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

Студент: Седов М.Д

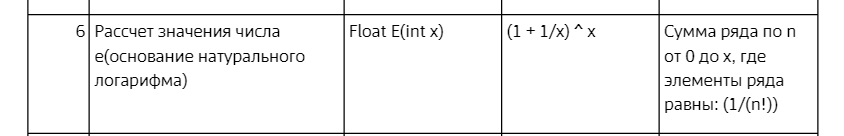
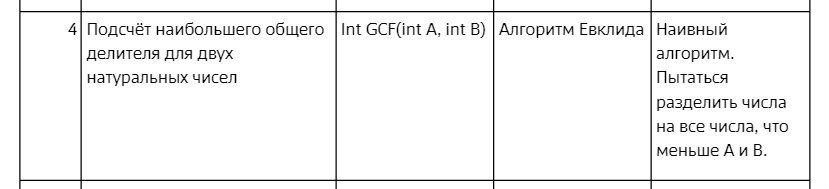
Преподаватель: Миронов Е.С.

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

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Москва, 2023

**Постановка задачи**

**Вариант 23.** Реализуем динамические библиотеки двух “контрактов”:  
 

**Общий метод и алгоритм решения**

Использованные системные вызовы:

* void \*dlopen(const char \*file, int mode) - открывает динамическую библиотеку и возвращает указатель на ее дескриптор.
* void \*dlsym(void \* handle, const char \* name) – используя указатель на дескриптор, возвращает адрес, указывающий, откуда загружается name.
* char \*dlerror() - возвращает строку с описанием последней ошибки, произошедшей в процессе работы с динамическими библиотеками.
* int dlclose(void \* handle) - закрывает дескриптор динамической библиотеки.

В каждой библиотеке у нас две функции, которые работают по разному, но выполняют одну задачу. Для того, чтобы библиотеки корректно подгружалась в код на этапе работы, необходимо создать их с атрибутом shared, также создать зависимость между библиотеками и основной программой. У пользователя будет выбор, какой контракт выбрать и какую функцию для этого использовать. Сама же работа с библиотекой и ее функциями происходит с помощью системных вызовов, связанных с динамическими библиотеками. Cначала мы открываем их с помощью dlopen(), затем в зависимости от контракта и функции получаем адрес на определнную функцию с помощью dlsym(). Выполняем задачи и затем закрываем библиотеки с помощью dlclose().

**Код программы**

**main.cpp**

#include <iostream>

#include "E/exp.h"

#include "GCF/gcf.h"

#include <dlfcn.h>

typedef int (\*MyGcfFunc)(int, int);

typedef float (\*MyExpFunc)(int);

int main() {

    void\* my\_gcf\_lib = dlopen("libGCF.so", RTLD\_LAZY);

    if (!my\_gcf\_lib) {

        std::cout << "Cannot open libGCF" << dlerror() << std::endl;

        return 1;

    }

    void\* my\_exp\_lib = dlopen("libEXP.so", RTLD\_LAZY);

    if (!my\_exp\_lib) {

        std::cout << "Cannot open libEXP" << dlerror() << std::endl;

        dlclose(my\_gcf\_lib);

        return 1;

    }

    int command;

    int a,b, x;

    bool switcher = true;

    while (true) {

        std::cout << "Enter command: ";

        if(!(std::cin >> command)){

            std::cout << "Finish work" << std::endl;

            dlclose(my\_gcf\_lib);

            dlclose(my\_exp\_lib);

            break;

        }

        switch (command){

        case 0:

            switcher = switcher ? false : true;

            std::cout << "Mode changed: " << (switcher ? "First" : "Second")

                                            << std::endl << std::endl;

            break;

        case 1:

            MyGcfFunc gcf\_func;

            if(switcher){

                gcf\_func = (MyGcfFunc) dlsym(my\_gcf\_lib, "gcf");

            }

            else{

                gcf\_func = (MyGcfFunc) dlsym(my\_gcf\_lib, "gcf\_naive");

            }

            if (!gcf\_func) {

                std::cout << "Cannot find symbol of libGCF: " << dlerror() << std::endl;

                dlclose(my\_gcf\_lib);

                return 1;

