Dangling Pointer

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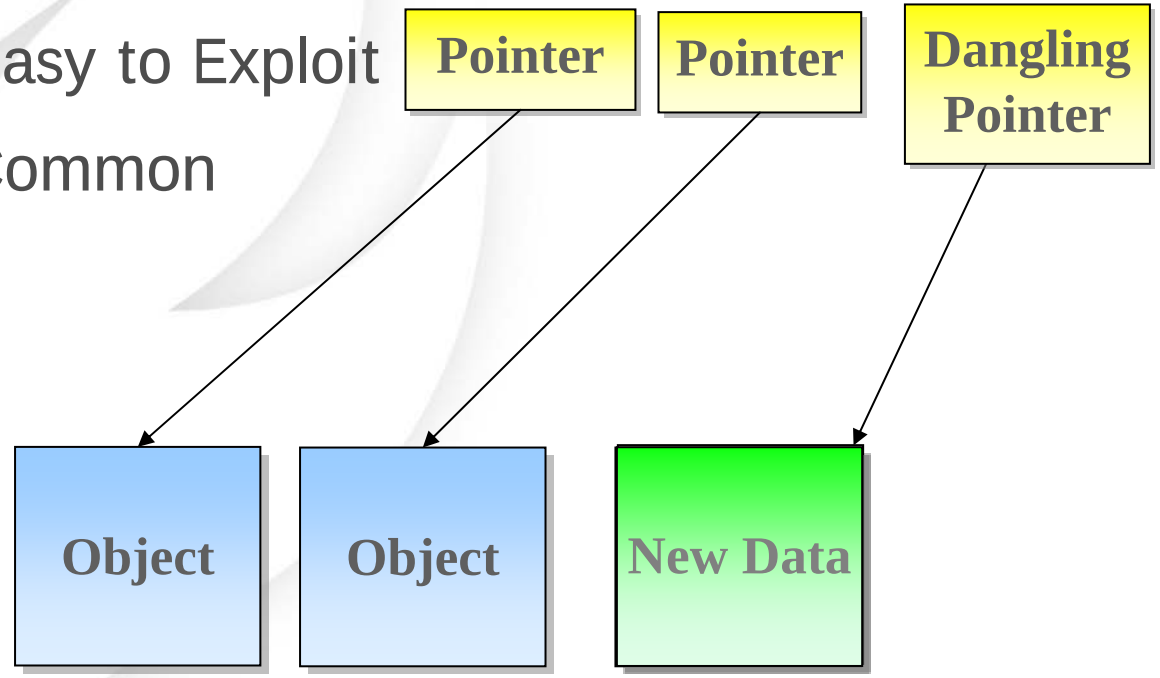
What is a Dangling Pointer?

Invalid Pointer:

- Dangerous
- Easy to Exploit
- Common



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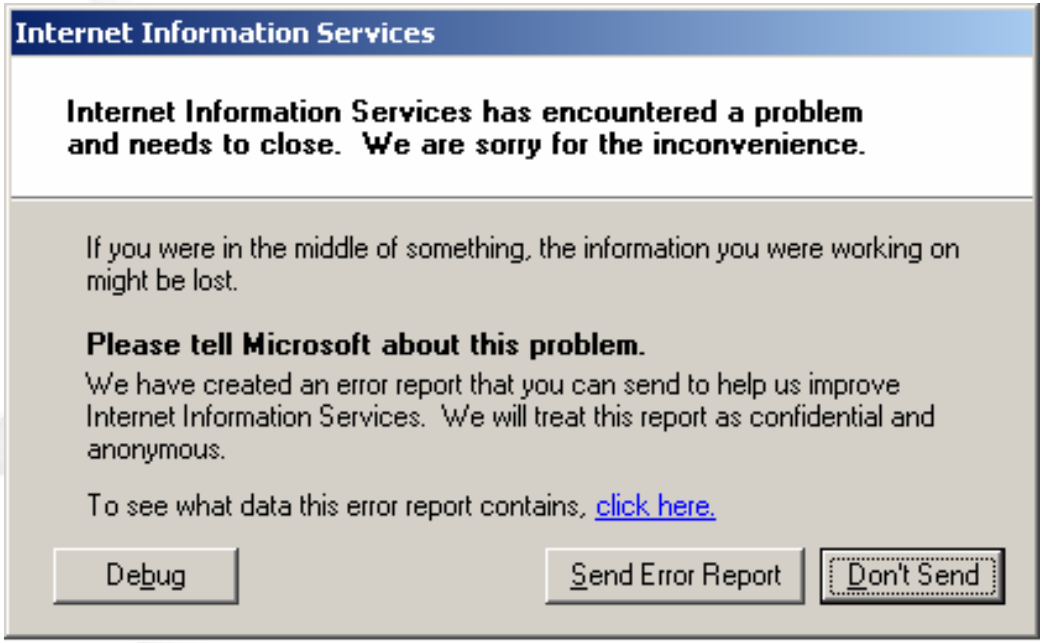
What is a Dangling Pointer? – An Example

