



CS609-System Programming
(Solved Macq's)
For Final Term



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1. How a DLL file is loaded inside a program during explicit linking?
Mention the API that is used for this purpose.

ANSWER:

NOTE: HERE is THREE TYPE ANSWER WHICH ONE PREFER AS YOU LIKE

- ❖ Call the LoadLibrary function with the name of the DLL file as its parameter to load the DLL into memory and obtain a handle to it.
- ❖ Use the GetProcAddress function to obtain the addresses of the functions and data within the DLL file.
- ❖ Call the functions or access the data within the DLL using the obtained function or data pointers.

OR

- ❖ Directory containing the application
- ❖ The system directory. This path can be determined by GetSystemDirectory()
- ❖ The windows directory (GetWindowsDirectory())
- ❖ The current directory
- ❖ Directories specified by the PATH environment variable

OR

Explicit linking requires the program to explicitly a specific DLL to be loaded or freed. Once the DLL is loaded then the program obtains the address of the specific entry point and uses that address as a pointer in function call. The function is not declared in the calling program. Rather a pointer to a function is declared. The functions required are:

HMODULE **LoadLibrary**(LPCTSTR lpLibFileName);

2. Write the names of functions that are used to determine the amount of time consumed by:

1. Process
2. Thread

ANSWER:

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- ❖ To determine the amount of time consumed by a process, the time function or the clock function can be used in C/C++ programming language.
- ❖ To determine the amount of time consumed by a thread, the clock_gettime or gettimeofday function can be used in C/C++ programming language. In other programming languages, such as Java, the System.nanoTime function can be used to measure the time consumed by a thread.

3. When a thread enters into the critical section and is not willing to leave the critical section, then what will its consequences?

ANSWER:

If a thread enters the critical section and refuses to leave, it can cause other threads to wait indefinitely, leading to a deadlock. This can result in a system hang or a crash.

4. Write the first two steps required for mapping a file to a region in virtual address space of a calling process.

ANSWER:

- ❖ The first step to map a file to a region in virtual address space of a calling process is to open the file using the open system call.
- ❖ The second step is to use the mmap system call to map the file to a region in virtual address space.

5. What is the purpose of InitializeCriticalSection And Spin CountO API? Also mention the names of its parameter.

ANSWER:

The InitializeCriticalSectionAndSpinCount API is used to initialize a critical section object in Windows with a spin count, which allows for better performance by using spinning instead of waiting. Its parameters are the critical section object to initialize and the spin count.

The names of its parameter:

LPCRITICAL_SECTION lpCriticalSection

6. What is Explicit Linking and which Windows API is used to load a DLL explicit inside a program?

ANSWER

Explicit linking is a method of loading dynamic-link libraries (DLLs) in Windows programs. When a program uses explicit linking, it loads the DLL manually at runtime and explicitly calls the functions within the DLL that it needs.

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The Windows API used to load a DLL explicitly inside a program is called "LoadLibrary".

7. Name any Two Windows API That are used to return the Pseudo and real handle of a process.

ANSWER:

❖ GetCurrentProcess()

GetCurrentProcess() is used to create a pseudohandle. It's not inheritable and desired access attributes are undefined.

❖ GetCurrentProcessId()

The OpenProcess() function is used to obtain the process handle using the process ID obtained by GetCurrentProcessId() or otherwise.

8. Briefly Describe the two parameters associated with the following windows API. FARPROC GetProcAddress(HMODULE hModule, LPCSTR lpProcName).

ANSWER:

The Windows API "GetProcAddress" is used to retrieve the address of an exported function or variable from a specified dynamic-link library (DLL).

It takes two parameters

❖ HMODULE hModule:

❖ LPCSTR lpProcName

9. In what situation the termination handler is ignore by a process

ANSWER:

The process has installed a signal handler that overrides the default termination handler for the SIGTERM signal. The process is unable to execute the termination handler due to resource constraints, such as a lack of available memory or CPU time.

