**Лабораторная работа №4
по курсу «Операционные системы»**

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Условие:

Создать 2 динамические библиотеки, реализующие одинаковые функции различными алгоритмами: рассчет значения числа Пи при заданной длине ряда (K), сигнатура: float Pi(int K), реализация 1: ряд Лейбница, реализация 2: формула Валлиса; сортировка целочисленного массива, сигнатура: Int * Sort(int * array), реализация 1: Пузырьковая сортировка, реализация 2: сортировка Хоара. Библиотеки должны использоваться двумя тестовыми программами разными способами: через статическую линковку на этапе компиляции и через динамическую загрузку во время выполнения.

Цель работы:

Приобретение практических навыков в: создании динамических библиотек; создании программ, использующих функции динамических библиотек двумя различными способами; анализе преимуществ и недостатков статической и динамической линковки.

Задание:

1 функция: рассчет значения числа Пи при заданной длине ряда (K), сигнатура: float Pi(int K), реализация 1: ряд Лейбница, реализация 2: формула Валлиса;

2 функция: сортировка целочисленного массива, сигнатура: Int * Sort(int * array), реализация 1: Пузырьковая сортировка, реализация 2: сортировка Хоара.

Вариант: 30

Описание программы

Метод решения

Данная программа реализует два различных способа использования динамических библиотек: статическую линковку на этапе компиляции и динамическую загрузку во время выполнения. Разработаны две динамические библиотеки с различными алгоритмами вычисления числа Пи и сортировки массивов, которые используются двумя тестовыми программами для демонстрации различий в подходах к связыванию кода.

Основные компоненты:

lib1.dll - первая динамическая библиотека, реализующая вычисление числа Пи через ряд Лейбница и сортировку массива пузырьковым методом;

lib2.dll - вторая динамическая библиотека, реализующая вычисление числа Пи через формулу Валлиса и сортировку массива быстрым методом Хоара;

Program1 - программа со статической линковкой, использующая одну из библиотек на этапе компиляции;

Program2 - программа с динамической загрузкой, способная переключаться между библиотеками во время выполнения;

DynamicLoader - модуль, инкапсулирующий системные вызовы для работы с динамическими библиотеками.

Описание программы

Структура проекта:

lab4/

    include/

        PiCalc.hpp // Абстрактный класс для вычисления числа Пи

        Sorter.hpp // Абстрактный класс для сортировки массивов

lib1/

        PiLeibniz.cpp // Реализация вычисления Пи методом Лейбница

        BubbleSort.cpp // Реализация пузырьковой сортировки

lib2/

        PiWallis.cpp // Реализация вычисления Пи методом Валлиса

        QuickSort.cpp // Реализация быстрой сортировки Хоара

prog1/

        main.cpp // Программа 1 (статическая линковка)

prog2/

        main.cpp // Программа 2 (динамическая загрузка)

        DynamicLoader.hpp // Заголовочный файл загрузчика библиотек

        DynamicLoader.cpp // Реализация загрузчика библиотек

CMakeLists.txt

Основные типы данных:

Абстрактный класс PiCalc - определяет интерфейс для вычисления числа Пи:

Абстрактный класс Sorter - определяет интерфейс для сортировки массивов:

Конкретные реализации (наследники абстрактных классов):

`LeibnizPi` - вычисление числа Пи по формуле Лейбница

`WallisPi` - вычисление числа Пи по формуле Валлиса

`BubbleSort` - сортировка пузырьковым методом

`QuickSort` - сортировка методом Хоара

Класс DynamicLoader - инкапсулирует работу с системными вызовами:

Принцип работы с типами данных:

Программа использует полиморфизм через абстрактные классы для обеспечения единого интерфейса к различным реализациям алгоритмов. Указатели на функции DLL позволяют динамически загружать и использовать реализации без перекомпиляции основной программы. При статической линковке реализации фиксируются на этапе сборки, при динамической - могут изменяться во время выполнения.

Основные функции программы:

В динамических библиотеках:

- `CreatePiCalculator()` - фабричный метод для создания объекта вычисления Пи

- `CreateArraySorter()` - фабричный метод для создания объекта сортировки

- `DeletePiCalculator()` - освобождение памяти объекта вычисления Пи

- `DeleteArraySorter()` - освобождение памяти объекта сортировки

В классе DynamicLoader:

- `load()` - загрузка динамической библиотеки в память

- `unload()` - выгрузка библиотеки из памяти

- `switchLib()` - переключение между библиотеками

- `getPiCalculator()` - получение объекта для вычисления Пи

- `getArraySorter()` - получение объекта для сортировки

Используемые системные вызовы (инкапсулированы в DynamicLoader):

Для Windows:

- `LoadLibraryA()` - загрузка динамической библиотеки в память процесса

- `GetProcAddress()` - получение адреса экспортируемой функции по имени

- `FreeLibrary()` - выгрузка библиотеки из памяти и уменьшение счетчика ссылок

Принцип работы программы:

1. **Program1 (статическая линковка):** - Библиотека линкуется на этапе компиляции через CMake (команда `target_link_libraries`)

- Программа имеет прямой доступ к функциям библиотеки

- Реализация фиксирована и не может быть изменена без перекомпиляции

- Обработка команд пользователя происходит напрямую через вызовы методов объектов

2. **Program2 (динамическая загрузка):** - Библиотека загружается во время выполнения через `DynamicLoader`

- Программа получает указатели на функции через `GetProcAddress()`

- Возможно переключение между библиотеками командой "0"

- Обработка команд осуществляется через методы `DynamicLoader`

При вводе команды "0" в Program2 вызывается метод `switchLib()` класса `DynamicLoader`, который:

Выгружает текущую библиотеку (`FreeLibrary()`)

Загружает альтернативную библиотеку (`LoadLibraryA()`)

Получает адреса функций из новой библиотеки (`GetProcAddress()`)

Обновляет внутренние указатели на фабричные методы

Результаты

Разработана система демонстрации двух принципиально различных подходов к использованию динамических библиотек: статической линковки на этапе компиляции и динамической загрузки во время выполнения.

Ключевые результаты:

- Созданы две динамические библиотеки (lib1.dll и lib2.dll), реализующие одинаковый программный интерфейс различными алгоритмами вычисления числа Пи и сортировки массивов;

- Разработана программа Program1, демонстрирующая принцип статической линковки, где реализация алгоритмов фиксируется на этапе сборки и не может быть изменена без перекомпиляции;

- Реализована программа Program2 с возможностью динамической загрузки библиотек, позволяющая переключаться между различными реализациями алгоритмов во время выполнения;

- Создан класс DynamicLoader, инкапсулирующий системные вызовы Windows API для работы с динамическими библиотеками, что соответствует требованию об отсутствии системных вызовов в основной программе;

Выводы

В ходе лабораторной работы я реализовала и сравнила два подхода к использованию библиотек: статическую линковку (Program1) и динамическую загрузку (Program2).

