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Кафедра вычислительной математики и программирования

**Лабораторная работа №1 по курсу**

**«Операционные системы»**

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**Репозиторий**

https://github.com/ssForz/OS-labs

**Постановка задачи**

Подробно рассказать о каждом системном вызове из утилиты strace на примере лабораторной работы №4.

**Описание работы strace**

execve — открывает исполняемый файл

brk — определение конца сегмента данных для процесса

arch\_prctl - задаёт состояние процесса или нити, зависящие от архитектуры

openat — открывает файл

fstat - считывает состояние файла

mmap, munmap - отражает файлы или устройства в памяти, снимает их отражение

mprotect - контролирует доступ к области памяти

read, write — чтение и запись

ПОДРОБНЕЕ:

void \*mmap(void \*addr, size\_t length, int prot, int flags, int fd, off\_t offset); - возвращает указатель на начало выделенного блока памяти. Addr — позволяет выбрать конкретный адрес, length — длина участвка, int prot — раззрешения (write, read), fd — файловый дескриптор, offset — сдвиг относительно адреса.

getpid() - возвращает id процесса, в котором была вызвана

off\_t lseek(int fd, off\_t offset, int whence); - сдвигает позицию в fd на значение offset в направлении whence.

**Демонстрация работы strace**

alex@saddtype:~/os-labs/OS-labs/lab-4$ strace -f ./main < test.txt

execve("./main", ["./main"], 0x7ffc0529bab8 /\* 60 vars \*/) = 0

brk(NULL) = 0x56028b994000

arch\_prctl(0x3001 /\* ARCH\_??? \*/, 0x7ffe6f824c10) = -1 EINVAL (Invalid argument)

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=92636, ...}) = 0

mmap(NULL, 92636, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0x7f7414bf5000

close(3) = 0

openat(AT\_FDCWD, "/lib/x86\_64-linux-gnu/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = 3

read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\340\22\n\0\0\0\0\0"..., 832) = 832

fstat(3, {st\_mode=S\_IFREG|0644, st\_size=2186464, ...}) = 0

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f7414bf3000

mmap(NULL, 2201728, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7f74149d9000

mmap(0x7f7414a72000, 1064960, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x99000) = 0x7f7414a72000

mmap(0x7f7414b76000, 442368, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x19d000) = 0x7f7414b76000

mmap(0x7f7414be2000, 57344, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x208000) = 0x7f7414be2000

mmap(0x7f7414bf0000, 10368, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f7414bf0000

close(3) = 0

openat(AT\_FDCWD, "/lib/x86\_64-linux-gnu/libgcc\_s.so.1", O\_RDONLY|O\_CLOEXEC) = 3

read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\3405\0\0\0\0\0\0"..., 832) = 832

fstat(3, {st\_mode=S\_IFREG|0644, st\_size=104984, ...}) = 0

mmap(NULL, 107592, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7f74149be000

mprotect(0x7f74149c1000, 90112, PROT\_NONE) = 0

mmap(0x7f74149c1000, 73728, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x3000) = 0x7f74149c1000

mmap(0x7f74149d3000, 12288, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x15000) = 0x7f74149d3000

mmap(0x7f74149d7000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x18000) = 0x7f74149d7000

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\3\0>\0\1\0\0\0\220q\0\0\0\0\0\0"..., 832) = 832

pread64(3, "\4\0\0\0\24\0\0\0\3\0\0\0GNU\0{E6\364\34\332\245\210\204\10\350-\0106\343="..., 68, 824) = 68

fstat(3, {st\_mode=S\_IFREG|0755, st\_size=157224, ...}) = 0

pread64(3, "\4\0\0\0\24\0\0\0\3\0\0\0GNU\0{E6\364\34\332\245\210\204\10\350-\0106\343="..., 68, 824) = 68

mmap(NULL, 140408, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7f741499b000

mmap(0x7f74149a1000, 69632, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x6000) = 0x7f74149a1000

mmap(0x7f74149b2000, 24576, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x17000) = 0x7f74149b2000

mmap(0x7f74149b8000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1c000) = 0x7f74149b8000

mmap(0x7f74149ba000, 13432, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f74149ba000

close(3) = 0

openat(AT\_FDCWD, "/lib/x86\_64-linux-gnu/libc.so.6", O\_RDONLY|O\_CLOEXEC) = 3

read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\300A\2\0\0\0\0\0"..., 832) = 832

