Московский Авиационный Институт

(Национальный Исследовательский Университет)

Институт №8 “Компьютерные науки и прикладная математика”

Кафедра №806 “Вычислительная математика и программирование”

**Лабораторная работа №1 по курсу**

**«Операционные системы»**

Группа: М8О-211Б-23

Студент: Сергеева А. А.

Преподаватель: Бахарев В.Д. (ФИИТ)

Оценка: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Постановка задачи**

**Вариант 1.**

Пользователь вводит команды вида: «число число число». Далее эти числа передаются от родительского процесса в дочерний. Дочерний процесс считает их сумму и выводит её в файл. Числа имеют тип int. Количество чисел может быть произвольным.

**Общий метод и алгоритм решения**

Использованные системные вызовы:

* pid\_t fork(void); – создает дочерний процесс.
* int pipe(int \*fd); – создаёт канал.
* int execv (const char \* path, char \*const argv[]) – вызов для замещения тела процесса, в случае успешного выполнения системного вызова виртуальное адресное, пространство процесса полностью заменяется. В path записывается абсолютный или относительный путь к исполняемой файлу для запуска, в argv массив аргументов командной строки.
* ssize\_t write (int fd, const void \* buf, size\_t n) – записывает n бит из указанного буфера в файл, соответствующий файловому дескриптору, возвращает количество записанных байт в случае успеха, иначе -1.
* ssize\_t read (int fd, void \* buf, size\_t nbytes) – считывает nbytes из файла, соответствующего файловому дескриптору fd в буфер buf, возвращает количество прочитанных байт, 0 – если достигнут конец файла, –1 в случае ошибки.
* int open(const char \*pathname, int oflag, ... /\* mode\_t mode\*/) – Открывает файл в соответствие с указанными модами, возвращает дескриптор файла в случае успеха, –1 в случае ошибки.
* int close (int fd) – закрывает файл.
* pid\_t wait(&pstatus) – приостанавливает выполнение текущего процесса до тех пор, пока какой-либо сыновний процесс не завершит своё выполнение, либо пока в текущий процесс не поступит сигнал, который вызовет обработчик сигнала или завершит выполнение процесса, записывает статус завершенного процесса в pstatus

Первой строчкой пользователь в консоль родительского процесса пишет имя файла, которое будет передано при создании дочернего процесса. В *posix\_ipc-server.c* родительский процесс создает дочерний процесс с помощью системного вызова fork. Родительский процесс передает команды пользователя через pipe, который связан с стандартным входным потоком дочернего процесса, с помощью функции dup2. С помощью системного вызова execv, заменяет образ дочернего процесса. Происходит выполнение клиентской программы. Дочерний процесс записывает результат суммы в файл, путь к которому вводил пользователь с консоли. Происходит ожидание завершения дочернего процесса с помощью системного вызова wait. Записываем в статус то, что возвращает дочерний процесс. Анализируем статус, если -1, то выводим сообщение об ошибке.

**Код программы**

**posix\_ipc-client.c**

#include <stdint.h>

#include <stdbool.h>

#include <stdlib.h>

#include <unistd.h>

#include <fcntl.h>

#include <stdio.h>

#include <limits.h>

#include <string.h>

#include <ctype.h>

enum err

{

OK,

LONG\_INT\_OVERFLOW,

NOT\_NUM

};

int check\_long\_int(char \*num, int size, long int \*res)

{

char \*end\_num = NULL;

\*res = strtol(num, &end\_num, 10);

if ((\*res == LONG\_MAX) || (\*res == LONG\_MIN))

{

return LONG\_INT\_OVERFLOW;

}

if ((\*end\_num != '\0') || (\*res == 0 && strcmp(num, "0") != 0))

{

return NOT\_NUM;

}

return 0;

}

int main(int argc, char \*\*argv)

{

char buf[4096];

ssize\_t bytes;

pid\_t pid = getpid();

int32\_t file = open(argv[1], O\_WRONLY | O\_CREAT | O\_TRUNC | O\_APPEND, 0600);

if (file == -1)

{

const char msg[] = "error: failed to open requested file\n";

write(STDERR\_FILENO, msg, sizeof(msg));

exit(EXIT\_FAILURE);

}

{

char msg[128];

int32\_t len = snprintf(msg, sizeof(msg) - 1, "%d: Start typing lines of text. Press 'Ctrl-D' or 'Enter' with no input to exit\n", pid);

write(STDOUT\_FILENO, msg, len);

