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

```c
#pragma once

float sin_integral(float a, float b, float e);
float square(float a, float b);
```

lib_lab04_impl1.c

```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

```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. \nFor 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;
```

```c
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. \nFor 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\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=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\3\0>\0\1\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.