- Results:

Crash



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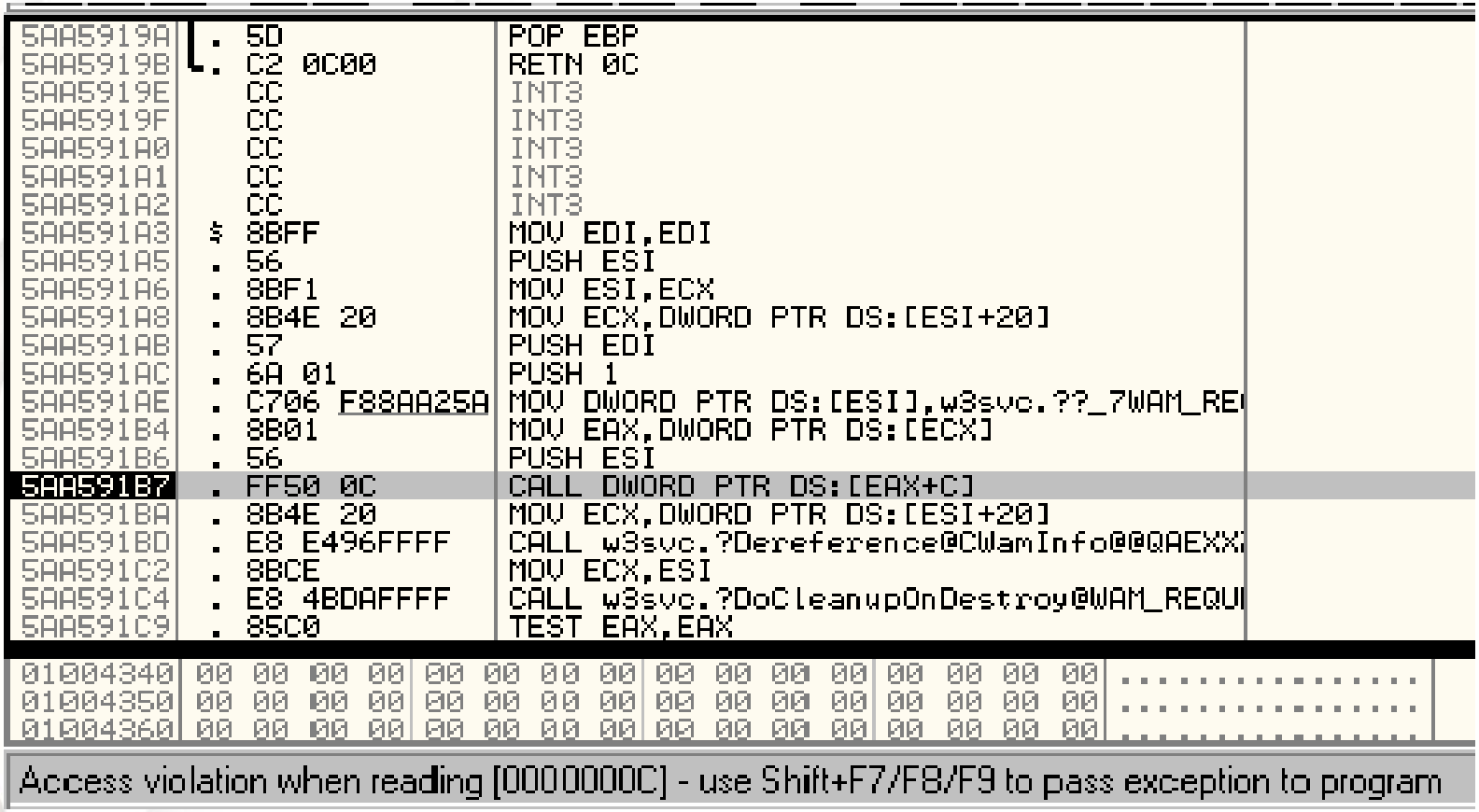
What is a Dangling Pointer? – An Example