Сравнение подходов:

Статическая линковка (Program1):

Плюсы:

Быстрый запуск (все уже в памяти)

Нет зависимостей от внешних файлов

Проще отладка

Минусы:

Чтобы сменить алгоритм, нужно перекомпилировать

Большой размер exe-файла

Нельзя обновить библиотеку отдельно

Динамическая загрузка (Program2):

Плюсы:

Можно менять библиотеки "на лету"

Можно обновлять библиотеки без перекомпиляции

Несколько программ могут использовать одну DLL

Меньший размер exe-файла

Минусы:

Медленнее запуск (нужно грузить DLL)

Зависит от наличия DLL-файлов

Сложнее отладка

Исходная программа

PiCalc.hpp

```
1  #ifndef PI_CALCULATOR_HPP
2  #define PI_CALCULATOR_HPP
3
4  class PiCalc {
5  public:
6      virtual float Calculate(int K) = 0;
7      virtual ~PiCalc() = default;
8  };
9
10 #endif
```

Sorter.hpp

```
1  #ifndef ARRAY_SORTER_HPP
2  #define ARRAY_SORTER_HPP
3
4  class Sorter {
5  public:
6      virtual int* Sort(int* array, int size) = 0;
7      virtual ~Sorter() = default;
8  };
9
10 #endif
```

PiLeibniz.cpp

```
1  #include "../include/PiCalc.hpp"
2
3
4  class LeibnizPi : public PiCalc {
5  public:
6      float Calculate(int K) override {
7          float result = 0.0f;
8          for (int n = 0; n < K; n++) {
9              float term = 1.0f / (2 * n + 1);
10             if (n % 2 == 0) result += term;
11             else result -= term;
12         }
13         return 4.0f * result;
14     }
15 };
16
17
18 extern "C" __declspec(dllexport) PiCalc* CreatePiCalculator() {
19     return new LeibnizPi();
20 }
21
22 extern "C" __declspec(dllexport) void DeletePiCalculator(PiCalc* p) {
23     delete p;
24 }
```

BubbleSort.cpp

```
1  #include "../include/Sorter.hpp"
2
3
4  class BubbleSort : public Sorter {
```

```
 5  public:
 6      int* Sort(int* array, int size) override {
 7          for (int i = 0; i < size - 1; i++) {
 8              for (int j = 0; j < size - i - 1; j++) {
 9                  if (array[j] > array[j + 1]) {
10                      int temp = array[j];
11                      array[j] = array[j + 1];
12                      array[j + 1] = temp;
13                  }
14              }
15          }
16          return array;
17      }
18  };
19
20  extern "C" __declspec(dllexport) Sorter* CreateArraySorter() {
21      return new BubbleSort();
22  }
23
24  extern "C" __declspec(dllexport) void DeleteArraySorter(Sorter* p) {
25      delete p;
26  }
```

PiWallis.cpp

```
 1  #include "../include/PiCalc.hpp"
 2
 3
 4  class WallisPi : public PiCalc {
 5  public:
 6      float Calculate(int K) override {
 7          float pi = 1.0f;
 8          for (int n = 1; n <= K; n++) {
 9              float numerator = 4.0f * n * n;
10              float denominator = 4.0f * n * n - 1.0f;
11              pi *= numerator / denominator;
12          }
13          return 2.0f * pi;
14      }
15  };
16
17  extern "C" __declspec(dllexport) PiCalc* CreatePiCalculator() {
18      return new WallisPi();
19  }
20
21  extern "C" __declspec(dllexport) void DeletePiCalculator(PiCalc* p) {
22      delete p;
23  }
```

QuickSort.cpp

```
 1  #include "../include/Sorter.hpp"
 2
 3
 4  class QuickSort : public Sorter {
 5  private:
 6      void quickSort(int* array, int low, int high) {
 7          if (low < high) {
 8              int pivot = array[high];
```

```
 9              int i = low - 1;
10
11              for (int j = low; j < high; j++) {
12                  if (array[j] <= pivot) {
13                      i++;
14                      int temp = array[i];
15                      array[i] = array[j];
16                      array[j] = temp;
17                  }
18              }
19
20              int temp = array[i + 1];
21              array[i + 1] = array[high];
22              array[high] = temp;
23
24              int pi = i + 1;
25              quickSort(array, low, pi - 1);
26              quickSort(array, pi + 1, high);
27          }
28      }
29
30  public:
31      int* Sort(int* array, int size) override {
32          if (size > 1) {
33              quickSort(array, 0, size - 1);
34          }
35          return array;
36      }
37  };
38
39  extern "C" __declspec(dllexport) Sorter* CreateArraySorter() {
40      return new QuickSort();
41  }
42
43  extern "C" __declspec(dllexport) void DeleteArraySorter(Sorter* p) {
44      delete p;
45  }
```

prog1/main.cpp

```cpp
 1  #include <iostream>
 2  #include <string>
 3  #include <sstream>
 4
 5  #include "../include/PiCalc.hpp"
 6  #include "../include/Sorter.hpp"
 7
 8
 9  // o   DLL
10  extern "C" {
11      PiCalc* CreatePiCalculator();
12      Sorter* CreateArraySorter();
13      void DeletePiCalculator(PiCalc*);
14      void DeleteArraySorter(Sorter*);
15  }
16
17  void printArray(int* arr, int size) {
18      for (int i = 0; i < size; i++) {
19          std::cout << arr[i] << " ";
```

```cpp
20          }
21          std::cout << std::endl;
22     }
23
24     int main() {
25          PiCalc* piCalc = CreatePiCalculator();
26          Sorter* sorter = CreateArraySorter();
27
28          std::cout << "Program 1 Static Linking " << std::endl;
29          std::cout << "0 - Exit" << std::endl;
30          std::cout << "1 K - Calculate Pi" << std::endl;
31          std::cout << "2 n a1 a2 ... an - Sort array" << std::endl;
32
33          std::string line;
34          while (true) {
35              std::cout << "\n> ";
36              std::getline(std::cin, line);
37
38              if (line.empty()) continue;
39
40              std::istringstream iss(line);
41              std::string cmd;
42              iss >> cmd;
43
44              if (cmd == "0") break;
45
46              if (cmd == "1") {
47                  int K;
48                  if (iss >> K && K > 0) {
49                      float pi = piCalc->Calculate(K);
50                      std::cout << "Pi(" << K << ") = " << pi << std::endl;
51                  }
52              }
53
54              else if (cmd == "2") {
55                  int n;
56                  if (iss >> n && n > 0) {
57                      int* array = new int[n];
58
59                      for (int i = 0; i < n; i++) {
60                          if (!(iss >> array[i])) {
61                              std::cout << "Error" << std::endl;
62                              delete[] array;
63                              array = nullptr;
64                              break;
65                          }
66                      }
67
68                      if (array) {
69                          std::cout << "Before: ";
70                          printArray(array, n);
71
72                          sorter->Sort(array, n);
73
74                          std::cout << "After: ";
75                          printArray(array, n);
76
77                          delete[] array;
```

```
78             }
79         }
80     }
81 }
82
83     DeletePiCalculator(piCalc);
84     DeleteArraySorter(sorter);
85
86     return 0;
87 }
```

