SANS DFIR

DIGITAL FORENSICS & INCIDENT RESPONSE

SANS DFIR Linux Distributions:

SIFT Workstation & REMnux

POSTER

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SANS DFIR
DIGITAL FORENSICS & INCIDENT RESPONSE

FOR498 **Battlefield Forensics & Data Acquisition**

FOR500 **Windows Forensic Analysis** GCFE

FOR518 **Mac and iOS Forensic Analysis and Incident Response**

FOR526 **Advanced Memory Forensics & Threat Detection**

FOR585 **Smartphone Forensic Analysis In-Depth** GASF

OPERATING SYSTEM & DEVICE IN-DEPTH

INCIDENT RESPONSE & THREAT HUNTING

FOR508 **Advanced Incident Response, Threat Hunting, and Digital Forensics** GCFA

FOR572 **Advanced Network Forensics: Threat Hunting, Analysis, and Incident Response** GNFA

FOR578 **Cyber Threat Intelligence** GCTI

FOR610 **REM: Malware Analysis** GREM

SEC504 **Hacker Tools, Techniques, Exploits, and Incident Handling** GCIH

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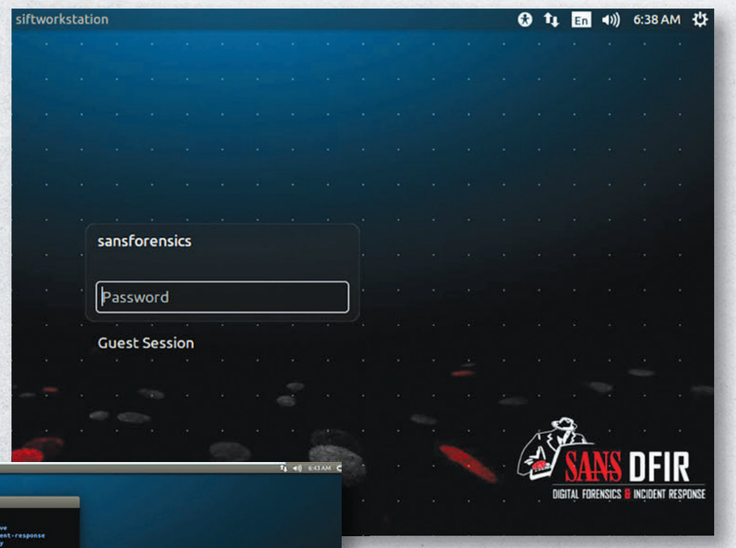
SANS DFIR Linux Distributions:

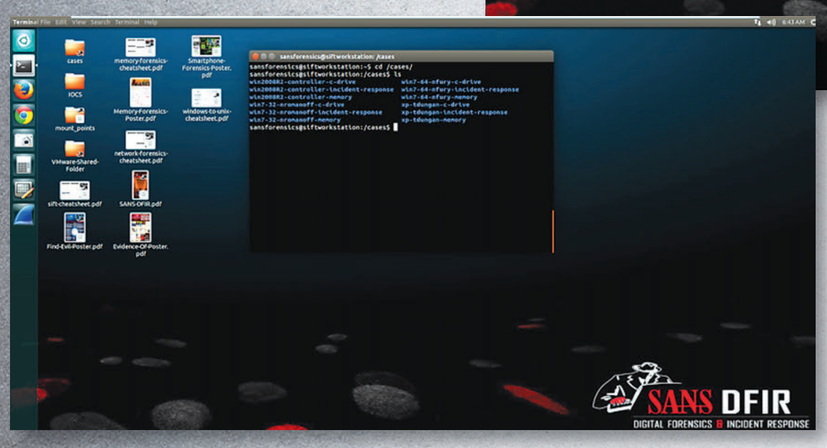
SIFT Workstation & REMnux

SANS faculty members maintain two popular Linux distributions for performing digital forensics and incident response (DFIR) work. SIFT Workstation,™ created by Rob Lee, is a powerful toolkit for examining forensic artifacts related to file system, registry, memory, and network investigations. REMnux®, created by Lenny Zeltser, focuses on malware analysis and reverse-engineering tasks. These freely available toolkits can be combined on a single host to create the ultimate forensication machine.

