Centro de
Investigación en
Computación

Herramientas de Análisis

Introducción

Revisión de conceptos

Laboratorios de malware

Course

Análisis y Detección de Malware

Instructor

Acosta Bermejo Raúl

Lecture notes

2024-B
7 de noviembre del 2024
Última actualizacioón

Instituto
Politécnico
Nacional

Table of contents (outline)

Tabla de contenido

1. Introducción
2. Archivos ejecutables
3. Herramientas de análisis
4. Des-ensamblado
5. Volcado de memoria
6. Conclusiones

Introduction

Introducción

Motivación

Introduction

Introducción

Definiciones (algunas)

- Des-ensamblar / Disassembly, Disassemblers
- De-compilar / Decompilers
- URL
  - Lista de herramientas

    https://en.wikibooks.org/wiki/X86_Disassembly/Disassemblers_and_Decompilers

Estructura de Ejecutables

PE, ELF, Mach-O

Conceptos, herramientas.

Herramientas de análisis

Introducción

Ejemplos

- Web

  https://elfy.io/

- GUI
- CLI: readelf (linux)
- API

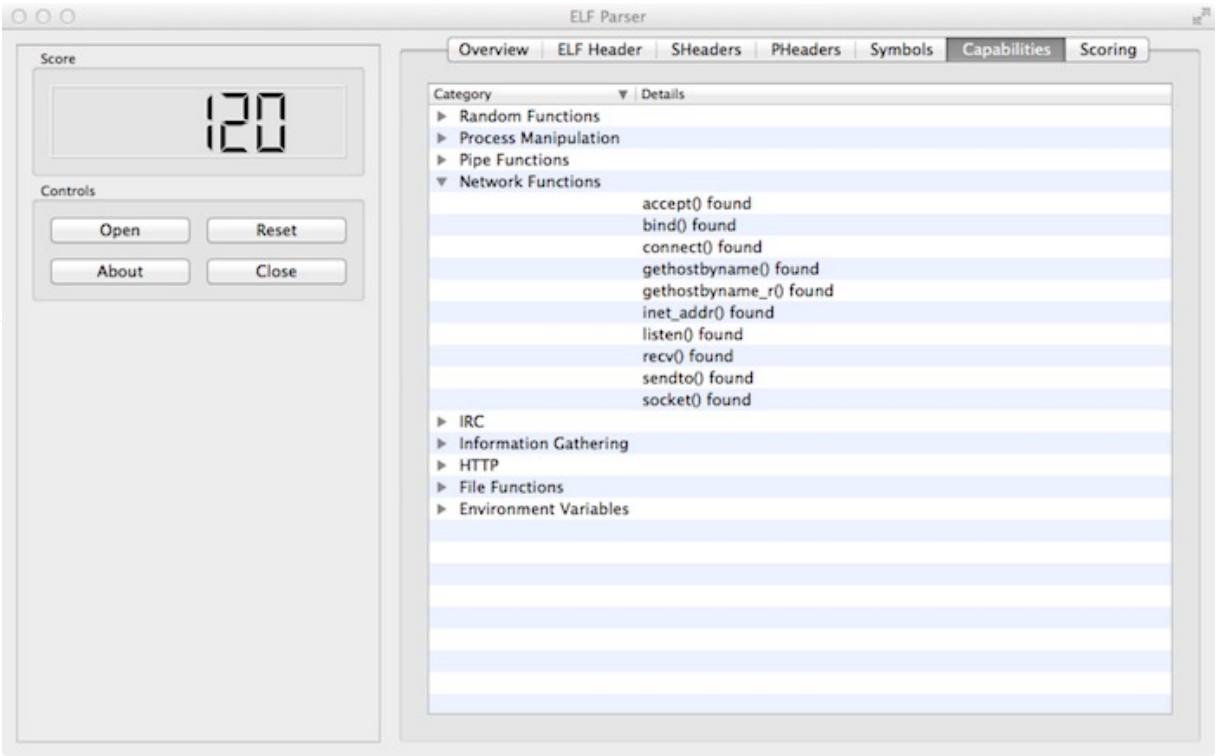
Librerías

C++, http://elfio.sourceforge.net/

C#, http://elfsharp.hellsgate.pl

ELF parser

http://www.elfparser.com



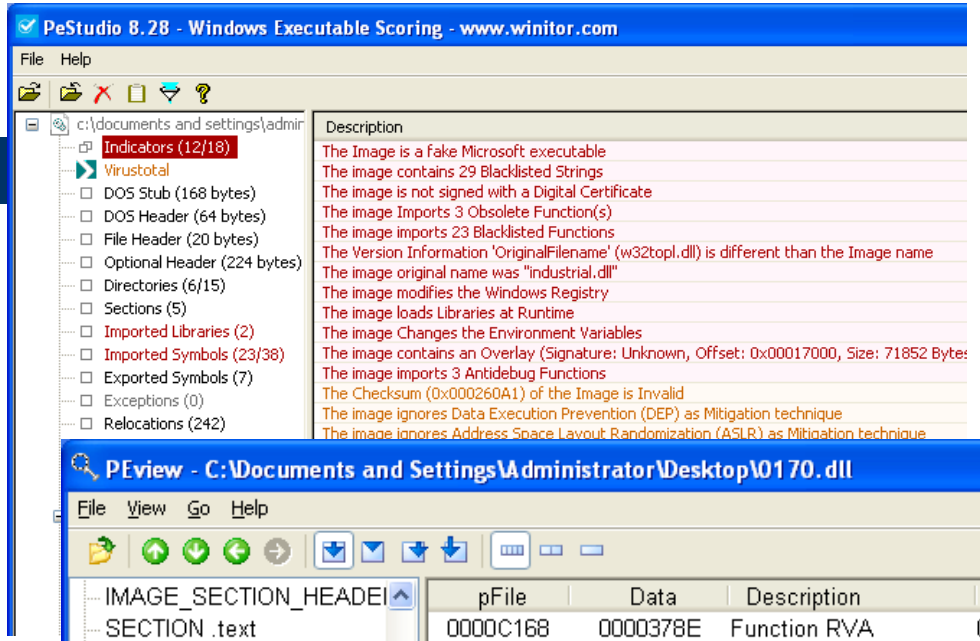
Herramientas de análisis

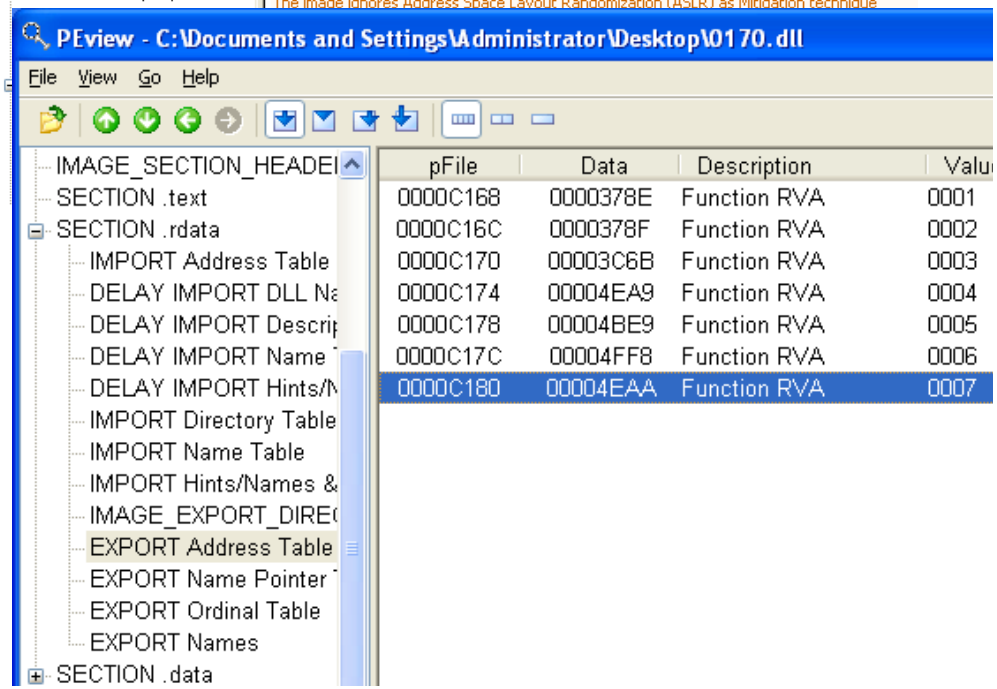
Introducción

Ejemplos

- Web
  - https://manalyzer.org/
- GUI
  - Peview, PEstudio
- CLI
  - https://github.com/erocarrera/pefile
  - http://pev.sourceforge.net/
- API

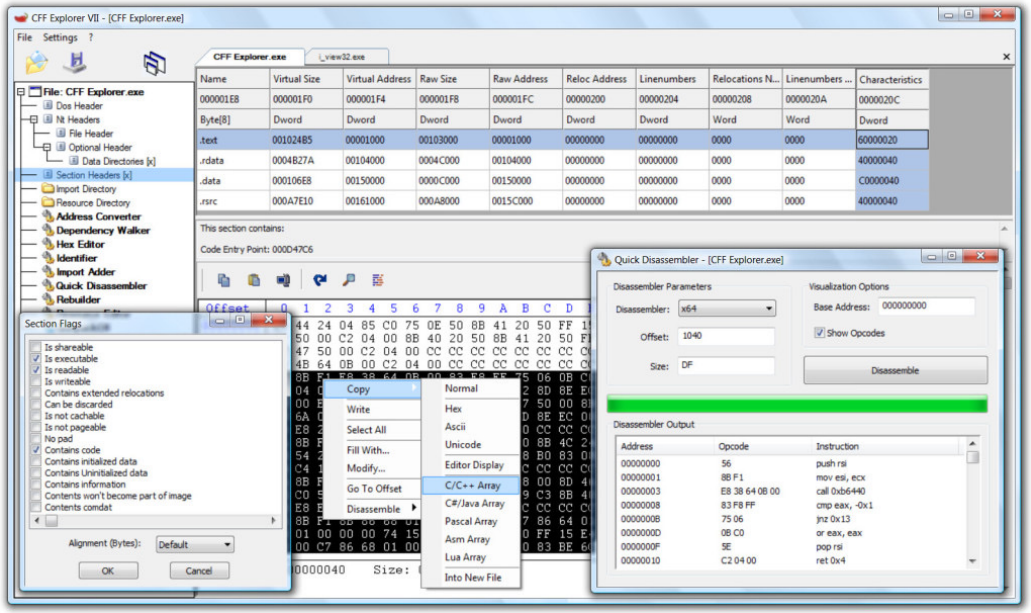
  Librerías
  - https://pypi.org/project/pefile/





Herramientas de análisis

Introducción

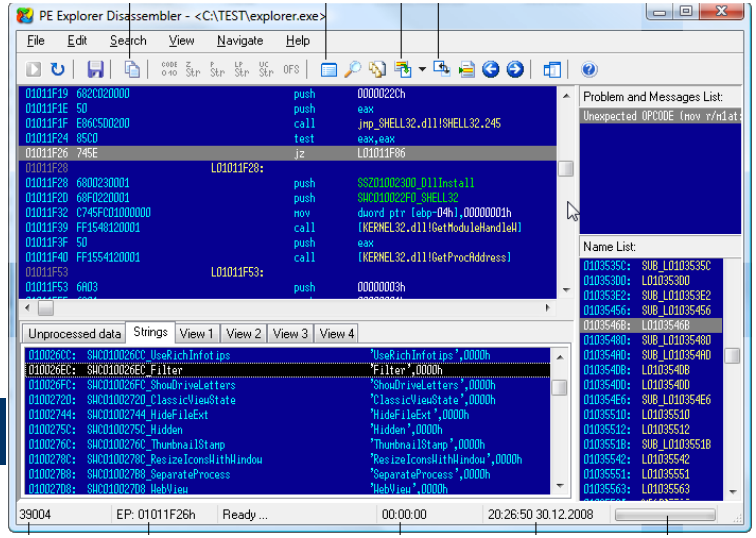


Ejemplos

- GUI
  - Varias herramientas para realizar el análisis de archivos en Windows.
  - Explorer Suite, CFF
  - Freeware
- Permite editar el PE
  - Encabezado o su contenido.
- Link
  - https://ntcore.com/

