Комп'ютерний практикум №2
Робота з файлами для WIN32

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Мета: вивчити основи роботи з двійковими і текстовими файлами на базі WIN32 API.

Завдання 10:

1. Створити системи каталогів типу FILE11/FILE12/FILE13/ та FILE21/FILE22/FILE23/;
2. Обійти другу систему директорій починаючи з кореневого каталогу та повернутись;
3. Створити файл у каталозі FILE23;
4. Read-Only. Час останньої зміни;
5. Скопіювати з якогось існуючого каталогу групу файлів (як бінарних так і текстових) у вказаній директорії;
6. Знайти файли у вказаній директорії за двома першими символами імені файлу;
7. Відкрити один з текстових файлів і зчитати зміст. Дописати до нього назву лабораторної роботи та номер завдання;
8. В заданому не пустому текстовому файлі підрахувати кількість слів, що мають довжину менше чотирьох букв. Читання файлу йде паралельно (асинхронно) з підрахунком в одному потоці;
9. Встановити розділюване блокування останнього 1 КБ файлу.

Код:

```
#include <tchar.h>
#include <windows.h>
#include <stdio.h>
#include <strsafe.h>

#define BUFFERSIZE 100
#define TESTSTRLEN 1000
DWORD g_BytesTransferred = 0;

VOID CALLBACK FileIOCompletionRoutine(
    __in  DWORD dwErrorCode,
    __in  DWORD dwNumberOfBytesTransfered,
    __in  LPOVERLAPPED lpOverlapped
);
```

```
VOID CALLBACK FileIOCompletionRoutine(
    __in  DWORD dwErrorCode,
    __in  DWORD dwNumberOfBytesTransfered,
    __in  LPOVERLAPPED lpOverlapped)
{
    // _tprintf(TEXT("Error code:\t%x\n"), dwErrorCode);
    // _tprintf(TEXT("Number of bytes:\t%x\n"),
dwNumberOfBytesTransfered);
    g_BytesTransferred = dwNumberOfBytesTransfered;
}

int searchFolders(LPCWSTR FolderName)
{
    WIN32_FIND_DATA FileData;
    HANDLE          hSearch;
    DWORD           dwAttrs;
    TCHAR           szDir[MAX_PATH];
    TCHAR           szNewDir[MAX_PATH];
    unsigned long long int numFolder = 0;

    _tprintf(TEXT("Search for files in %s\n"), FolderName);

    StringCchCopy(szDir, MAX_PATH, FolderName);
    StringCchCat(szDir, MAX_PATH, TEXT("\\*"));

    hSearch = FindFirstFile(szDir, &FileData);
    if (hSearch == INVALID_HANDLE_VALUE)
    {
        _tprintf(TEXT("No files found in %s\n"), FolderName);
        return 0;
    }

    while (TRUE)
    {
        StringCchCopy(szNewDir, MAX_PATH, FolderName);
        StringCchCat(szNewDir, MAX_PATH, TEXT("\\"));
        StringCchCat(szNewDir, MAX_PATH, FileData.cFileName);

        dwAttrs = GetFileAttributes(szNewDir);
        if (dwAttrs == INVALID_FILE_ATTRIBUTES) return 1;

        if (dwAttrs & FILE_ATTRIBUTE_DIRECTORY)
        {
            numFolder++;
            if (numFolder > 2)
```

```
                searchFolders(szNewDir);
        }

        if (!FindNextFile(hSearch, &FileData))
        {
            if (GetLastError() == ERROR_NO_MORE_FILES)
            {
                _tprintf(TEXT("All files checked in %s\n"), FolderName);
                break;
            }
            else
            {
                printf("Could not find next file.\n");
                return 1;
            }
        }
    }

    FindClose(hSearch);
    return 0;
}

int _tmain(int argc, TCHAR* argv[])
{
    WIN32_FIND_DATA FileData;
    HANDLE          hFile;
    HANDLE          hSearch;
    DWORD           dwAttrs;
    TCHAR           szNewPath[MAX_PATH];
    TCHAR           sFileName[MAX_PATH];
    FILETIME        ft;
    SYSTEMTIME      st;
    TCHAR           szSearchDir[MAX_PATH];
    TCHAR           szSearchMask[MAX_PATH];
    BOOL            fFinished;
    TCHAR           sTargetFileDirectory[MAX_PATH];

    char            DataBuffer1[] = "Lorem ipsum.\n";
    char            DataBuffer2[] = "ROBOTA Z FAYLAMY dlia WIN32.
