 832

pread64(3, "\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0"..., 784, 64) = 784

pread64(3, "\4\0\0\0\0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0"..., 48, 848) = 48

pread64(3, "\4\0\0\0\24\0\0\0\3\0\0\0GNU\00{\f225\|=201\327\312\301P\32\$\230\266\235"..., 68, 896) = 68

newfstatat(3, "", {st_mode=S_IFREG|0755, st_size=2220400, ...}, AT_EMPTY_PATH) = 0

pread64(3, "\6\0\0\0\4\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0@\0\0\0\0\0\0\0"..., 784, 64) = 784

mmap(NULL, 2264656, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7a7ea3800000

mprotect(0x7a7ea3828000, 2023424, PROT_NONE) = 0

mmap(0x7a7ea3828000, 1658880, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x7a7ea3828000

mmap(0x7a7ea39bd000, 360448, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1bd000) = 0x7a7ea39bd000

mmap(0x7a7ea3a16000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x215000) = 0x7a7ea3a16000

mmap(0x7a7ea3a1c000, 52816, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7a7ea3a1c000

close(3) = 0

mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7a7ea3a73000

arch_prctl(ARCH_SET_FS, 0x7a7ea3a73740) = 0

set_tid_address(0x7a7ea3a73a10) = 985

set_robust_list(0x7a7ea3a73a20, 24) = 0

rseq(0x7a7ea3a740e0, 0x20, 0, 0x53053053) = 0

mprotect(0x7a7ea3a16000, 16384, PROT_READ) = 0

mprotect(0x635e419ad000, 4096, PROT_READ) = 0

mprotect(0x7a7ea3abf000, 8192, PROT_READ) = 0

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

munmap(0x7a7ea3a76000, 61360) = 0

getrandom("\xa3\xfa\x5e\x44\xff\x61\xc1\xe", 8, GRND_NONBLOCK) = 8

brk(NULL) = 0x635e575d6000

brk(0x635e575f7000) = 0x635e575f7000

openat(AT_FDCWD, "commands.txt", O_RDONLY) = 3

openat(AT_FDCWD, "/dev/shm/lab3_shm", O_RDWR|O_CREAT|O_NOFOLLOW|O_CLOEXEC, 0666) = 4

ftruncate(4, 1036) = 0

mmap(NULL, 1036, PROT_READ|PROT_WRITE, MAP_SHARED, 4, 0) = 0x7a7ea3abe000

clone(child_stack=NULL, flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD, child_tidptr=0x7a7ea3a73a10) = 986

newfstatat(3, "", {st_mode=S_IFREG|0777, st_size=60, ...}, AT_EMPTY_PATH) = 0

read(3, "10 2 2.5\r\n0 3 2\r\n15 3 5\r\n20 \321\217\320\261"..., 4096) = 60

clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=10000000}, Calculation: 10.00 / 2.00 / 2.50 = 2.00

NULL) = 0

clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=10000000}, Calculation: 0.00 / 3.00 / 2.00 = 0.00

NULL) = 0

clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=10000000}, Calculation: 15.00 / 3.00 / 5.00 = 1.00

NULL) = 0

clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=0, tv_nsec=10000000}, Calculation: 20.00 / 0.00 -> ERROR: division by zero!

NULL) = 0

close(3) = 0

munmap(0x7a7ea3abe000, 1036) = 0

close(4) = 0

unlink("/dev/shm/lab3_shm") = 0

exit_group(0) = ?

+++ exited with 0 +++

Лабораторная работа №4

strace -f ./dynamic_program

execve("./dynamic_program", ["/dynamic_program"], 0x7ffcd6b58838 /* 27 vars */) = 0

brk(NULL) = 0x60f99e756000

arch_prctl(0x3001 /* ARCH_??? */, 0x7ffc027af860) = -1 EINVAL (Invalid argument)

mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x78f2a5843000

```

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

openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3

newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=61360, ...}, AT_EMPTY_PATH) = 0

mmap(NULL, 61360, PROT_READ, MAP_PRIVATE, 3, 0) = 0x78f2a5834000

close(3)                                = 0

openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) = 3

read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\3\0>\0\1\0\0\0P\237\2\0\0\0\0"..., 832) = 832

pread64(3, "\6\0\0\0\4\0\0\0@\0\0\0\0\0\0@\0\0\0\0\0\0@\0\0\0\0\0\0"..., 784, 64) = 784

pread64(3, "\4\0\0\0 \0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0"..., 48, 848) = 48

pread64(3, "\4\0\0\0\24\0\0\0\3\0\0\0GNU\0O{\f225\\=\201\327\312\301P\32$\230\266\235"...,
68, 896) = 68

newfstatat(3, "", {st_mode=S_IFREG|0755, st_size=2220400, ...}, AT_EMPTY_PATH) = 0

pread64(3, "\6\0\0\0\4\0\0\0@\0\0\0\0\0\0@\0\0\0\0\0\0@\0\0\0\0\0\0"..., 784, 64) = 784

mmap(NULL, 2264656, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x78f2a5600000

mprotect(0x78f2a5628000, 2023424, PROT_NONE) = 0

mmap(0x78f2a5628000, 1658880, PROT_READ|PROT_EXEC, MAP_PRIVATE|
MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) = 0x78f2a5628000

mmap(0x78f2a57bd000, 360448, PROT_READ, MAP_PRIVATE|MAP_FIXED|
MAP_DENYWRITE, 3, 0x1bd000) = 0x78f2a57bd000

mmap(0x78f2a5816000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|
MAP_FIXED|MAP_DENYWRITE, 3, 0x215000) = 0x78f2a5816000

mmap(0x78f2a581c000, 52816, PROT_READ|PROT_WRITE, MAP_PRIVATE|
MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x78f2a581c000

close(3)                                = 0

mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|
MAP_ANONYMOUS, -1, 0) = 0x78f2a5831000

arch_prctl(ARCH_SET_FS, 0x78f2a5831740) = 0

set_tid_address(0x78f2a5831a10)      = 1918

set_robust_list(0x78f2a5831a20, 24)   = 0

rseq(0x78f2a58320e0, 0x20, 0, 0x53053053) = 0

mprotect(0x78f2a5816000, 16384, PROT_READ) = 0

mprotect(0x60f964571000, 4096, PROT_READ) = 0

mprotect(0x78f2a587d000, 8192, PROT_READ) = 0

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

```

```

munmap(0x78f2a5834000, 61360) = 0

getrandom("\x53\x30\xb7\x42\xaa\x91\x66\xcb", 8, GRND_NONBLOCK) = 8

brk(NULL) = 0x60f99e756000

brk(0x60f99e777000) = 0x60f99e777000

openat(AT_FDCWD, "./lib1.so", O_RDONLY|O_CLOEXEC) = 3

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

newfstatat(3, "", {st_mode=S_IFREG|0777, st_size=15584, ...}, AT_EMPTY_PATH) = 0

getcwd("/mnt/c/Users/
\320\237\320\276\320\273\321\214\320\267\320\276\320\262\320\260\321\202\320\265\320\273\321\21
4/OneDrive/Desktop/2 \320\272\321\203\321\200\321\201/Laby_OC/Lab_4/src", 128) = 84

mmap(NULL, 16432, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x78f2a583e000

mmap(0x78f2a583f000, 4096, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|
MAP_DENYWRITE, 3, 0x1000) = 0x78f2a583f000

mmap(0x78f2a5840000, 4096, PROT_READ, MAP_PRIVATE|MAP_FIXED|
MAP_DENYWRITE, 3, 0x2000) = 0x78f2a5840000

mmap(0x78f2a5841000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|
MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x78f2a5841000

close(3) = 0

openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3

newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=61360, ...}, AT_EMPTY_PATH) = 0

mmap(NULL, 61360, PROT_READ, MAP_PRIVATE, 3, 0) = 0x78f2a55f1000

close(3) = 0

openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libm.so.6", O_RDONLY|O_CLOEXEC) = 3

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

newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=940560, ...}, AT_EMPTY_PATH) = 0

mmap(NULL, 942344, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x78f2a550a000

mmap(0x78f2a5518000, 507904, PROT_READ|PROT_EXEC, MAP_PRIVATE|
MAP_FIXED|MAP_DENYWRITE, 3, 0xe000) = 0x78f2a5518000

mmap(0x78f2a5594000, 372736, PROT_READ, MAP_PRIVATE|MAP_FIXED|
MAP_DENYWRITE, 3, 0x8a000) = 0x78f2a5594000

mmap(0x78f2a55ef000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|
MAP_DENYWRITE, 3, 0xe4000) = 0x78f2a55ef000

close(3) = 0

mprotect(0x78f2a55ef000, 4096, PROT_READ) = 0