- Debugger View



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Where are We

- What is a Dangling Pointer?
- **Code Injection**
- Object Overriding
- Demonstrations
- Remediation
- Summary
- Q&A

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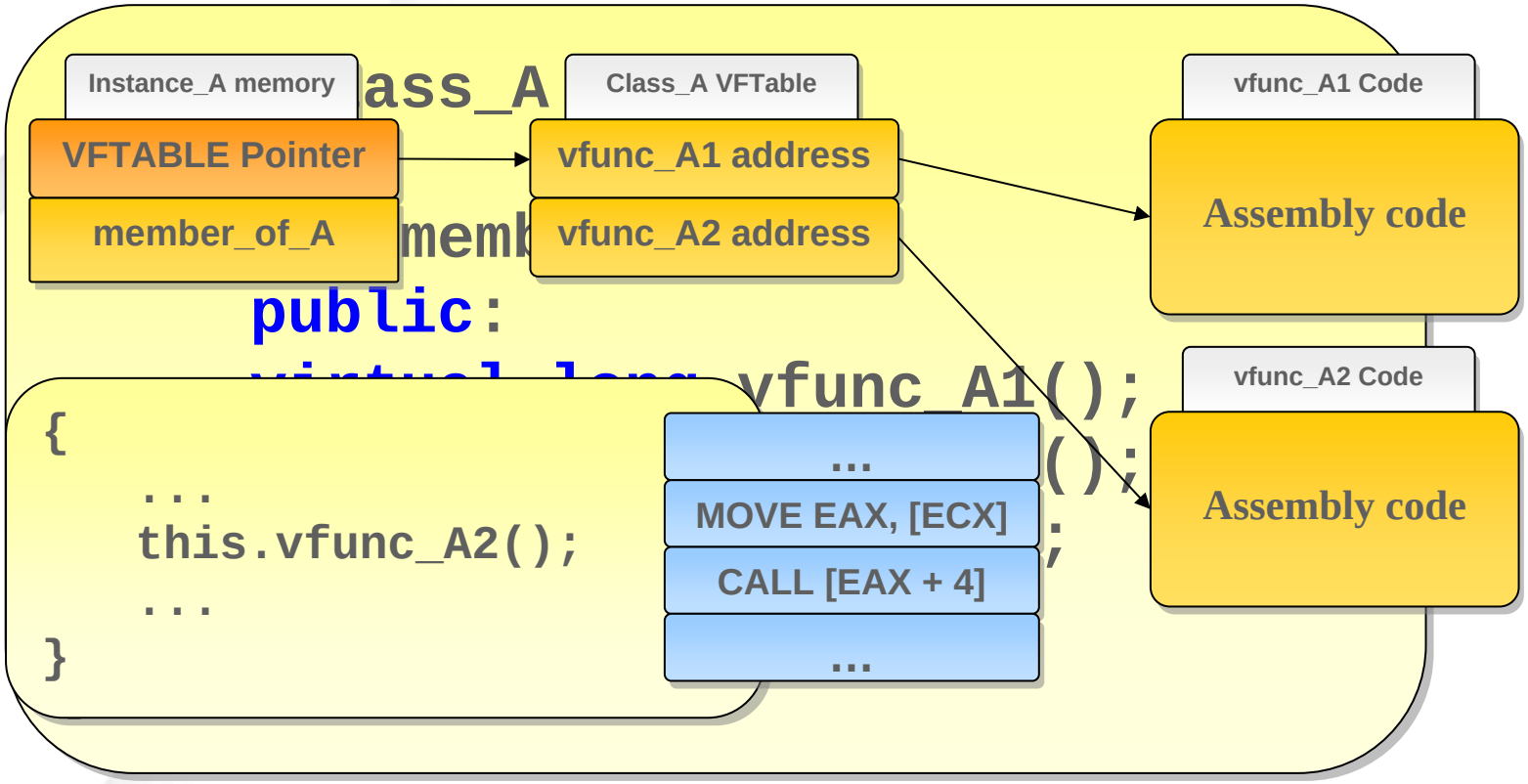
Code Injection – The Layout of an Object