            }

            std::cout << "Enter a and b: ";

            std::cin >> a >> b;

            std::cout << "GCF(" << a << ", " << b << ") = " << (\*gcf\_func)(a, b) << std::endl << std::endl;

            break;

        case 2:

            MyExpFunc exp\_func;

            if(switcher){

                exp\_func = (MyExpFunc) dlsym(my\_exp\_lib, "my\_exp");

            }

            else{

                exp\_func = (MyExpFunc) dlsym(my\_exp\_lib, "my\_exp\_series");

            }

            if (!exp\_func) {

                std::cout << "Cannot find symbol of libEXP: " << dlerror() << std::endl;

                dlclose(my\_exp\_lib);

                return 1;

            }

            std::cout << "Enter x: ";

            std::cin >> x;

            std::cout << "Exp(" << x << ") = " << (\*exp\_func)(x) << std::endl << std::endl;

            break;

        default:

            break;

        }

    }

    return 0;

}

**exp.h**

#pragma once

#include <iostream>

#include <cmath>

extern "C" float my\_exp(int x);

extern "C" float my\_exp\_series(int x);

**exp.cpp**

#include "exp.h"

float my\_exp(int x){

    return pow((1 + 1 / (float)x), x);

}

float my\_exp\_series(int x) {

    if (x < 0) {

        return 0.0;

    }

    float sum = 0.0;

    float factorial = 1.0;

    for (int n = 0; n <= x; n++) {

        sum += 1.0 / factorial;

        factorial \*= (n + 1);

    }

    return sum;

}

**gcf.h**

#pragma once

#include <iostream>

extern "C" int gcf(int a, int b);

extern "C" int gcf\_naive(int a, int b);

**gcf.cpp**

#include "gcf.h"

int gcf(int a, int b){

    if(a < b){

        std::swap(a, b);

    }

    if(b == 0){

        return a;

    }

    return gcf(b, a % b);

}

int gcf\_naive(int a, int b){

    if(b < a){

        std::swap(a, b);

    }

    int result = 1;

    for(int i = 1; i <= a; i++){

        if(a % i == 0 && b % i == 0){

            result = i;

        }

    }

    return result;

}

**Протокол работы программы**

**Тестирование:**

maksim@caseofpeace:~/course2/sem3/os/lab4/src/build$ ./lab4

Enter command: 1

Enter a and b: 30 31

GCF(30, 31) = 1

Enter command: 2

Enter x: 3

Exp(3) = 2.37037

Enter command: 0

Mode changed: Second

Enter command: 2

Enter x: 3

Exp(3) = 2.66667

Enter command: 1

Enter a and b: 30 31

GCF(30, 31) = 1

Enter command: 42 56

Enter command: Enter command: 1

Enter a and b: 42 56

GCF(42, 56) = 14

Enter command: 2

Enter x: 1

Exp(1) = 2

Enter command: 0

Mode changed: First

Enter command: 1

Enter a and b: 3 90

GCF(3, 90) = 3

Enter command: 2

Enter x: 1

Exp(1) = 2

Enter command: Finish work

**STRACE:**

maksim@caseofpeace:~/course2/sem3/os/lab4/src/build$ strace -f ./lab4

execve("./lab4", ["./lab4"], 0x7fffdefcb498 /\* 31 vars \*/) = 0

brk(NULL) = 0x7ffff1aff000

arch\_prctl(0x3001 /\* ARCH\_??? \*/, 0x7ffff8c730e0) = -1 EINVAL (Invalid argument)

