Class 9

CSC 471 Modern Malware Analysis
API Hook

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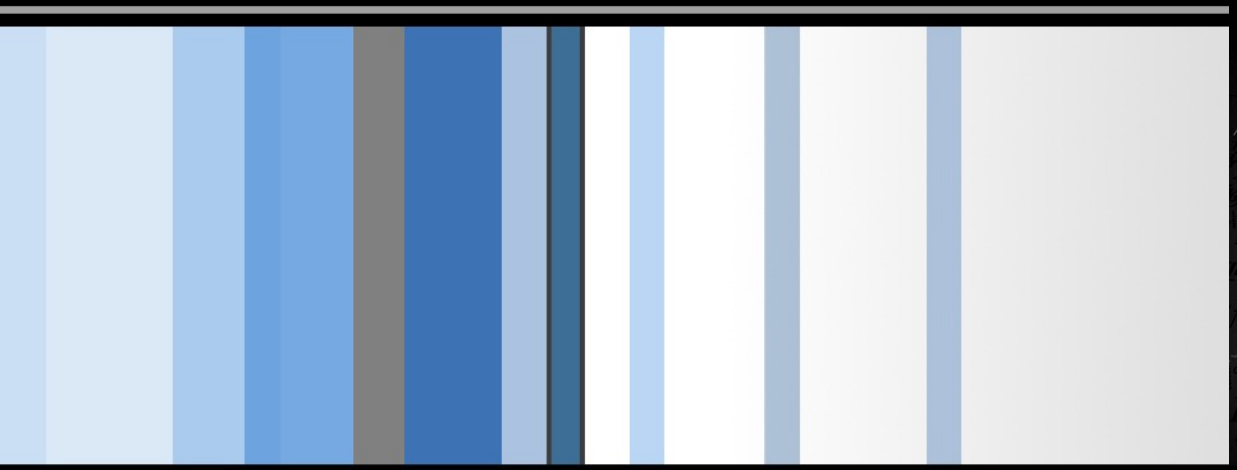
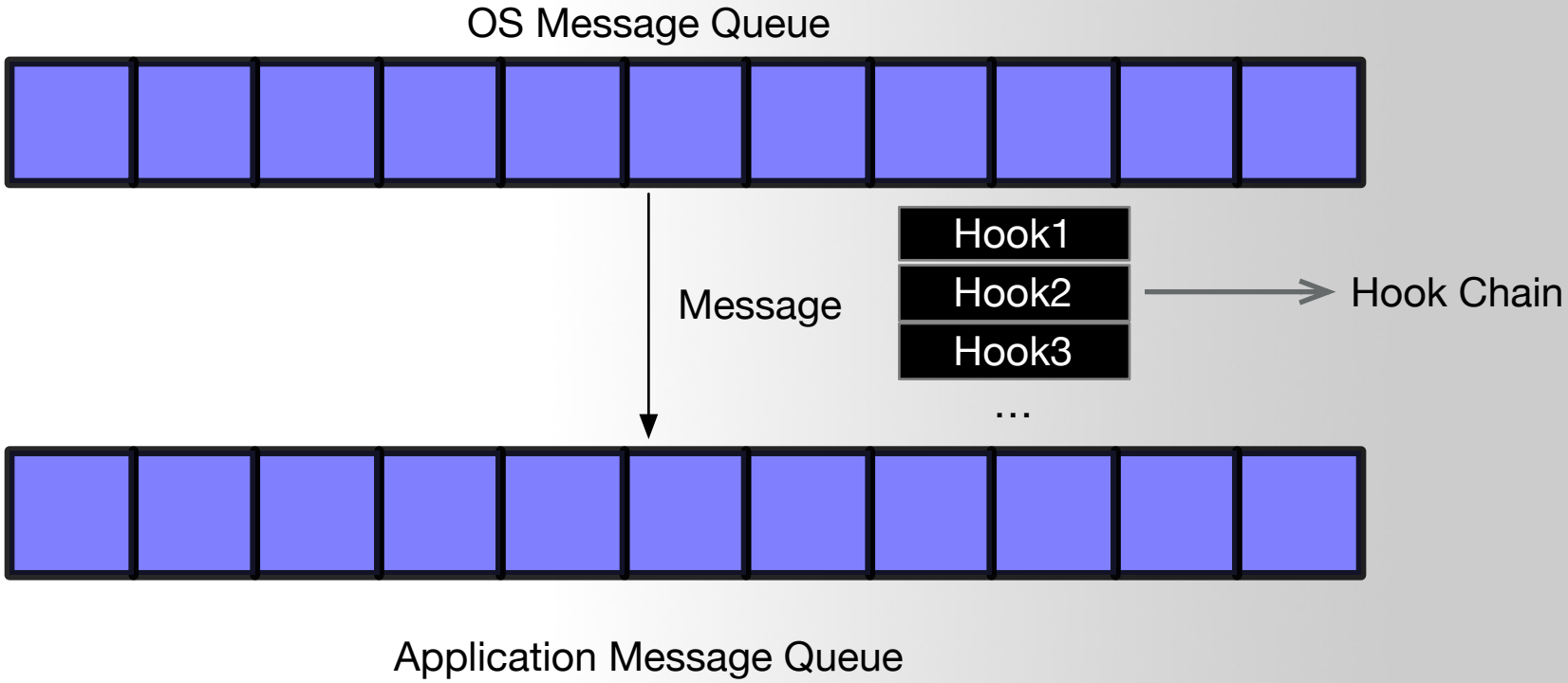
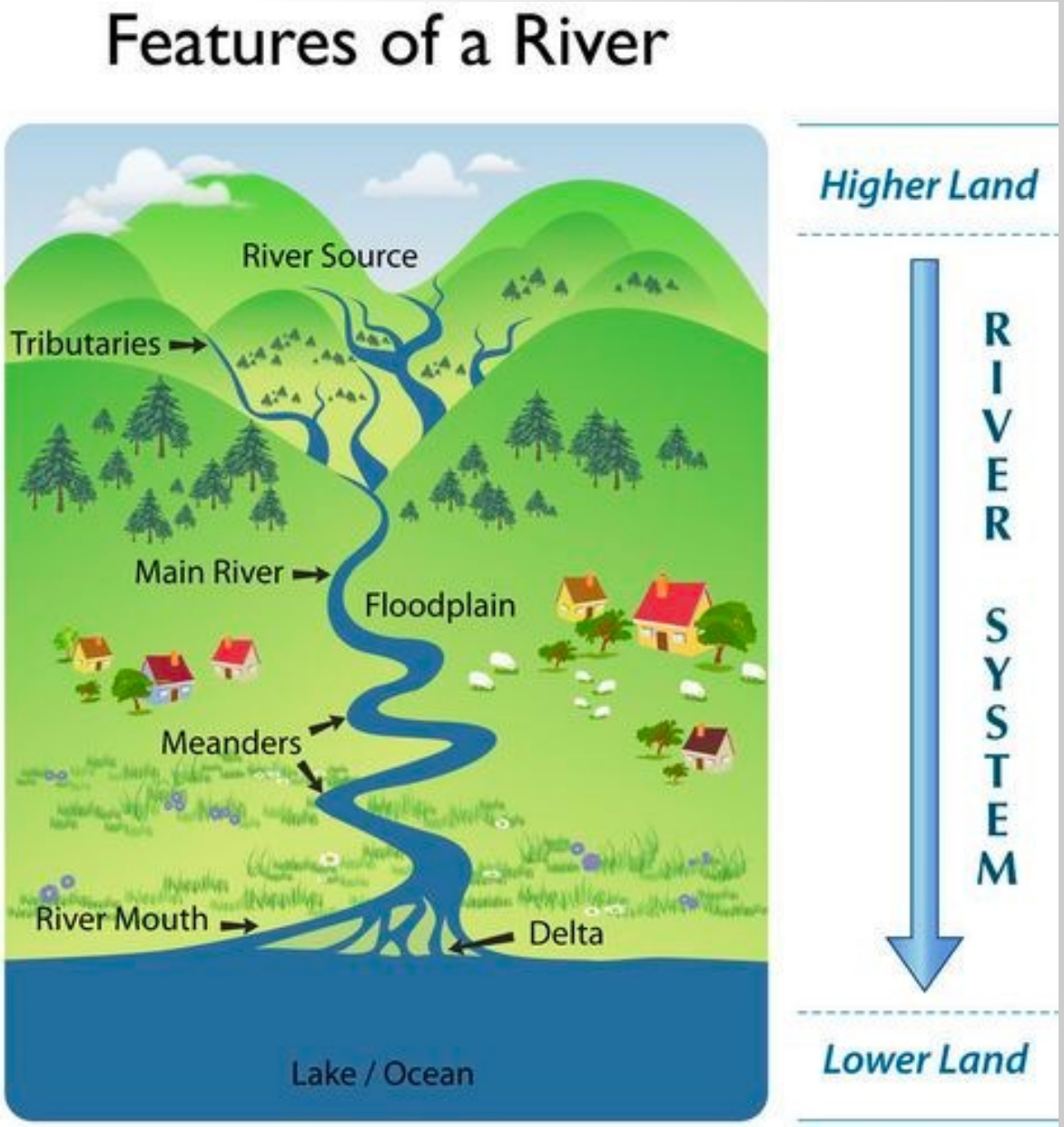


