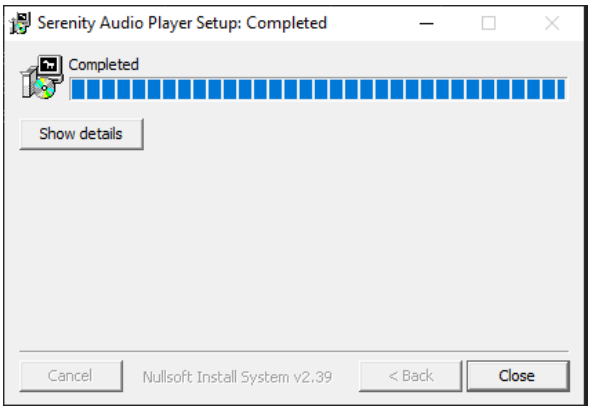
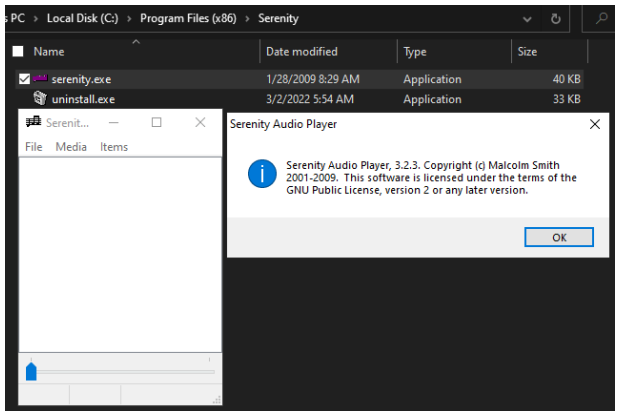
Lab 04 – Simple SEH Overwrite

Total Points: 18

Task 1 - Audio:
This is warm up and it corresponds to what we did in our class videos, so try to follow along and then take it a step further.

- Install the software





Part 1:

- Complete the following in-class activity:
  - Create a working SEH script. **Include the script for points**. Be sure it can run in the Windows 7 IA lab environment. It is fine if you develop it elsewhere, but you may need to adapt it so that, the script can be ran when graded.
  - Do one that utilizes *pop pop ret* **or** one that utilizes *add esp, 8* for the SEH overwrite.
  - Get some shellcode to run to pop a calculator; do not use malicious shellcode at this point.
  - Obtain two screenshots:
    - The first should show the results of !exchain to show your SEH and NSEH overwrites.
    - The second should show your successfully executing shellcode.
  - Hint: Your form of input will be a malicious .m3u file that is loaded into the target application.

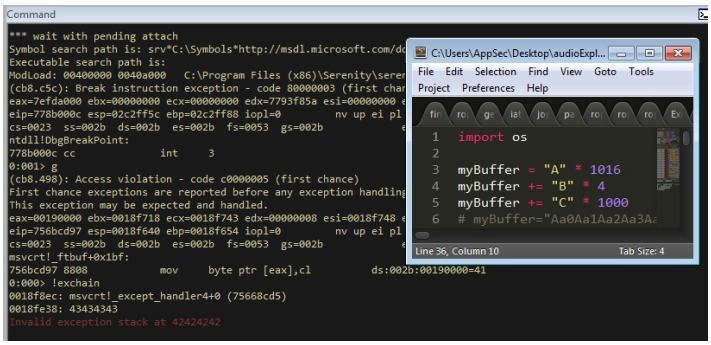


Figure 1: Hit EIP with 4-bytes of B's

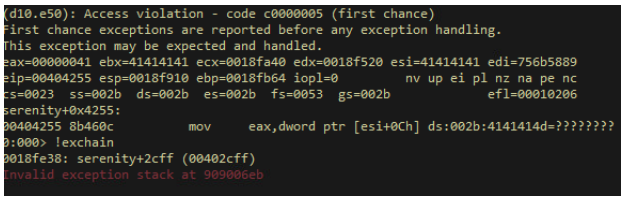


Figure 2: I used SEH 00402cff in my script shown above after short jmp 6.

