Московский Авиационный Институт

(Национальный Исследовательский Университет)

Институт №8 “Компьютерные науки и прикладная математика”

Кафедра №806 “Вычислительная математика и программирование”

Лабораторная работа №3 по курсу

«Операционные системы»

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Оценка: _____

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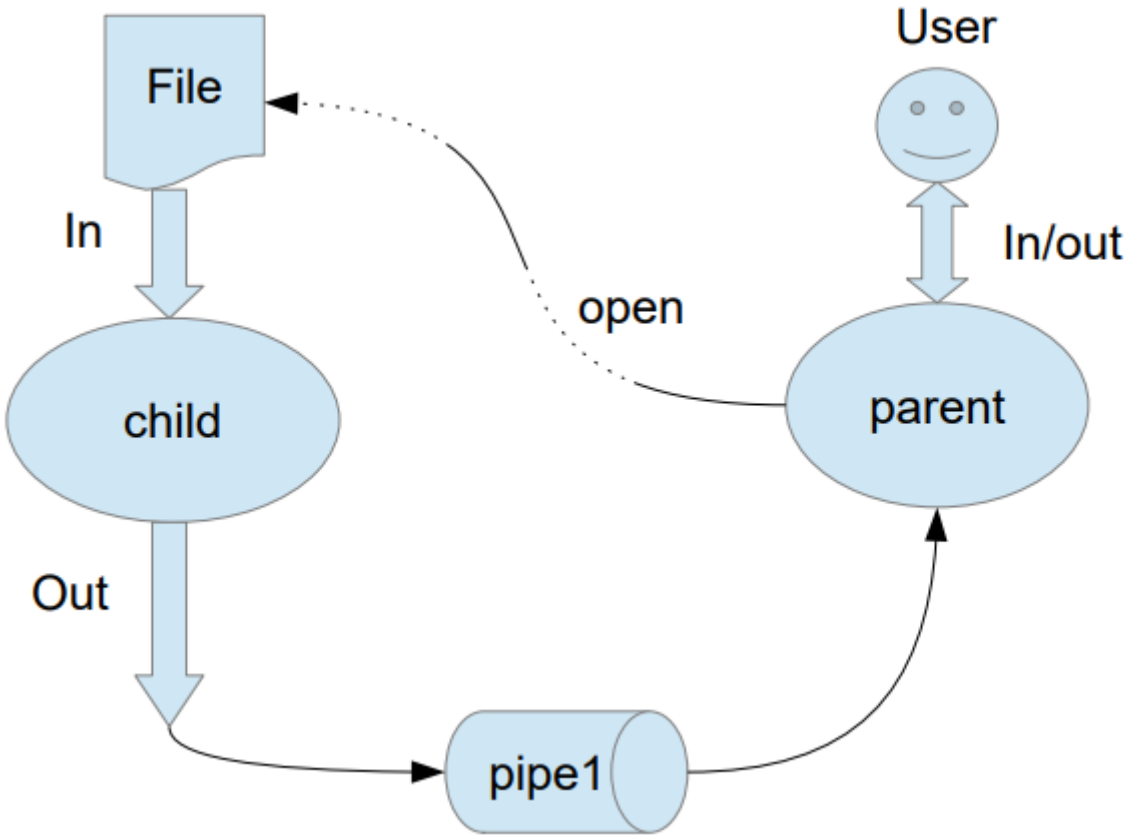
Постановка задачи

Вариант 9.



В файле записаны команды вида:«число число число<endline>». Дочерний процесс производит деление первого числа команда, на последующие числа в команде, а результат выводит в стандартный поток вывода. Если происходит деление на 0, то тогда дочерний и родительский процесс завершают свою работу. Проверка деления на 0 должна осуществляться на стороне дочернего процесса. Числа имеют тип float. Количество чисел может быть произвольным. Взаимодействие процессов производится с помощью mmap.

Общий метод и алгоритм решения

Использованные системные вызовы:

- shm_open, shm_unlink - создает/открывает или снимает объекты разделяемой памяти POSIX
- mmap, munmap - отражает файлы или устройства в памяти или снимает их отражение
- truncate, ftruncate - укорачивает файл до указанной длины
- pid_t fork(void); – создаёт дочерний процесс.

