Московский Авиационный Институт

(Национальный Исследовательский Университет)

Институт №8 “Компьютерные науки и прикладная математика”

Кафедра №806 “Вычислительная математика и программирование”

**Лабораторная работа №4 по курсу**

**«Операционные системы»**

Группа: М80-206Б-22

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

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**Постановка задачи**

**Вариант 6.**

1. Рассчет интеграла функции sin(x) на отрезке [A, B] с шагом e. Подсчет интеграла методом прямоугольников. Подсчет интеграла методом трапеций.
2. Подсчет площади плоской геометрической фигуры по двум сторонам. Фигура прямоугольник. Фигура прямоугольный треугольник.

**Общий метод и алгоритм решения**

Использованные системные вызовы:

* void \*dlopen(const char \*filename, int flag) - загружает динамическую библиотеку.
* int dlclose(void \*handle) - уменьшает на единицу счетчик ссылок на указатель динамической библиотеки handle.
* void \*dlsym(void \*handle, char \*symbol) - использует указатель на динамическую библиотеку, возвращаемую dlopen, и оканчивающееся нулем символьное имя, а затем возвращает адрес, указывающий, откуда загружается этот символ.

**Код программы**

**lib\_lab04.h**

#pragma once

float sin\_integral(float a, float b, float e);

float square(float a, float b);

**lib\_lab04\_impl1.c**

#include "lib\_lab04.h"

#include <math.h>

float sin\_integral(float a, float b, float e) {

float res = 0;

for (float i = a; i < b; i += e) {

res += sinf(i);

}

res \*= e;

return res;

}

float square(float a, float b) {

return a \* b;

}

**lib\_lab04\_impl2.c**

#include "lib\_lab04.h"

#include <math.h>

float sin\_integral(float a, float b, float e) {

float res = (sinf(a) + sinf(b)) / 2;

for (float i = a + e; i < b; i += e) {

res += sinf(i);

}

res \*= e;

return res;

}

float square(float a, float b) {

return a \* b / 2;

}

**main1.c**

#include "lib\_lab04.h"

#include <stdio.h>

void interface() {

printf("Test program 1. **\n**For help enter 'h' **\n**> ");

while (1) {

char cmd;

cmd = getchar();

if (cmd == 'h') {

printf("h - display this page you are seeing now**\n**");

printf("1 A B E - compute integral of sin(x) on the segment [A, B] with step E**\n**");

printf("2 A B - compute square of rectangle size of A x B**\n**");

printf("q - quit**\n**");

} else if (cmd == '1') {

float a, b, e;

scanf(" %f %f %f", &a, &b, &e);

printf("Result of sin\_integral is %f**\n**", sin\_integral(a, b, e));

} else if (cmd == '2') {

float a, b;

scanf(" %f %f", &a, &b);

printf("Result of square is %f**\n**", square(a, b));

} else if (cmd == 'q'){

**break**;

} else {

while (cmd != '**\n**') {

getchar();

}

printf("Invalid command!**\n**");

}

printf("> ");

cmd = getchar();

}

}

int main() {

interface();

return 0;

}

**main2.c**

#include <dlfcn.h>

#include <stdio.h>

#include <stdlib.h>

typedef struct {

int impl;

void\* handles[2];

void\* funcs[2];

} lib;

void change\_implementation(lib\* l, int impl) {

l->funcs[0] = dlsym(l->handles[impl], "sin\_integral");

l->funcs[1] = dlsym(l->handles[impl], "square");

l->impl = impl;

}

void interface(lib\* l) {

printf("Test program 1. **\n**For help enter 'h' **\n**> ");

while (1) {

char cmd;

cmd = getchar();

if (cmd == 'h') {

printf("h - display this page you are seeing now**\n**");

printf("0 - change implementation (could be 0 or 1)");

printf("1 A B E - compute integral of sin(x) on the segment [A, B] with step E**\n**");

printf("2 A B - compute square of rectangle size of A x B**\n**");

printf("q - quit**\n**");

} else if (cmd == '0') {

change\_implementation(l, (l->impl + 1) % 2);

printf("Implementation changed. Current is %d**\n**", l->impl);

} else if (cmd == '1') {

float a, b, e;

scanf(" %f %f %f", &a, &b, &e);

printf("Result of sin\_integral is %f**\n**", (((float (\*)(float, float, float)) l->funcs[0])(a, b, e)));

