МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ

Національний аерокосмічний університет ім. М. Є. Жуковського
«Харківський авіаційний інститут»

Факультет радіоелектроніки, комп'ютерних систем та інфокомунікацій

Кафедра комп'ютерних систем, мереж і кібербезпеки

Лабораторна робота

з Системного програмування
(назва дисципліни)

на тему: «Вивчення системних викликів Win32 API роботи з реєстром»

Виконав: студент 3-го курсу групи №525ст2
напряму підготовки (спеціальності)
123-«Комп'ютерна інженерія»
(шифр і назва напряму підготовки (спеціальності))
Золотопуп А.С.
(прізвище й ініціали студента)

Прийняв: асистент каф.503
Мозговий М.В.
(посада, науковий ступінь, прізвище й ініціали)

Національна шкала: _____
Кількість балів: _____
Оцінка: ECTS _____

Харків – 2020

Цель работы:
Изучение системных вызовов Win32 API работы с реестром.

Постановка задачи:
Требуется разроботать программу работы с реестром, которая бы реализовывала такие функции:

- По имени ключа выводит перечень подключей
- По имени уключа выводит перечень параметров ключа с их значением и типами
- Выполняет поиск по реестру заданной строки в названиях ключей, названиях параметров и их значениях. Ключ относительно которого выполнять поиск задается пользователем.
- Выполняет выгрузку заданного пользователем ключа в виде файла.