SIFT Workstation

An international team of forensics experts created the SIFT Workstation™ for incident response and digital forensics-use and made it available to the community as a public service. The free SIFT toolkit can match any modern incident response and forensic tool suite. It demonstrates that advanced incident response capabilities and deep-dive digital forensic techniques can be accomplished using cutting-edge open-source tools that are freely available and frequently updated.





How to Install SIFT

The easiest way to get the SIFT Workstation is by downloading a virtual machine instance directly from the http://dfir.sans.org website. Alternatively, you can install SIFT on any Ubuntu 14.04 operating system using the following commands.

Once installed, open a terminal and run

```
wget --quiet -O - https://raw.github.com/sans-dfir/sift-bootstrap/master/bootstrap.sh  | sudo bash -s -- -i -s -y
```

Once installed, SIFT can be kept up-to-date by issuing the following command: `update-sift`

The SIFT workstation contains hundreds of free and open-source tools that can be used for digital forensics and incident response. Many of the tools and associated analysis techniques are taught in the following courses at SANS:

FOR508: Advanced Digital Forensics, Incident Response, and Threat Hunting

FOR526: Advanced Memory Forensics & Threat Detection

FOR572: Advanced Network Forensics: Threat Hunting, Analysis, and Incident Response

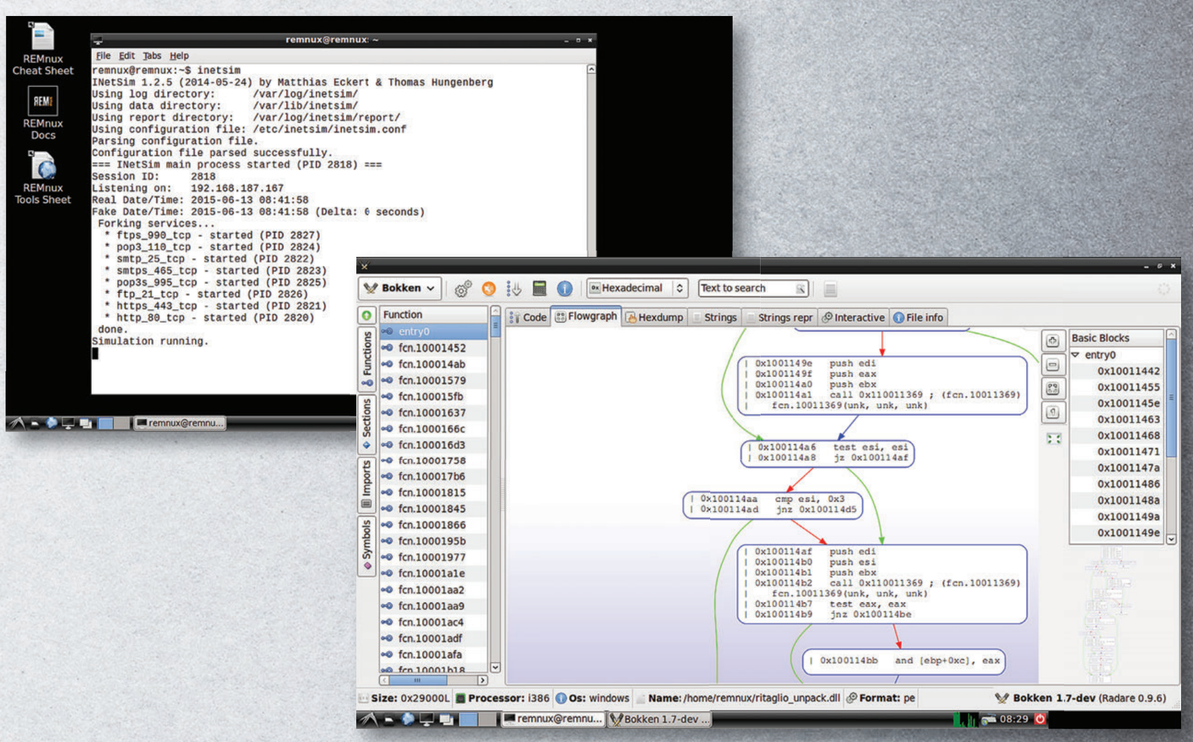
FOR578: Cyber Threat Intelligence

REMnux

REMnux® is a free Linux toolkit for assisting malware analysts with reverse-engineering malicious software. It strives to make it easier for forensic investigators and incident responders to start using the variety of freely-available tools that can examine malware, yet might be difficult to locate or set up.