}

while (bytes = read(STDIN\_FILENO, buf, sizeof(buf)))

{

if (bytes < 0)

{

const char msg[] = "error: failed to read from stdin\n";

write(STDERR\_FILENO, msg, sizeof(msg));

exit(EXIT\_FAILURE);

}

else if (buf[0] == '\n')

{

break;

}

{

int j = 0, length = 0;

long int res = 0, sum = 0;

char msg[33];

char num[20];

for (int i = 0; i < bytes / sizeof(char); ++i)

{

if (!isspace(buf[i]))

{

num[j++] = buf[i];

}

else

{

if (j != 0)

{

num[j] = '\0';

switch (check\_long\_int(num, j, &res))

{

case LONG\_INT\_OVERFLOW:

length = snprintf(msg, sizeof(msg) - 1, "error: overflow long int type\n");

write(STDERR\_FILENO, msg, length);

exit(EXIT\_FAILURE);

break;

case NOT\_NUM:

length = snprintf(msg, sizeof(msg) - 1, "error: lecsema not number\n");

write(STDERR\_FILENO, msg, length);

exit(EXIT\_FAILURE);

break;

case OK:

if (((res > 0) && (sum > LONG\_MAX - res)) || ((res < 0) && (sum < LONG\_MIN - res)))

{

length = snprintf(msg, sizeof(msg) - 1, "error: overflow long int type\n");

write(STDERR\_FILENO, msg, sizeof(msg));

exit(EXIT\_FAILURE);

}

else

{

sum += res;

}

break;

}

j = 0;

}

}

}

int32\_t len = snprintf(msg, sizeof(msg) - 1, "%ld -- sum\n", sum);

int32\_t written = write(file, msg, len);

if (written != len)

{

length = snprintf(msg, sizeof(msg) - 1, "error: failed to write to file\n");

write(STDERR\_FILENO, msg, sizeof(msg));

exit(EXIT\_FAILURE);

}

}

}

const char term = '\0';

write(file, &term, sizeof(term));

close(file);

}

**posix\_ipc-server.c**

#include <stdint.h>

#include <stdbool.h>

#include <unistd.h>

#include <sys/wait.h>

#include <stdlib.h>

#include <stdio.h>

static char CLIENT\_PROGRAM\_NAME[] = "posix\_ipc-client";

int main(int argc, char \*\*argv)

{

if (argc == 1)

{

char msg[1024];

uint32\_t len = snprintf(msg, sizeof(msg) - 1, "usage: %s filename\n", argv[0]);

write(STDERR\_FILENO, msg, len);

exit(EXIT\_SUCCESS);

}

char progpath[1024];

{

ssize\_t len = readlink("/proc/self/exe", progpath,

sizeof(progpath) - 1);

if (len == -1)

{

const char msg[] = "error: failed to read full program path\n";

write(STDERR\_FILENO, msg, sizeof(msg));

exit(EXIT\_FAILURE);

}

while (progpath[len] != '/')

--len;

progpath[len] = '\0';

}

int channel[2];

if (pipe(channel) == -1)

{

const char msg[] = "error: failed to create pipe\n";

write(STDERR\_FILENO, msg, sizeof(msg));

exit(EXIT\_FAILURE);

}

const pid\_t child = fork();

switch (child)

{

case -1:

{

const char msg[] = "error: failed to spawn new process\n";

write(STDERR\_FILENO, msg, sizeof(msg));

exit(EXIT\_FAILURE);

}

break;

case 0:

{

pid\_t pid = getpid();

dup2(STDIN\_FILENO, channel[STDIN\_FILENO]);

close(channel[STDOUT\_FILENO]);

{

char msg[64];

const int32\_t length = snprintf(msg, sizeof(msg), "%d: I'm a child\n", pid);

write(STDOUT\_FILENO, msg, length);

}

{

char path[1050];

snprintf(path, sizeof(path) - 1, "%s/%s", progpath, CLIENT\_PROGRAM\_NAME);

char \*const args[] = {CLIENT\_PROGRAM\_NAME, argv[1], NULL};

int32\_t status = execv(path, args);

if (status == -1)

{

const char msg[] = "error: failed to exec into new exectuable image\n";

write(STDERR\_FILENO, msg, sizeof(msg));

exit(EXIT\_FAILURE);

}

}

}

break;

default:

{

pid\_t pid = getpid();