Review – Hook

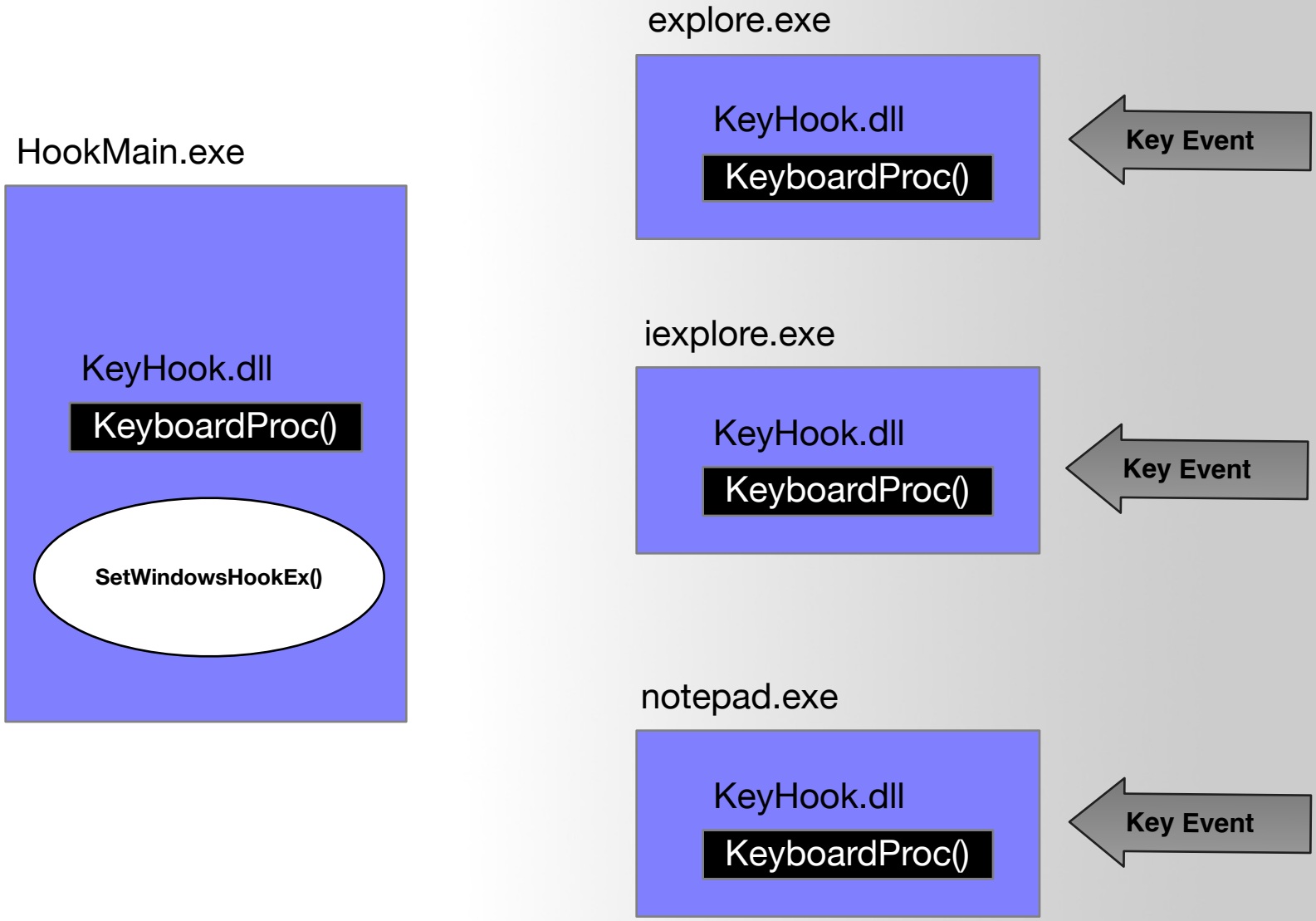
- A hook is a point in the system message-handling mechanism where an application can **install a subroutine** to monitor the message traffic in the system and process certain types of messages before they reach the target window procedure.



River System ???



Review – Message Hook



Introduction to WinAPI

- System resources (file, network, IO, device) may be accessed by multiple applications at the same time, can cause **confliction**.
- Modern OS protect these resources.

- E.g. How to let a program to wait for a while?