The heart of the project is the REMnux Linux distribution based on Ubuntu. This lightweight distro incorporates many tools for analyzing Windows and Linux malware, examining browser-based threats such as obfuscated JavaScript, exploring suspicious document files and taking apart other malicious artifacts. Investigators can also use the distro to intercept suspicious network traffic in an isolated lab when performing behavioral malware analysis.

The REMnux project also provides Docker images of popular malware analysis tools, so that investigators can run these apps as containers even without installing the REMnux distro.



How to Install REMnux

The easiest way to get REMnux is to download its virtual appliance from https://remnux.org. After importing it into your virtualization software, boot up the REMnux virtual machine and, if you are connected to the Internet, run the "`update-remnux full`" command. Alternatively, you can add REMnux software to an existing SIFT Workstation system. To do that, run the following command on SIFT:

```
wget --quiet -O - https://remnux.org/get-remnux.sh | sudo bash
```

The REMnux website explains other ways to install the distro, which include adding it to a compatible Ubuntu system or spinning it up in a public cloud environment.

Many of the tools and associated malware analysis techniques are taught in the following SANS course:

FOR610: Reverse-Engineering Malware: Malware Analysis Tools and Techniques

Getting Started with SIFT

When performing a response or an investigation, it is helpful to be reminded of the powerful tools and options available to the analyst. Below is a selected reference to some popular free tools that are available on the SIFT. Each of these commands runs locally.

- **Mounting Images**
- **Mounting Volume Shadow Copies**
- **Windows Memory Analysis**
- **Recovering Data**
- **Creating Super Timelines**
- **The Sleuthkit**
- **Stream Extraction**

Mounting DD Images

`mount -t fstype [options] datafile.dd mountpoint`

datafile.dd can be a disk partition or physical disk image

Useful Options:

ro	mount as read only	***loop***	mount on a loop device
loop	mount on a loop device	***offset=<bytes>***	logical drive mount
noexec	do not execute files	***show_sys_files***	show ntfs metafiles
ro	mount as read only	***streams_interface=windows***	use ADS

Mounting Volume Shadow Copies

Stage 1 – Attach local or remote system drive

```
# ewfmount datafile.E01 /mnt/ewf
```

Stage 2 – Mount raw image VSS

```
# vshadowmount /mnt/ewf/ewf1 /mnt/vss/
```

Stage 3 – Mount all logical filesystems of snapshot

```
# cd /mnt/vss
# for i in vss*; do mount -o ro,loop,show_sys_files,streams_interface=windows $i /mnt/shadow_mount/$i; done
```

Mounting E01 Images

```
# ewfmount datafile.E01 mountpoint
# mount –o loop,ro,show_sys_files,streams_interface=windows /mnt/ewf/ewf1 /mnt/windows_mount
```

Creating Super Timelines

```
# log2timeline.py plaso.dump [SOURCE]
# psort.py plaso.dump FILTER > supertimeline.csv
```

Example:

Step 1 – Create Comprehensive Timeline

```
# log2timeline.py plaso.dump datafile.img
```

Step 2 – Filter Timeline

```
# psort.py -z "EST5EDT" -o L2tcsv plaso.dump "date > 'YYYY-MM-DD HH:MM:SS' AND date < 'YYYY-MM-DD HH:MM:SS'" > supertimeline.csv
```

Stream Extraction

```
# bulk_extractor <options> –o output_dir datafile.img
```

Useful Options:

`-o outdir`		**`-e wordlist`**	enable scanner wordlist
`-f <regex>`	regular expression term	**`-e aes`**	enable scanner aes
`-F <rfile>`	file of regex terms	**`-e net`**	enable scanner net
`-Wn1:n2`	extract words between n1 and n2 in length		
`-q nn`	quiet mode		
`-e scanner`	enables a scanner		

```
# bulk_extractor -F keywords.txt –e net -e aes -e wordlist -o /cases/bulk-extractor-memory-output /cases/ memory.img
```