prog2/main.cpp

```cpp
1  #include <iostream>
2  #include <string>
3  #include <sstream>
4
5  #include "DynamicLoader.hpp"
6
7  void printArray(int* arr, int size) {
8      for (int i = 0; i < size; i++) {
9          std::cout << arr[i] << " ";
10     }
11     std::cout << std::endl;
12 }
13
14 int main() {
15     DynamicLoader manager;
16
17     if (!manager.load("lib1.dll")) {
18         std::cout << "Cannot load lib1.dll, trying lib2.dll..." << std::endl;
19         if (!manager.load("lib2.dll")) {
20             std::cout << "Cannot load any library!" << std::endl;
21             return 1;
22         }
23     }
24
25     std::cout << " Program 2 Dynamic Loading" << std::endl;
26     std::cout << "Current library: " << manager.currentLibrary() << std::endl;
27     std::cout << "Commands:" << std::endl;
28     std::cout << " 0 - Switch library" << std::endl;
29     std::cout << " 1 K - Calculate Pi" << std::endl;
30     std::cout << " 2 n a1 a2 ... an - Sort array" << std::endl;
31     std::cout << " 'exit' for exit" << std::endl;
32
33     std::string line;
34     while (true) {
35         std::cout << "\n> ";
36         std::getline(std::cin, line);
37
38         if (line.empty()) continue;
39         if (line == "exit") break;
40
41         std::istringstream iss(line);
42         std::string cmd;
43         iss >> cmd;
44
45         if (cmd == "0") {
46             if (manager.switchLib()) {
```

```cpp
            std::cout << "Switched to: " << manager.currentLibrary() << std::endl;
        } else {
            std::cout << "Switch failed!" << std::endl;
        }
    }

    else if (cmd == "1") {
        int K;
        if (iss >> K && K > 0) {
            PiCalc* calc = manager.getPiCalculator();
            if (calc) {
                float pi = calc->Calculate(K); //  !
                std::cout << "Pi(" << K << ") = " << pi << std::endl;
                manager.freePiCalculator(calc);
            } else {
                std::cout << "Failed to create PiCalculator" << std::endl;
            }
        } else {
            std::cout << "Invalid K value" << std::endl;
        }
    }

    else if (cmd == "2") {
        int n;
        if (iss >> n && n > 0) {
            int* arr = new int[n];
            bool ok = true;

            for (int i = 0; i < n; i++) {
                if (!(iss >> arr[i])) {
                    std::cout << "Need " << n << " numbers!" << std::endl;
                    delete[] arr;
                    arr = nullptr;
                    ok = false;
                    break;
                }
            }

            if (ok && arr) {
                Sorter* sorter = manager.getArraySorter();
                if (sorter) {
                    std::cout << "Before: ";
                    printArray(arr, n);

                    sorter->Sort(arr, n);

                    std::cout << "After: ";
                    printArray(arr, n);

                    manager.freeArraySorter(sorter);
                } else {
                    std::cout << "Failed to create Sorter" << std::endl;
                }
                delete[] arr;
            }
        } else {
            std::cout << "Invalid array size" << std::endl;
        }
```

```
105            }
106
107        else {
108            std::cout << "Unknown command: " << cmd << std::endl;
109        }
110    }
111
112    return 0;
113 }
```

DynamicLoader.hpp

```cpp
1  #pragma once
2
3  #include <string>
4
5  #include "../include/PiCalc.hpp"
6  #include "../include/Sorter.hpp"
7
8
9  class DynamicLoader {
10 private:
11     void* dllHandle;
12     std::string currentLib;
13
14     PiCalc* (*createPi)();
15     Sorter* (*createSort)();
16     void (*deletePi)(PiCalc*);
17     void (*deleteSort)(Sorter*);
18
19 public:
20     DynamicLoader();
21     ~DynamicLoader();
22
23     bool load(const std::string& dllPath);
24     void unload();
25     bool switchLib();
26
27     PiCalc* getPiCalculator();
28     Sorter* getArraySorter();
29     void freePiCalculator(PiCalc* p);
30     void freeArraySorter(Sorter* p);
31
32     std::string currentLibrary() const;
33     bool isLoaded() const;
34 };
```

DynamicLoader.cpp

```cpp
1  #include <windows.h>
2
3  #include "DynamicLoader.hpp"
4
5  DynamicLoader::DynamicLoader() : dllHandle(nullptr),
6                                   createPi(nullptr),
7                                   createSort(nullptr),
8                                   deletePi(nullptr),
9                                   deleteSort(nullptr) {}
10
```

```cpp
DynamicLoader::~DynamicLoader() {
    unload();
}

bool DynamicLoader::load(const std::string& dllPath) {
    unload();

    dllHandle = LoadLibraryA(dllPath.c_str());
    if (!dllHandle) {
        return false;
    }

    createPi = (PiCalc*(*)())GetProcAddress((HMODULE)dllHandle, "CreatePiCalculator");
    createSort = (Sorter*(*)())GetProcAddress((HMODULE)dllHandle, "CreateArraySorter")
        ;
    deletePi = (void(*)(PiCalc*))GetProcAddress((HMODULE)dllHandle, "
        DeletePiCalculator");
    deleteSort = (void(*)(Sorter*))GetProcAddress((HMODULE)dllHandle, "
        DeleteArraySorter");

    if (!createPi || !createSort || !deletePi || !deleteSort) {
        FreeLibrary((HMODULE)dllHandle);
        dllHandle = nullptr;
        return false;
    }

    currentLib = dllPath;
    return true;
}

void DynamicLoader::unload() {
    if (dllHandle) {
        FreeLibrary((HMODULE)dllHandle);
        dllHandle = nullptr;
    }
    currentLib.clear();

    createPi = nullptr;
    createSort = nullptr;
    deletePi = nullptr;
    deleteSort = nullptr;
}

bool DynamicLoader::switchLib() {
    if (currentLib.find("lib1") != std::string::npos) {
        return load("lib2.dll");
    } else {
        return load("lib1.dll");
    }
}

PiCalc* DynamicLoader::getPiCalculator() {
    if (createPi) {
        return createPi();
    }
    return nullptr;
}
```

```
66  Sorter* DynamicLoader::getArraySorter() {
67      if (createSort) {
68          return createSort();
69      }
70      return nullptr;
71  }
72
73  void DynamicLoader::freePiCalculator(PiCalc* p) {
74      if (deletePi && p) {
75          deletePi(p);
76      }
77  }
78
79  void DynamicLoader::freeArraySorter(Sorter* p) {
80      if (deleteSort && p) {
81          deleteSort(p);
82      }
83  }
84
85  std::string DynamicLoader::currentLibrary() const {
86      return currentLib;
87  }
88
89  bool DynamicLoader::isLoaded() const {
90      return dllHandle != nullptr;
91  }
```

strace for Program1

```
"Time of Day","Process Name","PID","Operation","Path","Result","Detail"
"17:09:14,7530688","Program1.exe","20912","Process Start","","SUCCESS","Parent
PID: 21036,Command line: ""C:\Users\kseni\lab4_OS\build\Program1.exe"",Current
directory: C:\Users\kseni\lab4_OS\build\,Environment:
; ALLUSERSPROFILE=C:\ProgramData
; APPDATA=C:\Users\kseni\AppData\Roaming
; CC=C:/Users/kseni/gcc/bin/gcc.exe
; CHROME_CRASHPAD_PIPE_NAME=\\.\pipe\crashpad_14992_EFVMFEHBOBIBUPZX
; CommonProgramFiles=C:\Program Files\Common Files
; CommonProgramFiles(x86)=C:\Program Files (x86)\Common Files
; CommonProgramW6432=C:\Program Files\Common Files
; COMPUTERNAME=LAPTOP-ECH40E5U
; ComSpec=C:\Windows\system32\cmd.exe
; CXX=C:/Users/kseni/gcc/bin/g++.exe
; DriverData=C:\Windows\System32\Drivers\DriverData
; EFC_4152=1
; HOMEDRIVE=C:
; HOMEPATH=\Users\kseni
; JAVA_HOME=C:\Program Files\Zulu\zulu-17\
; LOCALAPPDATA=C:\Users\kseni\AppData\Local
; LOGONSERVER=\\LAPTOP-ECH40E5U
; NUMBER_OF_PROCESSORS=8
; OneDrive=C:\Users\kseni\OneDrive
; OneDriveConsumer=C:\Users\kseni\OneDrive
```