Variant 10\n";
    DWORD           dwBytesToWrite;
    DWORD           dwBytesWritten;
    BOOL            bErrorFlag;

    DWORD           dwBytesRead1 = 0;
    char            ReadBuffer1[BUFFERSIZE] = {0};
```

```
    OVERLAPPED      ol1 = {0};
    DWORD           dwBytesRead2 = 0;
    char            ReadBuffer2[BUFFERSIZE] = {0};
    OVERLAPPED      ol2 = {0};

    BOOL fLockSuccess = FALSE;
    StringCchCopy(sTargetFileDirectory, MAX_PATH,
TEXT("FILE21\\FILE22\\FILE23"));

    if (argc != 3)
    {
        _tprintf(TEXT("Usage: %s <search dir> <search mask>\n"),
argv[0]);
        return 1;
    }

    // Create new directories.

    if (!CreateDirectory(TEXT("FILE11"), NULL))
    {
        printf("CreateDirectory failed (%d)\n", GetLastError());
        return 1;
    }
    if (!CreateDirectory(TEXT("FILE11\\FILE12"), NULL))
    {
        printf("CreateDirectory failed (%d)\n", GetLastError());
        return 1;
    }
    if (!CreateDirectory(TEXT("FILE11\\FILE12\\FILE13"), NULL))
    {
        printf("CreateDirectory failed (%d)\n", GetLastError());
        return 1;
    }

    if (!CreateDirectory(TEXT("FILE21"), NULL))
    {
        printf("CreateDirectory failed (%d)\n", GetLastError());
        return 1;
    }
    if (!CreateDirectory(TEXT("FILE21\\FILE22"), NULL))
    {
        printf("CreateDirectory failed (%d)\n", GetLastError());
        return 1;
    }
    if (!CreateDirectory(TEXT("FILE21\\FILE22\\FILE23"), NULL))
    {
```

```
        printf("CreateDirectory failed (%d)\n", GetLastError());
        return 1;
    }
    printf("Directories created\n\n");

    // Enumerate FILE21

    searchFolders(TEXT("FILE21"));

    // Create file in FILE23

    StringCchCopy(sFileName, MAX_PATH, sTargetFileDirectory);
    StringCchCat(sFileName, MAX_PATH, TEXT("\\TempFile.txt"));

    hFile = CreateFile(sFileName,
        GENERIC_WRITE,
        0,
        NULL,
        CREATE_NEW,
        FILE_ATTRIBUTE_NORMAL,
        NULL);

    if (hFile == INVALID_HANDLE_VALUE)
    {
        _tprintf(TEXT("Unable to create file \"%s\" for write.\n"),
sFileName);
        return 1;
    }

    _tprintf(TEXT("\nFile \"%s\" succesfully created.\n"), sFileName);

    // Write temp text to temp file

    dwBytesToWrite = (DWORD)strlen(DataBuffer1);
    dwBytesWritten = 0;
    bErrorFlag = FALSE;

    bErrorFlag = WriteFile(
        hFile,
        DataBuffer1,
        dwBytesToWrite,
        &dwBytesWritten,
        NULL);

    if (FALSE == bErrorFlag)