Код программы:

```
#define _CRT_SECURE_NO_WARNINGS
#include "Main.h"


int main()
{
	char choice = 0;


	for (;;)
	{
		PrintMenu();
		enum cases { print_list_subkeys, print_list_keys, searches_registry, save_key, exit };
		cin >> choice;
		switch (choice)
		{
		case 'print_list_subkeys':
		{
```

```
        HKEY hKey = { 0 };
        PHKEY phKey = &hKey;
        if (OpenKey(&phKey, KEY_READ, NULL) == true)
        {
            PrintListSubkeysByKey(hKey);
        }
}break;
case 'print_list_keys':
{
        HKEY hKey = { 0 };
        PHKEY phKey = &hKey;
        if (OpenKey(&phKey, KEY_QUERY_VALUE, NULL) == true)
        {
            PrintListParamsByKey(hKey);
        }
} break;
case 'searches_registry':
{
        HKEY hKey = { 0 };
        PHKEY phKey = &hKey;
        CHAR fullPath[MAX_PATH];
        if (OpenKey(&phKey, KEY_ALL_ACCESS, fullPath) == true)
        {
            CHAR reqString[MAX_PATH] = { '\0' };
            cout << "Input string for searching:";
            ReadStringWithWhitespaces(reqString, MAX_PATH, false);
            FindStringInReg(hKey, reqString, fullPath);
        }
```

```
		} break;
		case 'save_key':
		{
			HANDLE hToken;


			if (!OpenProcessToken(GetCurrentProcess(),
TOKEN_ADJUST_PRIVILEGES | TOKEN_QUERY, &hToken))
			{
				cout << "Cant get access rights (SE_BACKUP_NAME)\n
Error code:" << GetLastError() << endl;
			}
			if (SetPrivilege(hToken, SE_BACKUP_NAME, true))
			{
				HKEY hKey = { 0 };
				PHKEY phKey = &hKey;
				if (OpenKey(&phKey, KEY_ALL_ACCESS, NULL) == true)
				{
					SaveKeyIntoFile(hKey);
				}
			}
		} break;
		case 'exit':
		{
			return 0;
		} break;
		default:
			cout << "Error choice, try again\n";
			break;
		}
```

```
	}

	return 0;
}

bool FindStringInReg(HKEY hKey, LPCSTR reqStr, LPSTR fullPath)
{
	KEY_INFO keyInfo = { 0 };
	DWORD retCode = ERROR_SUCCESS;
	LPSTR newSubkeyPath;
	if (!GetKeyInfo(hKey, &keyInfo))
	{
		return false;
	}
	if (keyInfo.cSubKeys)
	{
		for (int i = 0; i < keyInfo.cSubKeys; i++)
		{
			keyInfo.cbName = MAX_KEY_LENGTH;
			retCode = RegEnumKeyEx(hKey,
				i,
				keyInfo.achKey,
				&keyInfo.cbName,
				NULL,
				NULL,
				NULL,
				NULL);
			if (retCode == ERROR_SUCCESS)
```

```
                {
                        if (_strcmpi(keyInfo.achKey, reqStr) == 0)
                        {
                                cout << " * Found in subkey name: " << fullPath << "\\"
<< keyInfo.achKey << endl;
                        }
                        newSubkeyPath = (LPSTR)malloc(MAX_VALUE_NAME *
sizeof(TCHAR));
                        strcpy(newSubkeyPath, fullPath);
                        strcat(newSubkeyPath, "\\");
                        strcat(newSubkeyPath, keyInfo.achKey);
                        HKEY newKey = { 0 };
                        if (RegOpenKeyEx(hKey, keyInfo.achKey, 0,
KEY_ALL_ACCESS, &newKey) == ERROR_SUCCESS)
                        {
                                FindStringInReg(newKey, reqStr, newSubkeyPath);
                        }
                        free(newSubkeyPath);