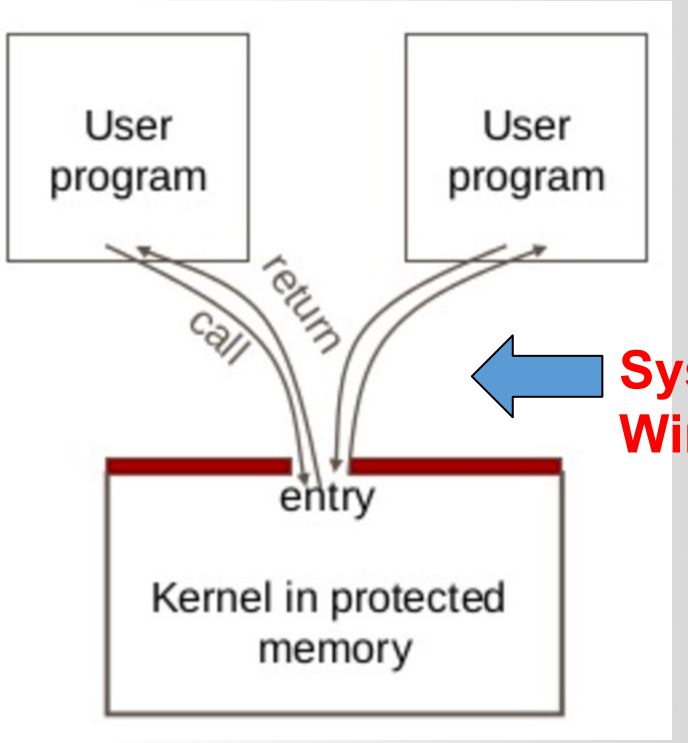
```
1 int i;
2 for(int = 0; i < 100000; ++i);
```

100Mhz CPU -> 1s
1000Mhz CPU -> 0.1s

Use WinAPI → Timer

System Call & WinAPI

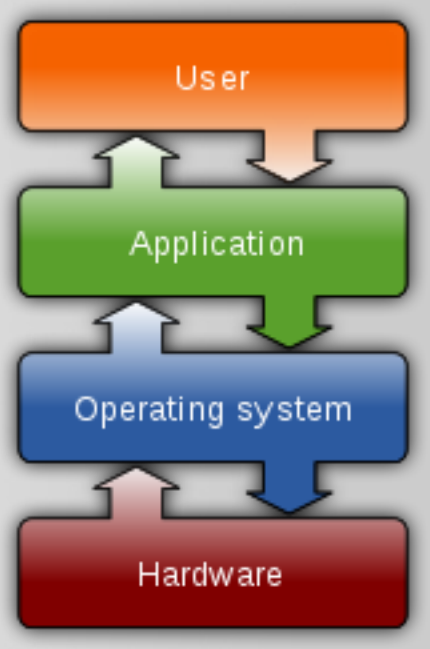
- User code can be arbitrary
- User code cannot modify kernel memory
- The call mechanism switches code to kernel mode



System Call → WinAPI (Windows)

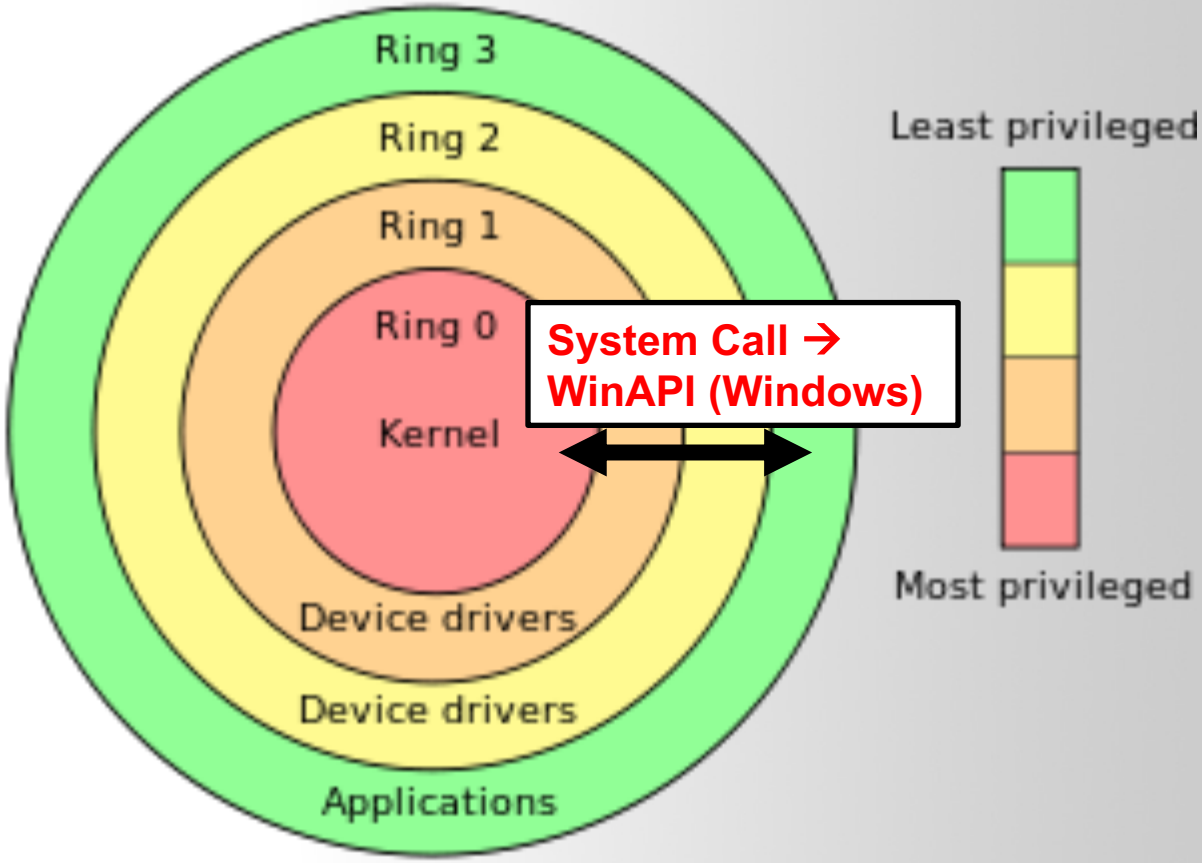
What is System Call?