{

char msg[64];

const int32\_t length = snprintf(msg, sizeof(msg), "%d: I'm a parent, my child has PID %d\n", pid, child);

write(STDOUT\_FILENO, msg, length);

}

int child\_status;

wait(&child\_status);

if (child\_status != EXIT\_SUCCESS)

{

const char msg[] = "error: child exited with error\n";

write(STDERR\_FILENO, msg, sizeof(msg));

exit(child\_status);

}

}

break;

}

}

**Протокол работы программы**

**Тестирование:**

ali\_@LAPTOP-TG8SK2OI:~/OS\_2/lab\_1\_$ ./posix\_ipc-server test2.txt

30062: I'm a parent, my child has PID 30063

30063: I'm a child

30063: Start typing lines of text. Press 'Ctrl-D' or 'Enter' with no input to exit

-1 12 45 0 -1

23 10000 3

1

ali\_@LAPTOP-TG8SK2OI:~/OS\_2/lab\_1\_$ cat test2.txt

55 -- sum

10026 -- sum

1 -- sum

ali\_@LAPTOP-TG8SK2OI:~/OS\_2/lab\_1\_$ ./posix\_ipc-server test2.txt

30488: I'm a parent, my child has PID 30489

30489: I'm a child

30489: Start typing lines of text. Press 'Ctrl-D' or 'Enter' with no input to exit

100000 -1000000 9

200000000000000000000000 7 8

error: overflow long int type

error: child exited with error

ali\_@LAPTOP-TG8SK2OI:~/OS\_2/lab\_1\_$ cat test2.txt

-899991 -- sum

ali\_@LAPTOP-TG8SK2OI:~/OS\_2/lab\_1\_$ ./posix\_ipc-server test2.txt

30690: I'm a parent, my child has PID 30691

30691: I'm a child

30691: Start typing lines of text. Press 'Ctrl-D' or 'Enter' with no input to exit

2661 8 1

27j 2

error: lecsema not number

error: child exited with error

ali\_@LAPTOP-TG8SK2OI:~/OS\_2/lab\_1\_$ cat test2.txt

2670 -- sum

ali\_@LAPTOP-TG8SK2OI:~/OS\_2/lab\_1\_$

**Starce 1:**

ali\_@LAPTOP-TG8SK2OI:~/OS\_2/lab\_1\_$ strace ./posix\_ipc-server test2.txt test3.txt

execve("./posix\_ipc-server", ["./posix\_ipc-server", "test2.txt", "test3.txt"], 0x7fffd3211880 /\* 28 vars \*/) = 0

brk(NULL) = 0x7fffd84b4000

arch\_prctl(0x3001 /\* ARCH\_??? \*/, 0x7fffe0936f60) = -1 EINVAL (Invalid argument)

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f69cc240000

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=17675, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 17675, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0x7f69cc24b000

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\0P\237\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 \0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0\0"..., 48, 848) = 48

pread64(3, "\4\0\0\0\24\0\0\0\3\0\0\0GNU\0I\17\357\204\3$\f\221\2039x\324\224\323\236S"..., 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) = 0x7f69cc010000

mprotect(0x7f69cc038000, 2023424, PROT\_NONE) = 0

mmap(0x7f69cc038000, 1658880, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x28000) = 0x7f69cc038000

mmap(0x7f69cc1cd000, 360448, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1bd000) = 0x7f69cc1cd000

mmap(0x7f69cc226000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x215000) = 0x7f69cc226000

mmap(0x7f69cc22c000, 52816, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f69cc22c000

close(3) = 0

mmap(NULL, 12288, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f69cc000000

arch\_prctl(ARCH\_SET\_FS, 0x7f69cc000740) = 0

set\_tid\_address(0x7f69cc000a10) = 28545

set\_robust\_list(0x7f69cc000a20, 24) = 0

rseq(0x7f69cc0010e0, 0x20, 0, 0x53053053) = -1 ENOSYS (Function not implemented)

mprotect(0x7f69cc226000, 16384, PROT\_READ) = 0

mprotect(0x7f69cc291000, 4096, PROT\_READ) = 0

mprotect(0x7f69cc288000, 8192, PROT\_READ) = 0

prlimit64(0, RLIMIT\_STACK, NULL, {rlim\_cur=8192\*1024, rlim\_max=8192\*1024}) = 0

munmap(0x7f69cc24b000, 17675) = 0

readlink("/proc/self/exe", "/home/ali\_/OS\_2/lab\_1\_/posix\_ipc"..., 1023) = 39