                }
        }
    }
    if (keyInfo.cValues)
    {
        LPSTR lpValue = NULL;
        DWORD dwValue = keyInfo.cchMaxValue + 1;

        DWORD dwType = 0;

        LPBYTE lpData = NULL;
```

```
		DWORD dwData = 0;

		lpValue = (LPSTR)malloc((keyInfo.cchMaxValue + 1) * sizeof(BYTE));

		for (int i = 0; i < keyInfo.cValues; i++)
		{
			retCode = RegEnumValueA(hKey, i, lpValue, &dwValue, NULL, NULL, NULL, &dwData);
			lpData = (LPBYTE)malloc((dwData + 1) * sizeof(BYTE));

			dwValue = keyInfo.cchMaxValue + 1;

			retCode = RegEnumValueA(hKey,
				i,
				lpValue,
				&dwValue,
				NULL,
				&dwType,
				lpData,
				&dwData);

			if (retCode == ERROR_SUCCESS)
			{
				if (_strcmpi(lpValue, reqStr) == 0)
				{
					cout << " * Found in value name: " << fullPath << "; " << lpValue << endl;
				}
```

```
                        if (((dwType & REG_EXPAND_SZ) == REG_EXPAND_SZ)
|| ((dwType & REG_SZ) == REG_SZ))
                        {
                                if (_strcmpi((LPSTR)lpData, reqStr) == 0)
                                {
                                        cout << " * Found in data of value " << fullPath
<< "; " << lpValue << ";\n   data:" << lpData << endl;
                                }
                        }
                }
        }
        RegCloseKey(hKey);
}

BOOL SetPrivilege(
        HANDLE hToken,          // access token handle
        LPCTSTR lpszPrivilege,  // name of privilege to enable/disable
        BOOL bEnablePrivilege   // to enable or disable privilege
)
{
        TOKEN_PRIVILEGES tp;
        LUID luid;

        if (!LookupPrivilegeValue(
                NULL,           // lookup privilege on local system
                lpszPrivilege,   // privilege to lookup
                &luid))        // receives LUID of privilege
        {
```

```
        printf("LookupPrivilegeValue error: %u\n", GetLastError());
        return FALSE;
}

tp.PrivilegeCount = 1;
tp.Privileges[0].Luid = luid;
if (bEnablePrivilege)
        tp.Privileges[0].Attributes = SE_PRIVILEGE_ENABLED;
else
        tp.Privileges[0].Attributes = 0;


if (!AdjustTokenPrivileges(
        hToken,
        FALSE,
        &tp,
        sizeof(TOKEN_PRIVILEGES),
        (PTOKEN_PRIVILEGES)NULL,
        (PDWORD)NULL))
{
        printf("AdjustTokenPrivileges error: %u\n", GetLastError());
        return FALSE;
}

if (GetLastError() == ERROR_NOT_ALL_ASSIGNED)
{
        printf("You account doesnt have SE_BACKUP_NAME privilege \n");
        return FALSE;
```

```
	}
	return TRUE;
}

bool SaveKeyIntoFile(HKEY hKey)
{
	CHAR filePath[MAX_PATH];
	DWORD retCode = ERROR_SUCCESS;
	cout << "Input path to new file:\n";
	ReadStringWithWhitespaces(filePath, MAX_PATH, false);

	retCode = RegSaveKey(hKey, filePath, NULL);
	switch (retCode)
	{
	case ERROR_SUCCESS:
	{
		cout << "Key saved in the file:\n" << filePath << endl;
		RegCloseKey(hKey);
		return true;
	} break;
	case ERROR_ALREADY_EXISTS:
	{
		cout << "Error! File already exists!\n Entered file path:\n" << filePath <<
endl;
	} break;
	default:
		cout << "Error! Cant save key into the file\n Error code:" << retCode <<
endl;
	}
```

```
        RegCloseKey(hKey);
        return false;
}

void PrintListParamsByKey(HKEY key)
{
        DWORD i, retCode = ERROR_SUCCESS;
        KEY_INFO keyInfo = { 0 };

        DWORD dwType = 0;

        LPBYTE lpData = NULL;
        DWORD dwData = 0;

        LPSTR lpValue = NULL;
        DWORD dwValue = 0;

        GetKeyInfo(key, &keyInfo);

        if (keyInfo.cValues)
        {
                cout << "\t Values count:" << keyInfo.cValues << endl;
                lpValue = (LPSTR)malloc((keyInfo.cchMaxValue + 1) * sizeof(BYTE));
                dwValue = keyInfo.cchMaxValue + 1;

                for (int i = 0; i < keyInfo.cValues; i++)
                {
```

```
                retCode = RegEnumValueA(key, i, lpValue, &dwValue, NULL,
NULL, NULL, &dwData);
                lpData = (LPBYTE)malloc((dwData + 1) * sizeof(BYTE));

                dwValue = keyInfo.cchMaxValue + 1;

                retCode = RegEnumValueA(key,
                        i,
                        lpValue,
                        &dwValue,
                        NULL,
                        &dwType,
                        lpData,
                        &dwData);

                if (retCode == ERROR_SUCCESS)
                {
                        if (strcmp(lpValue, "") == 0)
                        {
                                printf("\n(%d) Value name: %s\n", i + 1, "Default
value");
                        }
                        else
                        {
                                printf("\n(%d) Value name: %s\n", i + 1, lpValue);
                        }

                        switch (dwType)
                        {
```

```
                        case REG_BINARY:
                        {
                                printf("    Value type: REG_BINARY\n    Value data:
binary\n");
                        } break;
                        case REG_DWORD:
                        {
                                DWORD data = *(DWORD*)(lpData);
                                printf("    Value type: REG_DWORD\n    Value data:
%#x|%u\n", data, data);
                        } break;
                        case REG_EXPAND_SZ:
                        {
                                printf("    Value type: REG_EXPAND_SZ\n    Value
data: %s\n", lpData);
                        } break;
                        case REG_LINK:
                        {
                                wprintf(L"    Value type: REG_LINK\n    Value data:
%ws\n", lpData);
                        } break;
                        case REG_SZ:
                        {
                                printf("    Value type: REG_SZ\n    Value data: %s\n",
lpData);
                        } break;
                        case REG_NONE:
                        {
                                printf("    Value type: REG_NONE\n    Value data:
%x\n", *(DWORD*)(lpData));
```

```
                        } break;
                        default:
                                printf("    Value type: unknown\n    Value data: %x\n",
*(DWORD*)(lpData));
                                break;
                        }
                }
                free(lpData);
        }
        free(lpValue);
    }
    RegCloseKey(key);
}

void PrintListSubkeysByKey(HKEY key)
{
    DWORD i, retCode;
    KEY_INFO keyInfo = { 0 };

    GetKeyInfo(key, &keyInfo);

    if (keyInfo.cSubKeys)
    {
        cout << "\t Subkeys count:" << keyInfo.cSubKeys << endl;
        for (int i = 0; i < keyInfo.cSubKeys; i++)
        {
            keyInfo.cbName = MAX_KEY_LENGTH;
            retCode = RegEnumKeyEx(key,
```

```
                        i,
                        keyInfo.achKey,
                        &keyInfo.cbName,
                        NULL,
                        NULL,
                        NULL,
                        NULL);
                    if (retCode == ERROR_SUCCESS)
                    {
                        printf("(%d) %s\n", i + 1, keyInfo.achKey);
                    }
                }
            }
            RegCloseKey(key);
}

void ReadStringWithWhitespaces(CHAR sBuffNewPath[], DWORD maxBuffSize,
BOOL isUsedBeforeInputChar)
{
            memset(sBuffNewPath, '\0', sizeof(sBuffNewPath));
            if (isUsedBeforeInputChar)
                        fgets(sBuffNewPath, maxBuffSize, stdin);
            if ((strlen(sBuffNewPath) > 0) && (sBuffNewPath[strlen(sBuffNewPath) - 1] ==
'\n'))
                        sBuffNewPath[strlen(sBuffNewPath) - 1] = '\0';
}

bool GetKeyInfo(HKEY key, KEY_INFO * keyInfo)
{
```

```
	DWORD retCode = RegQueryInfoKey(key,
		(*keyInfo).achClass,
		&(*keyInfo).cchClassName,
		NULL,
		&(*keyInfo).cSubKeys,
		&(*keyInfo).cbMaxSubKey,
		&(*keyInfo).cchMaxClass,
		&(*keyInfo).cValues,
		&(*keyInfo).cchMaxValue,
		&(*keyInfo).cbMaxValueData,
		&(*keyInfo).cbSecurityDescriptor,
		&(*keyInfo).ftLastWriteTime);
	if (retCode == ERROR_SUCCESS) return true;
	else return false;
}

bool OpenKey(HKEY** hKey, DWORD dwOpenAccess, LPSTR fullPath)
{
	HKEY predKey;
	if (fullPath != NULL)  memset(fullPath, '\0', sizeof(fullPath));
	int choice = 0;
	cout << "Predefined keys:\n";
	cout << "1 - HKEY_CLASSES_ROOT\n";
	cout << "2 - HKEY_CURRENT_USER\n";
	cout << "3 - HKEY_LOCAL_MACHINE\n";
	cout << "4 - HKEY_USERS\n";
	cout << "5 - HKEY_CURRENT_CONFIG\n";
	cout << "6 - HKEY_PERFORMANCE_DATA\n";
```

```
cout << "Choose predefined key:";
scanf("%d", &choice);
switch (choice)
{
case 1:
{
	predKey = HKEY_CLASSES_ROOT;
	if (fullPath != NULL) strcpy(fullPath, "HKEY_CLASSES_ROOT\\");
} break;
case 2:
{
	predKey = HKEY_CURRENT_USER;
	if (fullPath != NULL) strcpy(fullPath, "HKEY_CURRENT_USER\\");
} break;
case 3:
{
	predKey = HKEY_LOCAL_MACHINE;
	if (fullPath != NULL) strcpy(fullPath, "HKEY_LOCAL_MACHINE\\");
} break;
case 4:
{
	predKey = HKEY_USERS;
	if (fullPath != NULL) strcpy(fullPath, "HKEY_USERS\\");
} break;
case 5:
{
	predKey = HKEY_CURRENT_CONFIG;
	if (fullPath != NULL) strcpy(fullPath, "HKEY_CURRENT_CONFIG\\");
```