        printf("Unable to write to file.\n");
```

```
    else
    {
        if (dwBytesWritten != dwBytesToWrite)
            printf("Error: dwBytesWritten != dwBytesToWrite\n");
        else
            _tprintf(TEXT("Wrote %d bytes to %s successfully.\n"),
dwBytesWritten, sFileName);
    }

    // Set attributes

    GetSystemTime(&st);
    SystemTimeToFileTime(&st, &ft);
    SetFileTime(hFile,
        (LPFILETIME) NULL,
        (LPFILETIME) NULL,
        &ft);

    dwAttrs = GetFileAttributes(sFileName);
    if (!(dwAttrs & FILE_ATTRIBUTE_READONLY))
    {
        SetFileAttributes(sFileName,
            dwAttrs | FILE_ATTRIBUTE_READONLY);
        SetFileAttributes(sFileName,
            dwAttrs | FILE_ATTRIBUTE_NORMAL);
    }

    _tprintf(TEXT("\nRead-Only and LastWriteFileTime attrs for file
\"%s\" changed.\n"), sFileName);

    CloseHandle(hFile);

    // Copy "*.txt" and "*.exe" files to FILE23 folder

    StringCchCopy(szSearchDir, MAX_PATH, argv[1]);
    StringCchCat(szSearchDir, MAX_PATH, TEXT("\\*.txt"));

    hSearch = FindFirstFile(szSearchDir, &FileData);
    if (hSearch == INVALID_HANDLE_VALUE)
    {
        printf("No *.txt files found.\n");
        return 1;
    }

    fFinished = FALSE;
    while (!fFinished)
```

```
    {
        StringCchPrintf(szNewPath, sizeof(szNewPath) /
sizeof(szNewPath[0]), TEXT("%s\\%s"), sTargetFileDirectory,
FileData.cFileName);

        if (!CopyFile(FileData.cFileName, szNewPath, FALSE))
        {
            _tprintf(TEXT("Could not copy file %s to %s\n"),
FileData.cFileName, szNewPath);
            return 1;
        }

        if (!FindNextFile(hSearch, &FileData))
        {
            if (GetLastError() == ERROR_NO_MORE_FILES)
            {
                _tprintf(TEXT("\nCopied %s to %s\n"), szSearchDir,
sTargetFileDirectory);
                fFinished = TRUE;
            }
            else
            {
                printf("Could not find next file.\n");
                return 1;
            }
        }
    }

    FindClose(hSearch);

    StringCchCopy(szSearchDir, MAX_PATH, argv[1]);
    StringCchCat(szSearchDir, MAX_PATH, TEXT("\\*.exe"));

    hSearch = FindFirstFile(szSearchDir, &FileData);
    if (hSearch == INVALID_HANDLE_VALUE)
    {
        printf("No *.exe files found.\n");
        return 1;
    }

    fFinished = FALSE;
    while (!fFinished)
    {
        StringCchPrintf(szNewPath, sizeof(szNewPath) /
sizeof(szNewPath[0]), TEXT("%s\\%s"), sTargetFileDirectory,