Des-ensamblador

PE Explorer's disassembler



- It tried to achieve most of the power of IDA Pro, while requiring less skill or knowledge, by automating more of the disassembly process.
- The disassembler supports the most common Intel x86 instruction sets and extensions (MMX, 3D Now!, SSE, SSE2 and SSE3).
- The PE Explorer disassembler assumes that some manual editing of the reproduced code will be needed. To facilitate additional hand coding, however, the disassembler utilizes a qualitative algorithm designed to reconstruct the assembly language source code of target binary win32 PE files (EXE, DLL, OCX) with the highest degree of accuracy possible.
- It runs on: Windows 98/ME/NT/2000/XP/Vista/7/8.

Links

- http://www.heaventools.com/PE_Explorer_disassembler.htm.

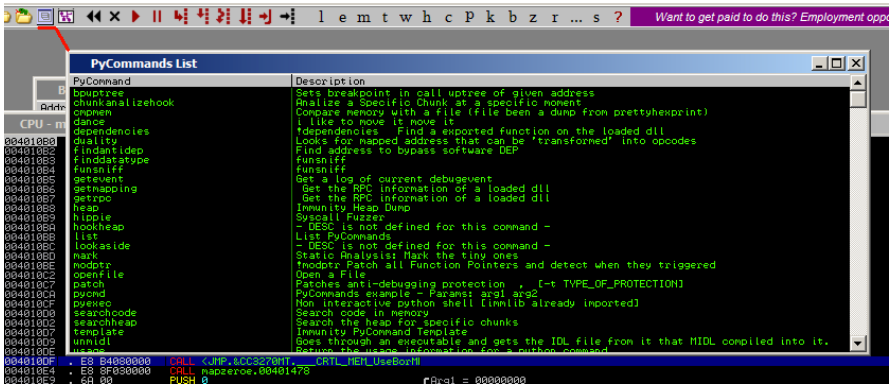
Des-ensamblador

Immunity Debugger

- Immunity Debugger is a branch of OllyDbg v1.10, with built-in support for Python scripting and much more.
- Immunity Debugger is a powerful new way to write exploits, analyze malware, and reverse engineer binary files. It builds on a solid user interface with function graphing, the industry's first heap analysis tool built specifically for heap creation, and a large and well supported Python API for easy extensibility.

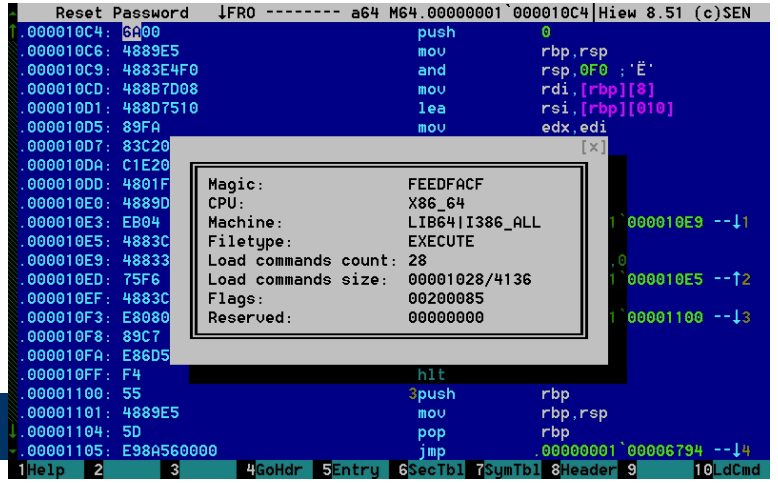
Links

- http://www.immunityinc.com/products/debugger/.



Des-ensamblador

Hiew



- It views and edits files of any length in text, hex, and decode modesx86-64 disassembler & assembler (AVX instructions include)
- Physical & logical drive view & edit
- Support for NE, LE, LX, PE/PE32+, ELF/ELF64(little-endian), Mach-O(little-endian) executable format
- Ssupport for Netware Loadable Modules like NLM, DSK, LAN,...
- Following direct call/jmp instructions in any executable file with one touch
- Pattern search in disassembler
- Built-in simple 64bit decrypt/crypt system.
- Unicode support.
- ArmV6 disassembler.

Links

- http://www.hiew.ru/.

Análisis de Ejecutables

Varios elementos

Conceptos, herramientas.

Introduction

Herramientas

Son programas especializados en el análisis de archivos binaries, por ejemplo, de archivos ejecutables, librerías, imágenes, etc.

Para malware la mayoría se centra en archivos ejecutables y su manipulación (ej, depuración):

1. IDA pro, comercial y gratuito
2. Radare2, gratutito
3. x64dbg
4. OllyDbg
5. ODA
6. Hooper, sólo para MacOSX

GUI
CLI
API

Herramientas de análisis

Introducción

Ejemplos de CLI

- Windows
  - Dumpbin
  - https://docs.microsoft.com/en-us/cpp/build/reference/dumpbin-reference?view=msvc-170
- Linux
  - Readelf
  - https://man7.org/linux/man-pages/man1/readelf.1.html

YASCA (Yet Another Source Code Analyzer)