Код программы

main.cpp

```
#include <unistd.h>
#include <iostream>
#include <string>
#include <fcntl.h>
#include <sys/mman.h>
#include <sys/stat.h>
#include <sys/wait.h>

using namespace std;

const int MAX_SIZE = 1024;

int main() {
    string file_name;
    cin >> file_name;

    int file = open(file_name.c_str(), O_RDONLY);

    string shmpath = "just_memory_space";


    int fd = shm_open(shmpath.c_str(), O_CREAT | O_RDWR, S_IREAD | S_IWRITE);

    if (fd == -1) {
        cerr << "shm_open err1\n";
    }


    if (ftruncate(fd, sizeof(char)* MAX_SIZE) == -1) {
        cerr << "ftruncate\n";
    }


    char* data = (char*) mmap(NULL, (sizeof(char)* MAX_SIZE), PROT_READ |
PROT_WRITE, MAP_SHARED, fd, 0);


    pid_t pid = fork();
    if (pid == -1) {
        cout << "Error fork!\n";
        return 1;

    } else if (pid == 0) {

        dup2(file, STDIN_FILENO);

        execl("./child", "./child", shmpath.c_str(), NULL);

        for (char el :"Ошибка запуска дочернего процесса!") {
            write(STDERR_FILENO, &el, sizeof(char));
        }

    } else {
        wait(0);
```

```
        for (int i = 0; i < MAX_SIZE; i++) {
            cout << data[i];
        }
        munmap(data, (sizeof(char)* MAX_SIZE));
        shm_unlink(shmpath.c_str());
        close(file);
    }


return 0;
}
```

child.cpp

```
#include <unistd.h>
#include <iostream>
#include <string>
#include <fcntl.h>
#include <sys/mman.h>
#include <sys/stat.h>
#include <sys/wait.h>

using namespace std;

const int MAX_SIZE = 1024;

int main(int argc, char *argv[]) {

    int fd = shm_open(argv[1], O_RDWR, S_IREAD | S_IWRITE);

    if (ftruncate(fd, sizeof(char)* MAX_SIZE) == -1) {
        cerr << "ftruncate2\n";
    }


    char* data = (char*) mmap(NULL, (sizeof(char)* MAX_SIZE), PROT_READ | PROT_WRITE, MAP_SHARED,
fd, 0);

    char c, enter = '\n';
    float num = 0, res;
    int counter = 0, isfirstnum = 1, ind = 0;

    while (read(STDIN_FILENO, &c, sizeof(c)) != 0) {

        if (c == ' ') {

            if (isfirstnum == 1) {
                res = num;
                isfirstnum = 0;

            } else {
                if (num != 0) {
                    res /= num;
                }
                else {
                    for (char el: "You want to '/' with zero.\n") {
                        data[ind++] = el;
```

```
                }
                return 1;
            }

        }
        num = 0;
        counter = 0;

    } else if (c == '.') {
        counter = 10;
    }

    else if (c == '\n') {
        if (num != 0) {
            res /= num;
            string buf = to_string(res);
            for (char el : buf) {
                data[ind++] = el;
            }
            data[ind++] = enter;

            counter = 0;
            isfirstnum = 1;
            num = 0;

        } else {
            for (char el: "You want to '/' with zero.\n") {
                data[ind++] = el;
            }
            return 1;
        }


    } else {
        if (counter == 0) {
            num *= 10;
            num += c - '0';
        } else {
            num += (float)(c - '0') / counter;
            counter *= 10;
        }
    }
  }
  munmap(data, (sizeof(char)* MAX_SIZE));
return 0;
}
```