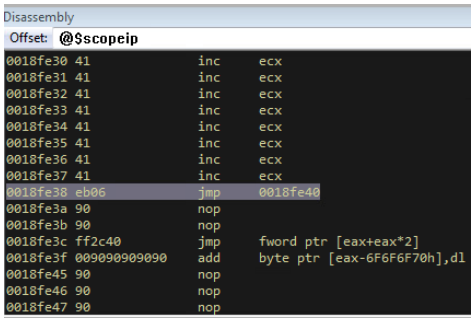


Figure 3: Buffer of A's then jump to the 30 nops from my script

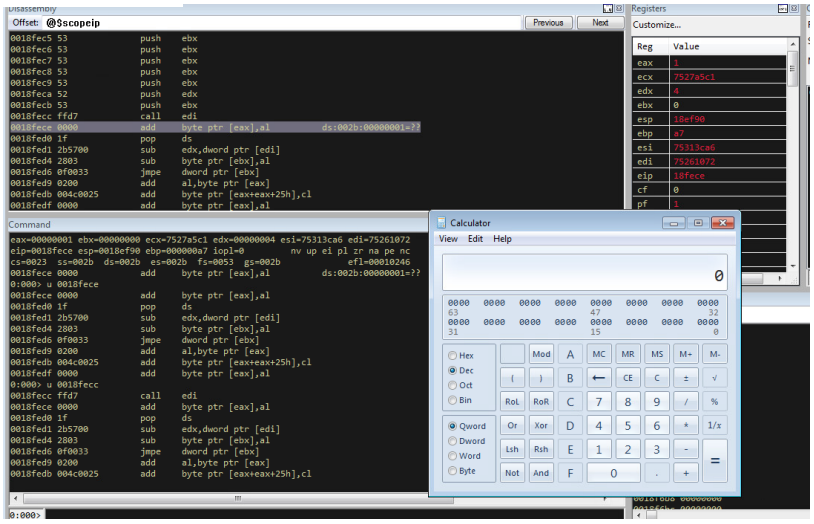


Figure 4: exploit script pops calc.exe

Part 2:

- What is the cause of the vulnerability? Trace it and find the vulnerable location in code that is exploitable.
    - Explain fully and utilize screenshots.
    - Be sure to trim your screenshots—no screenshots of your entire desktop please.

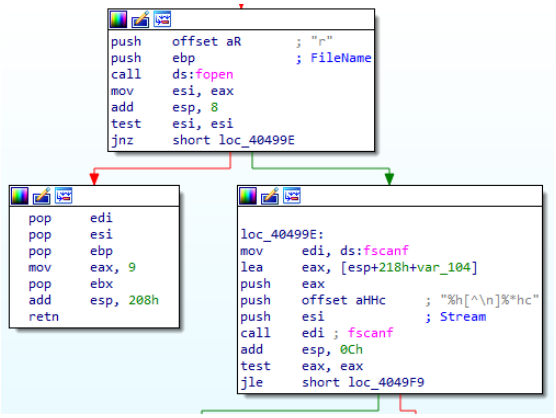
Answer:

From NIST: CVE-2009-4097: Stack-based buffer overflow in the MplayInputFile function in Serenity Audio Player 3.2.3 and earlier allows remote attackers to execute arbitrary code via a long URL in an M3U file.

Knowing I am able to overflow it with the file input, I looked for API calls to things related to file read. I came across fscanf() a known vulnerable function. Using IDAPro 7.6 I found calls to this function and looked at cross references (there's only 1). I looked at the function that used fscanf() and it was reading in a file as suspected. I used IDAPro's dissassembler and it was quite easy to see. Shortly after this there is a call to GlobalFree where there occurs a memory access situation.

```
char *v3; // eax
FILE *v4; // esi
char String[260]; // [esp+10h] [ebp-208h] BYREF
char v6[260]; // [esp+114h] [ebp-104h] BYREF

if ( !*Str )
  return 9;
v3 = strrchr(Str, 46);
if ( v3 )
{
  strcpy(String, v3 + 1);
  strupr(String);
}
else
{
  String[0] = byte_407518;
}
if ( !strcmp(String, aMsc) )
  return sub_404C80(a1, Str);
if ( strcmp(String, aM3u) )
  return sub_404A30(a1, Str);
v4 = fopen(Str, aR);
if ( !v4 )
  return 9;
if ( fscanf(v4, "%h[^\n]%*hc", v6) <= 0 )
{
LABEL_15:
  fclose(v4);
```



The file pointer *v4 is what the stream is read into as you can see in the fscanf() and it's put into the character array v6[260]. From the MSDN fscanf(pointer (v4), control string, location (v6). This is where the overflow occurs.

Task 2 – Chat Server:

The goal of this task is to manually fuzz and exploit the target binary. Obtain an SEH overwrite and get some shellcode to run. The target lab environment is Windows 7. **Your script should be runable as is in the IA lab environment, so if you work elsewhere, be sure to adapt it as need be to work in target environment.**

In order to accomplish this, you may wish to interact with the software and observe its normal behavior. You may even try to fuzz by copying and pasting into the console. Eventually, you will want to take a scripted approach, utilizing a Python or Perl script, to interact with the binary. (Note: You can also interact with the binary with just a Python interpreter, sending some of the same commands you might in a script. That could be part of an initial approach of interacting with it.) If you wanted to, you could capture traffic via Wireshark or similar tool and look at what if any commands go across the wire, although for this binary, it is simple enough you may not need to. Make sure to attach your debugger of choice to the binary, so you can capture exceptions and investigate. No debugger = no results.