- Class_A:



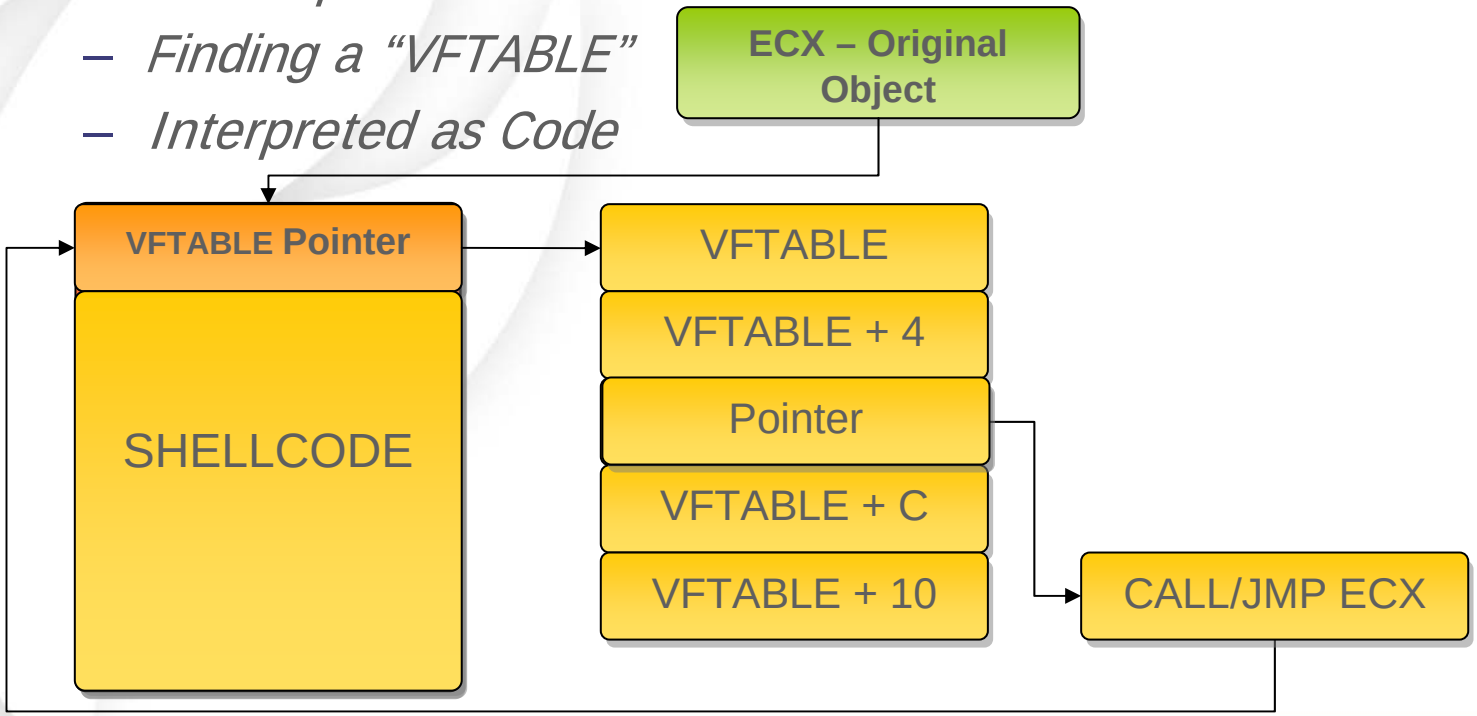
Code Injection – The Double Reference Exploit

Exploit Overview:

- Free the Object
- Override the Object – covered later
- Execute a Virtual Function

Code Injection – The Double Reference Exploit

- *Injecting Code*
  - *Free the Object*
  - *Shellcode*
  - *Call/Jmp ECX*
  - *Finding a "VFTABLE"*
  - *Interpreted as Code*
- *Continue*
  - *Automation*