Протокол работы программы

Strace:

```
execve("./main", ["./main", "lab03"], 0x7ffc50e86500 /* 60 vars */) = 0

brk(NULL)                               = 0x55c538910000

arch_prctl(0x3001 /* ARCH_??? */, 0x7ffe48644000) = -1 EINVAL (Недопустимый аргумент)

mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f7fd090a000

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

newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=75015, ...}, AT_EMPTY_PATH) = 0

mmap(NULL, 75015, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f7fd08f7000

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

newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=2260296, ...}, AT_EMPTY_PATH) = 0

mmap(NULL, 2275520, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f7fd06cb000

mprotect(0x7f7fd0765000, 1576960, PROT_NONE) = 0

mmap(0x7f7fd0765000, 1118208, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x9a000) =
0x7f7fd0765000

mmap(0x7f7fd0876000, 454656, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1ab000) = 0x7f7fd0876000

mmap(0x7f7fd08e6000, 57344, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x21a000) =
0x7f7fd08e6000

mmap(0x7f7fd08f4000, 10432, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) =
0x7f7fd08f4000

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

newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=125488, ...}, AT_EMPTY_PATH) = 0

mmap(NULL, 127720, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f7fd06ab000

mmap(0x7f7fd06ae000, 94208, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x3000) =
0x7f7fd06ae000

mmap(0x7f7fd06c5000, 16384, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1a000) = 0x7f7fd06c5000

mmap(0x7f7fd06c9000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1d000) =
0x7f7fd06c9000

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\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\0\244;\374\204(\337f#\315I\214\234\f\256\271\32"..., 68, 896) = 68

newfstatat(3, "", {st_mode=S_IFREG|0755, st_size=2216304, ...}, 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\0"..., 784, 64) = 784

mmap(NULL, 2260560, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f7fd0483000

mmap(0x7f7fd04ab000, 1658880, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x28000) =
0x7f7fd04ab000
```

```
mmap(0x7f7fd0640000, 360448, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1bd000) = 0x7f7fd0640000

mmap(0x7f7fd0698000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x214000) =
0x7f7fd0698000

mmap(0x7f7fd069e000, 52816, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) =
0x7f7fd069e000

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\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) = 0x7f7fd039c000

mmap(0x7f7fd03aa000, 507904, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe000) =
0x7f7fd03aa000

mmap(0x7f7fd0426000, 372736, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x8a000) = 0x7f7fd0426000

mmap(0x7f7fd0481000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0xe4000) =
0x7f7fd0481000

close(3)                                = 0

mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f7fd039a000

arch_prctl(ARCH_SET_FS, 0x7f7fd039b3c0) = 0

set_tid_address(0x7f7fd039b690)         = 63112

set_robust_list(0x7f7fd039b6a0, 24)     = 0

rseq(0x7f7fd039bd60, 0x20, 0, 0x53053053) = 0

mprotect(0x7f7fd0698000, 16384, PROT_READ) = 0

mprotect(0x7f7fd0481000, 4096, PROT_READ) = 0

mprotect(0x7f7fd06c9000, 4096, PROT_READ) = 0

mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f7fd0398000

mprotect(0x7f7fd08e6000, 45056, PROT_READ) = 0

mprotect(0x55c537481000, 4096, PROT_READ) = 0

mprotect(0x7f7fd0944000, 8192, PROT_READ) = 0

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

munmap(0x7f7fd08f7000, 75015)           = 0

getrandom("\xa4\xfc\xd8\x1a\x15\x3a\xe4\x0e", 8, GRND_NONBLOCK) = 8

brk(NULL)                               = 0x55c538910000

brk(0x55c538931000)                     = 0x55c538931000

futex(0x7f7fd08f477c, FUTEX_WAKE_PRIVATE, 2147483647) = 0

openat(AT_FDCWD, "/dev/shm/lab03", O_RDWR|O_CREAT|O_NOFOLLOW|O_CLOEXEC, 0600) = 3

ftruncate(3, 10000)                     = 0

mmap(NULL, 10000, PROT_READ|PROT_WRITE, MAP_SHARED, 3, 0) = 0x7f7fd0907000

newfstatat(0, "", {st_mode=S_IFCHR|0620, st_rdev=makedev(0x88, 0), ...}, AT_EMPTY_PATH) = 0

read(0, hello world!

"hello world!\n", 1024)         = 13

read(0, "", 1024)                       = 0
```

```
      clone(child_stack=NULL, flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD, child_tidptr=0x7f7fd039b690)
= 63551

      strace: Process 63551 attached