**pipe2([3, 4], 0) = 0**

**clone(child\_stack=NULL, flags=CLONE\_CHILD\_CLEARTID|CLONE\_CHILD\_SETTID|SIGCHLD28546: I'm a child**

**, child\_tidptr=0x7f69cc000a10) = 28546**

getpid(28546: Start typing lines of text. Press 'Ctrl-D' or 'Enter' with no input to exit

) = 28545

write(1, "28545: I'm a parent, my child ha"..., 4428545: I'm a parent, my child has PID 28546

) = 44

wait4(-1, 12 45 0 -1

23 10000 3

1

[{WIFEXITED(s) && WEXITSTATUS(s) == 0}], 0, NULL) = 28546

--- SIGCHLD {si\_signo=SIGCHLD, si\_code=CLD\_EXITED, si\_pid=28546, si\_uid=1000, si\_status=0, si\_utime=0, si\_stime=0} ---

exit\_group(0) = ?

+++ exited with 0 +++

**Strace 2:**

ali\_@LAPTOP-TG8SK2OI:~/OS\_2/lab\_1\_$ strace ./posix\_ipc-server test2.txt

execve("./posix\_ipc-server", ["./posix\_ipc-server", "test2.txt"], 0x7fffd80abe18 /\* 28 vars \*/) = 0

brk(NULL) = 0x7fffea2de000

arch\_prctl(0x3001 /\* ARCH\_??? \*/, 0x7ffff254bcc0) = -1 EINVAL (Invalid argument)

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f2b44d80000

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=17675, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 17675, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0x7f2b44d3b000

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\0P\237\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 \0\0\0\5\0\0\0GNU\0\2\0\0\300\4\0\0\0\3\0\0\0\0\0\0\0"..., 48, 848) = 48

pread64(3, "\4\0\0\0\24\0\0\0\3\0\0\0GNU\0I\17\357\204\3$\f\221\2039x\324\224\323\236S"..., 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) = 0x7f2b44b10000

mprotect(0x7f2b44b38000, 2023424, PROT\_NONE) = 0

mmap(0x7f2b44b38000, 1658880, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x28000) = 0x7f2b44b38000

mmap(0x7f2b44ccd000, 360448, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1bd000) = 0x7f2b44ccd000

mmap(0x7f2b44d26000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x215000) = 0x7f2b44d26000

mmap(0x7f2b44d2c000, 52816, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f2b44d2c000

close(3) = 0

mmap(NULL, 12288, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f2b44b00000

arch\_prctl(ARCH\_SET\_FS, 0x7f2b44b00740) = 0

set\_tid\_address(0x7f2b44b00a10) = 29531

set\_robust\_list(0x7f2b44b00a20, 24) = 0

rseq(0x7f2b44b010e0, 0x20, 0, 0x53053053) = -1 ENOSYS (Function not implemented)

mprotect(0x7f2b44d26000, 16384, PROT\_READ) = 0

mprotect(0x7f2b44d89000, 4096, PROT\_READ) = 0

mprotect(0x7f2b44d78000, 8192, PROT\_READ) = 0

prlimit64(0, RLIMIT\_STACK, NULL, {rlim\_cur=8192\*1024, rlim\_max=8192\*1024}) = 0

munmap(0x7f2b44d3b000, 17675) = 0

readlink("/proc/self/exe", "/home/ali\_/OS\_2/lab\_1\_/posix\_ipc"..., 1023) = 39

**pipe2([3, 4], 0) = 0**

**clone(child\_stack=NULL, flags=CLONE\_CHILD\_CLEARTID|CLONE\_CHILD\_SETTID|SIGCHLD29534: I'm a child**

**, child\_tidptr=0x7f2b44b00a10) = 29534**

getpid() = 29531

write(1, "29531: I'm a parent, my child ha"..., 4429531: I'm a parent, my child has PID 29534

) = 44

wait4(-1, 29534: Start typing lines of text. Press 'Ctrl-D' or 'Enter' with no input to exit

666666666666666666666666666666666 2222

error: overflow long int type

[{WIFEXITED(s) && WEXITSTATUS(s) == 1}], 0, NULL) = 29534

--- SIGCHLD {si\_signo=SIGCHLD, si\_code=CLD\_EXITED, si\_pid=29534, si\_uid=1000, si\_status=1, si\_utime=0, si\_stime=0} ---

write(2, "error: child exited with error\n\0", 32error: child exited with error

) = 32

exit\_group(256) = ?