- Let an application to access system resources.
- OS provide an interface (**System call**) for the application
- It usually use the technique called “interrupt vector”
  - Linux use **0x80**
  - Windows use **0x2E**

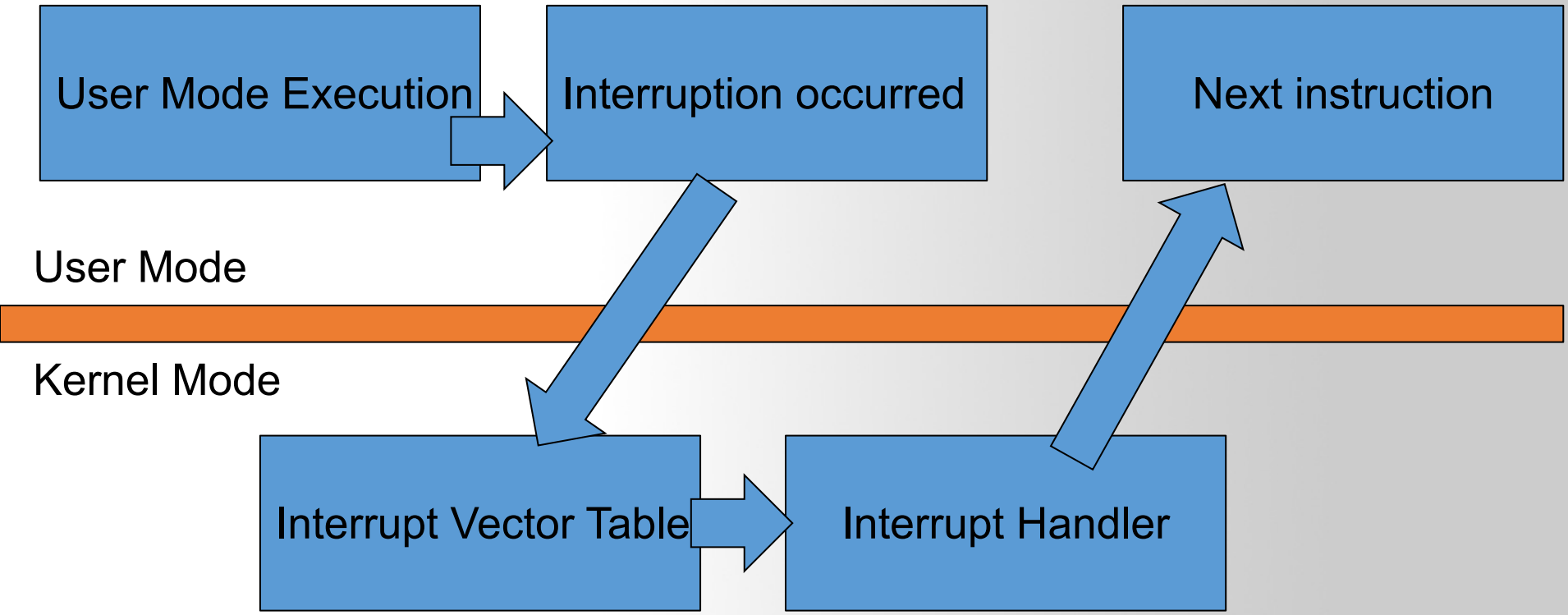


In system programming, an **interrupt** is a signal to the processor emitted by hardware or software indicating an event that needs immediate attention.

The “Ring”

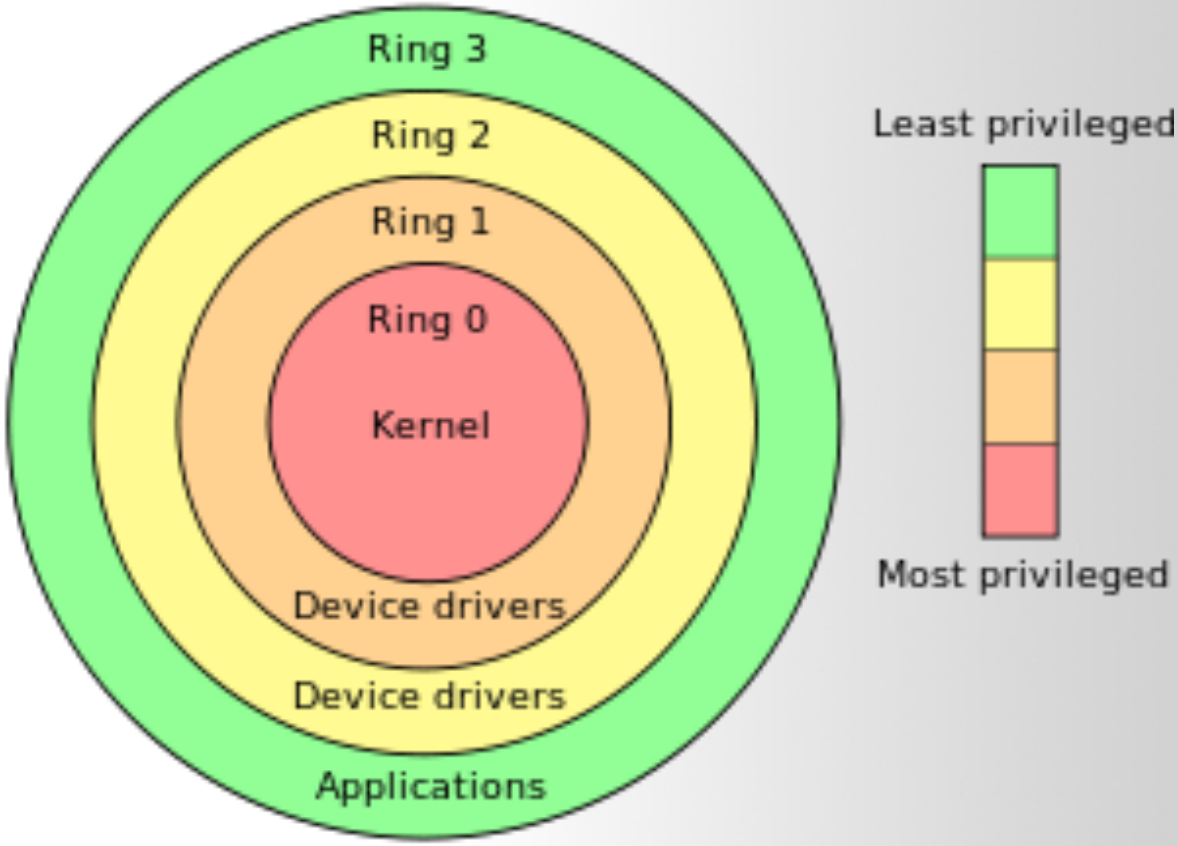

Ring 3
Ring 2
Ring 1
Ring 0
Kernel
Device drivers
Device drivers
Applications
System Call →
WinAPI (Windows)
Least privileged
Most privileged