      [pid 63112] wait4(-1,  <unfinished ...>

      [pid 63551] set_robust_list(0x7f7fd039b6a0, 24) = 0

      [pid 63551] execve("../build/child1", ["../build/child1", "lab03"], 0x7ffe486441e0 /* 60 vars */) = 0

      [pid 63551] brk(NULL)                   = 0x55d2a276f000

      [pid 63551] arch_prctl(0x3001 /* ARCH_??? */, 0x7ffe06ab4540) = -1 EINVAL (Недопустимый аргумент)

      [pid 63551] mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7fce44e28000

      [pid 63551] access("/etc/ld.so.preload", R_OK) = -1 ENOENT (Нет такого файла или каталога)

      [pid 63551] openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3

      [pid 63551] newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=75015, ...}, AT_EMPTY_PATH) = 0

      [pid 63551] mmap(NULL, 75015, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7fce44e15000

      [pid 63551] close(3)                    = 0

      [pid 63551] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libstdc++.so.6", O_RDONLY|O_CLOEXEC) = 3

      [pid 63551] read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

      [pid 63551] newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=2260296, ...}, AT_EMPTY_PATH) = 0

      [pid 63551] mmap(NULL, 2275520, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7fce44be9000

      [pid 63551] mprotect(0x7fce44c83000, 1576960, PROT_NONE) = 0

      [pid 63551] mmap(0x7fce44c83000, 1118208, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0x9a000) = 0x7fce44c83000

      [pid 63551] mmap(0x7fce44d94000, 454656, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1ab000) =
0x7fce44d94000

      [pid 63551] mmap(0x7fce44e04000, 57344, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0x21a000) = 0x7fce44e04000

      [pid 63551] mmap(0x7fce44e12000, 10432, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) =
0x7fce44e12000

      [pid 63551] close(3)                    = 0

      [pid 63551] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libgcc_s.so.1", O_RDONLY|O_CLOEXEC) = 3

      [pid 63551] read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

      [pid 63551] newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=125488, ...}, AT_EMPTY_PATH) = 0

      [pid 63551] mmap(NULL, 127720, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7fce44bc9000

      [pid 63551] mmap(0x7fce44bcc000, 94208, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x3000)
= 0x7fce44bcc000

      [pid 63551] mmap(0x7fce44be3000, 16384, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1a000) =
0x7fce44be3000

      [pid 63551] mmap(0x7fce44be7000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0x1d000) = 0x7fce44be7000

      [pid 63551] close(3)                    = 0

      [pid 63551] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) = 3

      [pid 63551] read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\3\0>\0\1\0\0\0P\237\2\0\0\0\0\0"..., 832) = 832

      [pid 63551] 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 63551] 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
```

```
      [pid 63551] pread64(3, "\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\244;\374\204(\337f#\315I\214\234\f\256\271\32"...,
68, 896) = 68

      [pid 63551] newfstatat(3, "", {st_mode=S_IFREG|0755, st_size=2216304, ...}, AT_EMPTY_PATH) = 0

      [pid 63551] 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 63551] mmap(NULL, 2260560, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7fce449a1000

      [pid 63551] mmap(0x7fce449c9000, 1658880, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0x28000) = 0x7fce449c9000

      [pid 63551] mmap(0x7fce44b5e000, 360448, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1bd000) =
0x7fce44b5e000

      [pid 63551] mmap(0x7fce44bb6000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0x214000) = 0x7fce44bb6000

      [pid 63551] mmap(0x7fce44bbc000, 52816, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) =
0x7fce44bbc000

      [pid 63551] close(3)                    = 0

      [pid 63551] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libm.so.6", O_RDONLY|O_CLOEXEC) = 3

      [pid 63551] read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

      [pid 63551] newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=940560, ...}, AT_EMPTY_PATH) = 0

      [pid 63551] mmap(NULL, 942344, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7fce448ba000

      [pid 63551] mmap(0x7fce448c8000, 507904, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0xe000) = 0x7fce448c8000