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

pread64(3, "\4\0\0\0\20\0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0\0", 32, 848) = 32

pread64(3, "\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\30x\346\264ur\f|Q\226\236i\253-'o"..., 68, 880) = 68

fstat(3, {st\_mode=S\_IFREG|0755, st\_size=2029592, ...}) = 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

pread64(3, "\4\0\0\0\20\0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0\0", 32, 848) = 32

pread64(3, "\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\30x\346\264ur\f|Q\226\236i\253-'o"..., 68, 880) = 68

mmap(NULL, 2037344, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7f74147a9000

mmap(0x7f74147cb000, 1540096, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x22000) = 0x7f74147cb000

mmap(0x7f7414943000, 319488, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x19a000) = 0x7f7414943000

mmap(0x7f7414991000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1e7000) = 0x7f7414991000

mmap(0x7f7414997000, 13920, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f7414997000

close(3) = 0

openat(AT\_FDCWD, "/lib/x86\_64-linux-gnu/libm.so.6", O\_RDONLY|O\_CLOEXEC) = 3

read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\300\323\0\0\0\0\0\0"..., 832) = 832

fstat(3, {st\_mode=S\_IFREG|0644, st\_size=1369384, ...}) = 0

mmap(NULL, 1368336, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7f741465a000

mmap(0x7f7414667000, 684032, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0xd000) = 0x7f7414667000

mmap(0x7f741470e000, 626688, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0xb4000) = 0x7f741470e000

mmap(0x7f74147a7000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x14c000) = 0x7f74147a7000

close(3) = 0

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f7414658000

mmap(NULL, 12288, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f7414655000

arch\_prctl(ARCH\_SET\_FS, 0x7f7414655740) = 0

mprotect(0x7f7414991000, 16384, PROT\_READ) = 0

mprotect(0x7f74147a7000, 4096, PROT\_READ) = 0

mprotect(0x7f74149b8000, 4096, PROT\_READ) = 0

mprotect(0x7f74149d7000, 4096, PROT\_READ) = 0

mprotect(0x7f7414be2000, 45056, PROT\_READ) = 0

mprotect(0x56028a7de000, 4096, PROT\_READ) = 0

mprotect(0x7f7414c39000, 4096, PROT\_READ) = 0

munmap(0x7f7414bf5000, 92636) = 0

set\_tid\_address(0x7f7414655a10) = 43101

set\_robust\_list(0x7f7414655a20, 24) = 0

rt\_sigaction(SIGRTMIN, {sa\_handler=0x7f74149a1bf0, sa\_mask=[], sa\_flags=SA\_RESTORER|SA\_SIGINFO, sa\_restorer=0x7f74149af420}, NULL, 8) = 0

rt\_sigaction(SIGRT\_1, {sa\_handler=0x7f74149a1c90, sa\_mask=[], sa\_flags=SA\_RESTORER|SA\_RESTART|SA\_SIGINFO, sa\_restorer=0x7f74149af420}, 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) = 0x56028b994000

brk(0x56028b9b5000) = 0x56028b9b5000

futex(0x7f7414bf06fc, FUTEX\_WAKE\_PRIVATE, 2147483647) = 0

futex(0x7f7414bf0708, FUTEX\_WAKE\_PRIVATE, 2147483647) = 0

fstat(1, {st\_mode=S\_IFCHR|0620, st\_rdev=makedev(0x88, 0), ...}) = 0

write(1, "Enter the name for first child f"..., 37Enter the name for first child file: ) = 37

fstat(0, {st\_mode=S\_IFREG|0664, st\_size=82, ...}) = 0

read(0, "a1.txt\na2.txt\n10\nabcd\nfdsghgd\n43"..., 4096) = 82

write(1, "\n", 1

) = 1

write(1, "Enter the name for second child "..., 38Enter the name for second child file: ) = 38