+++ exited with 0 +++

$ ./main

file1.txt

file2.txt

string1

string2

string3

string4

string5

$ cat < file1.txt

string1

string2

string3

$ cat < file2.txt

string4

string5

**Strace:**

$ strace -f ./main

execve("./main", ["./main"], 0x7ffde1b8ad38 /\* 49 vars \*/) = 0

brk(NULL) = 0x5643edd4d000

arch\_prctl(0x3001 /\* ARCH\_??? \*/, 0x7ffed25bee60) = -1 EINVAL (Недопустимый аргумент)

access("/etc/ld.so.preload", R\_OK) = -1 ENOENT (Нет такого файла или каталога)

openat(AT\_FDCWD, "/etc/ld.so.cache", O\_RDONLY|O\_CLOEXEC) = 3

fstat(3, {st\_mode=S\_IFREG|0644, st\_size=73833, ...}) = 0

mmap(NULL, 73833, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0x7fb731768000

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\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

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7fb731766000

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) = 0x7fb731574000

mprotect(0x7fb731599000, 1847296, PROT\_NONE) = 0

mmap(0x7fb731599000, 1540096, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x25000) = 0x7fb731599000

mmap(0x7fb731711000, 303104, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x19d000) = 0x7fb731711000

mmap(0x7fb73175c000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1e7000) = 0x7fb73175c000

mmap(0x7fb731762000, 13528, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7fb731762000

close(3) = 0

arch\_prctl(ARCH\_SET\_FS, 0x7fb731767540) = 0

mprotect(0x7fb73175c000, 12288, PROT\_READ) = 0

mprotect(0x5643edb3c000, 4096, PROT\_READ) = 0

mprotect(0x7fb7317a8000, 4096, PROT\_READ) = 0

munmap(0x7fb731768000, 73833) = 0

brk(NULL) = 0x5643edd4d000

brk(0x5643edd6e000) = 0x5643edd6e000

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

read(0, file1.txt

"file1.txt\n", 1024) = 10

openat(AT\_FDCWD, "file1.txt", O\_WRONLY|O\_CREAT|O\_TRUNC, 0666) = 3

read(0, file2.txt

"file2.txt\n", 1024) = 10

openat(AT\_FDCWD, "file2.txt", O\_WRONLY|O\_CREAT|O\_TRUNC, 0666) = 4

**pipe([5, 6]) = 0**

**pipe([7, 8]) = 0**

**clone(child\_stack=NULL, flags=CLONE\_CHILD\_CLEARTID|CLONE\_CHILD\_SETTID|SIGCHLD, child\_tidptr=0x7fb731767810) = 4728**

**clone(child\_stack=NULL, flags=CLONE\_CHILD\_CLEARTID|CLONE\_CHILD\_SETTID|SIGCHLD, child\_tidptr=0x7fb731767810) = 4729**

close(3) = 0

close(4) = 0

close(5) = 0

close(7) = 0

read(0, strace: Process 4728 attached

<unfinished ...>

[pid 4728] close(4) = 0

[pid 4728] close(7) = 0

[pid 4728] close(8) = 0

[pid 4728] close(6) = 0

[pid 4728] dup2(5, 0) = 0

[pid 4728] dup2(3, 1) = 1

[pid 4728] close(3strace: Process 4729 attached

) = 0

[pid 4728] execve("child", NULL, 0x7ffed25bef48 /\* 49 vars \*/ <unfinished ...>

[pid 4729] close(3) = 0

[pid 4729] close(5) = 0

[pid 4729] close(6) = 0

[pid 4729] close(8) = 0

[pid 4729] dup2(7, 0) = 0

[pid 4729] dup2(4, 1) = 1

[pid 4729] close(4) = 0

[pid 4729] execve("child", NULL, 0x7ffed25bef48 /\* 49 vars \*/ <unfinished ...>

[pid 4728] <... execve resumed>) = 0

[pid 4728] brk(NULL <unfinished ...>

[pid 4729] <... execve resumed>) = 0

[pid 4729] brk(NULL <unfinished ...>

[pid 4728] <... brk resumed>) = 0x55b32f123000

[pid 4728] arch\_prctl(0x3001 /\* ARCH\_??? \*/, 0x7ffc0937eb80 <unfinished ...>

[pid 4729] <... brk resumed>) = 0x55884ee36000

[pid 4729] arch\_prctl(0x3001 /\* ARCH\_??? \*/, 0x7ffd061df910) = -1 EINVAL (Недопустимый аргумент)