      [pid 63551] mmap(0x7fce44944000, 372736, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x8a000) =
0x7fce44944000

      [pid 63551] mmap(0x7fce4499f000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0xe4000) = 0x7fce4499f000

      [pid 63551] close(3)                    = 0

      [pid 63551] mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7fce448b8000

      [pid 63551] arch_prctl(ARCH_SET_FS, 0x7fce448b93c0) = 0

      [pid 63551] set_tid_address(0x7fce448b9690) = 63551

      [pid 63551] set_robust_list(0x7fce448b96a0, 24) = 0

      [pid 63551] rseq(0x7fce448b9d60, 0x20, 0, 0x53053053) = 0

      [pid 63551] mprotect(0x7fce44bb6000, 16384, PROT_READ) = 0

      [pid 63551] mprotect(0x7fce4499f000, 4096, PROT_READ) = 0

      [pid 63551] mprotect(0x7fce44be7000, 4096, PROT_READ) = 0

      [pid 63551] mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7fce448b6000

      [pid 63551] mprotect(0x7fce44e04000, 45056, PROT_READ) = 0

      [pid 63551] mprotect(0x55d2a0a10000, 4096, PROT_READ) = 0

      [pid 63551] mprotect(0x7fce44e62000, 8192, PROT_READ) = 0

      [pid 63551] prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024, rlim_max=RLIM64_INFINITY}) = 0

      [pid 63551] munmap(0x7fce44e15000, 75015) = 0

      [pid 63551] getrandom("\xfe\xeb\x94\x2f\xb9\x4d\xe2\x70", 8, GRND_NONBLOCK) = 8

      [pid 63551] brk(NULL)                   = 0x55d2a276f000

      [pid 63551] brk(0x55d2a2790000)         = 0x55d2a2790000

      [pid 63551] futex(0x7fce44e1277c, FUTEX_WAKE_PRIVATE, 2147483647) = 0

      [pid 63551] openat(AT_FDCWD, "/dev/shm/lab03", O_RDWR|O_CREAT|O_NOFOLLOW|O_CLOEXEC, 0600) = 3
```

```
[pid 63551] ftruncate(3, 10000)         = 0

[pid 63551] mmap(NULL, 10000, PROT_READ|PROT_WRITE, MAP_SHARED, 3, 0) = 0x7fce44e25000

[pid 63551] clone(child_stack=NULL, flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLDstrace: Process
63555 attached

, child_tidptr=0x7fce448b9690) = 63555

[pid 63555] set_robust_list(0x7fce448b96a0, 24 <unfinished ...>

[pid 63551] wait4(-1,  <unfinished ...>

[pid 63555] <... set_robust_list resumed>) = 0

[pid 63555] execve("../build/child2", ["../build/child2", "lab03"], 0x7ffe06ab4720 /* 60 vars */) = 0

[pid 63555] brk(NULL)                   = 0x557a9a8e4000

[pid 63555] arch_prctl(0x3001 /* ARCH_??? */, 0x7ffc81545220) = -1 EINVAL (Недопустимый аргумент)

[pid 63555] mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f01070c7000

[pid 63555] access("/etc/ld.so.preload", R_OK) = -1 ENOENT (Нет такого файла или каталога)

[pid 63555] openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3

[pid 63555] newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=75015, ...}, AT_EMPTY_PATH) = 0

[pid 63555] mmap(NULL, 75015, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f01070b4000

[pid 63555] close(3)                    = 0

[pid 63555] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libstdc++.so.6", O_RDONLY|O_CLOEXEC) = 3

[pid 63555] read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

[pid 63555] newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=2260296, ...}, AT_EMPTY_PATH) = 0

[pid 63555] mmap(NULL, 2275520, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f0106e88000

[pid 63555] mprotect(0x7f0106f22000, 1576960, PROT_NONE) = 0

[pid 63555] mmap(0x7f0106f22000, 1118208, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0x9a000) = 0x7f0106f22000

[pid 63555] mmap(0x7f0107033000, 454656, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1ab000) =
0x7f0107033000

[pid 63555] mmap(0x7f01070a3000, 57344, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0x21a000) = 0x7f01070a3000

[pid 63555] mmap(0x7f01070b1000, 10432, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) =
0x7f01070b1000

[pid 63555] close(3)                    = 0

[pid 63555] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libgcc_s.so.1", O_RDONLY|O_CLOEXEC) = 3

[pid 63555] read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

[pid 63555] newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=125488, ...}, AT_EMPTY_PATH) = 0

[pid 63555] mmap(NULL, 127720, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f0106e68000

[pid 63555] mmap(0x7f0106e6b000, 94208, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x3000)
= 0x7f0106e6b000

[pid 63555] mmap(0x7f0106e82000, 16384, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1a000) =
0x7f0106e82000

[pid 63555] mmap(0x7f0106e86000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0x1d000) = 0x7f0106e86000

[pid 63555] close(3)                    = 0

[pid 63555] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) = 3