Descripción

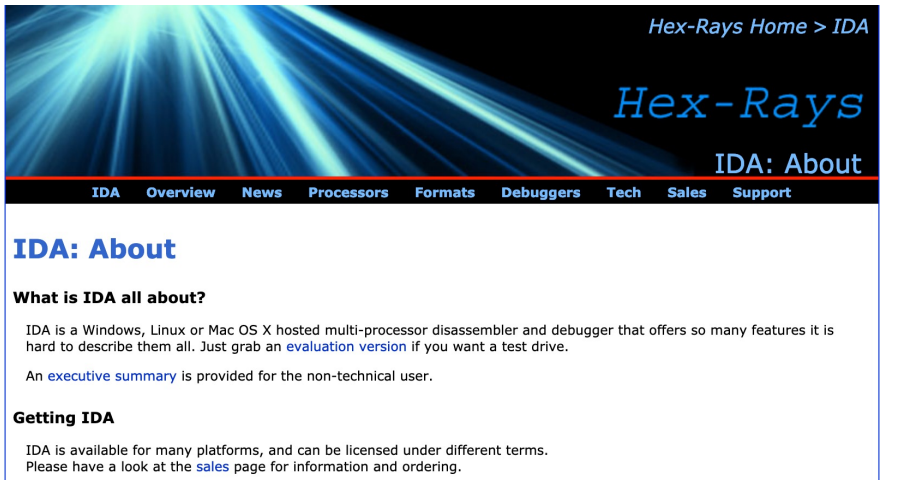
- It is an open source program which looks for security vulnerabilities, code-quality, performance, and conformance to best practices in program source code.
- It leverages external open source programs, such as FindBugs, PMD, JLint, JavaScript Lint, PHPLint, Cppcheck, ClamAV, Pixy, and RATS to scan specific file types, and also contains many custom scanners developed for Yasca.
- It is a command-line tool that generates reports in HTML, CSV, XML, MySQL, SQLite, and other formats.
- It is listed as an inactive project since 2010.

Link

- https://en.wikipedia.org/wiki/Yasca
- http://www.scovetta.com/yasca.html

Des-ensamblador

IDA



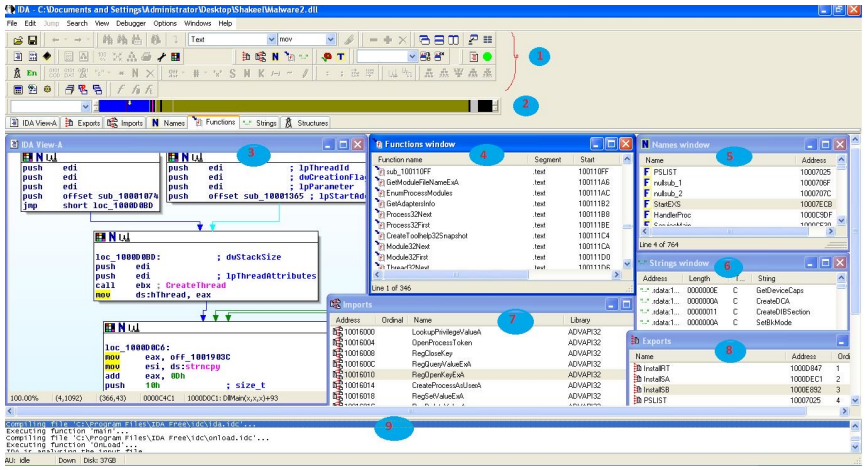
- IDA is the Interactive DisAssembler: the world's smartest and most feature-full disassembler, which many software security specialists are familiar with.
- Written entirely in C++, IDA runs on the three major operating systems: Microsoft Windows, Mac OS X, and Linux.
- IDA is also the solid foundation on which our second product, the Hex-Rays decompiler, is built.
- The unique Hex-Rays decompiler delivers on the promise of high level representation of binary executables. It can handle real world code.

Links

- https://www.hex-rays.com/index.shtml

En noviembre del 2019 se adquirió:

LICENSE	PRODUCT	NSEATS	SHA-1 DIGEST
48-B675-7A24-0C	IDAPROFL	1-user	511904fd95f43babb367a75d6aa316025cda741b (x64)



Des-ensamblador

IDA

Scripts

- IDC
  - https://hex-rays.com/products/ida/support/tutorials/idc/
- IDApython
  - https://github.com/tmr232/idapython
- CLI
  - https://www.hex-rays.com/products/ida/support/idadoc/417.shtml
- Tutoriales
  - https://programmerclick.com/article/64621916607/

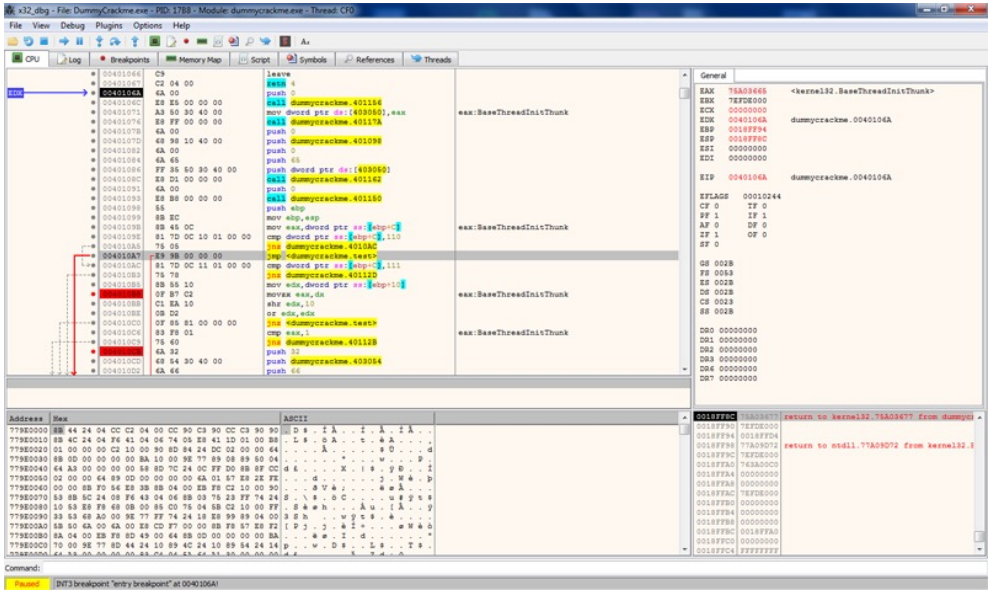
Des-ensamblador

x64dbg

- x64dbg is an **open source** that can debug both x64 and x32 applications for Windows.