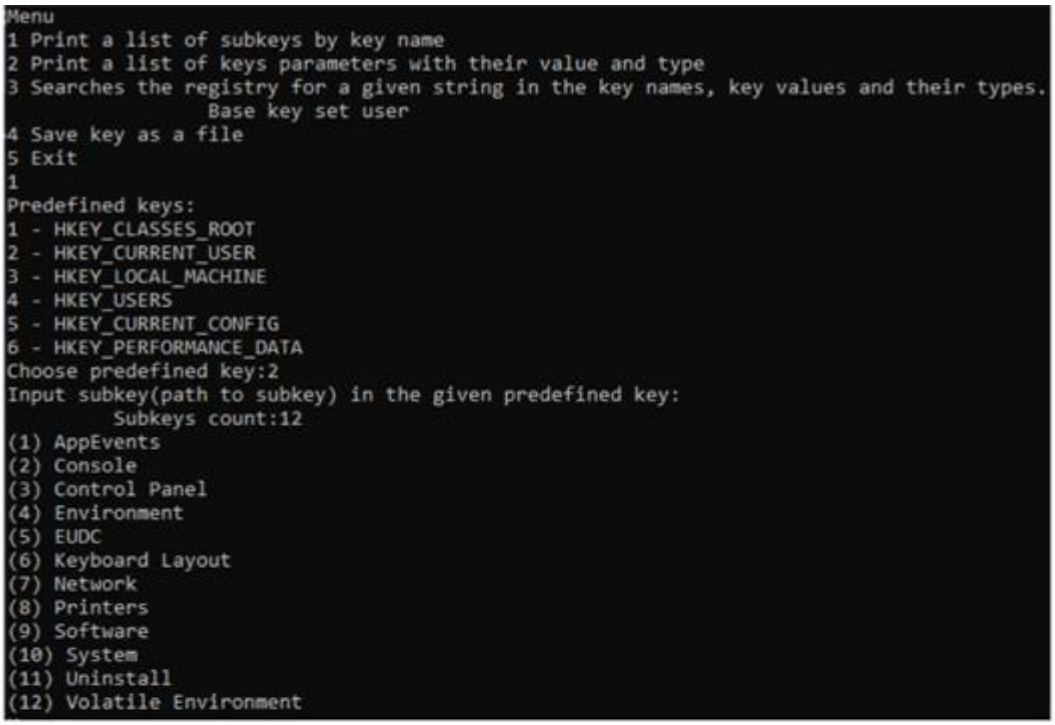
```
        } break;
        case 6:
        {
                predKey = HKEY_PERFORMANCE_DATA;
                if (fullPath != NULL) strcpy(fullPath,
"HKEY_PERFORMANCE_DATA\\");
        } break;
        default:
                return false;
        }

        CHAR keyArr[MAX_KEY_LENGTH] = { '\0' };
        LPSTR key = keyArr;
        cout << "Input subkey(path to subkey) in the given predefined key:\n";
        ReadStringWithWhitespaces(key, MAX_KEY_LENGTH, true);
        if (RegOpenKeyEx(predKey, (LPCSTR)key, 0, dwOpenAccess, *hKey) ==
ERROR_SUCCESS)
        {
                if (fullPath != NULL) strcat(fullPath, key);
                return true;
        }
        return false;
}

void PrintMenu()
{
        cout << "Menu\n";
        cout << "1 Print a list of subkeys by key name\n";
        cout << "2 Print a list of keys parameters with their value and type\n";
```

```
	cout << "3 Searches the registry for a given string in the key names, key values and their types.\n\t\t Base key set user\n";
	cout << "4 Save key as a file\n";
	cout << "5 Exit\n";
}
#include <stdio.h>
#include "windows.h"
#include "iostream"
#include "tchar.h"
#include "processthreadsapi.h"



#define MAX_KEY_LENGTH 255
#define MAX_VALUE_NAME 16383

using namespace std;

// struct for key information (mostly use in RegQueryInfoKey)
typedef struct {
	TCHAR    achKey[MAX_KEY_LENGTH];   // buffer for subkey name
	DWORD    cbName;                   // size of name string
	TCHAR    achClass[MAX_PATH] = TEXT("");  // buffer for class name
	DWORD    cchClassName = MAX_PATH;  // size of class string
	DWORD    cSubKeys = 0;               // number of subkeys
	DWORD    cbMaxSubKey;              // longest subkey size
	DWORD    cchMaxClass;              // longest class string
	DWORD    cValues;              // number of values for key
	DWORD    cchMaxValue;          // longest value name
```