[pid 4728] <... arch\_prctl resumed>) = -1 EINVAL (Недопустимый аргумент)

[pid 4729] access("/etc/ld.so.preload", R\_OK <unfinished ...>

[pid 4728] access("/etc/ld.so.preload", R\_OK) = -1 ENOENT (Нет такого файла или каталога)

[pid 4729] <... access resumed>) = -1 ENOENT (Нет такого файла или каталога)

[pid 4728] openat(AT\_FDCWD, "/etc/ld.so.cache", O\_RDONLY|O\_CLOEXEC <unfinished ...>

[pid 4729] openat(AT\_FDCWD, "/etc/ld.so.cache", O\_RDONLY|O\_CLOEXEC) = 3

[pid 4728] <... openat resumed>) = 3

[pid 4728] fstat(3, <unfinished ...>

[pid 4729] fstat(3, <unfinished ...>

[pid 4728] <... fstat resumed>{st\_mode=S\_IFREG|0644, st\_size=73833, ...}) = 0

[pid 4729] <... fstat resumed>{st\_mode=S\_IFREG|0644, st\_size=73833, ...}) = 0

[pid 4729] mmap(NULL, 73833, PROT\_READ, MAP\_PRIVATE, 3, 0 <unfinished ...>

[pid 4728] mmap(NULL, 73833, PROT\_READ, MAP\_PRIVATE, 3, 0 <unfinished ...>

[pid 4729] <... mmap resumed>) = 0x7f9f03ba1000

[pid 4728] <... mmap resumed>) = 0x7f8c0c66c000

[pid 4728] close(3 <unfinished ...>

[pid 4729] close(3 <unfinished ...>

[pid 4728] <... close resumed>) = 0

[pid 4729] <... close resumed>) = 0

[pid 4728] openat(AT\_FDCWD, "/lib/x86\_64-linux-gnu/libc.so.6", O\_RDONLY|O\_CLOEXEC <unfinished ...>

[pid 4729] openat(AT\_FDCWD, "/lib/x86\_64-linux-gnu/libc.so.6", O\_RDONLY|O\_CLOEXEC) = 3

[pid 4728] <... openat resumed>) = 3

[pid 4729] read(3, <unfinished ...>

[pid 4728] read(3, <unfinished ...>

[pid 4729] <... read resumed>"\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

[pid 4728] <... read resumed>"\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

[pid 4729] pread64(3, <unfinished ...>

[pid 4728] pread64(3, <unfinished ...>

[pid 4729] <... pread64 resumed>"\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

[pid 4728] <... pread64 resumed>"\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

[pid 4729] pread64(3, <unfinished ...>

[pid 4728] pread64(3, <unfinished ...>

[pid 4729] <... pread64 resumed>"\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

[pid 4728] <... pread64 resumed>"\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

[pid 4729] pread64(3, <unfinished ...>

[pid 4728] pread64(3, <unfinished ...>

[pid 4729] <... pread64 resumed>"\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

[pid 4728] <... pread64 resumed>"\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

[pid 4729] fstat(3, {st\_mode=S\_IFREG|0755, st\_size=2029224, ...}) = 0

[pid 4729] mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f9f03b9f000

[pid 4729] 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

[pid 4729] 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

[pid 4729] 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

[pid 4729] mmap(NULL, 2036952, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7f9f039ad000

[pid 4729] mprotect(0x7f9f039d2000, 1847296, PROT\_NONE) = 0

[pid 4729] mmap(0x7f9f039d2000, 1540096, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x25000) = 0x7f9f039d2000

[pid 4729] mmap(0x7f9f03b4a000, 303104, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x19d000) = 0x7f9f03b4a000

[pid 4729] mmap(0x7f9f03b95000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1e7000 <unfinished ...>

[pid 4728] fstat(3, <unfinished ...>

[pid 4729] <... mmap resumed>) = 0x7f9f03b95000

[pid 4728] <... fstat resumed>{st\_mode=S\_IFREG|0755, st\_size=2029224, ...}) = 0

[pid 4728] mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0 <unfinished ...>