CPU Interrupt

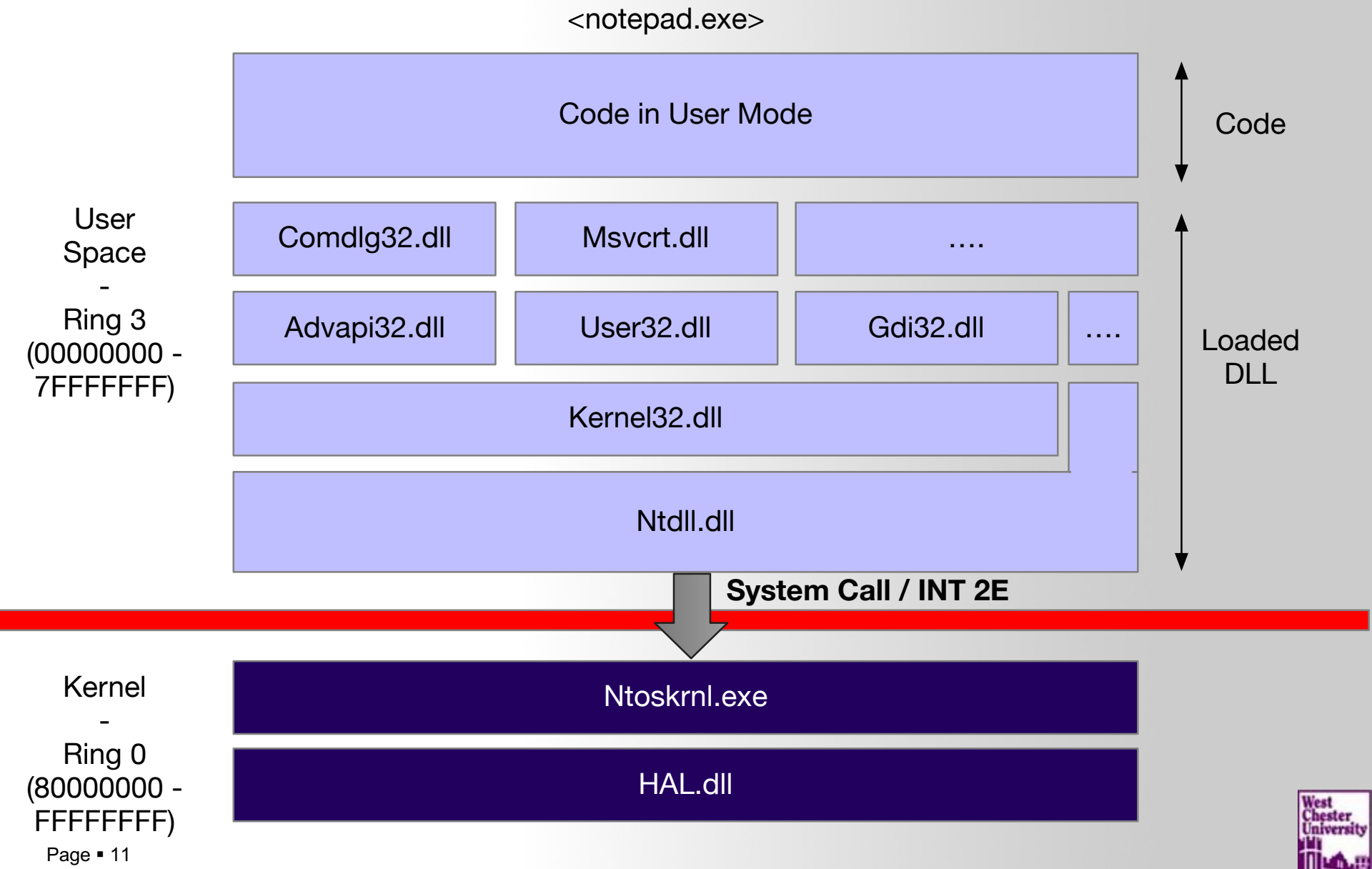


Windows System Call and API

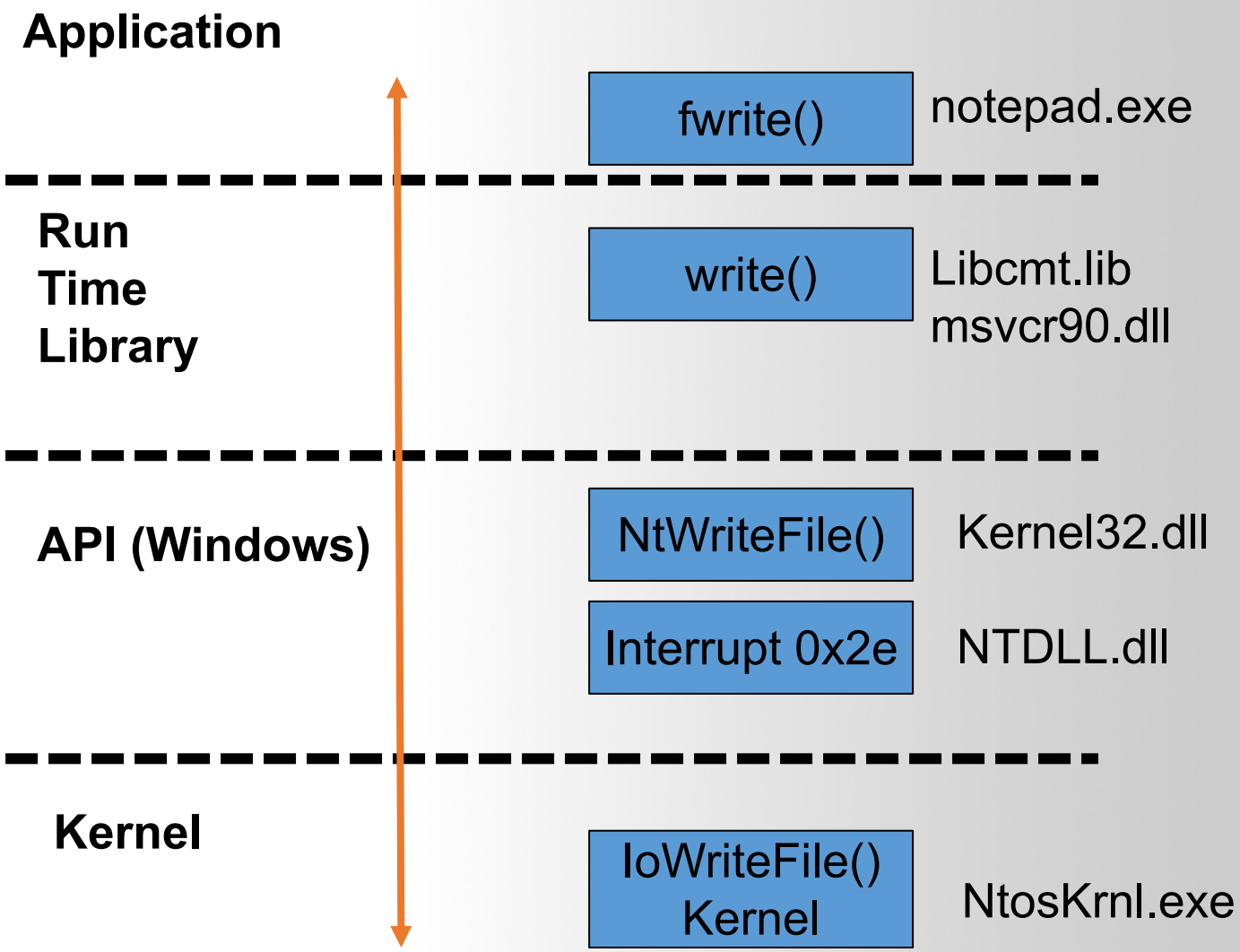
- The **Win32 API** is a layer that **runs in user mode** (ring 3).
- **Only API calls that use kernel resources** (CreateThread, VirtualAlloc, etc) will call into the "real" operating system (ntdll.dll) and trap into **ring 0** with a software interrupt (int 0x2e).