} else if (cmd == '2') {

float a, b;

scanf(" %f %f", &a, &b);

printf("Result of square is %f**\n**", ((float (\*)(float, float)) l->funcs[1])(a, b));

} else if (cmd == 'q'){

**break**;

} else {

while (cmd != '**\n**') {

getchar();

}

printf("Invalid command!**\n**");

}

printf("> ");

cmd = getchar();

}

}

int main() {

lib l;

l.handles[0] = dlopen("/home/cat\_mood/programming/mai-os-labs/lab04/build/liblib1.so", RTLD\_LAZY | RTLD\_LOCAL);

if (l.handles[0] == NULL) {

exit(1);

}

l.handles[1] = dlopen("/home/cat\_mood/programming/mai-os-labs/lab04/build/liblib2.so", RTLD\_LAZY | RTLD\_LOCAL);

if (l.handles[1] == NULL) {

exit(1);

}

change\_implementation(&l, 0);

interface(&l);

dlclose(l.handles[0]);

dlclose(l.handles[1]);

return 0;

}

**CMakeLists.txt**

cmake\_minimum\_required(VERSION 3.10)

project(lab04)

set(C\_STANDARD 99)

set(CMAKE\_CXX\_STANDARD\_REQUIRED ON)

set(INCLUDE\_DIR ${CMAKE\_CURRENT\_SOURCE\_DIR}/include)

set(SOURCE\_DIR ${CMAKE\_CURRENT\_SOURCE\_DIR}/src)

include\_directories(${INCLUDE\_DIR})

add\_library(lib1 SHARED ${SOURCE\_DIR}/lib\_lab04\_impl1.c)

target\_include\_directories(lib1 PUBLIC ${INCLUDE\_DIR})

add\_library(lib2 SHARED ${SOURCE\_DIR}/lib\_lab04\_impl2.c)

target\_include\_directories(lib2 PUBLIC ${INCLUDE\_DIR})

target\_link\_libraries(lib1 PRIVATE m)

target\_link\_libraries(lib2 PRIVATE m)

add\_executable(main1\_impl1 ${CMAKE\_CURRENT\_SOURCE\_DIR}/main1.c)

add\_executable(main1\_impl2 ${CMAKE\_CURRENT\_SOURCE\_DIR}/main1.c)

target\_link\_libraries(main1\_impl1 PRIVATE lib1 PRIVATE m)

target\_link\_libraries(main1\_impl2 PRIVATE lib2 PRIVATE m)

add\_executable(main2 ${CMAKE\_CURRENT\_SOURCE\_DIR}/main2.c)

Команда add\_library() компилирует динамическую библиотеку.

target\_link\_libraries() прилинковывает библиотеки к указанной цели.

add\_executable() компилирует в исполняемый файл

**Протокол работы программы**

**Strace:**

execve("./main1\_impl1", ["./main1\_impl1"], 0x7ffc10d8ab30 /\* 36 vars \*/) = 0

brk(NULL) = 0x55d755744000

arch\_prctl(0x3001 /\* ARCH\_??? \*/, 0x7ffcfc54f2e0) = -1 EINVAL (Invalid argument)

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f643c9b3000

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

openat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/glibc-hwcaps/x86-64-v3/liblib1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/glibc-hwcaps/x86-64-v3", 0x7ffcfc54e500, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/glibc-hwcaps/x86-64-v2/liblib1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/glibc-hwcaps/x86-64-v2", 0x7ffcfc54e500, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/tls/x86\_64/x86\_64/liblib1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/tls/x86\_64/x86\_64", 0x7ffcfc54e500, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/tls/x86\_64/liblib1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/tls/x86\_64", 0x7ffcfc54e500, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/tls/x86\_64/liblib1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/tls/x86\_64", 0x7ffcfc54e500, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/tls/liblib1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/tls", 0x7ffcfc54e500, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/x86\_64/x86\_64/liblib1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/x86\_64/x86\_64", 0x7ffcfc54e500, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/x86\_64/liblib1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/x86\_64", 0x7ffcfc54e500, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/x86\_64/liblib1.so", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/x86\_64", 0x7ffcfc54e500, 0) = -1 ENOENT (No such file or directory)

**openat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/liblib1.so", O\_RDONLY|O\_CLOEXEC) = 3**

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

newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=15592, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 16432, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7f643c9ae000

mmap(0x7f643c9af000, 4096, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1000) = 0x7f643c9af000

mmap(0x7f643c9b0000, 4096, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x2000) = 0x7f643c9b0000

mmap(0x7f643c9b1000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x2000) = 0x7f643c9b1000

close(3) = 0

openat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

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

newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=25087, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 25087, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0x7f643c9a7000