[pid 4729] mmap(0x7f9f03b9b000, 13528, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0 <unfinished ...>

[pid 4728] <... mmap resumed>) = 0x7f8c0c66a000

[pid 4728] pread64(3, <unfinished ...>

[pid 4729] <... mmap resumed>) = 0x7f9f03b9b000

[pid 4729] close(3 <unfinished ...>

[pid 4728] <... pread64 resumed>"\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

[pid 4728] pread64(3, <unfinished ...>

[pid 4729] <... close resumed>) = 0

[pid 4728] <... pread64 resumed>"\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

[pid 4729] arch\_prctl(ARCH\_SET\_FS, 0x7f9f03ba0540 <unfinished ...>

[pid 4728] 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

[pid 4728] mmap(NULL, 2036952, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7f8c0c478000

[pid 4728] mprotect(0x7f8c0c49d000, 1847296, PROT\_NONE) = 0

[pid 4729] <... arch\_prctl resumed>) = 0

[pid 4729] mprotect(0x7f9f03b95000, 12288, PROT\_READ <unfinished ...>

[pid 4728] mmap(0x7f8c0c49d000, 1540096, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x25000) = 0x7f8c0c49d000

[pid 4728] mmap(0x7f8c0c615000, 303104, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x19d000) = 0x7f8c0c615000

[pid 4728] mmap(0x7f8c0c660000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1e7000) = 0x7f8c0c660000

[pid 4728] mmap(0x7f8c0c666000, 13528, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f8c0c666000

