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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 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_LENGTH = 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_LENGTH, M_WRITE | M_READ);
    char c = getchar();
    int i = 1;
    while (c != EOF) {
        mm[i] = c;
        ++i;
        if (i == MAX_LENGTH) {
            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_LENGTH, 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_LENGTH, 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) = 0x7fd090a000
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) = 0x7fd08f7000
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"..., 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"..., 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\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\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"..., 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\xe", 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"..., 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"..., 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\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\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\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\3\0>\0\1\0\0\0\0\0\0\0\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"..., 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_etime=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_etime=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.