Московский Авиационный Институт

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Факультет информационных технологий и прикладной математики

Кафедра вычислительной математики и программирования

Лабораторная работа №1 по курсу

«Операционные системы»

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Подпись: ___________

Москва, 2022

Содержание

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)