Links

- http://x64dbg.com/
- https://sourceforge.net/projects/x64dbg/files/snapshots/.



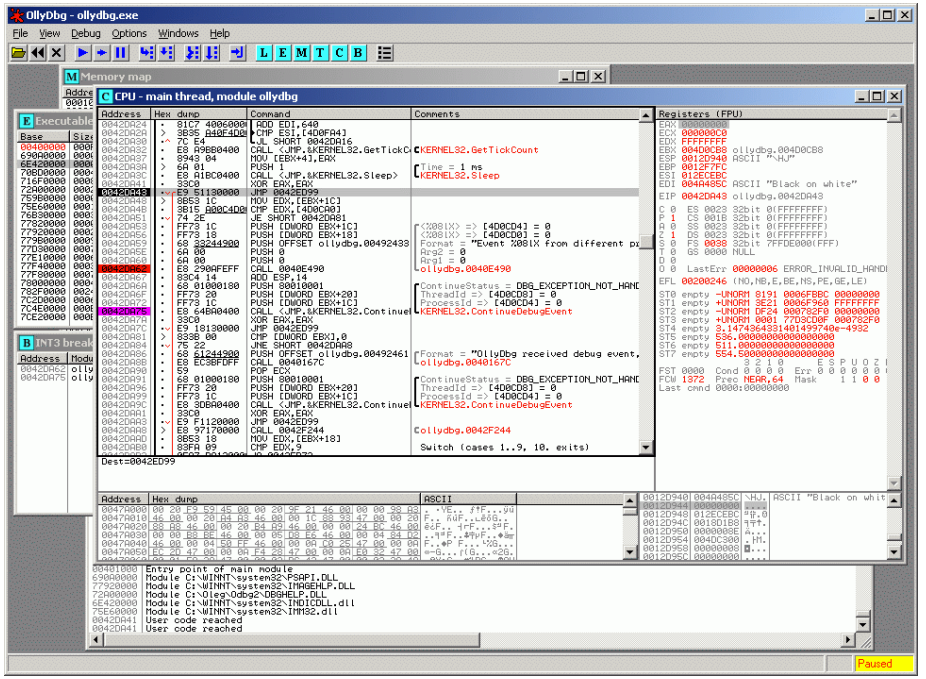
Des-ensamblador

OllyDbg

- It is a 32-bit assembler level analysing debugger for Microsoft® Windows®.
- Emphasis on binary code analysis makes it particularly useful in cases where source is unavailable.
- OllyDbg is a shareware, but you can download and use it for free.
- Version 2.01 (27/sept/2013)

Links

- http://www.ollydbg.de/.



Des-ensamblador

Radare2

- Radare2 is an open source tool to disassemble, debug, analyze and manipulate binary files.
- It actually supports many architectures:

  x86{16,32,64}, Dalvik, avr, ARM, java, PowerPC, Sparc, MIPS.
- Several binary formats:

  pe{32,64}, [fat]mach0{32,64}, ELF{32,64}, dex and Java classes
- Apart from support for filesystem images and many more features.

Links

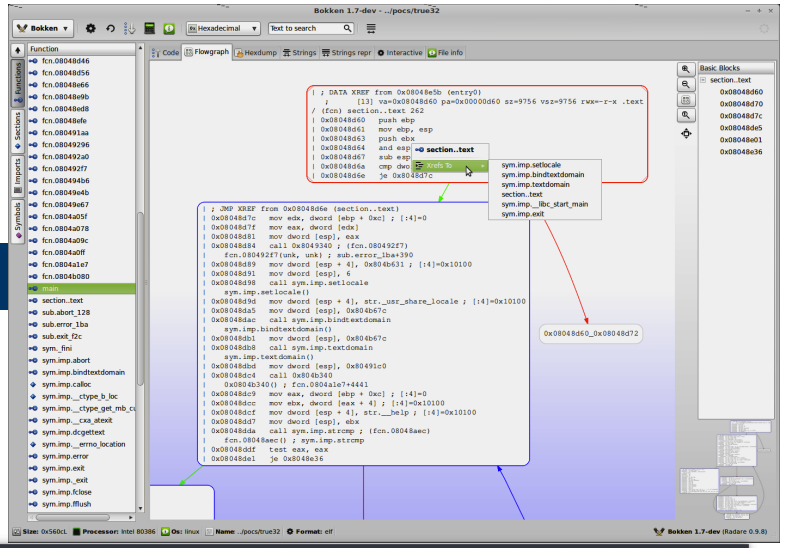
- http://radare.org/r/.
- **Book**: https://book.rada.re/
- **Wiki**: https://r2wiki.readthedocs.io/en/latest/