write(1, "\n", 1

) = 1

write(1, "Enter amount of strings: ", 25Enter amount of strings: ) = 25

statfs("/dev/shm/", {f\_type=TMPFS\_MAGIC, f\_bsize=4096, f\_blocks=1966489, f\_bfree=1960458, f\_bavail=1960458, f\_files=1966489, f\_ffree=1966437, f\_fsid={val=[1830830292, 349117747]}, f\_namelen=255, f\_frsize=4096, f\_flags=ST\_VALID|ST\_NOSUID|ST\_NODEV}) = 0

futex(0x7f74149bd390, FUTEX\_WAKE\_PRIVATE, 2147483647) = 0

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

getpid() = 43101

clock\_gettime(CLOCK\_MONOTONIC, {tv\_sec=33441, tv\_nsec=812245771}) = 0

lstat("/dev/shm/Ncu3Ti", 0x7ffe6f824840) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/dev/shm/Ncu3Ti", O\_RDWR|O\_CREAT|O\_EXCL, 0644) = 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) = 0x7f7414c38000

link("/dev/shm/Ncu3Ti", "/dev/shm/sem.a.semaphore") = 0

fstat(3, {st\_mode=S\_IFREG|0644, st\_size=32, ...}) = 0

unlink("/dev/shm/Ncu3Ti") = 0

close(3) = 0

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

getpid() = 43101

clock\_gettime(CLOCK\_MONOTONIC, {tv\_sec=33441, tv\_nsec=812752260}) = 0

lstat("/dev/shm/wAoWsg", 0x7ffe6f824840) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/dev/shm/wAoWsg", O\_RDWR|O\_CREAT|O\_EXCL, 0644) = 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) = 0x7f7414c0b000

link("/dev/shm/wAoWsg", "/dev/shm/sem.b.semaphore") = 0

fstat(3, {st\_mode=S\_IFREG|0644, st\_size=32, ...}) = 0

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

close(3) = 0

mmap(NULL, 2560, PROT\_READ|PROT\_WRITE, MAP\_SHARED|MAP\_ANONYMOUS, -1, 0) = 0x7f7414c0a000

mmap(NULL, 2560, PROT\_READ|PROT\_WRITE, MAP\_SHARED|MAP\_ANONYMOUS, -1, 0) = 0x7f7414c09000

clone(child\_stack=NULL, flags=CLONE\_CHILD\_CLEARTID|CLONE\_CHILD\_SETTID|SIGCHLDstrace: Process 43102 attached

, child\_tidptr=0x7f7414655a10) = 43102

[pid 43101] clone(child\_stack=NULL, flags=CLONE\_CHILD\_CLEARTID|CLONE\_CHILD\_SETTID|SIGCHLD <unfinished ...>

[pid 43102] set\_robust\_list(0x7f7414655a20, 24) = 0

strace: Process 43103 attached

[pid 43101] <... clone resumed>, child\_tidptr=0x7f7414655a10) = 43103

[pid 43101] write(1, "\n", 1 <unfinished ...>

[pid 43103] set\_robust\_list(0x7f7414655a20, 24 <unfinished ...>

[pid 43102] openat(AT\_FDCWD, "a1.txt", O\_RDWR|O\_CREAT|O\_APPEND, 0666 <unfinished ...>

[pid 43101] <... write resumed>) = 1

[pid 43103] <... set\_robust\_list resumed>) = 0

[pid 43102] <... openat resumed>) = 3

[pid 43101] munmap(0x7f7414c0a000, 2560 <unfinished ...>

[pid 43102] openat(AT\_FDCWD, "/dev/shm/sem.a.semaphore", O\_RDWR|O\_NOFOLLOW <unfinished ...>

[pid 43101] <... munmap resumed>) = 0

[pid 43102] <... openat resumed>) = 4

[pid 43101] munmap(0x7f7414c09000, 2560 <unfinished ...>

[pid 43102] fstat(4, <unfinished ...>

[pid 43103] openat(AT\_FDCWD, "a2.txt", O\_RDWR|O\_CREAT|O\_APPEND, 0666 <unfinished ...>

[pid 43101] <... munmap resumed>) = 0

[pid 43102] <... fstat resumed>{st\_mode=S\_IFREG|0644, st\_size=32, ...}) = 0

[pid 43103] <... openat resumed>) = 3

[pid 43101] munmap(0x7f7414c38000, 32 <unfinished ...>

[pid 43102] close(4 <unfinished ...>

[pid 43103] openat(AT\_FDCWD, "/dev/shm/sem.b.semaphore", O\_RDWR|O\_NOFOLLOW <unfinished ...>