10. Which window function is used to convert thread into fiber?

ANSWER:

Converting a thread into a fiber is a programming concept that involves creating a lightweight thread that can be cooperatively scheduled within a single operating system thread. The concept of converting a thread into a fiber is not directly related to window functions, and there is no specific window function that is used for this purpose.

11. Write the signature of InterlockedExchange() API with its return type and parameters

ANSWER:

```
LONG InterlockedExchange(  
    LONG volatile *Target,
```

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LONG Value

);

return type and parameters is Loong Integer

12. Write the name of the API which is used to map the view of a file mapping into the address space of a process

ANSWER:

```
LPVOID MapViewOfFile( HANDLE hFileMappingObject,  
                      DWORD dwDesiredAccess,  
                      DWORD dwFileOffsetHigh,  
                      DWORD dwFileOffsetLow,  
                      SIZE_T dwNumberOfBytesToMap );
```

Note: The name of the API is **MapViewOfFile**.

13. Write the name of the API which is used to open map the view of a file mapping into the address space of a process?

ANSWER:

```
HANDLE OpenFileMapping(  
                      DWORD dwDesiredAccess,  
                      BOOL bInheritHandle,  
                      LPCSTR lpMapName );
```

Note: The name of the API is **openFileMapping**.

14. Suppose we have a semaphore named as hThrottleSem objects current count is to be increased by 1 and the previous count is not required. you need to write the code to release this semaphore using the above mentioned information.

Note: Make use of Windows API to release semaphore.

ANSWER:

ReleaseSemaphore function. code snippet to release the hThrottleSem semaphore and increase itscount by 1:

```
ReleaseSemaphore(hThrottleSem, 1, NULL);
```

15. Pointer declaration Windows: LPTSTR pFile = Null; define two based pointers on the above pointer. take pSize and pIn as their names. their types should be DWORD and TCHAR respectively.

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ANSWER:

Assuming that TCHAR is defined as a wide-character (Unicode) character type, here's how you can define two base pointers pSize and pIn based on the LPTSTR pointer pFile:

Code:

```
DWORD* pSize = NULL;  
TCHAR** pIn = NULL;  
pSize = (DWORD*)pFile;  
pIn = (TCHAR**)(pSize + 1);
```

OR

```
DWORD* pSize = nullptr;  
TCHAR** pIn = nullptr;  
  
pSize = reinterpret_cast<DWORD*>(pFile);  
pIn = reinterpret_cast<TCHAR**>(pFile + sizeof(DWORD));
```

Here, pSize is a pointer to a DWORD, and pIn is a pointer to a pointer to a TCHAR.

16. What is the purpose of *Addend and Value parameter used in InterlockedExchangeAdd() API?

ANSWER:

InterlockedExchangeAdd is a function provided by the Windows API for performing an atomic addition operation on a variable.

LONG InterlockedExchangeAdd(LONG volatile *Addend, LONG Value);

The Addend parameter is a pointer to the variable to which the atomic addition operation should be applied, and Value is the value to be added to the variable

17. VOID sleep(DWORD dwMilliseconds);

- i. In above API if the parameter dwMilliseconds is specified as INFINITE then what happened with threads.
- ii. If the parameter dwMilliseconds is specified as 0 then what happened with threads?

ANSWER:

- ❖ If the dwMilliseconds parameter is specified as INFINITE:
The Sleep function suspends the thread indefinitely until it is awakened by an external event.
- ❖ If the dwMilliseconds parameter is specified as 0:
The Sleep function causes the thread to yield the remainder of its time slice and immediately return, allowing other threads to run.

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18.(Give answer in Yes No)

- I. Is it incorrect that Actual handle has its own security and access attributes while the Pseudo handle has no?
- II. Name the API used for getting Pseudo handle.
- III. Name the API used for getting Actual handle.

ANSWER:

- I. Yes, it is incorrect. Both actual handles and pseudo handles have security and access attributes associated with them, which are used to determine whether a process or thread has permission to access the object represented by the handle.
- II. The API used for getting a pseudo handle is GetCurrentProcess.
- III. The API used for getting an actual handle depends on the type of object being opened.