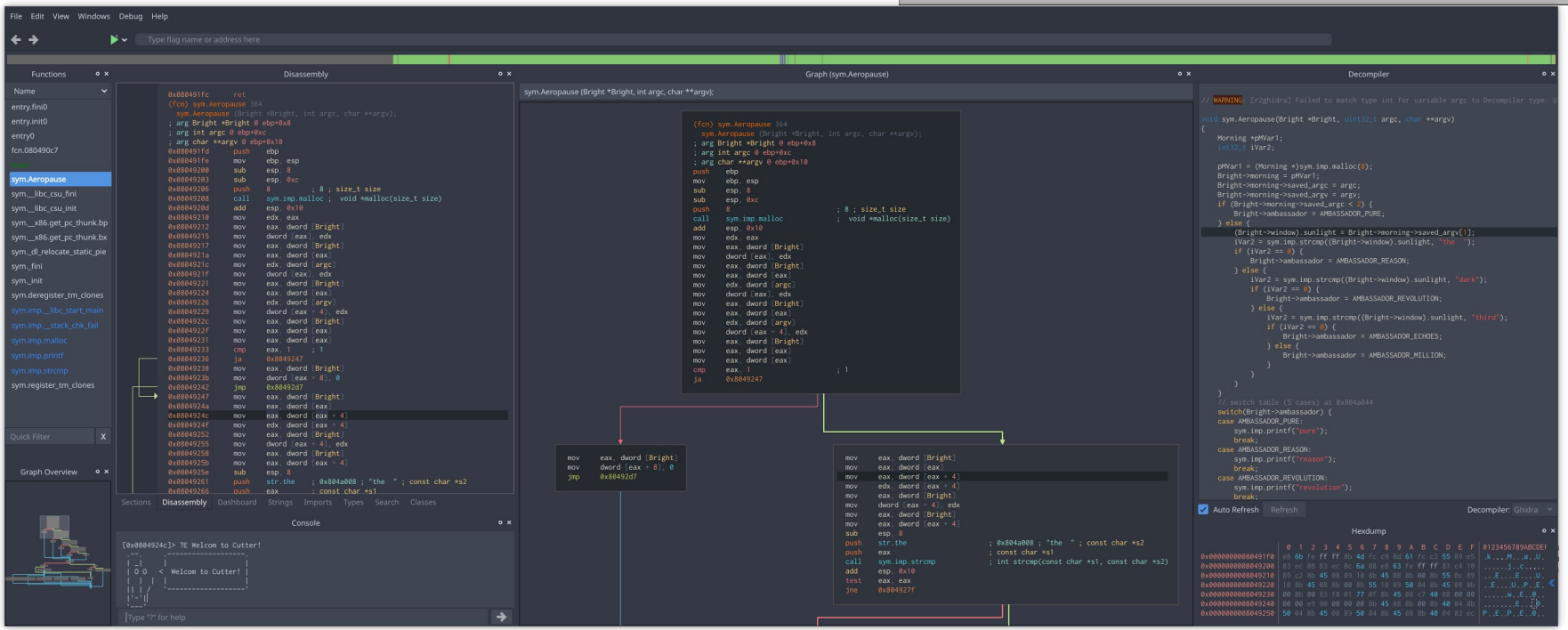
Des-ensamblador

Radare2

Radare2 GUI

- Cutter
- PyGTK





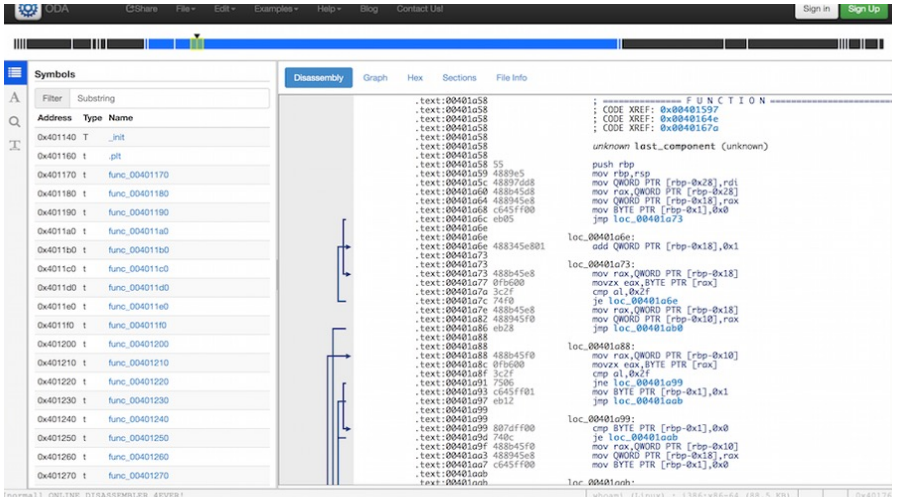
Des-ensamblador

ODA

- A lightweight, online service that explores executables by dissecting its sections, strings, symbols, raw hex and machine level instructions.
- It supports over 60 machine architectures, including x86, ARM, PowerPC, MIPS and many more.
- All major file formats supported, including Windows PE, ELF, COFF, SREC, Mach-O, and more.
- Graph View visually shows the control flow of the currently selected function.

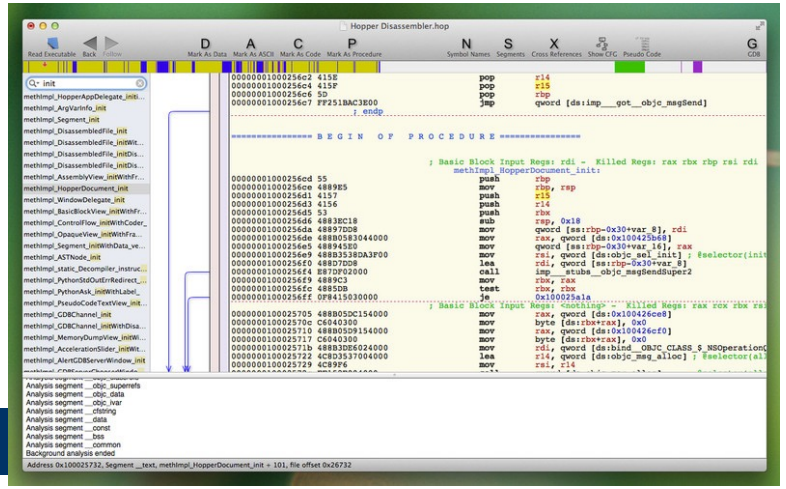
Links

- https://www.onlinedisassembler.com/.



Des-ensamblador

Hopper



- Hopper is a reverse engineering tool for OS X and Linux, that lets you disassemble, and decompile your 32/64bits Intel Mac, Linux, Windows and iOS executables.
- Release 3 (13/ago/2016), Commercial and Demo with limitations.
- The idea behind Hopper is to transform a set of bytes (the binary you want to analyze) into something that could be read by a human. To do so, Hopper will try to **associate a type to each byte of the file**. Because it would be too much expensive to do it manually, Hopper proceeds to an automatic analysis as soon as you loaded a file. The various types that can be used in hopper are:
  - **Data**: an area is set to the *data* type when Hopper thinks it is an area that represents a constant, like an array of *int* for instance.
  - **ASCII**: a NULL terminated C string.
  - **Code**: an instruction
  - **Procedure**: a byte receives this type once it has been determinate that it is part of a method that has been successfully reconstructed by Hopper.
  - **Undefined**: this is an area that has not yet been explored by Hopper.

