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Кафедра вычислительной математики и программирования

**Лабораторная работа №1 по курсу**

**«Операционные системы»**

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**Репозиторий**

https://github.com/Kurmaxim/OS

**Постановка задачи**

Подробно рассказать о каждом системном вызове из утилиты strace на примере лабораторной работы №5.

Strace — это утилита Linux, отслеживающая системные вызовы, которые представляют собой механизм трансляции, обеспечивающий интерфейс между процессом и операционной системой. Использование данной утилиты позволяет понять, что процесс пытается сделать в данное время. Strace может быть полезен при отладке программ.

Для удобства работы с протоколом утилиты можно использовать следующие ключи:

* -o file – Перенаправить протокол утилиты в файл file
* -e trace=filters – Указать выражения, по которым будут фильтроваться системные вызовы. Например -e trace=write,%process задаёт фильтрацию по системным вызовам write и по группе системных вызовов, связанных с межпроцессорным взаимодействием.
* -f – Отслеживать системные вызовы в дочерних процессах
* -y – Заменить в протоколе все файловые дескрипторы на имена соответствующих им файлов (где возможно).
* -p file – Отслеживать только обращения к файлу file
* -k – Отображать стек вызовов

**Демонстрация работы strace**

execve("./main1", ["./main1"], 0x7fffc0b9ee50 /\* 18 vars \*/) = 0

brk(NULL) = 0x7fffdb27a000

arch\_prctl(0x3001 /\* ARCH\_??? \*/, 0x7fffe2ad47a0) = -1 EINVAL (Invalid argument)

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

openat(AT\_FDCWD, "./tls/haswell/x86\_64/libd2.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "./tls/haswell/libd2.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "./tls/x86\_64/libd2.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "./tls/libd2.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "./haswell/x86\_64/libd2.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "./haswell/libd2.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "./x86\_64/libd2.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "./libd2.so", 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\200O\0\0\0\0\0\0"..., 832) = 832

fstat(3, {st\_mode=S\_IFREG|0777, st\_size=51856, ...}) = 0

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7fa9626f0000

getcwd("/mnt/c/Users/max-/Desktop", 128) = 27

mmap(NULL, 41984, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7fa9626f5000

mmap(0x7fa9626f9000, 12288, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x4000) = 0x7fa9626f9000

mmap(0x7fa9626fc000, 8192, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x7000) = 0x7fa9626fc000

mmap(0x7fa9626fe000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x8000) = 0x7fa9626fe000

close(3) = 0

openat(AT\_FDCWD, "./tls/haswell/x86\_64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

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

openat(AT\_FDCWD, "./tls/x86\_64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

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

openat(AT\_FDCWD, "./haswell/x86\_64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

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

openat(AT\_FDCWD, "./x86\_64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "./libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -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=33838, ...}) = 0

mmap(NULL, 33838, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0x7fa9626e7000

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`\341\t\0\0\0\0\0"..., 832) = 832

fstat(3, {st\_mode=S\_IFREG|0644, st\_size=1956992, ...}) = 0

mmap(NULL, 1972224, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7fa962500000

mprotect(0x7fa962596000, 1290240, PROT\_NONE) = 0

mmap(0x7fa962596000, 987136, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x96000) = 0x7fa962596000

mmap(0x7fa962687000, 299008, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x187000) = 0x7fa962687000

mmap(0x7fa9626d1000, 57344, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1d0000) = 0x7fa9626d1000

mmap(0x7fa9626df000, 10240, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7fa9626df000

close(3) = 0

openat(AT\_FDCWD, "./tls/haswell/x86\_64/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

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

openat(AT\_FDCWD, "./tls/x86\_64/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

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

openat(AT\_FDCWD, "./haswell/x86\_64/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

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

openat(AT\_FDCWD, "./x86\_64/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

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

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\360q\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\t\233\222%\274\260\320\31\331\326\10\204\276X>\263"..., 68, 880) = 68

fstat(3, {st\_mode=S\_IFREG|0755, st\_size=2029224, ...}) = 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\t\233\222%\274\260\320\31\331\326\10\204\276X>\263"..., 68, 880) = 68

mmap(NULL, 2036952, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7fa962300000

mprotect(0x7fa962325000, 1847296, PROT\_NONE) = 0

mmap(0x7fa962325000, 1540096, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x25000) = 0x7fa962325000

mmap(0x7fa96249d000, 303104, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x19d000) = 0x7fa96249d000

mmap(0x7fa9624e8000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1e7000) = 0x7fa9624e8000

mmap(0x7fa9624ee000, 13528, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7fa9624ee000