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 =\340\2563\265?\356\25x\261\27\313A#\350"..., 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) = 0x7f643c77f000

mmap(0x7f643c7a7000, 1658880, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x28000) = 0x7f643c7a7000

mmap(0x7f643c93c000, 360448, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1bd000) = 0x7f643c93c000

mmap(0x7f643c994000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x214000) = 0x7f643c994000

mmap(0x7f643c99a000, 52816, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f643c99a000

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) = 0x7f643c698000

mmap(0x7f643c6a6000, 507904, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0xe000) = 0x7f643c6a6000

mmap(0x7f643c722000, 372736, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x8a000) = 0x7f643c722000

mmap(0x7f643c77d000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0xe4000) = 0x7f643c77d000

close(3) = 0

mmap(NULL, 12288, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f643c695000

arch\_prctl(ARCH\_SET\_FS, 0x7f643c695740) = 0

set\_tid\_address(0x7f643c695a10) = 16131

set\_robust\_list(0x7f643c695a20, 24) = 0

rseq(0x7f643c6960e0, 0x20, 0, 0x53053053) = 0

mprotect(0x7f643c994000, 16384, PROT\_READ) = 0

mprotect(0x7f643c77d000, 4096, PROT\_READ) = 0

mprotect(0x7f643c9b1000, 4096, PROT\_READ) = 0

mprotect(0x55d7544a7000, 4096, PROT\_READ) = 0

mprotect(0x7f643c9ed000, 8192, PROT\_READ) = 0

prlimit64(0, RLIMIT\_STACK, NULL, {rlim\_cur=8192\*1024, rlim\_max=RLIM64\_INFINITY}) = 0

munmap(0x7f643c9a7000, 25087) = 0

newfstatat(1, "", {st\_mode=S\_IFCHR|0620, st\_rdev=makedev(0x88, 0x5), ...}, AT\_EMPTY\_PATH) = 0

getrandom("\x27\xd9\x17\xca\x4f\x48\xee\x55", 8, GRND\_NONBLOCK) = 8

brk(NULL) = 0x55d755744000

brk(0x55d755765000) = 0x55d755765000

write(1, "Test program 1. \n", 17Test program 1.

) = 17

write(1, "For help enter 'h' \n", 20For help enter 'h'

) = 20

newfstatat(0, "", {st\_mode=S\_IFCHR|0620, st\_rdev=makedev(0x88, 0x5), ...}, AT\_EMPTY\_PATH) = 0

write(1, "> ", 2> ) = 2

read(0, q

"q\n", 1024) = 2

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

exit\_group(0) = ?

+++ exited with 0 +++

**Вторая программа**

execve("./main2", ["./main2"], 0x7fff828656a0 /\* 36 vars \*/) = 0

brk(NULL) = 0x5607d3d01000

arch\_prctl(0x3001 /\* ARCH\_??? \*/, 0x7ffe44d13960) = -1 EINVAL (Invalid argument)

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f981eebf000

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=25023, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 25023, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0x7f981eeb8000

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 =\340\2563\265?\356\25x\261\27\313A#\350"..., 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) = 0x7f981ec90000

mmap(0x7f981ecb8000, 1658880, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x28000) = 0x7f981ecb8000

mmap(0x7f981ee4d000, 360448, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1bd000) = 0x7f981ee4d000

mmap(0x7f981eea5000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x214000) = 0x7f981eea5000

mmap(0x7f981eeab000, 52816, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f981eeab000

close(3) = 0

mmap(NULL, 12288, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f981ec8d000

arch\_prctl(ARCH\_SET\_FS, 0x7f981ec8d740) = 0

set\_tid\_address(0x7f981ec8da10) = 7005

set\_robust\_list(0x7f981ec8da20, 24) = 0

rseq(0x7f981ec8e0e0, 0x20, 0, 0x53053053) = 0

mprotect(0x7f981eea5000, 16384, PROT\_READ) = 0

mprotect(0x5607d1f4b000, 4096, PROT\_READ) = 0

mprotect(0x7f981eef9000, 8192, PROT\_READ) = 0

prlimit64(0, RLIMIT\_STACK, NULL, {rlim\_cur=8192\*1024, rlim\_max=RLIM64\_INFINITY}) = 0