In WinDbg, after you get an exception that you think is from your malicious input, run the command !exchain to view the SEH handler and NSEH, as these are what you will need to overwrite. Craft your input to overwrite the SEH and NSEH. Once you have overwritten these, replace them with real values, and then use a nop sled and ride it down to your shellcode. As to the shellcode, you are left to your own devices. At this stage, anything is acceptable, so it could be a benign shellcode or something generated by msfvenom (Metasploit). Note: you can search the internet for shellcode for Windows 7. You are not graded on what your shellcode does, so long as it does something. Something benign like popping a calculator is acceptable. **Note:** If your shellcode is malicious, please identify it as such.

This application is inherently flawed, so it also does not run as correctly as it could. Focus on trying to cause the SEH overwrite.

To complete the lab, provide the following tasks.

Part 1:

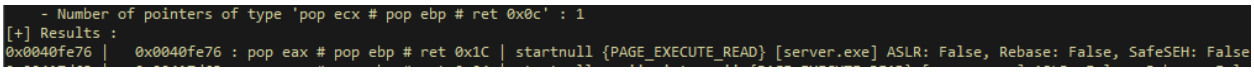
- Provide a narrative of how your exploit worked (limited to a maximum of one page);

Answer:

The exploit worked by overflowing a buffer in the vulnerable server.exe code. It was accomplished by running the server and fuzzing it through a socket connection on the listening port. I used A's, B's, and C's for the initial payload. I set B's to 4 bytes and C's to 1000 and just changed the A's using intuition to guess where it should be. It took me ~8-10 times of changing the A values before hitting the 4 bytes of B's exact. Then using some of my previous code from question 1 I set the NSEH to short jmp 6 or \xEB\x06\x90\x90. This is the pointer to the next SEH record and then used mona in windbg to find a valid pop pop ret I could use. The SHE get's triggered with the A's and you need to overwrite both parts (next record and pointer to current records exception handler) of the SEH record. When sending all this at the same time you are overwriting the SEH (ESP+8) with the short jmp 6, the pop pop ret. The pop pop ret pops 8 bytes off the stack and returns execution to the top of the stack which leaves the pointer to the next SHE at the top of the stack. This happens to be where the shellcode, nor nops then shellcode, sits you can ride in on your shellcode which in my case was calc.exe.

- Identify the gadget your used in your SEH overwrite. For instance, if this is pop pop ret or add esp, 0x8, then label the memory address for the gadget that does this.

Answer:
I used the pop pop ret at address 0040FE76 which was the first one that mona.py returned.

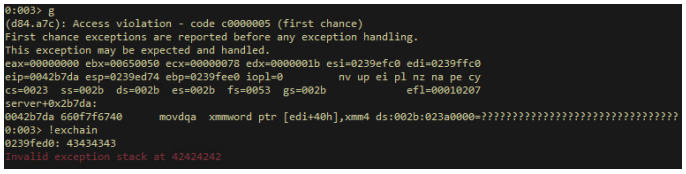


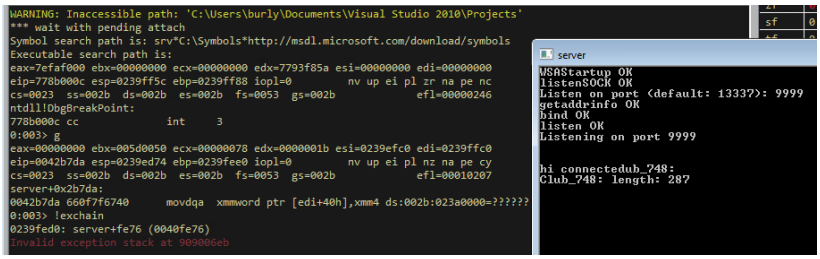
- Describe the process of finding gadgets to use for your SEH overwrite in the tools you choose to use. (You are taught to use some software, but if you know others, you are free to work with the tools of your choosing.) For instance, would you use WinDbg and Mona—what would you do with them, and what would your workflow be?