FileData.cFileName);
```

```
        if (!CopyFile(FileData.cFileName, szNewPath, FALSE))
        {
            _tprintf(TEXT("Could not copy file %s to %s\n"),
FileData.cFileName, szNewPath);
            return 1;
        }

        if (!FindNextFile(hSearch, &FileData))
        {
            if (GetLastError() == ERROR_NO_MORE_FILES)
            {
                _tprintf(TEXT("Copied %s to %s\n"), szSearchDir,
sTargetFileDirectory);
                fFinished = TRUE;
            }
            else
            {
                printf("Could not find next file.\n");
                return 1;
            }
        }
    }

    FindClose(hSearch);

    // Find files in FILE23 by a mask

    StringCchCopy(szSearchMask, MAX_PATH, sTargetFileDirectory);
    StringCchCat(szSearchMask, MAX_PATH, TEXT("\\"));
    StringCchCat(szSearchMask, MAX_PATH, argv[2]);

    printf("\nSearching files...\n");
    hSearch = FindFirstFile(szSearchMask, &FileData);
    if (hSearch == INVALID_HANDLE_VALUE)
    {
        _tprintf(TEXT("No %s files found.\n"), argv[2]);
        return 1;
    }

    fFinished = FALSE;
    while (!fFinished)
    {
        StringCchPrintf(szNewPath, sizeof(szNewPath) /
sizeof(szNewPath[0]), TEXT("%s\\%s"), sTargetFileDirectory,
FileData.cFileName);
```

```
        _tprintf(TEXT("Found: %s\n"), szNewPath);

        if (!FindNextFile(hSearch, &FileData))
        {
            if (GetLastError() == ERROR_NO_MORE_FILES)
            {
                _tprintf(TEXT("All %s files checked in %s\n"), argv[2],
sTargetFileDirectory);
                fFinished = TRUE;
            }
            else
            {
                printf("Could not find next file.\n");
                return 1;
            }
        }
    }

    FindClose(hSearch);

    // Read TempFile.txt and append Lab Info

    StringCchCopy(sFileName, MAX_PATH, sTargetFileDirectory);
    StringCchCat(sFileName, MAX_PATH, TEXT("\\TempFile.txt"));

    hFile = CreateFile(sFileName,
        GENERIC_READ,
        FILE_SHARE_READ,
        NULL,
        OPEN_EXISTING,
        FILE_ATTRIBUTE_NORMAL | FILE_FLAG_OVERLAPPED,
        NULL);

    if (hFile == INVALID_HANDLE_VALUE)
    {
        _tprintf(TEXT("Unable to open file \"%s\" for read.\n"),
sFileName);
        return 1;
    }

    if (FALSE == ReadFileEx(hFile, ReadBuffer1, BUFFERSIZE - 1, &ol1,
FileIOCompletionRoutine))
    {
        printf("Unable to read from file.\n GetLastError=%08x\n",
GetLastError());