19. Write the names of 4 functions used to create and manage Semaphores.

ANSWER:

- ❖ CreateSemaphore()
- ❖ CreateSemaphoreEx()
- ❖ OpenSemaphore()
- ❖ ReleaseSemaphore().

20. Briefly describe the following parameters that are used with CreateProcess0 API.

- I. LPCSTR lpApplication Name
- II. BOOL bInheritHandles
- III. LPVOID lpEnvironment
- IV. LPCSTR lpCurrentDirectory

ANSWER:

- ❖ **LPCSTR lpApplicationName:** This parameter is a pointer to a null-terminated string that specifies the name of the executable module to be run. If this parameter is NULL, the module name must be the first white space-delimited token in the lpCommandLine parameter.
- ❖ **BOOL bInheritHandles:** This parameter specifies whether or not the new process should inherit handles from the calling process. If this parameter is TRUE, handles marked as inheritable will be inherited by the new process. If it is FALSE, the new process will not inherit any handles from the calling process.
- ❖ **LPVOID lpEnvironment:** This parameter is a pointer to an environment block for the new process. If this parameter is NULL, the new process inherits the environment of the calling process. Otherwise,

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the environment block is created from the specified block.

- ❖ **LPCSTR lpCurrentDirectory:** This parameter is a pointer to a null-terminated string that specifies the current directory for the new process. If this parameter is NULL, the new process uses the current directory of the calling process.

21. Write the naming convention for the client and server when they are on the same machine versus a different machine in Named Pipes?

ANSWER:

In Named Pipes, when the client and server are on the same machine, the server uses a period (".") as the server name, and the client can either use a period or the local computer name as the server name. When the client and server are on different machines, the server name is the network name or IP address of the machine running the server, and the client uses that name to connect to the server.

22. What are based pointers. Write their syntax.

ANSWER:

Based pointers are a legacy mechanism for accessing memory using segmented addressing in Windows programming.

Syntax:

```
typedef struct
{
    unsigned short offset;
    unsigned short segment;
}
MYFARPOINTER;
```

```
#define MAKEMYFARPOINTER(s,o) ((MYFARPOINTER)MAKELONG(o, s))
```

```
MYFARPOINTER fpMyPointer = MAKEMYFARPOINTER(0x0001, 0x1234);
```

23. If a thread enters a critical section and is not willing to leave the CS then what will be its consequences?

ANSWER:

If a thread enters a critical section and is not willing to leave, it can cause a deadlock situation where other threads waiting to enter the critical section will be blocked indefinitely, leading to a halt in program execution. It is important to design the program logic to avoid such scenarios and ensure that threads release the critical section once they have finished their critical work.

24. Multi-threaded network, Is it possible to attach same DLL file?

Entry point in DLL file is Compulsory or optional?

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ANSWER:

Yes, it is possible to attach the same DLL file in a multi-threaded network application. The entry point in a DLL file is optional, but it is typically defined to provide a standardized interface for loading and using the DLL's functionality.

25.If CreateProcess() returns successfully then it returns 2 handles,write their resources.

ANSWER:

When CreateProcess() returns successfully

It returns two handles:

- ❖ a process handles
- ❖ a primary thread handles.

The process handle is used to manipulate the process object, while the primary thread handle is used to manipulate the main thread of the newly created process.

26.What WaitForSingleObject() Returns if mutex is abandoned?

ANSWER:

WaitForSingleObject() is used to wait for a single specified object

If mutex is abandoned the return type is WAIT_ABANDONED

27.WaitForMultipleObjects

ANSWER:

WaitForMultipleObjects can be used for more than 1 object, those objects are defined in the form of an array.

return type is DWORD.

28.How many synchronization objects Windows Provide?

ANSWER:

Windows Provide four synchronization objects

- ❖ Mutexes
- ❖ Semaphores
- ❖ Events
- ❖ Critical Section

29.What is the return type of dwopenmutex

ANSWER:

There is no function called "dwopenmutex" in the Windows API. It is possible that you meant "OpenMutex", which is a function that opens an existing named mutex object, and its return type is a HANDLE.