; ORIGINAL_XDG_CURRENT_DESKTOP=undefined
; OS=Windows_NT
; Path=%PATH%;C:\Program Files\Python312;C:\Program Files\Python312\Scripts;C:\Users\
Files\Git\bin;C:\Users\kseni\AppData\Local\Programs\Microsoft VS Code\bin;C:\Program
Files\CMake\bin;D:\Program Files\VMware\VMware Workstation\bin\;C:\Program
Files\swipl\bin;
; PATHEXT=.COM;.EXE;.BAT;.CMD;.VBS;.VBE;.JS;.JSE;.WSF;.WSH;.MSC;.CPL
; PROCESSOR_ARCHITECTURE=AMD64
; PROCESSOR_IDENTIFIER=Intel64 Family 6 Model 140 Stepping 2,GenuineIntel
; PROCESSOR_LEVEL=6
; PROCESSOR_REVISION=8c02
; ProgramData=C:\ProgramData
; ProgramFiles=C:\Program Files
; ProgramFiles(x86)=C:\Program Files (x86)
; ProgramW6432=C:\Program Files
; PSModulePath=C:\Users\kseni\OneDrive\Документы\WindowsPowerShell\Modules;C:\Program
Files\WindowsPowerShell\Modules;C:\Windows\system32\WindowsPowerShell\v1.0\Modules
; PUBLIC=C:\Users\Public
; PyCharm Community Edition=C:\Program Files\JetBrains\PyCharm Community Edition
2023.3.3\bin;
; SESSIONNAME=Console
; SystemDrive=C:
; SystemRoot=C:\Windows
; TEMP=C:\Users\kseni\AppData\Local\Temp
; TMP=C:\Users\kseni\AppData\Local\Temp
; USERDOMAIN=LAPTOP-ECH40E5U
; USERDOMAIN_ROAMINGPROFILE=LAPTOP-ECH40E5U
; USERNAME=kseni
; USERPROFILE=C:\Users\kseni
; VSCODE_PYTHON_AUTOACTIVATE_GUARD=1
; windir=C:\Windows
; ZES_ENABLE_SYSMAN=1
; TERM_PROGRAM=vscode
; TERM_PROGRAM_VERSION=1.106.3
; LANG=en_US.UTF-8
; COLORTERM=truecolor
; GIT_ASKPASS=c:\Users\kseni\AppData\Local\Programs\Microsoft VS Code\resources\app\e:
; VSCODE_GIT_ASKPASS_NODE=C:\Users\kseni\AppData\Local\Programs\Microsoft VS
Code\Code.exe
; VSCODE_GIT_ASKPASS_EXTRA_ARGS=
; VSCODE_GIT_ASKPASS_MAIN=c:\Users\kseni\AppData\Local\Programs\Microsoft VS
Code\resources\app\extensions\git\dist\askpass-main.js
; VSCODE_GIT_IPC_HANDLE=\\.\pipe\vscode-git-c0429ea22d-sock
; VSCODE_INJECTION=1"
"17:09:14,7530801","Program1.exe","20912","Thread Create","","SUCCESS","Thread
ID: 1684"
"17:09:14,7563884","Program1.exe","20912","Load Image","C:\Users\kseni\lab4_OS\build\
Base: 0x7ff60d9a0000,Image Size: 0xe77000"

"17:09:14,7564439","Program1.exe","20912","Load Image","C:\Windows\System32\ntdll.dll
Base: 0x7ffcff190000,Image Size: 0x217000"
"17:09:14,7565720","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Access: Read"
"17:09:14,7566095","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Access: Read"
"17:09:14,7566313","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl
REG_SZ,Length: 10,Data: 1251"
"17:09:14,7566535","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl
REG_SZ,Length: 8,Data: 866"
"17:09:14,7566673","Program1.exe","20912","RegCloseKey","HKLM\System\CurrentControlSe
"17:09:14,7567539","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Manager","REPARSE","Desired Access: Query Value"
"17:09:14,7567697","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Manager","SUCCESS","Desired Access: Query Value"
"17:09:14,7567859","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl
Manager\RaiseExceptionOnPossibleDeadlock","NAME NOT FOUND","Length: 80"
"17:09:14,7567994","Program1.exe","20912","RegCloseKey","HKLM\System\CurrentControlSe
Manager","SUCCESS",""
"17:09:14,7568142","Program1.exe","20912","RegOpenKey","HKLM\SYSTEM\CurrentControlSet
Manager\Segment Heap","REPARSE","Desired Access: Query Value"
"17:09:14,7568241","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Manager\Segment Heap","NAME NOT FOUND","Desired Access: Query Value"
"17:09:14,7568636","Program1.exe","20912","RegOpenKey","HKLM\SYSTEM\CurrentControlSet
Manager","REPARSE","Desired Access: Query Value,Enumerate Sub Keys"
"17:09:14,7568773","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Manager","SUCCESS","Desired Access: Query Value,Enumerate Sub Keys"
"17:09:14,7568907","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl
Manager\ResourcePolicies","NAME NOT FOUND","Length: 24"
"17:09:14,7569032","Program1.exe","20912","RegCloseKey","HKLM\System\CurrentControlSe
Manager","SUCCESS",""
"17:09:14,7571179","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl
NOT FOUND","Length: 528"
"17:09:14,7571723","Program1.exe","20912","QueryNameInformationFile","C:\Windows\Syst
\Windows\System32\ntdll.dll"
"17:09:14,7572404","Program1.exe","20912","RegOpenKey","HKLM\SYSTEM\CurrentControlSet
Manager","REPARSE","Desired Access: Query Value,Enumerate Sub Keys"
"17:09:14,7572597","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Manager","SUCCESS","Desired Access: Query Value,Enumerate Sub Keys"
"17:09:14,7572780","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl
Manager\ResourcePolicies","NAME NOT FOUND","Length: 24"
"17:09:14,7572951","Program1.exe","20912","RegCloseKey","HKLM\System\CurrentControlSe
Manager","SUCCESS",""
"17:09:14,7575445","Program1.exe","20912","CreateFile","C:\Users\kseni\lab4_OS\build"
Access: Execute/Traverse,Synchronize,Disposition: Open,Options: Directory,Synchronous
IO Non-Alert,Attributes: n/a,ShareMode: Read,Write,AllocationSize: n/a,OpenResult:
Opened"
"17:09:14,7576813","Program1.exe","20912","Load Image","C:\Windows\System32\kernel32.