```

```
        CloseHandle(hFile);
        return 1;
    }
    SleepEx(5000, TRUE);
    dwBytesRead1 = g_BytesTransferred;

    if (dwBytesRead1 > 0 && dwBytesRead1 <= BUFFERSIZE - 1)
    {
        ReadBuffer1[dwBytesRead1] = '\0'; // NULL character

        _tprintf(TEXT("\nData read from %s (%d bytes): \n"), sFileName,
dwBytesRead1);
        printf("%s", ReadBuffer1);
    }
    else if (dwBytesRead1 == 0)
        _tprintf(TEXT("No data read from file %s\n"), sFileName);
    else
        printf("\n ** Unexpected value for dwBytesRead ** \n");

    CloseHandle(hFile);

    hFile = CreateFile(sFileName,
        FILE_APPEND_DATA,
        0,
        NULL,
        OPEN_ALWAYS,
        FILE_ATTRIBUTE_NORMAL,
        NULL);

    if (hFile == INVALID_HANDLE_VALUE)
    {
        _tprintf(TEXT("Unable to create file \"%s\" for write.\n"),
sFileName);
        return 1;
    }

    dwBytesToWrite = (DWORD)strlen(DataBuffer2);
    dwBytesWritten = 0;
    bErrorFlag = FALSE;

    bErrorFlag = WriteFile(
        hFile,
        DataBuffer2,
        dwBytesToWrite,
        &dwBytesWritten,
        NULL);
```

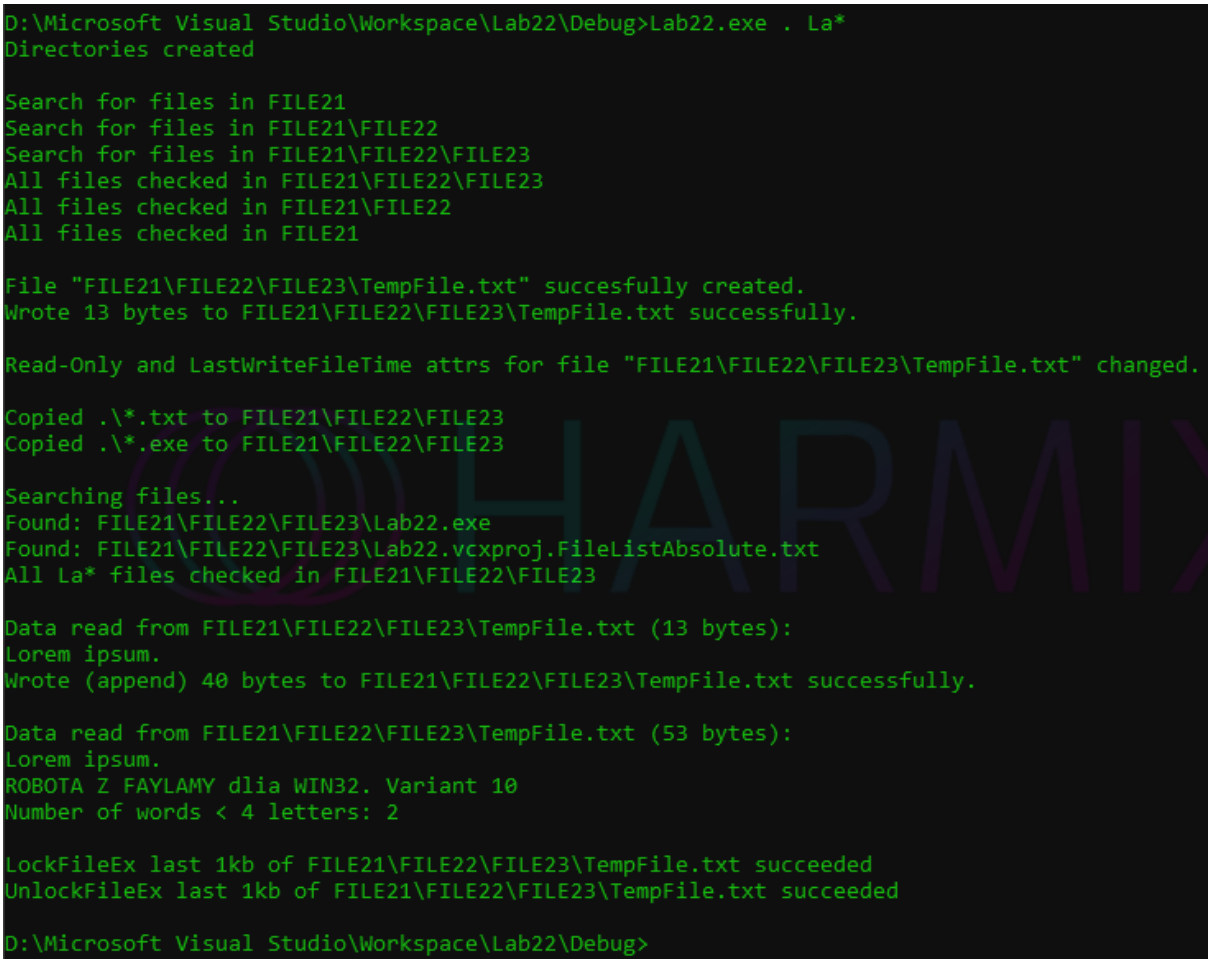
```
    if (FALSE == bErrorFlag)
        printf("Unable to write to file.\n");
    else
    {
        if (dwBytesWritten != dwBytesToWrite)
            printf("Error: dwBytesWritten != dwBytesToWrite\n");
        else
            _tprintf(TEXT("Wrote (append) %d bytes to %s
successfully.\n"), dwBytesWritten, sFileName);
    }

    dwAttrs = GetFileAttributes(sFileName);
    if (!(dwAttrs & FILE_ATTRIBUTE_READONLY))
    {
        SetFileAttributes(sFileName,
            dwAttrs | FILE_ATTRIBUTE_READONLY);
    }

    CloseHandle(hFile);

    // Async count words < 4 letters in TempFile.txt

    StringCchCopy(sFileName, MAX_PATH, sTargetFileDirectory);
    StringCchCat(sFileName, MAX_PATH, TEXT("\\TempFile.txt"));

    hFile = CreateFile(sFileName,
        GENERIC_READ,
        FILE_SHARE_READ,
        NULL,
        OPEN_EXISTING,
        FILE_ATTRIBUTE_NORMAL | FILE_FLAG_OVERLAPPED,
        NULL);

    if (hFile == INVALID_HANDLE_VALUE)
    {
        _tprintf(TEXT("Unable to open file \"%s\" for read.\n"),
sFileName);
        return 1;
    }

    if (FALSE == ReadFileEx(hFile, ReadBuffer2, BUFFERSIZE - 1, &ol2,
FileIOCompletionRoutine))
    {
        printf("Unable to read from file.\n GetLastError=%08x\n",
GetLastError());
```

```
        CloseHandle(hFile);
        return 1;
    }
    SleepEx(5000, TRUE);