```

```

mprotect(0x78f2a5841000, 4096, PROT_READ) = 0
munmap(0x78f2a55f1000, 61360) = 0
newfstatat(0, "", {st_mode=S_IFCHR|0600, st_rdev=makedev(0x88, 0x2), ...},
AT_EMPTY_PATH) = 0
read(0, 1
"1\n", 1024) = 2
read(0, 10
"10\n", 1024) = 3
read(0, 30
"30\n", 1024) = 3
newfstatat(1, "", {st_mode=S_IFCHR|0600, st_rdev=makedev(0x88, 0x2), ...},
AT_EMPTY_PATH) = 0
write(1, "PrimeCount(10, 30) = 6\n", 23PrimeCount(10, 30) = 6
) = 23
read(0, 2
"2\n", 1024) = 2
read(0, 5
"5\n", 1024) = 2
write(1, "E(5) = 2.488321\n", 16E(5) = 2.488321
) = 16
read(0, 0
"0\n", 1024) = 2
munmap(0x78f2a583e000, 16432) = 0
munmap(0x78f2a550a000, 942344) = 0
openat(AT_FDCWD, "./lib2.so", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0"..., 832) = 832
newfstatat(3, "", {st_mode=S_IFREG|0777, st_size=15704, ...}, AT_EMPTY_PATH) = 0
getcwd("/mnt/c/Users/
\320\237\320\276\320\273\321\214\320\267\320\276\320\262\320\260\321\202\320\265\320\273\321\21
4\OneDrive\Desktop\2 \320\272\321\203\321\200\321\201\Laby_OC\Lab_4/src", 128) = 84
mmap(NULL, 16448, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x78f2a583e000
mmap(0x78f2a583f000, 4096, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|
MAP_DENYWRITE, 3, 0x1000) = 0x78f2a583f000

```

```
mmap(0x78f2a5840000, 4096, PROT_READ, MAP_PRIVATE|MAP_FIXED|
MAP_DENYWRITE, 3, 0x2000) = 0x78f2a5840000
```

```
mmap(0x78f2a5841000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|
MAP_FIXED|MAP_DENYWRITE, 3, 0x2000) = 0x78f2a5841000
```

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

```
mprotect(0x78f2a5841000, 4096, PROT_READ) = 0
```

```
write(1, "\320\221\320\270\320\261\320\273\320\270\320\276\321\202\320\265\320\272\320\260\320\277\320\265\321\200\320\265\320\272\320"...  
..., 60Библиотека переключена на: ./lib2.so
```

```
) = 60
```

```
read(0, 1
```

```
"1\n", 1024) = 2
```

```
read(0, 1
```

```
"1\n", 1024) = 2
```

```
read(0, 20
```

```
"20\n", 1024) = 3
```

```
write(1, "PrimeCount(1, 20) = 8\n", 22PrimeCount(1, 20) = 8
```

```
) = 22
```

```
read(0, -1
```

```
"-1\n", 1024) = 3
```

```
write(1, "\320\222\321\213\321\205\320\276\320\264.\n", 12Выход.
```

```
) = 12
```

```
munmap(0x78f2a583e000, 16448) = 0
```

```
lseek(0, -1, SEEK_CUR) = -1 ESPIPE (Illegal seek)
```

```
exit_group(0) = ?
```

```
+++ exited with 0 +++
```

Вывод

В ходе выполнения работы были получены навыки по диагностике работы программного обеспечения с помощью консольной команды strace. Полученные в итоге навыки помогли лучше понять, как операционная система и программы взаимодействуют между собой.