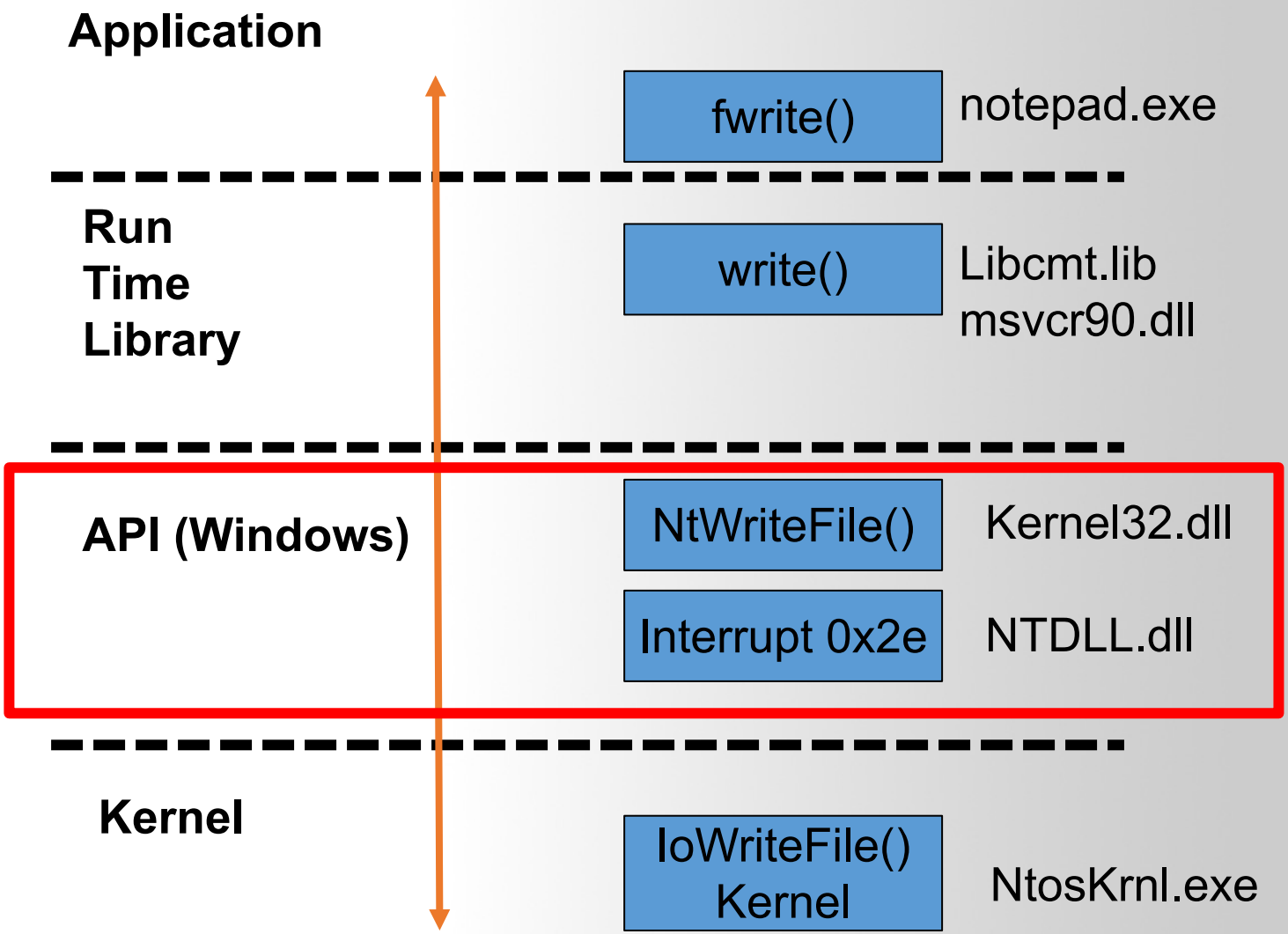
User Mode and Kernel



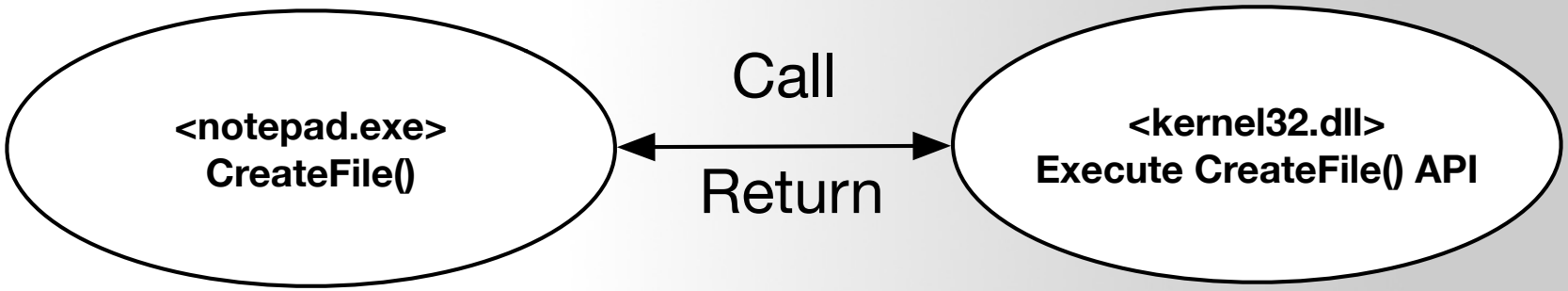
Write a file in Notepad



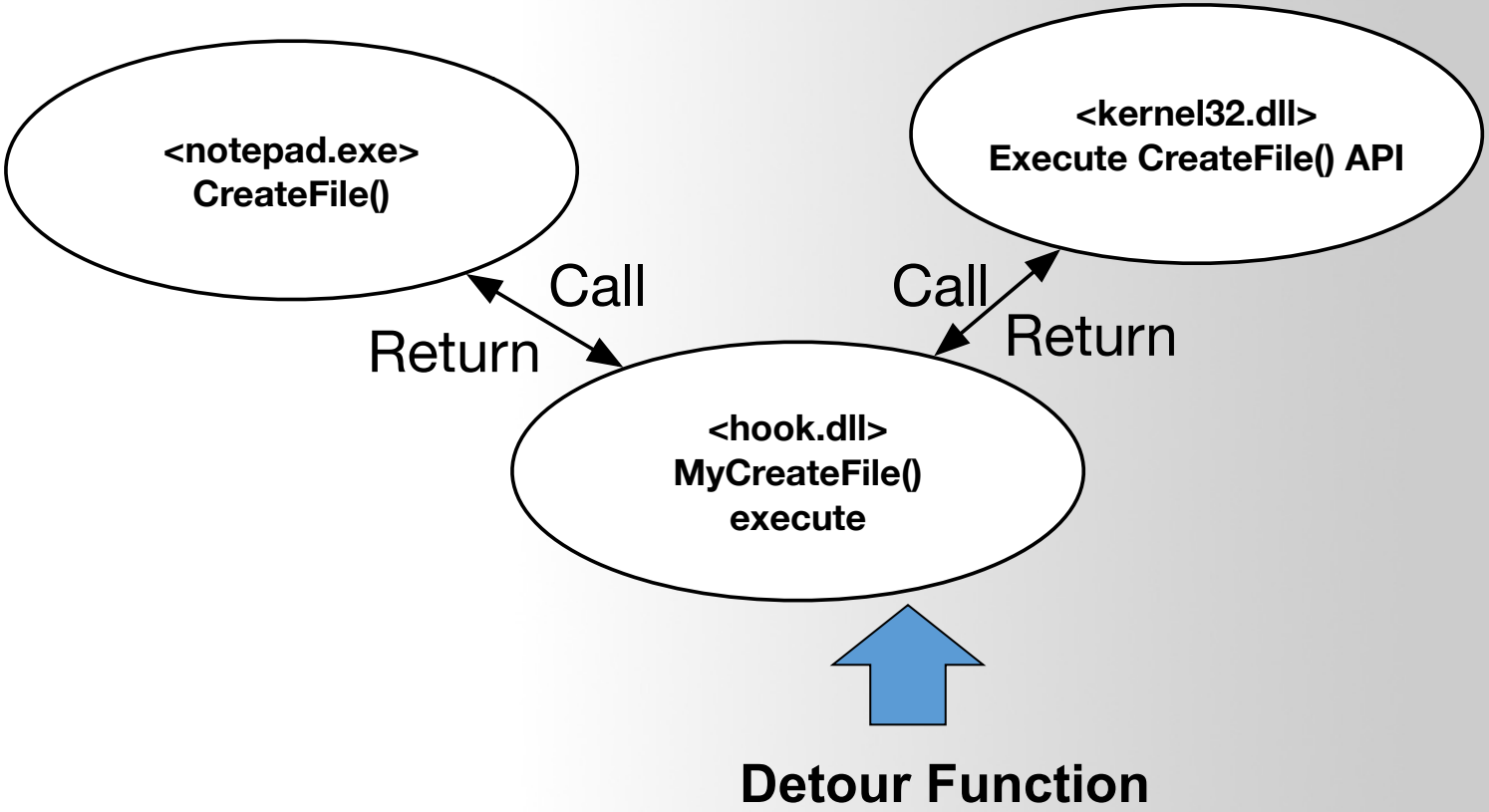
API Hook


Application
fwrite()
notepad.exe
Run
Time
Library
write()
Libcmt.lib
msvcr90.dll
API (Windows)
NtWriteFile()
Kernel32.dll
Interrupt 0x2e
NTDLL.dll
Kernel
IoWriteFile()
Kernel
NtosKrnl.exe

API Call (Normally)



API Hook


<notepad.exe>
CreateFile()
<kernel32.dll>
Execute CreateFile() API
Call
Return
Call
Return
<hook.dll>