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f54eb010000

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

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/glibc-hwcaps/x86-64-v4/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/glibc-hwcaps/x86-64-v4", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/glibc-hwcaps/x86-64-v3/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/glibc-hwcaps/x86-64-v3", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/glibc-hwcaps/x86-64-v2/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/glibc-hwcaps/x86-64-v2", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls/haswell/avx512\_1/x86\_64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls/haswell/avx512\_1/x86\_64", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls/haswell/avx512\_1/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls/haswell/avx512\_1", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls/haswell/x86\_64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls/haswell/x86\_64", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls/haswell/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls/haswell", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls/avx512\_1/x86\_64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls/avx512\_1/x86\_64", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls/avx512\_1/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls/avx512\_1", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls/x86\_64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls/x86\_64", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/tls", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/haswell/avx512\_1/x86\_64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/haswell/avx512\_1/x86\_64", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/haswell/avx512\_1/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/haswell/avx512\_1", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/haswell/x86\_64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/haswell/x86\_64", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/haswell/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/haswell", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/avx512\_1/x86\_64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/avx512\_1/x86\_64", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/avx512\_1/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/avx512\_1", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/x86\_64/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/x86\_64", 0x7ffff8c72300, 0) = -1 ENOENT (No such file or directory)

**openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/libstdc++.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)**

newfstatat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build", {st\_mode=S\_IFDIR|0755, st\_size=4096, ...}, 0) = 0

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

newfstatat(3, "", {st\_mode=S\_IFREG|0644, st\_size=22607, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 22607, PROT\_READ, MAP\_PRIVATE, 3, 0) = 0x7f54eb01a000

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) = 0x7f54eade0000

mprotect(0x7f54eae7a000, 1576960, PROT\_NONE) = 0

mmap(0x7f54eae7a000, 1118208, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x9a000) = 0x7f54eae7a000

mmap(0x7f54eaf8b000, 454656, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1ab000) = 0x7f54eaf8b000

mmap(0x7f54eaffb000, 57344, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x21a000) = 0x7f54eaffb000

mmap(0x7f54eb009000, 10432, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f54eb009000

close(3) = 0

**openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/libc.so.6", O\_RDONLY|O\_CLOEXEC) = -1 ENOENT (No such file or directory)**

**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) = 0x7f54eabb0000

mmap(0x7f54eabd8000, 1658880, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x28000) = 0x7f54eabd8000

mmap(0x7f54ead6d000, 360448, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1bd000) = 0x7f54ead6d000

mmap(0x7f54eadc5000, 24576, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x214000) = 0x7f54eadc5000

mmap(0x7f54eadcb000, 52816, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_ANONYMOUS, -1, 0) = 0x7f54eadcb000

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) = 0x7f54eaac0000

mmap(0x7f54eaace000, 507904, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0xe000) = 0x7f54eaace000

mmap(0x7f54eab4a000, 372736, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x8a000) = 0x7f54eab4a000

mmap(0x7f54eaba5000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0xe4000) = 0x7f54eaba5000

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) = 0x7f54eaaa0000

mmap(0x7f54eaaa3000, 94208, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x3000) = 0x7f54eaaa3000

mmap(0x7f54eaaba000, 16384, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1a000) = 0x7f54eaaba000

mmap(0x7f54eaabe000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1d000) = 0x7f54eaabe000

close(3) = 0

mmap(NULL, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f54eaa90000

mmap(NULL, 12288, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_ANONYMOUS, -1, 0) = 0x7f54eaa80000

arch\_prctl(ARCH\_SET\_FS, 0x7f54eaa80740) = 0

set\_tid\_address(0x7f54eaa80a10) = 9803

set\_robust\_list(0x7f54eaa80a20, 24) = 0

rseq(0x7f54eaa810e0, 0x20, 0, 0x53053053) = -1 ENOSYS (Function not implemented)

mprotect(0x7f54eadc5000, 16384, PROT\_READ) = 0

mprotect(0x7f54eaabe000, 4096, PROT\_READ) = 0

mprotect(0x7f54eaba5000, 4096, PROT\_READ) = 0

mprotect(0x7f54eaffb000, 45056, PROT\_READ) = 0

mprotect(0x7f54eb063000, 4096, PROT\_READ) = 0

mprotect(0x7f54eb058000, 8192, PROT\_READ) = 0

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

munmap(0x7f54eb01a000, 22607) = 0

getrandom("\x7f\x8d\x3e\x91\xaf\x39\xac\x56", 8, GRND\_NONBLOCK) = 8

brk(NULL) = 0x7ffff1aff000

brk(0x7ffff1b20000) = 0x7ffff1b20000

futex(0x7f54eb00977c, FUTEX\_WAKE\_PRIVATE, 2147483647) = 0

**openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/libGCF.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=16184, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 16464, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7f54eaa70000

