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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**Постановка задачи**

**Вариант 2.**

Родительский процесс создает два дочерних процесса. Child1 переводит строки в верхний регистр. Child2 превращает все пробельные символы в символ «\_». 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**

**mmap.h**

#pragma once

#include <unistd.h>

#include <iostream>

#include <sys/mman.h>

#include <sys/stat.h>

#include <fcntl.h>

#include <exception>

#include <string>

#define M\_READ PROT\_READ

#define M\_WRITE PROT\_WRITE

#define M\_EXEC PROT\_EXEC

#define M\_NONE PROT\_NONE

const int MAX\_LENGHT = 10000;

template <class T>

class MemoryMap {

public:

MemoryMap() = delete;

MemoryMap(const std::string& s, size\_t size, int mode);

void delete\_shm\_file();

~MemoryMap();

T\* data() noexcept;

size\_t size() noexcept;

T& operator[](int idx);

private:

T\* \_data;

int \_fd;

std::string \_name;

size\_t \_size;

};

template <class T>

MemoryMap<T>::MemoryMap(const std::string& name, size\_t size, int mode) : \_name{name}, \_size{size} {

\_fd = shm\_open(name.c\_str(), O\_CREAT | O\_RDWR, S\_IREAD | S\_IWRITE);

if (ftruncate(\_fd, size) != 0) {

throw std::runtime\_error("ftruncate error");

}

if (\_fd == -1) {

throw std::runtime\_error("shm\_open error");

}

\_data = (T\*) mmap(NULL, size, mode, MAP\_SHARED, \_fd, 0);

if (\_data == MAP\_FAILED) {

throw std::runtime\_error("mmap error");

}

}

template <class T>

void MemoryMap<T>::delete\_shm\_file() {

int error\_code = shm\_unlink(\_name.c\_str());

if (error\_code == -1) {

throw std::runtime\_error("shm\_unlink");

}

}

template <class T>

MemoryMap<T>::~MemoryMap() {

munmap(\_data, \_size);

}

template <class T>

T\* MemoryMap<T>::data() noexcept {

return \_data;

}

template <class T>

size\_t MemoryMap<T>::size() noexcept {

return \_size;

}

template <class T>

T& MemoryMap<T>::operator[](int idx) {

if (idx > \_size - 1) {

throw std::range\_error("out of range");

}

return \_data[idx];

}

**parent.cpp**

#include "mmap.h"

#include <sys/wait.h>

int create\_process() {

pid\_t pid = fork();

if (pid == -1) {

perror("Fork error!**\n**");

exit(-1);

}

return pid;

}

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

if (argc != 2) {

perror("Too few arguments. Usage: ./lab03 NAME\_OF\_FILE");

}

std::string mm\_name(argv[1]);

MemoryMap<char> mm(mm\_name, sizeof(char)\*MAX\_LENGHT, M\_WRITE | M\_READ);

char c = getchar();

int i = 1;

while (c != EOF) {

mm[i] = c;

++i;

if (i == MAX\_LENGHT) {

break;

}

c = getchar();

}

mm[0] = i - 1; // number of elements

int pid = create\_process();

if (pid == 0) { // child 1

execl("../build/child1", "../build/child1", mm\_name.c\_str(), NULL);

} else { // parent

wait(NULL);

int elems = mm[0];

for (int i = 1; i <= elems; ++i) {

putchar(mm[i]);

}

mm.delete\_shm\_file();

}

return 0;

}

**child1.cpp**

#include "mmap.h"

#include <sys/wait.h>

#include <unistd.h>

int create\_process() {

pid\_t pid = fork();

if (pid == -1) {

perror("Fork error!**\n**");

exit(-1);

}

return pid;

}

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

std::string mm\_name(argv[1]);

MemoryMap<char> mm(mm\_name, sizeof(char) \* MAX\_LENGHT, M\_WRITE | M\_READ);

int elems = ((char \*) mm.data())[0];

for (int i = 1; i <= elems; ++i) {

mm[i] = toupper(mm[i]);

}

int pid = create\_process();

if (pid == 0) { // child 2

execl("../build/child2", "../build/child2", argv[1], NULL);

} else { // child 1

wait(NULL);

}

return 0;

}

**child2.cpp**

#include "mmap.h"

#include <sys/wait.h>

#include <unistd.h>

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

std::string mm\_name(argv[1]);

MemoryMap<char> mm(mm\_name, sizeof(char) \* MAX\_LENGHT, M\_WRITE | M\_READ);

int elems = mm[0];

for (int i = 1; i <= elems; ++i) {

if (mm[i] == ' ') {

mm[i] = '\_';

}

}

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\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\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"..., 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"..., 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\0\3\0>\0\1\0\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\0\3\0>\0\1\0\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\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\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\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\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\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\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:**

cat\_mood@nuclear-box:~/programming/mai-os-labs/lab03/build$ ./main lab03

> hello world!

HELLO\_WORLD!

cat\_mood@nuclear-box:~/programming/mai-os-labs/lab03/build$ ./main lab03

> HaaH hAAh

HAAH\_HAAH\_\_\_\_\_\_

cat\_mood@nuclear-box:~/programming/mai-os-labs/lab03/build$ ./main lab03

>

\_\_\_\_

cat\_mood@nuclear-box:~/programming/mai-os-labs/lab03/build$ ./main lab03

123 #$$ {}":

123\_#$$\_{}":

**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.