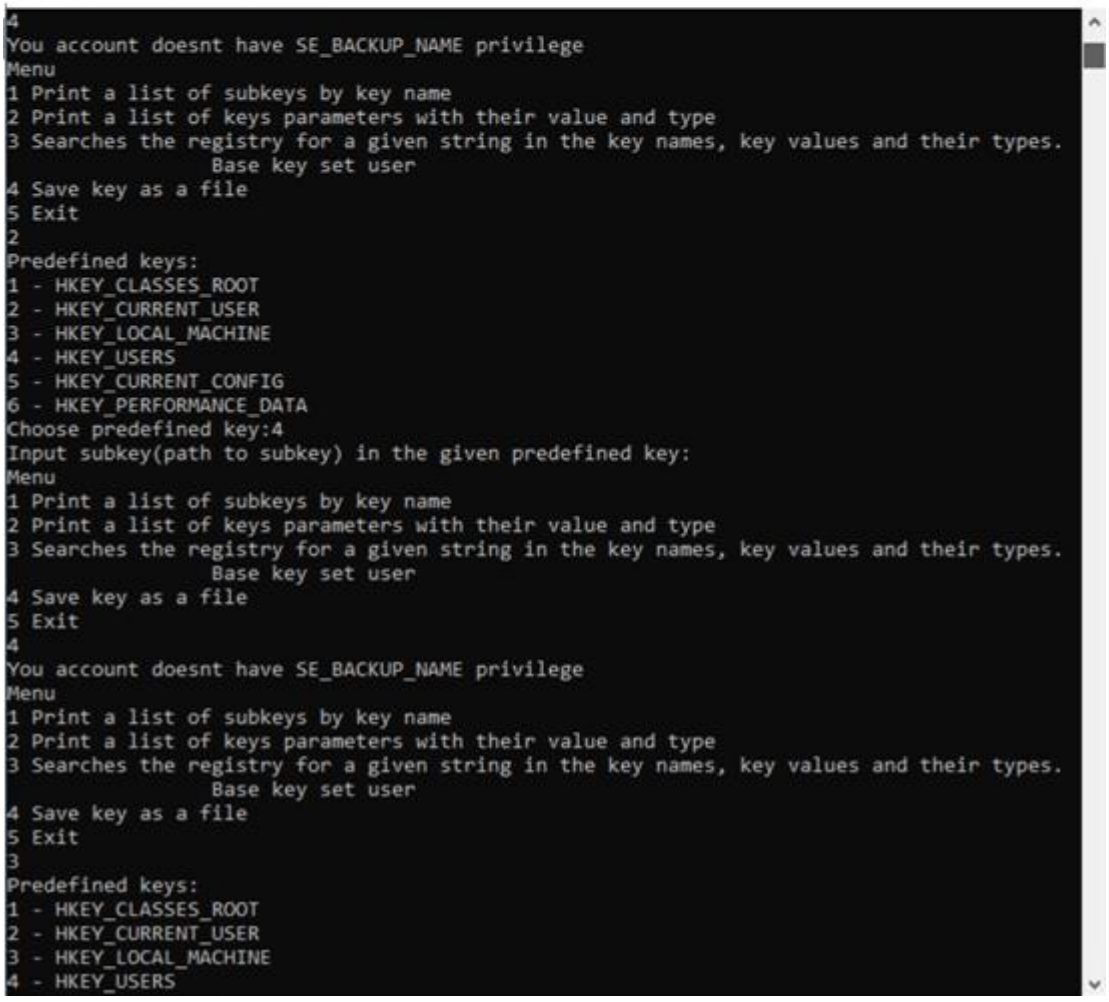
```
        DWORD    cbMaxValueData;       // longest value data
        DWORD    cbSecurityDescriptor; // size of security descriptor
        FILETIME ftLastWriteTime;      // last write time
} KEY_INFO, *pKEY_INFO;

// common functions
// print menu to console
void PrintMenu();

// open key in registry, fullPath can be NULL
bool OpenKey(HKEY** hKey, DWORD dwOpenAccess, LPSTR fullPath);

// Read string form sdtin
void ReadStringWithWhitespaces(CHAR sBuffNewPath[], DWORD maxBuffSize,
BOOL isUsedBeforeInputChar);

// Get key information (KEY_INFO struct)
bool GetKeyInfo(HKEY key, KEY_INFO* keyInfo);

//-------------------------------------------//
// function for print list subkeys by key name
void PrintListSubkeysByKey(HKEY key);

//-------------------------------------------//
// function for print all key parameters and their types
void PrintListParamsByKey(HKEY key);

//-------------------------------------------//
```

```
// function for search string in reg (recursive function), output in
// stdout all hits
bool FindStringInReg(HKEY hKey, LPCSTR reqStr, LPSTR fullPath);

//-----------------------------------------//
// function for save key in file
// save key into the file
bool SaveKeyIntoFile(HKEY hKey);
// set requierd privilege (SE_BACKUP_NAME) for current process
BOOL SetPrivilege(
        HANDLE hToken,          // access token handle
        LPCTSTR lpszPrivilege,  // name of privilege to enable/disable
        BOOL bEnablePrivilege   // to enable or disable privilege
);
```