30.Write the Syntax of InterlockedIncrement and InterlockedDecrement

ANSWER:

```
LONG InterlockedIncrement(  
    LONG volatile *lpAddend  
);
```

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```
LONG InterlockedDecrement(  
    LONG volatile *lpAddend  
);
```

31. Threadpool Ky parameter and return type.

ANSWER:

The thread pool functions in Windows programming have various parameters and return types depending on the specific function being used.

Return type of ThreadPool() is Boolean

- ❖ CreateThreadPool()
- ❖ SubmitThreadPoolWork()
- ❖ WaitForThreadPoolWorkCallbacks().

32. Waitthreadpool() function explain

ANSWER:

There is no WaitThreadPool() function in the Windows API.

There is a function called WaitForThreadPoolWorkCallbacks(), which waits for all pending work associated with a thread pool to complete. The function takes a handle to a thread pool, and an optional flag to indicate whether to cancel any remaining work items before waiting.

33. How many threads can enter the critical section?

ANSWER:

Only one thread can enter a critical section at a time. If another thread attempts to enter the same critical section while it is already occupied by another thread, it will be blocked until the first thread exits the critical section.

34. Briefly explain system mask and process mask.

ANSWER:

In Windows programming, the system mask and process mask are bitmaps used to indicate which processor(s) a thread is allowed to run on.

The **system mask** represents all available processors on the system, while the **process mask** represents the subset of processors that are available to a particular process.

35. Briefly describe each parameter in the following Windows API.

BOOL GetProcessTime(HANDLE hProcess,

LPTIME lpCreationTime,

LPTIME lpExitTime,

LPTIME lpKernelTime,

LPTIME lpUserTime);

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ANSWER:

The GetProcessTimes() Windows API is used to retrieve timing information about a specified process. It takes a handle to the process in question, and four pointer arguments that receive the process's creation time, exit time, kernel time, and user time, respectively. The function returns a boolean value indicating success or failure.

36. What is the purpose of dwPipeMode parameter in CreateNamedPipe() API and mention the names of its two commonly used values.

ANSWER:

dwPipeMode indicates whether writing is message oriented or byte oriented. CreateNamedPipe() creates an instance of the named pipe and returns a handle.

The dwPipeMode parameter can be set to one or more of the following flags:

The two commonly used values for this parameter are

- ❖ PIPE_WAIT
- ❖ PIPE_NOWAIT

37. Which Windows API is used to release the Ownership of mutex? Also Write it's Signature

ANSWER:

The Windows API used to release the ownership of a mutex is called ReleaseMutex().

The signature of the ReleaseMutex() API is as follows:

BOOL ReleaseMutex(HANDLE hMutex);

38. Name any third-party frameworks that are used for thread optimization.

ANSWER:

- ❖ OpenMP
- ❖ cilk++

39. Synchronization mutex thread synchronization mutex thread model.

ANSWER:

A synchronization mutex is used in thread synchronization to ensure that only one thread can access a critical section or a shared resource at a time. This is a key component of the thread synchronization model, which is used to coordinate and control the execution of multiple threads in a concurrent program.

OR

Synchronization refers to the coordination of multiple threads or processes to ensure that they access shared resources in a mutually exclusive and coordinated manner. The **mutex model** is widely used in multithreaded

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programming to prevent race conditions and ensure data consistency in shared resources

40. Syntax allocate and deallocate function

ANSWER:

Allocate:

allocate(<data_type>, <size>)

Deallocate:

deallocate(<pointer>)

41. Interlocked Function.

ANSWER:

The Interlocked functions are a set of functions provided by the Windows operating system to provide atomic operations on shared variables that are accessed concurrently by multiple threads.

The most basic of these functions are InterlockedIncrement() and InterlockedDecrement().

42. Types of callback Functions.

ANSWER:

❖ CreateThreadpoolTimer()

❖ CreateThreadpoolIO()

❖ CreateThreadpoolWait()

43. What is Critical section?

ANSWER:

A critical section refers to a portion of a program where shared resources (such as variables, data structures, or devices) are being accessed and modified by multiple threads or processes. To prevent conflicts and ensure proper synchronization, access to the critical section must be carefully coordinated using synchronization techniques such as locks, semaphores, or monitors.

OR

Critical section is the part of the code that can only be executed by one thread at a time. Windows provides the **CRITICAL_SECTION** objects as a simple lock mechanism for solving critical section problems.

44. Write the name of setting pointer.

ANSWER:

❖ SetFilePointer()

❖ SetFilePointerEx()

45. Write the types of floating-point exception?

ANSWER:

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- ❖ Invalid operation
- ❖ Division by zero
- ❖ Overflow
- ❖ Underflow
- ❖ Inexact calculation

46. Write the name of API that is used to remove the lock from the locked file area?

ANSWER:

The API that is commonly used to remove the lock from the locked file area is called `unlock` or `unlockfile` depending on the programming language or operating system being used.

47. CreatePipe parameters Api

ANSWER:

```
BOOL CreatePipe (  
HANDLE phRead,  
HANDLE phWrite,  
LPSECURITY_ATTRIBUTES lpsa,  
DWORD cbPipe);
```

48. SetThreadAffinityMask

ANSWER:

```
DWORD_PTR SetThreadAffinityMask (  
HANDLE hThread,  
DWORD dwThreadAffinityMask);
```

49. Write the GetProcessAffinityMask parameters API for get and set these masks a set of APIs

ANSWER:

```
BOOL GetProcessAffinityMask (  
HANDLE hprocess,  
LPDWORD lpProcessAffinityMask,  
LPDWORD lpSystemAffinityMask);
```

50. SetProcessAffinityMask()

ANSWER:

```
BOOL SetProcessAffinityMask (  
HANDLE hNamedPipe,  
DWORD_PTR dwProcessAffinityMask);
```

51. InterlockedExchangeAdd write the parameter or return type

ANSWEWR:

```
LONG InterlockedExchangeAdd(  
LONG volatile *Addend,  
LONG Value)
```

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return type and parameters is Long Integer

52. When thread Object is created, the space stack memory?

ANSWER:

When a thread is created, the operating system allocates memory to hold the thread's execution context, which includes the thread's stack space. The stack is a portion of memory that is used to store local variables, function parameters, and return addresses for the functions called by the thread.

53. Write the name of functions or APIs used for the following tasks.

- I. Creating a job object**
- II. Opening a named job object**
- III. Adding a process to a job object**
- IV. To destroy or close job object**

ANSWER:

I. The function used for creating a job object is CreateJobObject.

II. The function used for opening a named job object is OpenJobObject.

III. The function used for adding a process to a job object is AssignProcessToJobObject.

IV. The function used for destroying or closing a job object is CloseHandle.

54. Mention the names of two type of events and which function is used to set these types?

ANSWER:

Two types of events are

- ❖ Manual-reset events
- ❖ Auto-reset events.

A manual-reset event can signal several waiting threads simultaneously and can be reset. An auto-reset event signals a single waiting thread, and the event is reset automatically.

55. What is the name of Windows API that is used to get and report error to the user?

ANSWER:

The Windows API that is commonly used to get and report errors to the user is called GetLastError() and FormatMessage

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56. Write the name of three windows functions that are used to manage Mutexes?

ANSWER:

- ❖ CreateMutex()
- ❖ ReleaseMutex()
- ❖ OpenMutex()

57. Write the general syntax of APIs that are used for:

- I. Allocating index in the Thread Local Storage (TLS)**
- II. Deallocating index in the Thread Local Storage (TLS)**

ANSWER:

- I. Allocating index in the Thread Local Storage (TLS)**
DWORD TlsAlloc();
- II. Deallocating index in the Thread Local Storage (TLS)**
BOOL TlsFree(DWORD dwTlsIndex);

58. Write the Functionalities of the Following APIs.

- I. GetLastError()**
- II. FormatMessage()**
- III. LocalFree()**

ANSWER:

- ❖ **GetLastError()** retrieves the error code associated with the last encountered error on the current thread. This function is commonly used in conjunction with other error-handling functions to diagnose and handle errors in an application.
- ❖ **FormatMessage()** retrieves the system error message associated with a given error code and formats it into a user-readable string. This function is commonly used to display error messages to users or log error information for debugging purposes.
- ❖ **LocalFree()** frees a block of memory that was previously allocated using the LocalAlloc function. This function is commonly used to release memory resources after they are no longer needed by an application.

59. In the CreateNamePipe() API function the dwOpenMode specifies many flags. Name any Three

ANSWER:

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- ❖ PIPE_ACCESS_DUPLEX
- ❖ PIPE_ACCESS_INBOUND
- ❖ PIPE_ACCESS_OUTBOUND

60. Keeping in View the following syntax of DuplicationHandle() API, answer the questions.