[pid 4728] close(3) = 0

[pid 4728] arch\_prctl(ARCH\_SET\_FS, 0x7f8c0c66b540 <unfinished ...>

[pid 4729] <... mprotect resumed>) = 0

[pid 4728] <... arch\_prctl resumed>) = 0

[pid 4728] mprotect(0x7f8c0c660000, 12288, PROT\_READ <unfinished ...>

[pid 4729] mprotect(0x55884dfa5000, 4096, PROT\_READ) = 0

[pid 4729] mprotect(0x7f9f03be1000, 4096, PROT\_READ) = 0

[pid 4729] munmap(0x7f9f03ba1000, 73833) = 0

[pid 4728] <... mprotect resumed>) = 0

[pid 4728] mprotect(0x55b32d937000, 4096, PROT\_READ <unfinished ...>

[pid 4729] read(0, <unfinished ...>

[pid 4728] <... mprotect resumed>) = 0

[pid 4728] mprotect(0x7f8c0c6ac000, 4096, PROT\_READ) = 0

[pid 4728] munmap(0x7f8c0c66c000, 73833) = 0

[pid 4728] read(0, 123456789123456789123456789

<unfinished ...>

[pid 4726] <... read resumed>"1", 1) = 1

[pid 4726] read(0, "2", 1) = 1

[pid 4726] read(0, "3", 1) = 1

[pid 4726] read(0, "4", 1) = 1

[pid 4726] read(0, "5", 1) = 1

[pid 4726] read(0, "6", 1) = 1

[pid 4726] read(0, "7", 1) = 1

[pid 4726] read(0, "8", 1) = 1

[pid 4726] read(0, "9", 1) = 1

[pid 4726] read(0, "1", 1) = 1

[pid 4726] read(0, "2", 1) = 1

[pid 4726] read(0, "3", 1) = 1

[pid 4726] read(0, "4", 1) = 1

[pid 4726] read(0, "5", 1) = 1

[pid 4726] read(0, "6", 1) = 1

[pid 4726] read(0, "7", 1) = 1

[pid 4726] read(0, "8", 1) = 1

[pid 4726] read(0, "9", 1) = 1

[pid 4726] read(0, "1", 1) = 1

[pid 4726] read(0, "2", 1) = 1

[pid 4726] read(0, "3", 1) = 1

[pid 4726] read(0, "4", 1) = 1

[pid 4726] read(0, "5", 1) = 1

[pid 4726] read(0, "6", 1) = 1

[pid 4726] read(0, "7", 1) = 1

[pid 4726] read(0, "8", 1) = 1

[pid 4726] read(0, "9", 1) = 1

[pid 4726] read(0, "\n", 1) = 1

[pid 4726] write(8, "\33\0\0\0", 4) = 4

[pid 4726] write(8, "123456789123456789123456789", 27) = 27

[pid 4726] read(0, <unfinished ...>

[pid 4729] <... read resumed>"\33\0\0\0", 4) = 4

[pid 4729] read(0, "123456789123456789123456789", 27) = 27

[pid 4729] fstat(1, {st\_mode=S\_IFREG|0664, st\_size=0, ...}) = 0

[pid 4729] brk(NULL) = 0x55884ee36000

[pid 4729] brk(0x55884ee57000) = 0x55884ee57000

[pid 4729] write(1, "987654321987654321987654321\n", 28) = 28

[pid 4729] read(0, okay

<unfinished ...>

[pid 4726] <... read resumed>"o", 1) = 1

[pid 4726] read(0, "k", 1) = 1

[pid 4726] read(0, "a", 1) = 1

[pid 4726] read(0, "y", 1) = 1

[pid 4726] read(0, "\n", 1) = 1

[pid 4726] write(8, "\4\0\0\0", 4) = 4

[pid 4726] write(8, "okay", 4) = 4

[pid 4726] read(0, <unfinished ...>

[pid 4729] <... read resumed>"\4\0\0\0", 4) = 4

[pid 4729] read(0, "okay", 4) = 4

[pid 4729] write(1, "yako\n", 5) = 5

[pid 4729] read(0, fedor

<unfinished ...>

[pid 4726] <... read resumed>"f", 1) = 1

[pid 4726] read(0, "e", 1) = 1

[pid 4726] read(0, "d", 1) = 1

[pid 4726] read(0, "o", 1) = 1

[pid 4726] read(0, "r", 1) = 1

[pid 4726] read(0, "\n", 1) = 1

[pid 4726] write(6, "\5\0\0\0", 4) = 4

[pid 4726] write(6, "fedor", 5) = 5

[pid 4726] read(0, <unfinished ...>

[pid 4728] <... read resumed>"\5\0\0\0", 4) = 4

[pid 4728] read(0, "fedor", 5) = 5

[pid 4728] fstat(1, {st\_mode=S\_IFREG|0664, st\_size=0, ...}) = 0

[pid 4728] brk(NULL) = 0x55b32f123000

[pid 4728] brk(0x55b32f144000) = 0x55b32f144000

[pid 4728] write(1, "rodef\n", 6) = 6

[pid 4728] read(0, rodeo

<unfinished ...>

[pid 4726] <... read resumed>"r", 1) = 1

[pid 4726] read(0, "o", 1) = 1

[pid 4726] read(0, "d", 1) = 1

[pid 4726] read(0, "e", 1) = 1

[pid 4726] read(0, "o", 1) = 1

[pid 4726] read(0, "\n", 1) = 1

[pid 4726] write(6, "\5\0\0\0", 4) = 4

[pid 4726] write(6, "rodeo", 5) = 5

[pid 4726] read(0, <unfinished ...>

[pid 4728] <... read resumed>"\5\0\0\0", 4) = 4

[pid 4728] read(0, "rodeo", 5) = 5

[pid 4728] write(1, "oedor\n", 6) = 6

[pid 4728] read(0, hihihi

<unfinished ...>

[pid 4726] <... read resumed>"h", 1) = 1

[pid 4726] read(0, "i", 1) = 1

[pid 4726] read(0, "h", 1) = 1

[pid 4726] read(0, "i", 1) = 1

[pid 4726] read(0, "h", 1) = 1

[pid 4726] read(0, "i", 1) = 1

[pid 4726] read(0, "\n", 1) = 1

[pid 4726] write(8, "\6\0\0\0", 4) = 4

[pid 4726] write(8, "hihihi", 6) = 6

[pid 4726] read(0, <unfinished ...>

[pid 4729] <... read resumed>"\6\0\0\0", 4) = 4

[pid 4729] read(0, "hihihi", 6) = 6

[pid 4729] write(1, "ihihih\n", 7) = 7

[pid 4729] read(0, <unfinished ...>

[pid 4726] <... read resumed>"", 1) = 0

[pid 4726] close(6) = 0

[pid 4726] close(8) = 0

[pid 4726] exit\_group(0) = ?

[pid 4726] +++ exited with 0 +++

[pid 4728] <... read resumed>"", 4) = 0

[pid 4728] exit\_group(0) = ?

[pid 4728] +++ exited with 0 +++

<... read resumed>"", 4) = 0

exit\_group(0) = ?

+++ exited with 0 +++

**Вывод**

Я приобрела навыки управления процессами в ОС и обеспечение обмена данных между процессами посредством каналов.