    dwBytesRead2 = g_BytesTransferred;

    if (dwBytesRead2 > 0 && dwBytesRead2 <= BUFFERSIZE - 1)
    {
        ReadBuffer2[dwBytesRead2] = '\0'; // NULL character

        _tprintf(TEXT("\nData read from %s (%d bytes): \n"), sFileName,
dwBytesRead2);
        printf("%s", ReadBuffer2);

        int i = 0, word_length = 0, words_amount = 0;
        while (TRUE)
        {
            if ((ReadBuffer2[i] == ' ') | (ReadBuffer2[i] == '\0'))
            {
                if (word_length < 4)
                    words_amount++;
                word_length = 0;
                if (ReadBuffer2[i] == '\0')
                    break;
            }
            else
                word_length++;
            i++;
        }

        _tprintf(TEXT("Number of words < 4 letters: %d\n"),
words_amount);
    }
    else if (dwBytesRead2 == 0)
        _tprintf(TEXT("No data read from file %s\n"), sFileName);
    else
        printf("\n ** Unexpected value for dwBytesRead ** \n");

    CloseHandle(hFile);

    // Lock last 1kb of TempFile.txt

    StringCchCopy(sFileName, MAX_PATH, sTargetFileDirectory);
    StringCchCat(sFileName, MAX_PATH, TEXT("\\TempFile.txt"));

    hFile = CreateFile(sFileName,
```

```
        GENERIC_READ,
        FILE_SHARE_READ,
        NULL,
        OPEN_EXISTING,
        FILE_ATTRIBUTE_NORMAL | FILE_FLAG_OVERLAPPED,
        NULL);

    if (hFile == INVALID_HANDLE_VALUE)
    {
        _tprintf(TEXT("Unable to open file \"%s\" for read.\n"),
sFileName);
        return 1;
    }

    OVERLAPPED sOverlapped;
    sOverlapped.Offset = TESTSTRLEN * 3;
    sOverlapped.OffsetHigh = 0;

    fLockSuccess = LockFileEx(hFile,
        NULL,
        0,
        TESTSTRLEN,
        0,
        &sOverlapped);

    if (!fLockSuccess)
    {
        printf("LockFileEx failed (%d)\n", GetLastError());
        return 1;
    }
    else _tprintf(TEXT("\nLockFileEx last 1kb of %s succeeded\n"),
sFileName);

    // Unlock the file

    fLockSuccess = UnlockFileEx(hFile,
        0,
        TESTSTRLEN,
        0,
        &sOverlapped);

    if (!fLockSuccess)
    {
        printf("UnlockFileEx failed (%d)\n", GetLastError());
        return 1;
    }
```

```
    else _tprintf(TEXT("UnlockFileEx last 1kb of %s succeeded\n"),
sFileName);

    CloseHandle(hFile);

    return 0;
}
```

Скріншоти:



Повний код можна знайти у GitHub-репозиторії:
https://github.com/NazarPonochevnyi/Programming-Labs/blob/master/System%20Programming/Lab2/lab2.cpp