mmap(0x7f54eaa71000, 4096, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1000) = 0x7f54eaa71000

mmap(0x7f54eaa72000, 4096, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x2000) = 0x7f54eaa72000

mmap(0x7f54eaa73000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x2000) = 0x7f54eaa73000

close(3) = 0

mprotect(0x7f54eaa73000, 4096, PROT\_READ) = 0

**openat(AT\_FDCWD, "/home/maksim/course2/sem3/os/lab4/src/build/libEXP.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=15944, ...}, AT\_EMPTY\_PATH) = 0

mmap(NULL, 16448, PROT\_READ, MAP\_PRIVATE|MAP\_DENYWRITE, 3, 0) = 0x7f54eaa60000

mmap(0x7f54eaa61000, 4096, PROT\_READ|PROT\_EXEC, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x1000) = 0x7f54eaa61000

mmap(0x7f54eaa62000, 4096, PROT\_READ, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x2000) = 0x7f54eaa62000

mmap(0x7f54eaa63000, 8192, PROT\_READ|PROT\_WRITE, MAP\_PRIVATE|MAP\_FIXED|MAP\_DENYWRITE, 3, 0x2000) = 0x7f54eaa63000

close(3) = 0

mprotect(0x7f54eaa63000, 4096, PROT\_READ) = 0

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

write(1, "Enter command: ", 15Enter command: ) = 15

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

read(0, 1

"1\n", 1024) = 2

write(1, "Enter a and b: ", 15Enter a and b: ) = 15

read(0, 36 78

"36 78\n", 1024) = 6

write(1, "GCF(36, 78) = 6\n", 16GCF(36, 78) = 6

) = 16

write(1, "\n", 1

) = 1

write(1, "Enter command: ", 15Enter command: ) = 15

read(0, 0

"0\n", 1024) = 2

write(1, "Mode changed: Second\n", 21Mode changed: Second

) = 21

write(1, "\n", 1

) = 1

write(1, "Enter command: ", 15Enter command: ) = 15

read(0, 1

"1\n", 1024) = 2

write(1, "Enter a and b: ", 15Enter a and b: ) = 15

read(0, 97 67

"97 67\n", 1024) = 6

write(1, "GCF(97, 67) = 1\n", 16GCF(97, 67) = 1

) = 16

write(1, "\n", 1

) = 1

write(1, "Enter command: ", 15Enter command: ) = 15

read(0, 2

"2\n", 1024) = 2

write(1, "Enter x: ", 9Enter x: ) = 9

read(0, 4

"4\n", 1024) = 2

write(1, "Exp(4) = 2.70833\n", 17Exp(4) = 2.70833

) = 17

write(1, "\n", 1

) = 1

write(1, "Enter command: ", 15Enter command: ) = 15

read(0, 0

"0\n", 1024) = 2

write(1, "Mode changed: First\n", 20Mode changed: First

) = 20

write(1, "\n", 1

) = 1

write(1, "Enter command: ", 15Enter command: ) = 15

read(0, 2

"2\n", 1024) = 2

write(1, "Enter x: ", 9Enter x: ) = 9

read(0, 6

"6\n", 1024) = 2

write(1, "Exp(6) = 2.52163\n", 17Exp(6) = 2.52163

) = 17

write(1, "\n", 1

) = 1

write(1, "Enter command: ", 15Enter command: ) = 15

read(0, "", 1024) = 0

write(1, "Finish work\n", 12Finish work

) = 12

munmap(0x7f54eaa70000, 16464) = 0

munmap(0x7f54eaa60000, 16448) = 0

exit\_group(0) = ?

+++ exited with 0 +++

**Вывод**

Во время выполнения лабораторной работы разобрался в отличие статической и динамической библиотеке. Использование динамической библиотеке эффективно в том случае, когда нам надо работать с объемной библиотекой, в которой мы можем обращаться только к нужным нам функциям. По итогу, научился создавать и взаимодействовать с динамической библиотекой.