Links

- https://www.hopperapp.com/

Des-ensamblador

Capstone

The current version is 4.0.2, which was released on May 8, 2020

- Capstone is a lightweight multi-platform, multi-architecture disassembly framework. Our target is to make Capstone the ultimate disassembly engine for binary analysis and reversing in the security community.
- Highlight features
  - Multi-architectures: Arm, Arm64 (Armv8), BPF, Ethereum Virtual Machine, M68K, M680X, Mips, MOS65XX, PowerPC, RISCV, Sparc, SystemZ, TMS320C64X, Web Assembly, XCore & X86 (include X86_64).
  - Clean/simple/lightweight/intuitive architecture-neutral API.
  - Provide details on disassembled instruction (called “decomposer” by some others).
  - Provide some semantics of the disassembled instruction, such as list of implicit registers read & written.
  - Implemented in pure C language, with bindings for D, Clojure, F#, Common Lisp, Visual Basic, PHP, PowerShell, Haskell, Perl, Python, Ruby, C#, NodeJS, Java, GO, C++, OCaml, Lua, Rust, D elphi, Free Pascal & Vala available.
  - Native support for Windows & *nix (with Mac OSX, iOS, Android, Linux, *BSD & Solaris confirmed).
  - Thread-safe by design.
  - High performance & suitable for malware analysis (capable of handling various X86 malware tricks).
  - Distributed under the open source BSD license.

Links

- https://www.capstone-engine.org/

Des-ensamblador

Comando

Uso de CLIs

- Linux
  - Comando objdump.
  - $ objdump –d /bin/ls
- Windows
  - Comando que forma parte del SDK
  - $ dumpbin /disasm

Des-ensamblador

API

Uso de APIs

- IDA pro
  - Tiene varios plugins y uno permite hacer el desensamblado con Python.
  - Requiere que IDA pro esté corriendo todo el tiempo.
  - Links
    - https://www.hex-rays.com/products/ida/support/idapython_docs/
    - https://sites.utexas.edu/iso/2016/03/24/reverse-engineering-necurs-part-4-ida-pros-python-api/
    - **Lista de plugins**: https://github.com/onethawt/idaplugins-list

Des-ensamblador

API

Uso de APIs

- Capstone
  - The next generation disassembly framework!
  - Usa el toolchain LLVM.
  - Links
    - https://www.capstone-engine.org/.
    - **Desensamblado**: https://www.capstone-engine.org/BHUSA2014-capstone.pdf

Hay varios problemas en el desensamblado

Features	Distorm3	BeaEngine	Udis86	Libopcode
X86|Arm	✓|X	✓|X	✓|X	✓|✓ [1]
Linux|Windows	✓|✓	✓|✓	✓|✓	✓|X
Python|Ruby bindings	✓|X [2]	✓|X	✓|X	✓|X
Update	X	?	X	X
License	GPL	LGPL3	BSD	GPL

Des-ensamblador

API

Capstone

- 28 Ejemplos
  - https://www.programcreek.com/python/example/102929/capstone.Cs
- Ejemplos completos
  - https://isleem.medium.com/create-your-own-disassembler-in-python-pefile-capstone-754f863b2e1c

Des-ensamblador

API

Otras herramientas

- Una lista larga en:
  - http://www.capstone-engine.org/showcase.html
  - https://reverseengineering.stackexchange.com/questions/1817/is-there-any-disassembler-to-rival-ida-pro
- Pywe
  - http://joxeankoret.com/blog/2010/02/08/pyew-a-python-tool-to-analyze-malware/
  - https://github.com/joxeankoret/pyew
- ImmunityDbg, similar a IDA pro usando python
  - http://www.immunityinc.com/products/debugger/

Des-ensamblador

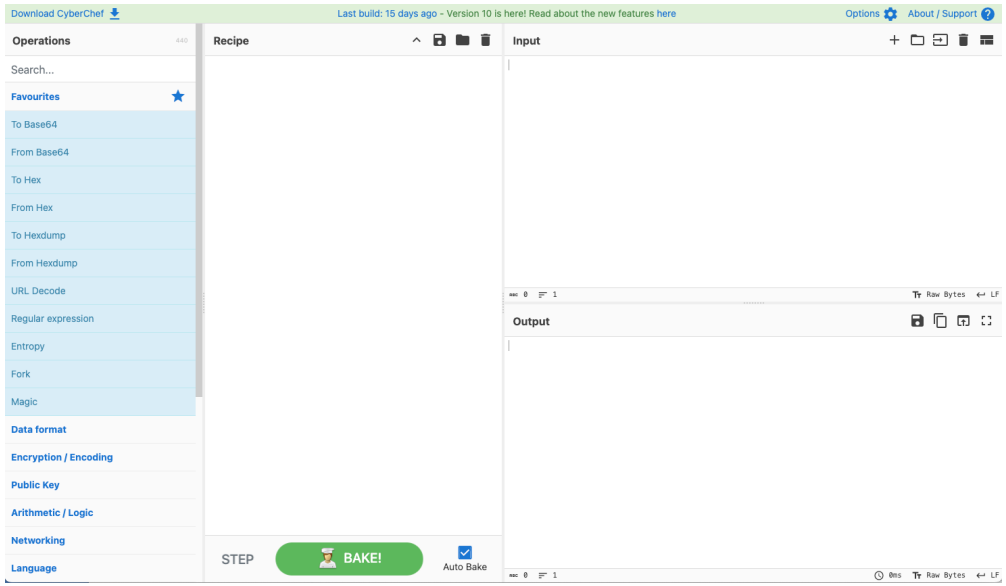
API

Cada semestre …

Se encuentran nuevas herramientas, por ejemplo:

2024-B

- Standalone App
- https://gchq.github.io/CyberChef/



Volcado de memoria

Toda o por proceso

Conceptos, herramientas.