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\363\0\0\0\0\0\0"..., 832) = 832

fstat(3, {st\_mode=S\_IFREG|0644, st\_size=1369352, ...}) = 0

mmap(NULL, 1368336, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7fa9621b1000

mmap(0x7fa9621c0000, 684032, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0xf000) = 0x7fa9621c0000

mmap(0x7fa962267000, 618496, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0xb6000) = 0x7fa962267000

mmap(0x7fa9622fe000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x14c000) = 0x7fa9622fe000

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) = 0x7fa962190000

mmap(0x7fa962193000, 73728, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x3000) = 0x7fa962193000

mmap(0x7fa9621a5000, 16384, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x15000) = 0x7fa9621a5000

mmap(0x7fa9621a9000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x18000) = 0x7fa9621a9000

close(3) = 0

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7fa962180000

mmap(NULL, 12288, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7fa962170000

arch\_prctl(ARCH\_SET\_FS, 0x7fa962170740) = 0

mprotect(0x7fa9624e8000, 12288, PROT\_READ) = 0

mprotect(0x7fa9621a9000, 4096, PROT\_READ) = 0

mprotect(0x7fa9622fe000, 4096, PROT\_READ) = 0

mprotect(0x7fa9626d1000, 45056, PROT\_READ) = 0

mprotect(0x7fa9626fe000, 4096, PROT\_READ) = 0

mprotect(0x7fa962734000, 4096, PROT\_READ) = 0

mprotect(0x7fa96272d000, 4096, PROT\_READ) = 0

munmap(0x7fa9626e7000, 33838) = 0

brk(NULL) = 0x7fffdb27a000

brk(0x7fffdb29b000) = 0x7fffdb29b000

fstat(1, {st\_mode=S\_IFCHR|0660, st\_rdev=makedev(0x4, 0x1), ...}) = 0

ioctl(1, TCGETS, {B38400 opost isig icanon echo ...}) = 0

write(1, "Choose a function\n", 18) = 18

fstat(0, {st\_mode=S\_IFCHR|0660, st\_rdev=makedev(0x4, 0x1), ...}) = 0

ioctl(0, TCGETS, {B38400 opost isig icanon echo ...}) = 0

read(0, "1\n", 512) = 2

write(1, "Enter A and B numbers\n", 22) = 22

read(0, "0 18\n", 512) = 5

mmap(NULL, 1937408, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7fa961f90000

brk(0x7fffdb2bd000) = 0x7fffdb2bd000

mmap(NULL, 135168, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7fa961f60000

brk(0x7fffdb2ad000) = 0x7fffdb2ad000

mmap(NULL, 266240, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7fa961f10000

munmap(0x7fa961f60000, 135168) = 0

mmap(NULL, 528384, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7fa961e80000

munmap(0x7fa961f10000, 266240) = 0

mmap(NULL, 1052672, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7fa961d70000

munmap(0x7fa961e80000, 528384) = 0

mmap(NULL, 2101248, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7fa961b60000

munmap(0x7fa961d70000, 1052672) = 0

mmap(NULL, 4198400, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7fa961750000

munmap(0x7fa961b60000, 2101248) = 0

mmap(NULL, 8392704, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7fa960f40000

munmap(0x7fa961750000, 4198400) = 0

munmap(0x7fa960f40000, 8392704) = 0

munmap(0x7fa961f90000, 1937408) = 0

write(1, "Your answer: 7\n", 15) = 15

read(0, "2\n", 512) = 2

write(1, "Enter positive K\n", 17) = 17

read(0, "919\n", 512) = 4

write(1, "Pi = 3.14074\n", 15) = 15

read(0, "3\n", 512) = 2

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

exit\_group(0) = ?

+++ exited with 0 +++

**Вывод**

Проделав лабораторную работу, я приобрёл навыки, необходимые для работы с strace, а также изучил системные вызовы.