Base: 0x7ffcfe350000,Image Size: 0xc4000"
"17:09:14,7578457","Program1.exe","20912","Load Image","C:\Windows\System32\KernelBas<
Base: 0x7ffcfc790000,Image Size: 0x3b7000"
"17:09:14,7592454","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl:
NOT FOUND","Length: 528"
"17:09:14,7593115","Program1.exe","20912","QueryNameInformationFile","C:\Windows\Syste
\Windows\System32\KernelBase.dll"
"17:09:14,7595366","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl:
NOT FOUND","Length: 528"
"17:09:14,7595870","Program1.exe","20912","QueryNameInformationFile","C:\Windows\Syste
\Windows\System32\KernelBase.dll"
"17:09:14,7597654","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Access: Read"
"17:09:14,7597938","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
NOT FOUND","Desired Access: Read"
"17:09:14,7598752","Program1.exe","20912","QueryNameInformationFile","C:\Windows\Syste
\Windows\System32\KernelBase.dll"
"17:09:14,7599334","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl:
NOT FOUND","Length: 528"
"17:09:14,7599849","Program1.exe","20912","QueryNameInformationFile","C:\Windows\Syste
\Windows\System32\KernelBase.dll"
"17:09:14,7600496","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Server","REPARSE","Desired Access: Read"
"17:09:14,7600691","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Server","SUCCESS","Desired Access: Read"
"17:09:14,7600902","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl:
Server\TSAppCompat","NAME NOT FOUND","Length: 548"
"17:09:14,7601046","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl:
Server\TSUserEnabled","SUCCESS","Type: REG_DWORD,Length: 4,Data: 0"
"17:09:14,7601215","Program1.exe","20912","RegCloseKey","HKLM\System\CurrentControlSe
Server","SUCCESS",""
"17:09:14,7603237","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Access: Query Value,Set Value"
"17:09:14,7603393","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
NOT FOUND","Desired Access: Query Value,Set Value"
"17:09:14,7603578","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Access: Read"
"17:09:14,7603664","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Access: Read"
"17:09:14,7603796","Program1.exe","20912","RegQueryKey","HKLM\System\CurrentControlSe
Full,SubKeys: 1,Values: 0"
"17:09:14,7603913","Program1.exe","20912","RegCloseKey","HKLM\System\CurrentControlSe
"17:09:14,7604002","Program1.exe","20912","RegOpenKey","HKLM\Software\Policies\Micros
Access: Query Value"
"17:09:14,7604179","Program1.exe","20912","RegQueryValue","HKLM\SOFTWARE\Policies\Mic
NOT FOUND","Length: 80"
"17:09:14,7604342","Program1.exe","20912","RegCloseKey","HKLM\SOFTWARE\Policies\Micros
"17:09:14,7604471","Program1.exe","20912","RegOpenKey","HKCU\Software\Policies\Microso

NOT FOUND","Desired Access: Query Value"
"17:09:14,7604708","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Access: Read"
"17:09:14,7604792","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Access: Read"
"17:09:14,7604891","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl
REG_DWORD,Length: 4,Data: 1"
"17:09:14,7605010","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl
NOT FOUND","Length: 20"
"17:09:14,7605100","Program1.exe","20912","RegCloseKey","HKLM\System\CurrentControlSe
"17:09:14,7606672","Program1.exe","20912","Load Image","C:\Windows\System32\msvcrt.dl
Base: 0x7ffcfe150000,Image Size: 0xa7000"
"17:09:14,7607882","Program1.exe","20912","Thread Create","","SUCCESS","Thread
ID: 16056"
"17:09:14,7609199","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Manager","REPARSE","Desired Access: Query Value"
"17:09:14,7609398","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Manager","SUCCESS","Desired Access: Query Value"
"17:09:14,7609570","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl
Manager\SafeDllSearchMode","NAME NOT FOUND","Length: 16"
"17:09:14,7610630","Program1.exe","20912","Thread Create","","SUCCESS","Thread
ID: 3904"
"17:09:14,7611324","Program1.exe","20912","CreateFile","C:\Users\kseni\lab4_OS\build\
Access: Read Attributes,Disposition: Open,Options: Open Reparse Point,Attributes:
n/a,ShareMode: Read,Write,Delete,AllocationSize: n/a,OpenResult: Opened"
"17:09:14,7611619","Program1.exe","20912","QueryBasicInformationFile","C:\Users\kseni
08.12.2025 16:09:51,LastAccessTime: 08.12.2025 17:07:42,LastWriteTime: 08.12.2025
17:02:45,ChangeTime: 08.12.2025 17:02:45,FileAttributes: A"
"17:09:14,7611760","Program1.exe","20912","CloseFile","C:\Users\kseni\lab4_OS\build\l
"17:09:14,7612845","Program1.exe","20912","CreateFile","C:\Users\kseni\lab4_OS\build\
Access: Read Data/List Directory,Execute/Traverse,Synchronize,Disposition:
Open,Options: Synchronous IO Non-Alert,Non-Directory File,Attributes: n/a,ShareMode:
Read,Delete,AllocationSize: n/a,OpenResult: Opened"
"17:09:14,7613336","Program1.exe","20912","CreateFileMapping","C:\Users\kseni\lab4_OS
LOCKED WITH ONLY READERS","SyncType: SyncTypeCreateSection,PageProtection:
PAGE_EXECUTE_READ|PAGE_NOCACHE"
"17:09:14,7614141","Program1.exe","20912","CreateFileMapping","C:\Users\kseni\lab4_OS
SyncTypeOther"
"17:09:14,7614448","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Access: Read"
"17:09:14,7614655","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet
Access: Read"
"17:09:14,7614884","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl
REG_DWORD,Length: 4,Data: 2"
"17:09:14,7615075","Program1.exe","20912","RegCloseKey","HKLM\System\CurrentControlSe
"17:09:14,7615829","Program1.exe","20912","Load Image","C:\Users\kseni\lab4_OS\build\
Base: 0x7ffcebd80000,Image Size: 0xc8000"
"17:09:14,7616537","Program1.exe","20912","CloseFile","C:\Users\kseni\lab4_OS\build\l

"17:09:14,7620339","Program1.exe","20912","RegOpenKey","HKLM\SYSTEM\CurrentControlSet\
Manager","REPARSE","Desired Access: Query Value,Enumerate Sub Keys"
"17:09:14,7620544","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet\
Manager","SUCCESS","Desired Access: Query Value,Enumerate Sub Keys"
"17:09:14,7620709","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl\
Manager\ResourcePolicies","NAME NOT FOUND","Length: 24"
"17:09:14,7621033","Program1.exe","20912","RegCloseKey","HKLM\System\CurrentControlSe\
Manager","SUCCESS",""
"17:09:14,7621992","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet\
Access: Read"
"17:09:14,7622184","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet\
Access: Read"
"17:09:14,7622414","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl\
REG_SZ,Length: 18,Data: 00060403"
"17:09:14,7622597","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl\
REG_SZ,Length: 26,Data: kernel32.dll"
"17:09:14,7623860","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet\
Manager","REPARSE","Desired Access: Query Value"
"17:09:14,7624013","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet\
Manager","SUCCESS","Desired Access: Query Value"
"17:09:14,7624169","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl\
Manager\SmtDelaySleepLoopWindowSize","NAME NOT FOUND","Length: 80"
"17:09:14,7624287","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl\
Manager\SmtDelaySpinCountThreshold","NAME NOT FOUND","Length: 80"
"17:09:14,7624410","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl\
Manager\SmtDelayBaseYield","NAME NOT FOUND","Length: 80"
"17:09:14,7624570","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl\
Manager\SmtFactorYield","NAME NOT FOUND","Length: 80"
"17:09:14,7624681","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl\
Manager\SmtDelayMaxYield","NAME NOT FOUND","Length: 80"
"17:09:14,7624819","Program1.exe","20912","RegCloseKey","HKLM\System\CurrentControlSe\
Manager","SUCCESS",""
"17:09:14,7625809","Program1.exe","20912","QueryNameInformationFile","C:\Users\kseni\
\Users\kseni\lab4_OS\build\Program1.exe"
"17:09:34,8704094","Program1.exe","20912","Thread Exit","","SUCCESS","Thread
ID: 3904,User Time: 0.0000000,Kernel Time: 0.0000000"
"17:09:34,8704341","Program1.exe","20912","Thread Exit","","SUCCESS","Thread
ID: 16056,User Time: 0.0000000,Kernel Time: 0.0000000"
"17:09:34,8705034","Program1.exe","20912","Thread Exit","","SUCCESS","Thread
ID: 1684,User Time: 0.0000000,Kernel Time: 0.0000000"
"17:09:34,8707727","Program1.exe","20912","Process Exit","","SUCCESS","Exit
Status: 0,User Time: 0.0000000 seconds,Kernel Time: 0.0000000 seconds,Private
Bytes: 868 352,Peak Private Bytes: 868 352,Working Set: 3 731 456,Peak Working
Set: 3 731 456"
"17:09:34,8708042","Program1.exe","20912","RegOpenKey","HKLM\System\CurrentControlSet\
Access: All Access"
"17:09:34,8708283","Program1.exe","20912","RegQueryValue","HKLM\System\CurrentControl\
NOT FOUND","Length: 40"