```
BOOL DuplicateHandle (  
HANDLE hSourceProcessHandle,  
HANDLE hSourceHandle,  
HANDLE hTargetProcessHandle,  
LPHANDLE lpTargetHandle,  
DWORD dwDesiredAccess,  
BOOL bInheritHandle,  
DWORD dwOptions );
```

I. Mention the name of parameter that shows the original or real handle.

OR

Which argument will provide the original source handle?

II. Mention the name of parameter that receives a copy of the original handle.

OR

Which target handle will receive the pointer of original source?

NOTE: HERE is TWO type Question can be asked

ANSWER:

- I. hSourceHandle
- II. lpTargetHandle

61. Consider the Following Code given below for using Threthead pools.

```
Int _tmain(DWORD argc,LPTSTR argv){  
INT nThread;  
HANDLE *pWorkobjects;  
THARG *pThreadArg;  
TP_CALLBACK_ENVIRON cbe;  
Nthread-_ttoi(argv[]);
```

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You need to write code to first allocate memory to pWorkobjects using malloc() then use CreateThreadpoolWork() api function to create a thread pool worker object.

Considering the name of work call back is “Worker”.

ANSWER:

```
// Allocate memory for the array of work objects
pWorkobjects = (HANDLE*)malloc(nThread * sizeof(HANDLE));

// Initialize the thread pool callback environment
InitializeThreadpoolEnvironment(&cbe);

// Create the thread pool worker objects
for (int i = 0; i < nThread; i++) {
    pThreadArg = (THARG*)malloc(sizeof(THARG));
    pThreadArg->worknum = i;
    pWorkobjects[i] = CreateThreadpoolWork(Worker, pThreadArg, &cbe);
}
```

62. Pulseevent its return type and parameters

ANSWER:

BOOL PulseEvent (HANDLE hEvent

return type is BOOL

63. Write the APIs Parameter of Openfilemapping.

ANSWER:

```
HANDLE OpenFileMapping (
    DWORD dwDesiredAccess,
    BOOL bInheritHandle,
    LPCTSTR lpMapName );
```

return type is Handle

64. Explain Memory barrier

ANSWER:

A memory barrier is a hardware or software mechanism used to ensure that memory operations appear to occur in a specific order, even if they are executed out of order by the CPU. It is used to synchronize data

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access between multiple threads and prevent unexpected results caused by inconsistent data ordering.

65. While Creating NamedPipe, which options are available in dwOpenMode

ANSWER:

dwOpenMode is the open mode which can be.

- ❖ PIPE_ACCESS_DUPLEX,
- ❖ PIPE_ACCESS_INBOUND,
- ❖ PIPE_ACCESS_OUTBOUND along with many other options.

66. In Create file mapping, use these characteristics and show the API

- ❖ Given file name is hIN
- ❖ You do not want to set any security attributes.
- ❖ You want to use the file size.
- ❖ The file should be only PAGE_READONLY
- ❖ You do not want to share the map with any other process.