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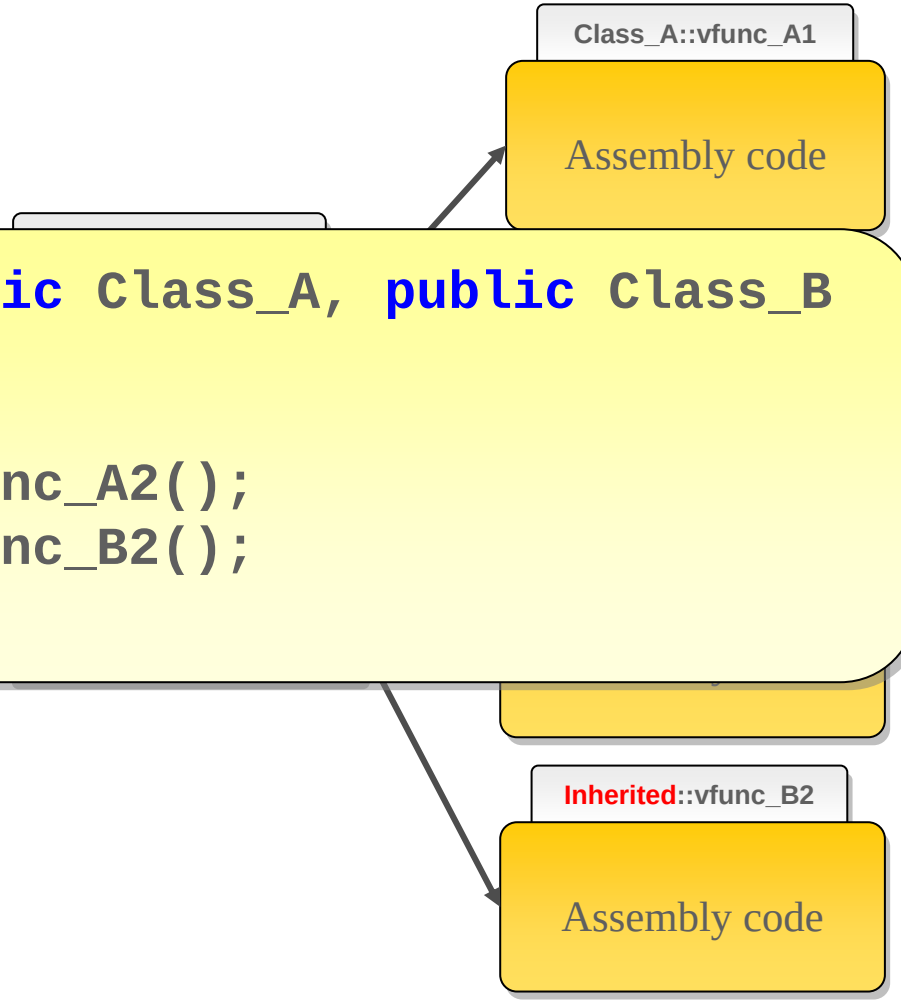
Code Injection – Double Inheritance

- Multiple Inheritance

```
class Inherited: public Class_A, public Class_B
{
public:
      virtual int vfunc_A2();
      virtual int vfunc_B2();
};
```



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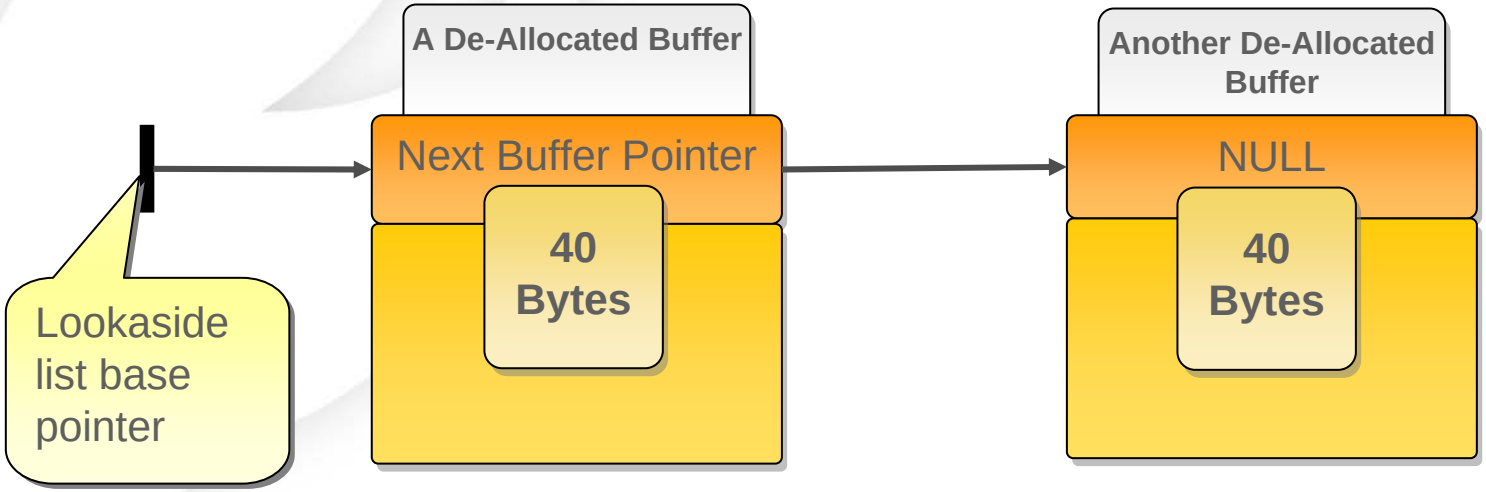
Object Overriding