[pid 63555] 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"..., 832) = 832
```

```
[pid 63555] 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 63555] 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

[pid 63555] pread64(3, "\4\0\0\0\24\0\0\0\3\0\0\0GNU\0\244;\374\204(\337f#\315I\214\234\f\256\271\32"...,
68, 896) = 68

[pid 63555] newfstatat(3, "", {st_mode=S_IFREG|0755, st_size=2216304, ...}, AT_EMPTY_PATH) = 0

[pid 63555] 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 63555] mmap(NULL, 2260560, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f0106c40000

[pid 63555] mmap(0x7f0106c68000, 1658880, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0x28000) = 0x7f0106c68000

[pid 63555] mmap(0x7f0106dfd000, 360448, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1bd000) =
0x7f0106dfd000

[pid 63555] mmap(0x7f0106e55000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0x214000) = 0x7f0106e55000

[pid 63555] mmap(0x7f0106e5b000, 52816, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) =
0x7f0106e5b000

[pid 63555] close(3)                    = 0

[pid 63555] openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libm.so.6", O_RDONLY|O_CLOEXEC) = 3

[pid 63555] read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\0\0\0\0\0\0\0"..., 832) = 832

[pid 63555] newfstatat(3, "", {st_mode=S_IFREG|0644, st_size=940560, ...}, AT_EMPTY_PATH) = 0

[pid 63555] mmap(NULL, 942344, PROT_READ, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f0106b59000

[pid 63555] mmap(0x7f0106b67000, 507904, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0xe000) = 0x7f0106b67000

[pid 63555] mmap(0x7f0106be3000, 372736, PROT_READ, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x8a000) =
0x7f0106be3000

[pid 63555] mmap(0x7f0106c3e000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3,
0xe4000) = 0x7f0106c3e000

[pid 63555] close(3)                    = 0

[pid 63555] mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f0106b57000

[pid 63555] arch_prctl(ARCH_SET_FS, 0x7f0106b583c0) = 0

[pid 63555] set_tid_address(0x7f0106b58690) = 63555

[pid 63555] set_robust_list(0x7f0106b586a0, 24) = 0

[pid 63555] rseq(0x7f0106b58d60, 0x20, 0, 0x53053053) = 0

[pid 63555] mprotect(0x7f0106e55000, 16384, PROT_READ) = 0

[pid 63555] mprotect(0x7f0106c3e000, 4096, PROT_READ) = 0

[pid 63555] mprotect(0x7f0106e86000, 4096, PROT_READ) = 0

[pid 63555] mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f0106b55000

[pid 63555] mprotect(0x7f01070a3000, 45056, PROT_READ) = 0

[pid 63555] mprotect(0x557a9a071000, 4096, PROT_READ) = 0

[pid 63555] mprotect(0x7f0107101000, 8192, PROT_READ) = 0

[pid 63555] prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024, rlim_max=RLIM64_INFINITY}) = 0

[pid 63555] munmap(0x7f01070b4000, 75015) = 0

[pid 63555] getrandom("\x1b\x6d\x35\x51\xe3\x1e\xd0\x5d", 8, GRND_NONBLOCK) = 8

[pid 63555] brk(NULL)                   = 0x557a9a8e4000

[pid 63555] brk(0x557a9a905000)         = 0x557a9a905000
```

```
[pid 63555] futex(0x7f01070b177c, FUTEX_WAKE_PRIVATE, 2147483647) = 0

[pid 63555] openat(AT_FDCWD, "/dev/shm/lab03", O_RDWR|O_CREAT|O_NOFOLLOW|O_CLOEXEC, 0600) = 3

[pid 63555] ftruncate(3, 10000)         = 0

[pid 63555] mmap(NULL, 10000, PROT_READ|PROT_WRITE, MAP_SHARED, 3, 0) = 0x7f01070c4000

[pid 63555] munmap(0x7f01070c4000, 10000) = 0

[pid 63555] exit_group(0)               = ?

[pid 63555] +++ exited with 0 +++

[pid 63551] <... wait4 resumed>NULL, 0, NULL) = 63555

[pid 63551] --- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=63555, si_uid=1000, si_status=0,
si_utime=0, si_stime=0} ---

[pid 63551] munmap(0x7fce44e25000, 10000) = 0

[pid 63551] exit_group(0)               = ?

[pid 63551] +++ exited with 0 +++

<... wait4 resumed>NULL, 0, NULL)       = 63551

--- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=63551, si_uid=1000, si_status=0, si_utime=0,
si_stime=1} ---

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

write(1, "HELLO_WORLD!\n", 13HELLO_WORLD!

)           = 13

unlink("/dev/shm/lab03")                = 0

munmap(0x7f7fd0907000, 10000)           = 0

exit_group(0)                           = ?

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

Тестирование:

```
artyom@artyom-Dell-G15-5510:~/Документы/vs code projects/OS_labs/lab3/build$ ./main

../src/test.txt

0.750000

0.166667

0.777778

0.000000

You want to '/' with zero.
```

Вывод

В ходе лабораторной работы я поработал с memory map. Написал для своей программы некоторую оболочку над вызовами mmap, shm_open и т. д. Выполнил первую лабораторную, используя вместо pipe mmap.