[pid 43101] <... munmap resumed>) = 0

[pid 43102] <... close resumed>) = 0

[pid 43103] <... openat resumed>) = 4

[pid 43101] munmap(0x7f7414c0b000, 32) = 0

[pid 43103] fstat(4, <unfinished ...>

[pid 43102] write(3, "dcba\n", 5 <unfinished ...>

[pid 43101] unlink("/dev/shm/sem.a.semaphore" <unfinished ...>

[pid 43103] <... fstat resumed>{st\_mode=S\_IFREG|0644, st\_size=32, ...}) = 0

[pid 43101] <... unlink resumed>) = 0

[pid 43102] <... write resumed>) = 5

[pid 43103] close(4 <unfinished ...>

[pid 43101] unlink("/dev/shm/sem.b.semaphore" <unfinished ...>

[pid 43103] <... close resumed>) = 0

[pid 43102] write(1, "Added result stroke to a1.txt\n", 30 <unfinished ...>

[pid 43101] <... unlink resumed>) = 0

Added result stroke to a1.txt

[pid 43103] write(3, "mvnsjf\n", 7 <unfinished ...>

[pid 43102] <... write resumed>) = 30

[pid 43102] write(3, "dghgsdf\n", 8 <unfinished ...>

[pid 43103] <... write resumed>) = 7

[pid 43101] lseek(0, -1, SEEK\_CUR) = 81

[pid 43103] write(1, "Added result stroke to a2.txt\n", 30 <unfinished ...>

[pid 43102] <... write resumed>) = 8

Added result stroke to a2.txt

[pid 43101] exit\_group(0 <unfinished ...>

[pid 43103] <... write resumed>) = 30

[pid 43102] write(1, "Added result stroke to a1.txt\n", 30 <unfinished ...>

[pid 43101] <... exit\_group resumed>) = ?

Added result stroke to a1.txt

[pid 43103] write(1, "ITS OVER\n", 9 <unfinished ...>

[pid 43102] <... write resumed>) = 30

ITS OVER

[pid 43103] <... write resumed>) = 9

[pid 43102] write(3, "fkj234\n", 7 <unfinished ...>

[pid 43103] close(3 <unfinished ...>

[pid 43102] <... write resumed>) = 7

[pid 43103] <... close resumed>) = 0

[pid 43102] write(1, "Added result stroke to a1.txt\n", 30Added result stroke to a1.txt

<unfinished ...>

[pid 43103] lseek(0, -66, SEEK\_CUR <unfinished ...>

[pid 43101] +++ exited with 0 +++

[pid 43103] <... lseek resumed>) = 15

[pid 43102] <... write resumed>) = 30

[pid 43103] exit\_group(0) = ?

[pid 43102] write(3, "dlsia\n", 6) = 6

[pid 43102] write(1, "Added result stroke to a1.txt\n", 30Added result stroke to a1.txt

) = 30

[pid 43102] write(3, "aa\n", 3) = 3

[pid 43103] +++ exited with 0 +++

write(1, "Added result stroke to a1.txt\n", 30Added result stroke to a1.txt

) = 30

write(3, "ldpproti\n", 9) = 9

write(1, "Added result stroke to a1.txt\n", 30Added result stroke to a1.txt

) = 30

write(3, "glpoo\n", 6) = 6

write(1, "Added result stroke to a1.txt\n", 30Added result stroke to a1.txt

) = 30

write(3, "yu99\n", 5) = 5

write(1, "Added result stroke to a1.txt\n", 30Added result stroke to a1.txt

) = 30

write(3, "mmcnnvbb\n", 9) = 9

write(1, "Added result stroke to a1.txt\n", 30Added result stroke to a1.txt

) = 30

write(1, "ITS OVER\n", 9ITS OVER

) = 9

close(3) = 0

lseek(0, -66, SEEK\_CUR) = -1 EINVAL (Invalid argument)

exit\_group(0) = ?

+++ exited with 0 +++

**Выводы**

В данной лабораторной работе я попрактиковался в использовании strace и разобрался с некоторыми системными вызовами (похожее я уже делал с третьей лабораторной с потоками)