- Allocation Implementation
  - Numerous heaps
    - Two Default heaps
    - Different API
    - C-Runtime functions
      - Malloc
      - Free
      - New
      - Delete
      - Etc.

Object Overriding

- Allocation implementation details
  - Lookaside List
    - A list for each size (8-1024) (8) and for each heap
    - First Allocation Priority
    - Merges



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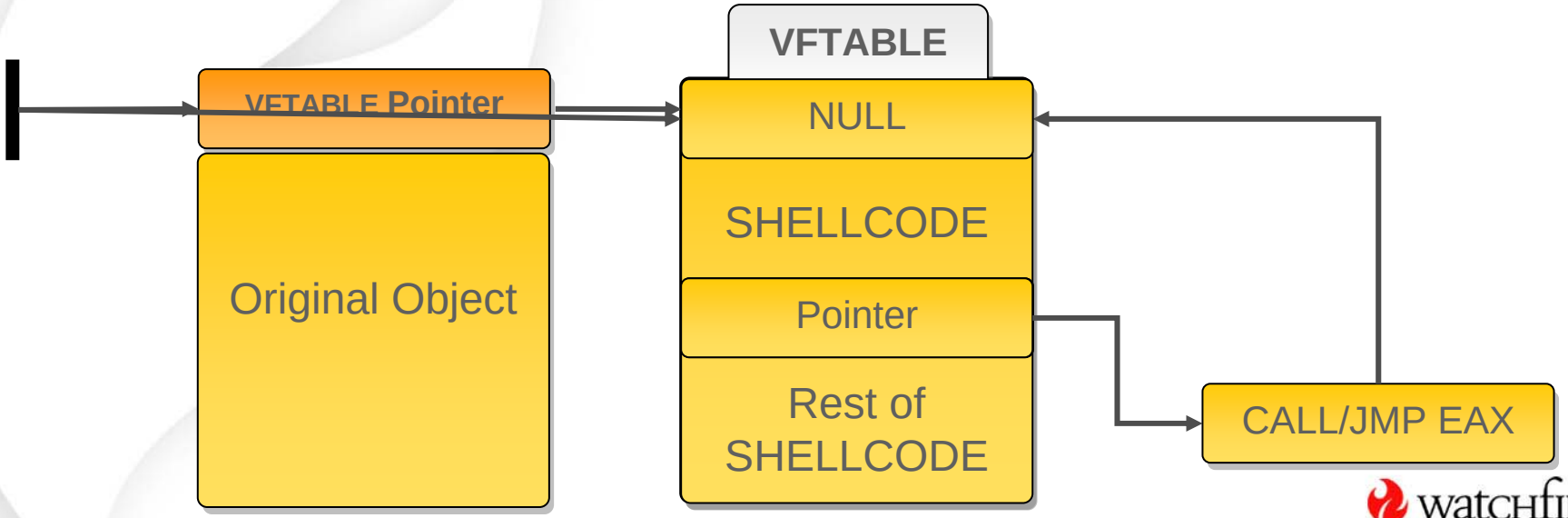
Object Overriding