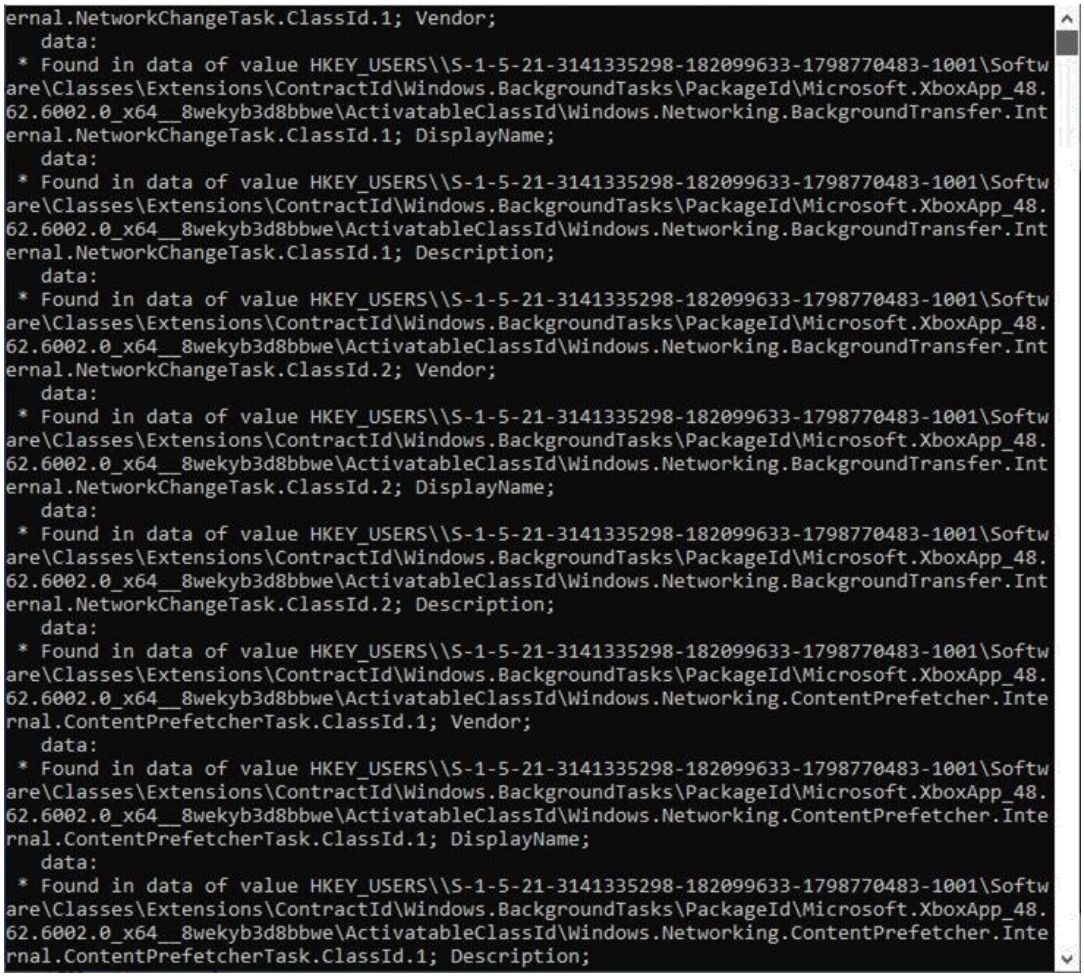
Результат работы:



```
Menu
1 Print a list of subkeys by key name
2 Print a list of keys parameters with their value and type
3 Searches the registry for a given string in the key names, key values and their types.
                Base key set user
4 Save key as a file
5 Exit
1
Predefined keys:
1 - HKEY_CLASSES_ROOT
2 - HKEY_CURRENT_USER
3 - HKEY_LOCAL_MACHINE
4 - HKEY_USERS
5 - HKEY_CURRENT_CONFIG
6 - HKEY_PERFORMANCE_DATA
Choose predefined key:2
Input subkey(path to subkey) in the given predefined key:
        Subkeys count:12
(1) AppEvents
(2) Console
(3) Control Panel
(4) Environment
(5) EUDC
(6) Keyboard Layout
(7) Network
(8) Printers
(9) Software
(10) System
(11) Uninstall
(12) Volatile Environment
```



```
4
You account doesnt have SE_BACKUP_NAME privilege
Menu
1 Print a list of subkeys by key name
2 Print a list of keys parameters with their value and type
3 Searches the registry for a given string in the key names, key values and their types.
                Base key set user
4 Save key as a file
5 Exit
2
Predefined keys:
1 - HKEY_CLASSES_ROOT
2 - HKEY_CURRENT_USER
3 - HKEY_LOCAL_MACHINE
4 - HKEY_USERS
5 - HKEY_CURRENT_CONFIG
6 - HKEY_PERFORMANCE_DATA
Choose predefined key:4
Input subkey(path to subkey) in the given predefined key:
Menu
1 Print a list of subkeys by key name
2 Print a list of keys parameters with their value and type
3 Searches the registry for a given string in the key names, key values and their types.
                Base key set user
4 Save key as a file
5 Exit
4
You account doesnt have SE_BACKUP_NAME privilege
Menu
1 Print a list of subkeys by key name
2 Print a list of keys parameters with their value and type
3 Searches the registry for a given string in the key names, key values and their types.
                Base key set user
4 Save key as a file
5 Exit
3
Predefined keys:
1 - HKEY_CLASSES_ROOT
2 - HKEY_CURRENT_USER
3 - HKEY_LOCAL_MACHINE
4 - HKEY_USERS
```



Выводы:

В результате выполнения данной лабораторной работы были изучены системных вызовов Win32 API работы с реестром.