MyCreateFile()
execute
Detour Function

API Hook Tech Map

Method	Target	Location	Tech		API
Dynamic	Process/Memory 00000000 - 7FFFFFFF	1) IAT 2) Code 3) EAT	Interactive Debug		DebugActiveProcess GetThreadContext SetThreadContext
			Standalone Injection	Independent Code	CreateRemoteThread
				DII File	Resistry (AppInit_DLLs) BHO (IE only)
					SetWindowsHookEx CreateRemoteThread

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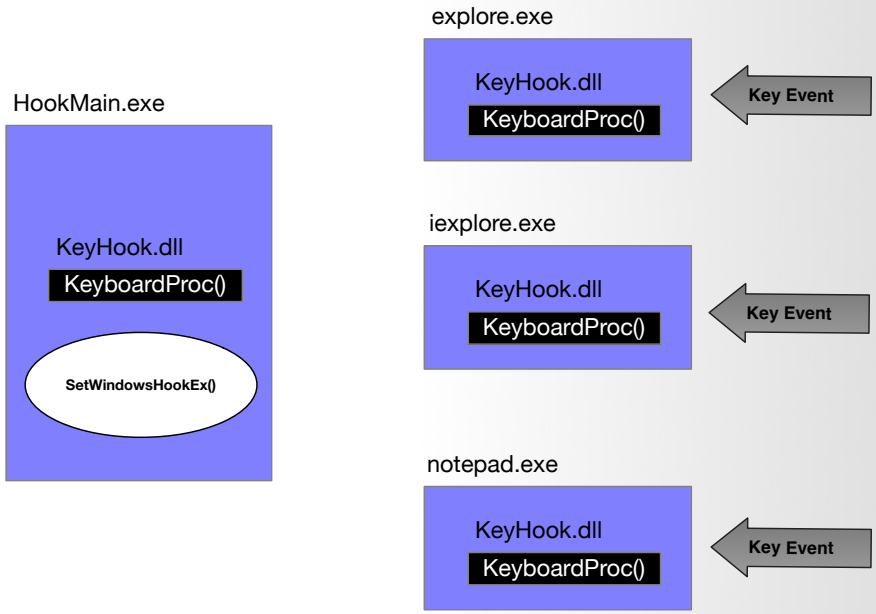
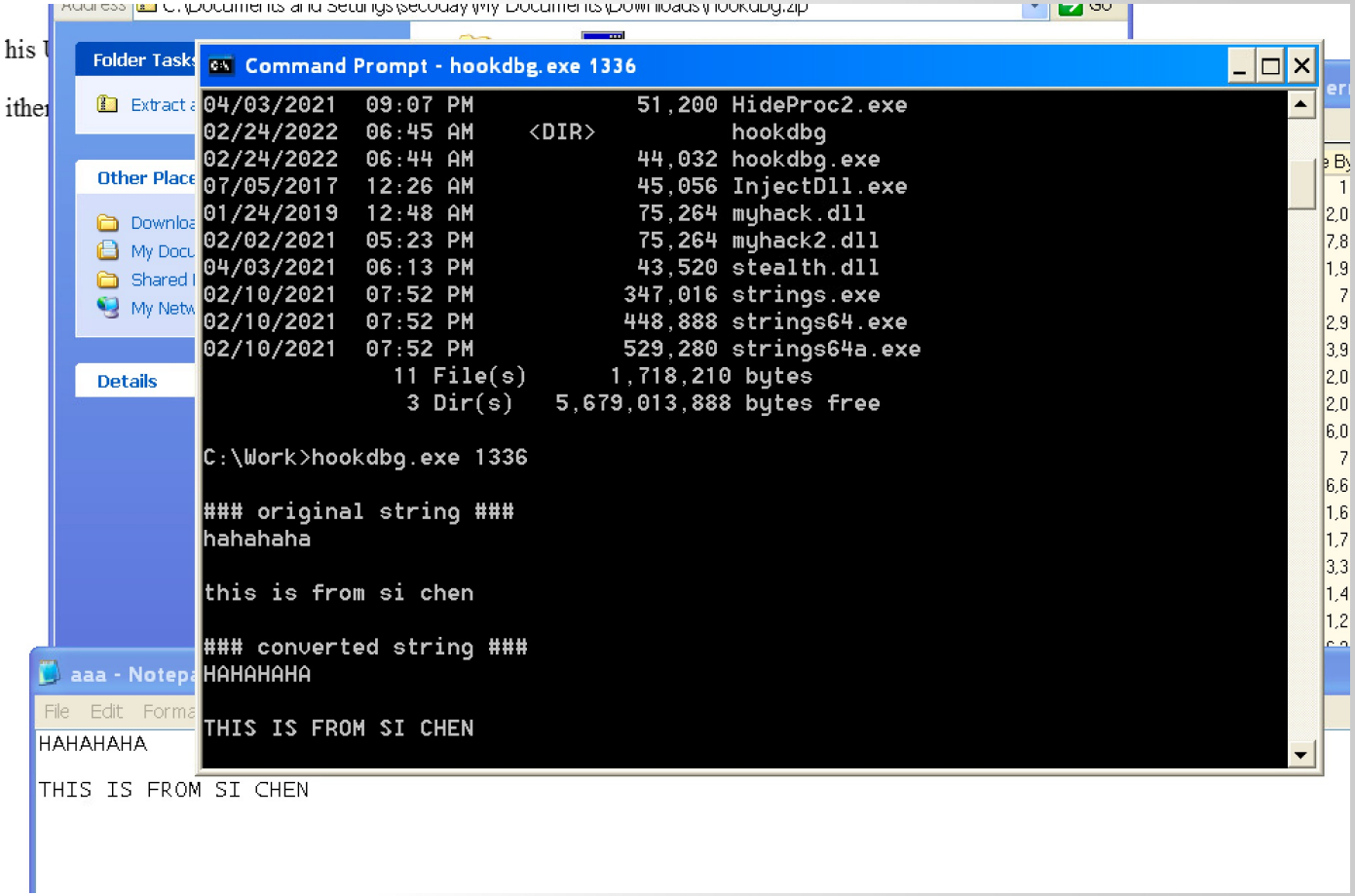