Volcado de memoria

Herramientas

Volatility ver. 2.6, 3 v1.0.0 (Python 3 Rewrite)

- It is a command line memory analysis and forensics tool for extracting artifacts from memory dumps.
- It has significant in-depth research into OS internals, applications, malicious code, and suspect activities. In general, has many forensics capabilities.
- Operating System Support: 19 types
  - 10 for windows: Win Server, Win 10, ..., WinXP.
  - 1 for Linux: 32- and 64-bit Linux kernels from 2.6.11 to 4.2.3
  - 8 for MacOS
- Memory Format Support: 10 types
  - Virtualbox Core Dumps
  - VMware Saved State (.vmss) and Snapshot (.vmsn)
  - QEMU memory dumps.

Links

- www.volatilityfoundation.org

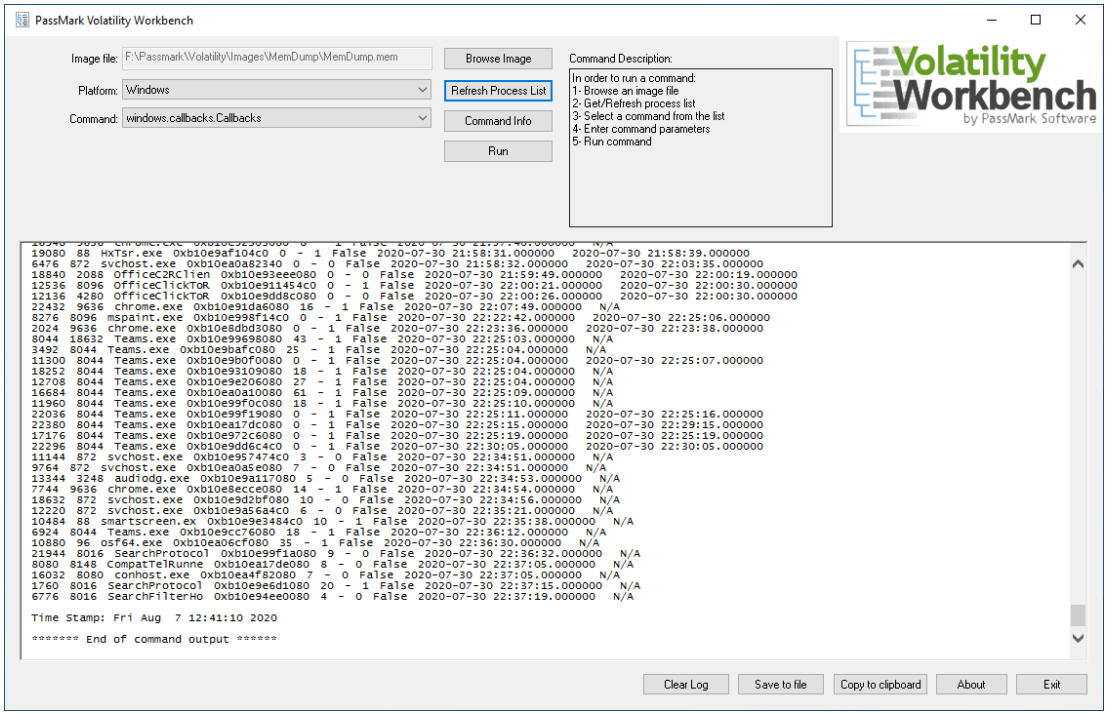
Volcado de memoria

Herramientas

Volatility Workbench

- It is a GUI for the Volatility tool.
- It is free, open source and runs in Windows.
- It provides a number of advantages over the command line version including: ...

Ver sitio.

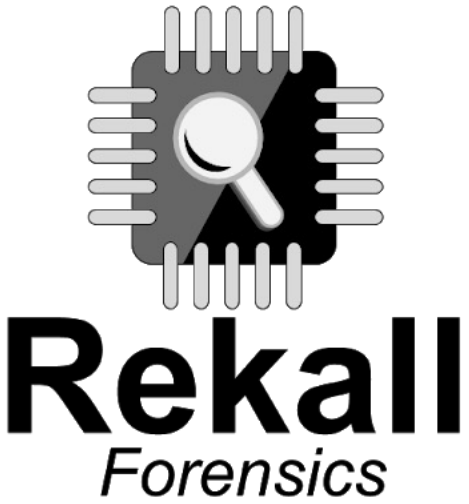


Links

- www.osforensics.com/tools/volatility-workbench.html

Volcado de memoria

Herramientas



Rekall

- It is an advanced forensic and incident response framework.
- **Rekall Agent** is a complete endpoint incident response and forensic tool. The Rekall Agent extends Rekall's advanced capabilities to a scalable, distributed environment. The Rekall Agent is easy to deploy and scale, based on modern cloud technologies.
- Characteristics:
  - It locates significant kernel data structures.
  - It maintains the largest public profile repository for many operating system versions.
  - While other tools rely on heuristics and signatures.

Links

  - http://www.rekall-forensic.com/

The end

Contacto

Raúl Acosta Bermejo

http:www.cic.ipn.mx
http://www.ciseg.cic.ipn.mx/

racostab@ipn.mx
racosta@cic.ipn.mx

57-29-60-00
Ext. 56652

Práctica de Análisis

Archivos binarios

Por equipo

Práctica

Archivos binarios

Descripción

- Obtener la información de varios archivos binaries (6)
  - Obtener información general:
  - Desensamblar con 3 herramientas: gui, cli, api.
- Cada alumno debe analizar:
  - Archivo(s) malware (dentro de cuckoo) y archivo(s) benigno.
- Analizar archivos de tipo: librería, ejecutable del sistema
- Realizar un reporte por equipo
  - Pueden determiner con que compilador se creo?
  - Cuando se compiló? Que librerias usa?
  - Que diferencias hay entre los ensambladores?
  - Que procesador require y cuántos bits?, Etc.