- And Finally – Overriding
  - Search for Allocations
    - Static Analysis
      - Method: Disassembly
      - Restriction: Static Size
      - Validation: Controllable Content
      - Usage: Causing the Allocation
    - Dynamic analysis
      - Method: API Breakpoints
      - Restriction: Static/Dynamic Size
      - Validation: Controllable Content

Object Overriding – The VFTABLE Exploit

- Exploitation:
  - Empty the Lookaside List
  - Allocate a Buffer
  - Insert Content
  - Free the Buffer
- Continue:
  - Free the Object
  - Execute a VFunc



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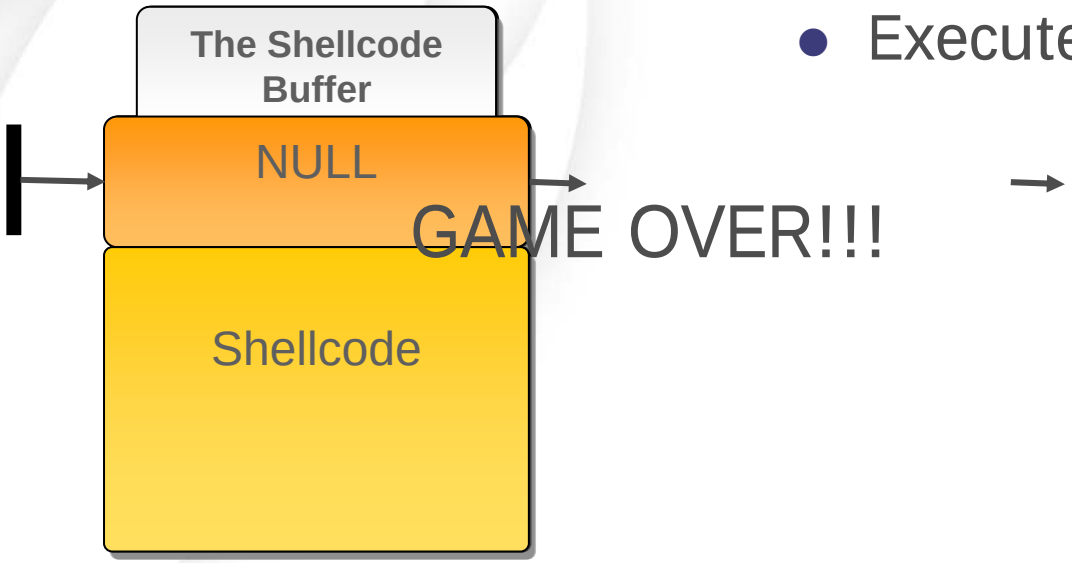
Object Overriding – The Lookaside Exploit

- Empty the Lookaside
- Allocate Two Buffers
- Insert Shellcode



- Free One Buffer
- Free The Other
- Free The Object
- Execute the Destructor

Object Overriding – The Lookaside Exploit

- Executing NULL – NO Problem

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Summary

- Summary
  - Double Reference
    - Controllable First DWORD
    - Static Address
  - VFTABLE Exploit
    - Controllable Allocations
    - No First DWORD
    - Static Address
  - Lookaside Exploit
    - Controllable Allocations
    - No First DWORD
    - No Static Address
    - Destructor Execution

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Where are We

- What is a Dangling Pointer?
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- Object Overriding
- **Demonstrations**
- Remediation
- Summary
- Q&A

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Demonstrations – Configuration Item

- Allocating the Object
- De-Allocation the Object

Demonstrations – Configuration Item

- Allocating User Data

Demonstrations – Configuration Item

- Executing a VFunc

Demonstrations – Configuration Item

- Putting it Together
  - De-Allocate
  - Re-Allocate
  - Execute

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Demonstrations – Remote Exploit

- Another Exploit on IIS,
  but this time – a remote one

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Where are We

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- Demonstrations
- **Remediation?**
- Summary
- Q&A

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Remediation

- Known Protection Mechanisms
  - NX Bit
  - ASLR
- VFTABLE Sanitation
- Safe Programming

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Summary

- Technical Background
  - Memory Allocations
  - Objects Implementation
- Exploits
  - Double Reference Exploit
  - VFTABLE Exploit
  - Lookaside Exploit
- Demonstrations
  - Configuration Item
  - Remote Exploit
- Dangling Pointer
  - Only Object Oriented Objects

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Questions

- Ask Away...

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