Hookdbg.exe

- API hook for Notepad WriteFile() function



Hookdbg.exe

- kernel32!WriteFile() API

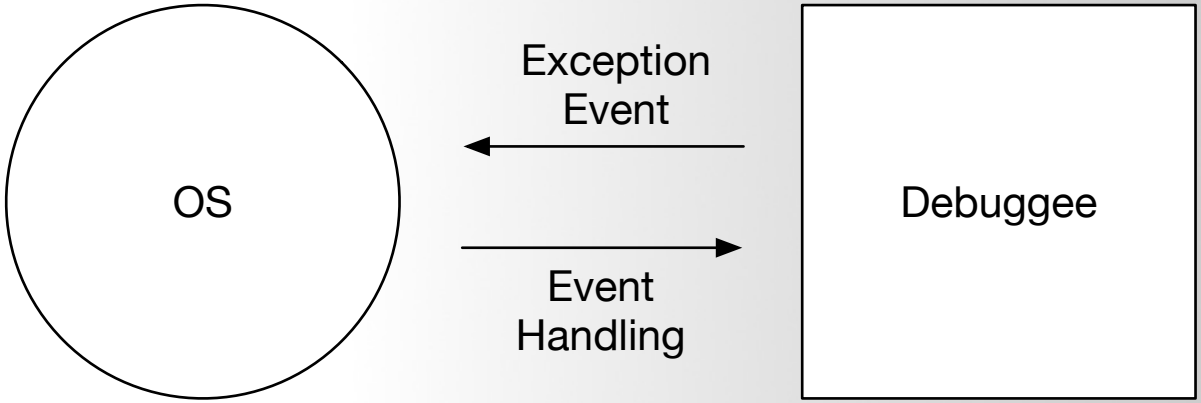
Syntax

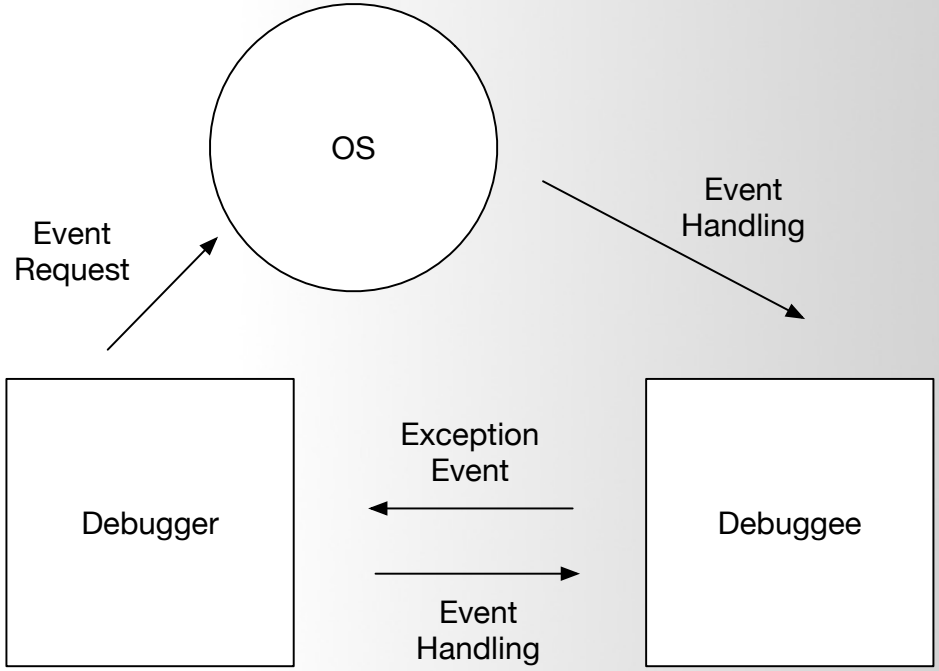
C++ Copy

```
BOOL WriteFile(
  [in]                HANDLE       hFile,
  [in]                LPCVOID      lpBuffer,
  [in]                DWORD        nNumberOfBytesToWrite,
  [out, optional]     LPDWORD      lpNumberOfBytesWritten,
  [in, out, optional] LPOVERLAPPED lpOverlapped
);
```

https://docs.microsoft.com/en-us/windows/win32/api/fileapi/nf-fileapi-writefile

How Debugger Works





`ExceptionCode`

The reason the exception occurred. This is the code generated by a hardware exception, or the code specified in the RaiseException function for a software-generated exception. The following tables describes the exception codes that are likely to occur due to common programming errors.

Value	Meaning
EXCEPTION_ACCESS_VIOLATION	The thread tried to read from or write to a virtual address for which it does not have the appropriate access.
EXCEPTION_ARRAY_BOUNDS_EXCEEDED	The thread tried to access an array element that is out of bounds and the underlying hardware supports bounds checking.

https://docs.microsoft.com/en-us/windows/win32/api/winnt/ns-winnt-exception_record

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IAT Hook Example

Q & A