"17:09:34,8708489","Program1.exe","20912","RegCloseKey","HKLM\System\CurrentControlSe
"17:09:34,8709014","Program1.exe","20912","CloseFile","C:\Users\kseni\lab4_OS\build",
"17:09:34,8710110","Program1.exe","20912","RegCloseKey","HKLM\System\CurrentControlSe
Manager","SUCCESS",""
"17:09:34,8710210","Program1.exe","20912","RegCloseKey","HKLM\System\CurrentControlSe

strace for Program2

"Time of Day","Process Name","PID","Operation","Path","Result","Detail"
"17:11:00,9458735","Program2.exe","8972","Process Start","","SUCCESS","Parent
PID: 21036,Command line: ""C:\Users\kseni\lab4_OS\build\Program2.exe"",Current
directory: C:\Users\kseni\lab4_OS\build\,Environment:
; ALLUSERSPROFILE=C:\ProgramData
; APPDATA=C:\Users\kseni\AppData\Roaming
; CC=C:/Users/kseni/gcc/bin/gcc.exe
; CHROME_CRASHPAD_PIPE_NAME=\\.\pipe\crashpad_14992_EFVMFEHBOBIBUPZX
; CommonProgramFiles=C:\Program Files\Common Files
; CommonProgramFiles(x86)=C:\Program Files (x86)\Common Files
; CommonProgramW6432=C:\Program Files\Common Files
; COMPUTERNAME=LAPTOP-ECH40E5U
; ComSpec=C:\Windows\system32\cmd.exe
; CXX=C:/Users/kseni/gcc/bin/g++.exe
; DriverData=C:\Windows\System32\Drivers\DriverData
; EFC_4152=1
; HOMEDRIVE=C:
; HOMEPATH=\Users\kseni
; JAVA_HOME=C:\Program Files\Zulu\zulu-17\
; LOCALAPPDATA=C:\Users\kseni\AppData\Local
; LOGONSERVER=\\LAPTOP-ECH40E5U
; NUMBER_OF_PROCESSORS=8
; OneDrive=C:\Users\kseni\OneDrive
; OneDriveConsumer=C:\Users\kseni\OneDrive
; ORIGINAL_XDG_CURRENT_DESKTOP=undefined
; OS=Windows_NT
; Path=%PATH%;C:\Program Files\Python312;C:\Program Files\Python312\Scripts;C:\Users\k
Files\Git\bin;C:\Users\kseni\AppData\Local\Programs\Microsoft VS Code\bin;C:\Program
Files\CMake\bin;D:\Program Files\VMware\VMware Workstation\bin\;C:\Program
Files\swipl\bin;
; PATHEXT=.COM;.EXE;.BAT;.CMD;.VBS;.VBE;.JS;.JSE;.WSF;.WSH;.MSC;.CPL
; PROCESSOR_ARCHITECTURE=AMD64
; PROCESSOR_IDENTIFIER=Intel64 Family 6 Model 140 Stepping 2,GenuineIntel
; PROCESSOR_LEVEL=6
; PROCESSOR_REVISION=8c02
; ProgramData=C:\ProgramData
; ProgramFiles=C:\Program Files
; ProgramFiles(x86)=C:\Program Files (x86)
; ProgramW6432=C:\Program Files

; PSModulePath=C:\Users\kseni\OneDrive\Документы\WindowsPowerShell\Modules;C:\Program
Files\WindowsPowerShell\Modules;C:\Windows\system32\WindowsPowerShell\v1.0\Modules
; PUBLIC=C:\Users\Public
; PyCharm Community Edition=C:\Program Files\JetBrains\PyCharm Community Edition
2023.3.3\bin;
; SESSIONNAME=Console
; SystemDrive=C:
; SystemRoot=C:\Windows
; TEMP=C:\Users\kseni\AppData\Local\Temp
; TMP=C:\Users\kseni\AppData\Local\Temp
; USERDOMAIN=LAPTOP-ECH40E5U
; USERDOMAIN_ROAMINGPROFILE=LAPTOP-ECH40E5U
; USERNAME=kseni
; USERPROFILE=C:\Users\kseni
; VSCODE_PYTHON_AUTOACTIVATE_GUARD=1
; windir=C:\Windows
; ZES_ENABLE_SYSMAN=1
; TERM_PROGRAM=vscode
; TERM_PROGRAM_VERSION=1.106.3
; LANG=en_US.UTF-8
; COLORTERM=truecolor
; GIT_ASKPASS=c:\Users\kseni\AppData\Local\Programs\Microsoft VS Code\resources\app\e:
; VSCODE_GIT_ASKPASS_NODE=C:\Users\kseni\AppData\Local\Programs\Microsoft VS
Code\Code.exe
; VSCODE_GIT_ASKPASS_EXTRA_ARGS=
; VSCODE_GIT_ASKPASS_MAIN=c:\Users\kseni\AppData\Local\Programs\Microsoft VS
Code\resources\app\extensions\git\dist\askpass-main.js
; VSCODE_GIT_IPC_HANDLE=\\.\pipe\vscode-git-c0429ea22d-sock
; VSCODE_INJECTION=1"
"17:11:00,9458927","Program2.exe","8972","Thread Create","","SUCCESS","Thread
ID: 340"
"17:11:00,9486890","Program2.exe","8972","Load Image","C:\Users\kseni\lab4_OS\build\P:
Base: 0x7ff74f4c0000,Image Size: 0xe77000"
"17:11:00,9487563","Program2.exe","8972","Load Image","C:\Windows\System32\ntdll.dll"
Base: 0x7ffcff190000,Image Size: 0x217000"
"17:11:00,9488705","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
Access: Read"
"17:11:00,9488918","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
Access: Read"
"17:11:00,9489307","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
REG_SZ,Length: 10,Data: 1251"
"17:11:00,9489640","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
REG_SZ,Length: 8,Data: 866"
"17:11:00,9489791","Program2.exe","8972","RegCloseKey","HKLM\System\CurrentControlSet
"17:11:00,9490773","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
Manager","REPARSE","Desired Access: Query Value"
"17:11:00,9491071","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
Manager","SUCCESS","Desired Access: Query Value"