Answer:

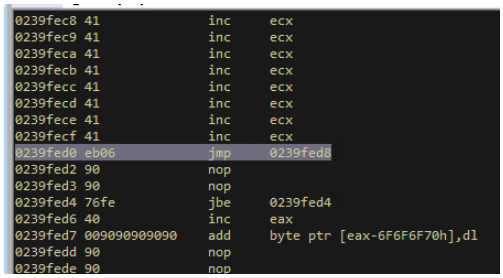
I used mona.py with windbg as shown in the class but I've used immunity debugger before with mona in Offsec OSCP but want to get better with windbg so I stuck with that. After fuzzing and once I controlled the 4 bytes in EIP I ran mona in windbg to find an appropriate SEH with pop pop ret instructions to use. I chose the first one from the list (0040FE76) and it worked successfully.

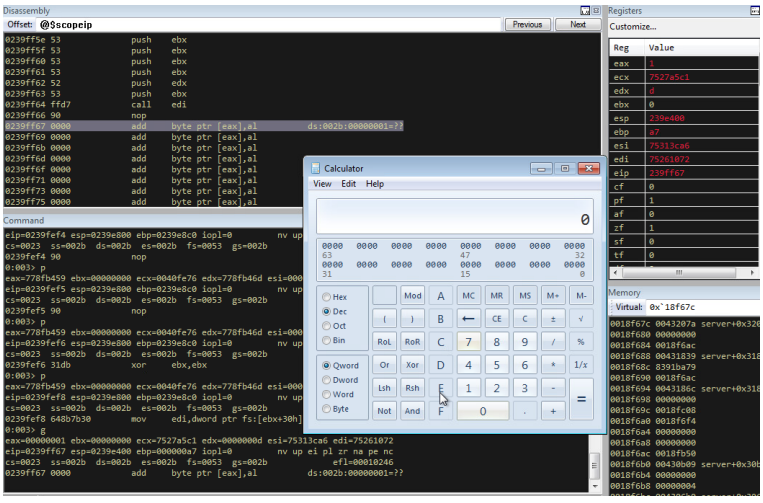
- A screenshot of successful execution, showing it in the debugger and execution of your shellcode, e.g. popping a calc. The images must accurately depict what is requested.
    - Show this via a screenshot with !exchain in WinDbg





    - Show your shellcode being executed.





- Your Python script must be included. I will look at and may run your scripts. Again, it should be written to run in the IA lab Windows 7 environment, so if you work elsewhere, be sure to adapt it.

Answer:

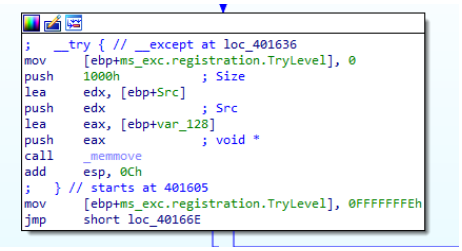
Requested scripts are attached to assignment.

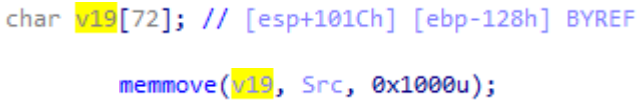
Part 2:

- Provide a narrative explaining the core vulnerability that caused this. What is it?
    - Find it in IDA Pro or Ghidra, along with your debugger—this is your evidence.
        - Confirm your suspicions. Don't just assume something is the cause because you saw it in static analysis; figure out how to confirm it in the debugger and present your evidence. (A one sentence description of the vulnerability with no evidence is not adequate.)
    - Show evidence in the form of screenshots and written descriptions—**both are expected.** Use coherent paragraph(s) while avoiding unnecessary, irrelevant digressions.
    - Explain the vulnerability. What can be done to fix it? Provide recommendations for remediation.
        - You must identify the vulnerability. If you do not know how to remediate it, then you can skip this.

Answer:

The core vulnerability is the function memmove(). The destination is smaller than the source. It causes an exception exactly on the call to memmove.





In the disassembly and decompilation above you can see that size 1000h is specified and read into an array size 72h. Memcopy doesn't do bounds check so it's vulnerable to buffer overflows in this fashion. To fix this you should use memcompy_s as this "secure" version incorporates bounds checking or what is called parameter validation to prevents a destination buffer from being overflowed.

Deliverable:

- **No zip files.** Attach each separately
- Your Python scripts.
- A Word Document or PDF that provides the requested tasks.
    - This is limited to no more than 10 pages, although it likely could be done in a lot less. Answers with a few screenshots and 1 or 2 sentences though will be inadequate and loss points. You can be brief, but you must explain fully.

- Do not need 15 pages showing images of varying amounts of A’s and B’s as input. 😊 It is fine to retain those for your personal notes, but that should not be a part of the submission.