munmap(0x7f981eeb8000, 25023) = 0

getrandom("\x0f\x39\xd2\xf2\xcb\xdd\x9d\x6a", 8, GRND\_NONBLOCK) = 8

brk(NULL) = 0x5607d3d01000

brk(0x5607d3d22000) = 0x5607d3d22000

**openat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/liblib1.so", O\_RDONLY|O\_CLOEXEC) = 3**

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

newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=15536, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 16432, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7f981eeba000

mmap(0x7f981eebb000, 4096, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1000) = 0x7f981eebb000

mmap(0x7f981eebc000, 4096, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x2000) = 0x7f981eebc000

mmap(0x7f981eebd000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x2000) = 0x7f981eebd000

close(3) = 0

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

newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=25023, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 25023, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0x7f981ec86000

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) = 0x7f981eb9f000

mmap(0x7f981ebad000, 507904, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0xe000) = 0x7f981ebad000

mmap(0x7f981ec29000, 372736, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x8a000) = 0x7f981ec29000

mmap(0x7f981ec84000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0xe4000) = 0x7f981ec84000

close(3) = 0

mprotect(0x7f981ec84000, 4096, PROT\_READ) = 0

mprotect(0x7f981eebd000, 4096, PROT\_READ) = 0

munmap(0x7f981ec86000, 25023) = 0

openat(AT\_FDCWD, "/home/cat\_mood/programming/mai-os-labs/lab04/build/liblib2.so", O\_RDONLY|O\_CLOEXEC) = 3

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

newfstatat(3, "", {st\_mode=S\_IFREG|0755, st\_size=15608, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 16432, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7f981ec88000

mmap(0x7f981ec89000, 4096, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1000) = 0x7f981ec89000

mmap(0x7f981ec8a000, 4096, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x2000) = 0x7f981ec8a000

mmap(0x7f981ec8b000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x2000) = 0x7f981ec8b000

close(3) = 0

mprotect(0x7f981ec8b000, 4096, PROT\_READ) = 0

newfstatat(1, "", {st\_mode=S\_IFCHR|0620, st\_rdev=makedev(0x88, 0x5), ...}, AT\_EMPTY\_PATH) = 0

write(1, "Test program 1. \n", 17Test program 1.

) = 17

write(1, "For help enter 'h' \n", 20For help enter 'h'

) = 20

newfstatat(0, "", {st\_mode=S\_IFCHR|0620, st\_rdev=makedev(0x88, 0x5), ...}, AT\_EMPTY\_PATH) = 0

write(1, "> ", 2> ) = 2

read(0, 0

"0\n", 1024) = 2

write(1, "Implementation changed. Current "..., 37Implementation changed. Current is 1

) = 37

write(1, "> ", 2> ) = 2

read(0, q

"q\n", 1024) = 2

munmap(0x7f981eeba000, 16432) = 0

munmap(0x7f981ec88000, 16432) = 0

munmap(0x7f981eb9f000, 942344) = 0

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

exit\_group(0) = ?

+++ exited with 0 +++

**Тестирование:**

cat\_mood@nuclear-box:~/programming/mai-os-labs/lab04/build$ ./main1\_impl1

Test program 1.

For help enter 'h'

> h

h - display this page you are seeing now

1 A B E - compute integral of sin(x) on the segment [A, B] with step E

2 A B - compute square of rectangle size of A x B

q - quit

> 1 1 5 0.001

Result of sin\_integral is 0.256649

> 2 2 5

Result of square is 10.000000

> q

cat\_mood@nuclear-box:~/programming/mai-os-labs/lab04/build$ ./main1\_impl2

Test program 1.

For help enter 'h'

> 1 1 5 0.001

Result of sin\_integral is 0.255749

> 2 2 5

Result of square is 5.000000

> q

cat\_mood@nuclear-box:~/programming/mai-os-labs/lab04/build$ ./main2

Test program 1.

For help enter 'h'

> 1 1 5 0.001

Result of sin\_integral is 0.256649

> 2 2 5

Result of square is 10.000000

> 0

Implementation changed. Current is 1

> 1 1 5 0.001

Result of sin\_integral is 0.255749

> 2 2 5

Result of square is 5.000000

> q

**Вывод**

В ходе лабораторной работы я получил опыт разработки динамической библиотеки, узнал о dynamic link и dynamic loading library, их различии; использовал такие системные вызовы, как dlopen, dlsym, dlclose; узнал, как компилируются динамические библиотеки.