"17:11:00,9491238","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlS
Manager\RaiseExceptionOnPossibleDeadlock","NAME NOT FOUND","Length: 80"
"17:11:00,9491373","Program2.exe","8972","RegCloseKey","HKLM\System\CurrentControlSet`
Manager","SUCCESS",""
"17:11:00,9491511","Program2.exe","8972","RegOpenKey","HKLM\SYSTEM\CurrentControlSet\(
Manager\Segment Heap","REPARSE","Desired Access: Query Value"
"17:11:00,9491661","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
Manager\Segment Heap","NAME NOT FOUND","Desired Access: Query Value"
"17:11:00,9492072","Program2.exe","8972","RegOpenKey","HKLM\SYSTEM\CurrentControlSet\(
Manager","REPARSE","Desired Access: Query Value,Enumerate Sub Keys"
"17:11:00,9492187","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
Manager","SUCCESS","Desired Access: Query Value,Enumerate Sub Keys"
"17:11:00,9492310","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
Manager\ResourcePolicies","NAME NOT FOUND","Length: 24"
"17:11:00,9492442","Program2.exe","8972","RegCloseKey","HKLM\System\CurrentControlSet`
Manager","SUCCESS",""
"17:11:00,9493845","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
NOT FOUND","Length: 528"
"17:11:00,9494263","Program2.exe","8972","QueryNameInformationFile","C:\Windows\System
\Windows\System32\ntdll.dll"
"17:11:00,9494768","Program2.exe","8972","RegOpenKey","HKLM\SYSTEM\CurrentControlSet\(
Manager","REPARSE","Desired Access: Query Value,Enumerate Sub Keys"
"17:11:00,9494886","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
Manager","SUCCESS","Desired Access: Query Value,Enumerate Sub Keys"
"17:11:00,9494995","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
Manager\ResourcePolicies","NAME NOT FOUND","Length: 24"
"17:11:00,9495097","Program2.exe","8972","RegCloseKey","HKLM\System\CurrentControlSet`
Manager","SUCCESS",""
"17:11:00,9497122","Program2.exe","8972","CreateFile","C:\Users\kseni\lab4_OS\build",
Access: Execute/Traverse,Synchronize,Disposition: Open,Options: Directory,Synchronous
IO Non-Alert,Attributes: n/a,ShareMode: Read,Write,AllocationSize: n/a,OpenResult:
Opened"
"17:11:00,9498644","Program2.exe","8972","Load Image","C:\Windows\System32\kernel32.dl
Base: 0x7ffcfe350000,Image Size: 0xc4000"
"17:11:00,9500466","Program2.exe","8972","Load Image","C:\Windows\System32\KernelBase
Base: 0x7ffcfc790000,Image Size: 0x3b7000"
"17:11:00,9511167","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
NOT FOUND","Length: 528"
"17:11:00,9511583","Program2.exe","8972","QueryNameInformationFile","C:\Windows\System
\Windows\System32\KernelBase.dll"
"17:11:00,9513041","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
NOT FOUND","Length: 528"
"17:11:00,9513284","Program2.exe","8972","QueryNameInformationFile","C:\Windows\System
\Windows\System32\KernelBase.dll"
"17:11:00,9514561","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
Access: Read"
"17:11:00,9514705","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
NOT FOUND","Desired Access: Read"

"17:11:00,9515215","Program2.exe","8972","QueryNameInformationFile","C:\Windows\System
\Windows\System32\KernelBase.dll"
"17:11:00,9515472","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlS
NOT FOUND","Length: 528"
"17:11:00,9515712","Program2.exe","8972","QueryNameInformationFile","C:\Windows\System
\Windows\System32\KernelBase.dll"
"17:11:00,9516058","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\
Server","REPARSE","Desired Access: Read"
"17:11:00,9516171","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\
Server","SUCCESS","Desired Access: Read"
"17:11:00,9516325","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlS
Server\TSAppCompat","NAME NOT FOUND","Length: 548"
"17:11:00,9516415","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlS
Server\TSUserEnabled","SUCCESS","Type: REG_DWORD,Length: 4,Data: 0"
"17:11:00,9516536","Program2.exe","8972","RegCloseKey","HKLM\System\CurrentControlSet
Server","SUCCESS",""
"17:11:00,9517979","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\
Access: Query Value,Set Value"
"17:11:00,9518069","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\
NOT FOUND","Desired Access: Query Value,Set Value"
"17:11:00,9518180","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\
Access: Read"
"17:11:00,9518265","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\
Access: Read"
"17:11:00,9518378","Program2.exe","8972","RegQueryKey","HKLM\System\CurrentControlSet
Full,SubKeys: 1,Values: 0"
"17:11:00,9518488","Program2.exe","8972","RegCloseKey","HKLM\System\CurrentControlSet
"17:11:00,9518573","Program2.exe","8972","RegOpenKey","HKLM\Software\Policies\Microso
Access: Query Value"
"17:11:00,9518719","Program2.exe","8972","RegQueryValue","HKLM\SOFTWARE\Policies\Micr
NOT FOUND","Length: 80"
"17:11:00,9518816","Program2.exe","8972","RegCloseKey","HKLM\SOFTWARE\Policies\Micros
"17:11:00,9518921","Program2.exe","8972","RegOpenKey","HKCU\Software\Policies\Microso
NOT FOUND","Desired Access: Query Value"
"17:11:00,9519125","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\
Access: Read"
"17:11:00,9519216","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\
Access: Read"
"17:11:00,9519313","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlS
REG_DWORD,Length: 4,Data: 1"
"17:11:00,9519435","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlS
NOT FOUND","Length: 20"
"17:11:00,9519521","Program2.exe","8972","RegCloseKey","HKLM\System\CurrentControlSet
"17:11:00,9520963","Program2.exe","8972","Load Image","C:\Windows\System32\msvcrt.dll
Base: 0x7ffcfe150000,Image Size: 0xa7000"
"17:11:00,9522227","Program2.exe","8972","Thread Create","","SUCCESS","Thread
ID: 10696"
"17:11:00,9525786","Program2.exe","8972","RegOpenKey","HKLM\SYSTEM\CurrentControlSet\

Manager","REPARSE","Desired Access: Query Value,Enumerate Sub Keys"
"17:11:00,9526000","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
Manager","SUCCESS","Desired Access: Query Value,Enumerate Sub Keys"
"17:11:00,9526163","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
Manager\ResourcePolicies","NAME NOT FOUND","Length: 24"
"17:11:00,9526295","Program2.exe","8972","RegCloseKey","HKLM\System\CurrentControlSet\
Manager","SUCCESS",""
"17:11:00,9526711","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
Access: Read"
"17:11:00,9526826","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
Access: Read"
"17:11:00,9526973","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
REG_SZ,Length: 18,Data: 00060403"
"17:11:00,9527089","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
REG_SZ,Length: 26,Data: kernel32.dll"
"17:11:00,9527645","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
Manager","REPARSE","Desired Access: Query Value"
"17:11:00,9527735","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
Manager","SUCCESS","Desired Access: Query Value"
"17:11:00,9527826","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
Manager\SmtDelaySleepLoopWindowSize","NAME NOT FOUND","Length: 80"
"17:11:00,9527899","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
Manager\SmtDelaySpinCountThreshold","NAME NOT FOUND","Length: 80"
"17:11:00,9527988","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
Manager\SmtDelayBaseYield","NAME NOT FOUND","Length: 80"
"17:11:00,9528056","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
Manager\SmtFactorYield","NAME NOT FOUND","Length: 80"
"17:11:00,9528120","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
Manager\SmtDelayMaxYield","NAME NOT FOUND","Length: 80"
"17:11:00,9528206","Program2.exe","8972","RegCloseKey","HKLM\System\CurrentControlSet\
Manager","SUCCESS",""
"17:11:00,9528877","Program2.exe","8972","QueryNameInformationFile","C:\Users\kseni\la
\Users\kseni\lab4_OS\build\Program2.exe"
"17:11:00,9530297","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
Manager","REPARSE","Desired Access: Query Value"
"17:11:00,9530420","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\(
Manager","SUCCESS","Desired Access: Query Value"
"17:11:00,9530535","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
Manager\SafeDllSearchMode","NAME NOT FOUND","Length: 16"
"17:11:00,9532480","Program2.exe","8972","CreateFile","C:\Users\kseni\lab4_OS\build\l:
Access: Read Attributes,Disposition: Open,Options: Open Reparse Point,Attributes:
n/a,ShareMode: Read,Write,Delete,AllocationSize: n/a,OpenResult: Opened"
"17:11:00,9532787","Program2.exe","8972","QueryBasicInformationFile","C:\Users\kseni\
08.12.2025 16:09:58,LastAccessTime: 08.12.2025 17:03:10,LastWriteTime: 08.12.2025
17:02:52,ChangeTime: 08.12.2025 17:02:52,FileAttributes: A"
"17:11:00,9533083","Program2.exe","8972","CloseFile","C:\Users\kseni\lab4_OS\build\lil
"17:11:00,9534164","Program2.exe","8972","CreateFile","C:\Users\kseni\lab4_OS\build\l:
Access: Read Data/List Directory,Execute/Traverse,Synchronize,Disposition:

Open,Options: Synchronous IO Non-Alert,Non-Directory File,Attributes: n/a,ShareMode:
Read,Delete,AllocationSize: n/a,OpenResult: Opened"
"17:11:00,9534632","Program2.exe","8972","CreateFileMapping","C:\Users\kseni\lab4_OS\l
LOCKED WITH ONLY READERS","SyncType: SyncTypeCreateSection,PageProtection:
PAGE_EXECUTE_READ|PAGE_NOCACHE"
"17:11:00,9535635","Program2.exe","8972","CreateFileMapping","C:\Users\kseni\lab4_OS\l
SyncTypeOther"
"17:11:00,9535949","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\C
Access: Read"
"17:11:00,9536175","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\C
Access: Read"
"17:11:00,9536380","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
REG_DWORD,Length: 4,Data: 2"
"17:11:00,9536571","Program2.exe","8972","RegCloseKey","HKLM\System\CurrentControlSet\
"17:11:00,9537398","Program2.exe","8972","Load Image","C:\Users\kseni\lab4_OS\build\l
Base: 0x7ffca2580000,Image Size: 0xc8000"
"17:11:00,9538258","Program2.exe","8972","CloseFile","C:\Users\kseni\lab4_OS\build\lil
"17:11:06,3636601","Program2.exe","8972","CreateFile","C:\Users\kseni\lab4_OS\build\l
Access: Read Attributes,Disposition: Open,Options: Open Reparse Point,Attributes:
n/a,ShareMode: Read,Write,Delete,AllocationSize: n/a,OpenResult: Opened"
"17:11:06,3636927","Program2.exe","8972","QueryBasicInformationFile","C:\Users\kseni\l
08.12.2025 16:09:58,LastAccessTime: 08.12.2025 17:03:10,LastWriteTime: 08.12.2025
17:02:52,ChangeTime: 08.12.2025 17:02:52,FileAttributes: A"
"17:11:06,3637054","Program2.exe","8972","CloseFile","C:\Users\kseni\lab4_OS\build\lil
"17:11:06,3637774","Program2.exe","8972","CreateFile","C:\Users\kseni\lab4_OS\build\l
Access: Read Data/List Directory,Execute/Traverse,Synchronize,Disposition:
Open,Options: Synchronous IO Non-Alert,Non-Directory File,Attributes: n/a,ShareMode:
Read,Delete,AllocationSize: n/a,OpenResult: Opened"
"17:11:06,3638156","Program2.exe","8972","CreateFileMapping","C:\Users\kseni\lab4_OS\l
LOCKED WITH ONLY READERS","SyncType: SyncTypeCreateSection,PageProtection:
PAGE_EXECUTE_READ|PAGE_NOCACHE"
"17:11:06,3638855","Program2.exe","8972","CreateFileMapping","C:\Users\kseni\lab4_OS\l
SyncTypeOther"
"17:11:06,3639107","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\C
Access: Read"
"17:11:06,3639306","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\C
Access: Read"
"17:11:06,3639476","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlSe
REG_DWORD,Length: 4,Data: 2"
"17:11:06,3639627","Program2.exe","8972","RegCloseKey","HKLM\System\CurrentControlSet\
"17:11:06,3641161","Program2.exe","8972","Load Image","C:\Users\kseni\lab4_OS\build\l
Base: 0x7ffca2580000,Image Size: 0xc8000"
"17:11:06,3642129","Program2.exe","8972","CloseFile","C:\Users\kseni\lab4_OS\build\lil
"17:11:10,2538977","Program2.exe","8972","CreateFile","C:\Users\kseni\lab4_OS\build\l
Access: Read Attributes,Disposition: Open,Options: Open Reparse Point,Attributes:
n/a,ShareMode: Read,Write,Delete,AllocationSize: n/a,OpenResult: Opened"
"17:11:10,2539282","Program2.exe","8972","QueryBasicInformationFile","C:\Users\kseni\l
08.12.2025 16:09:58,LastAccessTime: 08.12.2025 17:11:00,LastWriteTime: 08.12.2025

17:02:52,ChangeTime: 08.12.2025 17:02:52,FileAttributes: A"
"17:11:10,2539411","Program2.exe","8972","CloseFile","C:\Users\kseni\lab4_OS\build\li
"17:11:10,2540129","Program2.exe","8972","CreateFile","C:\Users\kseni\lab4_OS\build\l
Access: Read Data/List Directory,Execute/Traverse,Synchronize,Disposition:
Open,Options: Synchronous IO Non-Alert,Non-Directory File,Attributes: n/a,ShareMode:
Read,Delete,AllocationSize: n/a,OpenResult: Opened"
"17:11:10,2540502","Program2.exe","8972","CreateFileMapping","C:\Users\kseni\lab4_OS\
LOCKED WITH ONLY READERS","SyncType: SyncTypeCreateSection,PageProtection:
PAGE_EXECUTE_READ|PAGE_NOCACHE"
"17:11:10,2541108","Program2.exe","8972","CreateFileMapping","C:\Users\kseni\lab4_OS\
SyncTypeOther"
"17:11:10,2541374","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\
Access: Read"
"17:11:10,2541573","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\
Access: Read"
"17:11:10,2541740","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlS
REG_DWORD,Length: 4,Data: 2"
"17:11:10,2541890","Program2.exe","8972","RegCloseKey","HKLM\System\CurrentControlSet
"17:11:10,2542536","Program2.exe","8972","Load Image","C:\Users\kseni\lab4_OS\build\l
Base: 0x7ffca2580000,Image Size: 0xc8000"
"17:11:10,2544272","Program2.exe","8972","CloseFile","C:\Users\kseni\lab4_OS\build\li
"17:11:24,0989416","Program2.exe","8972","Thread Exit","","SUCCESS","Thread
ID: 10696,User Time: 0.0000000,Kernel Time: 0.0000000"
"17:11:24,0989960","Program2.exe","8972","Thread Exit","","SUCCESS","Thread
ID: 340,User Time: 0.0000000,Kernel Time: 0.0000000"
"17:11:24,0992375","Program2.exe","8972","Process Exit","","SUCCESS","Exit
Status: 0,User Time: 0.0000000 seconds,Kernel Time: 0.0000000 seconds,Private
Bytes: 987 136,Peak Private Bytes: 1 019 904,Working Set: 3 719 168,Peak Working
Set: 3 723 264"
"17:11:24,0992650","Program2.exe","8972","RegOpenKey","HKLM\System\CurrentControlSet\
Access: All Access"
"17:11:24,0992924","Program2.exe","8972","RegQueryValue","HKLM\System\CurrentControlS
NOT FOUND","Length: 40"
"17:11:24,0993111","Program2.exe","8972","RegCloseKey","HKLM\System\CurrentControlSet
"17:11:24,0993642","Program2.exe","8972","CloseFile","C:\Users\kseni\lab4_OS\build","
"17:11:24,0994506","Program2.exe","8972","RegCloseKey","HKLM\System\CurrentControlSet
"17:11:24,0994604","Program2.exe","8972","RegCloseKey","HKLM\System\CurrentControlSet
Manager","SUCCESS",""