Sleuthkit Tools

File System Layer Tools (Partition Information)

fsstat Displays details about the file system
`# fsstat datafile.img`

Data Layer Tools (Block or Cluster)

blkcat Displays the contents of a disk block
`# blkcat datafile.img block_num`

blkls Lists contents of deleted disk blocks
`# blkls datafile.img > imagefile.blkls`

blkcalc Maps between disk image and blkls results
`# blkcalc datafile.img -u blkls_num`

blkstat Display allocation status of block
`# blkstat datafile.img cluster_number`

MetaData Layer Tools (Inode, MFT, or Directry Entry)

ils Displays inode details
`# ils datafile.img`

istat Displays file system metadata about a specific inode
`# istat datafile.img inode_num`

icat Displays contents of blocks allocated to an inode
`# icat datafile.img inode_num`

ifind Determine which inode contains a specific block
`# ifind datafile.img –d block_num`

Filename Layer Tools

fls Displays deleted file entries in an image
`# fls -rpd datafile.img`

ffind Find the filename using the inode
`# ffind datafile.img inode_num`

Recovering Data

Create Unallocated Image (deleted data) using **`blkls`**

```
# blkls datafile.img > unallocated_imagefile.blkls
```

Create Slack Image Using dls (for FAT and NTFS)

```
# blkls –s datafile.img > imagefile.slack
```

Foremost Carves out files based on headers and footers
`data_file.img` = raw data, slack space, memory, unallocated space

```
# foremost –o outputdir –c /path/to/foremost.conf  datafile.img
```

Sigfind - search for a binary value at a given offset (-o)
`-o <offset>` start search at byte **`<offset>`**

```
# sigfind <hexvalue> -o <offset> datafile.img
```

Registry Parsing – Regripper

```
# rip.pl –r <HIVEFILE> –f <HIVETYPE>
```

Useful Options:

- ***-r*** Registry hive file to parse <*HIVEFILE*>
- ***-f*** Use <*HIVETYPE*> (e.g. **`sam`**, **`security`**, **`software`**, **`system`**, **`ntuser`**)
- ***-l*** List all plugins

```
# rip.pl –r /mnt/windows_mount/Windows/System32/config/SAM –f sam > /cases/windowsforensics/SAM.txt
```

Getting Started with REMnux

Below are some of the malware analysis tasks you can perform on REMnux. For the full listing of the many command-line tools available in this distro, see remnux.org.

Statically Examine Files

- Inspect file properties using **`pescanner`**, **`pestr`**, **`pyew`**, **`readpe`**, **`pedump`**, **`peframe`**, **`signsrch`**, and **`readpe.py`**
- Investigate binary files in-depth using **`bokken`**, **`vivbin`**, **`udcli`**, **`RATDecoders`**, **`radare2`**, **`yara`**, and **`wxHexEditor`**
- Deobfuscate contents with **`xorsearch`**, **`unxor.py`**, **`Balbuzard`**, **`NoMoreXOR.py`**, **`brxor.py`**, and **`xortool`**
- Examine memory snapshots using **`Rekall`** and **`Volatility`**
- Assess packed files using **`densityscout`**, **`bytehist`**, **`packerid`**, and **`upx`**
- Extract and carve file contents using **`hachoir-subfile`**, **`bulk_extractor`**, **`scalpel`**, **`foremost`**
- Scan files for malware signatures using **`clamscan`** after refreshing signatures with **`freshclam`**
- Examine and track multiple malware samples with **`mas`**, **`viper`**, **`maltrieve`**, and **`Ragpicker`**
- Work with file hashes using **`nsrllookup`**, **`Automater`**, **`hash_id`**, **`ssdeep`**, **`totalhash`**, **`virustotal-search`**, and **`vt`**
- Define signatures with **`yaraGenerator.py`**, **`autorule.py`**, **`IOCextractor.py`**, and **`rule-editor`**

Handle Network Interactions

- Analyze network traffic with **`wireshark`**, **`ngrep`**, **`tcpick`**, **`tcpxtract`**, **`tcpflow`**, and **`tcpdump`**
- Intercept all laboratory traffic destined for IP addresses using **`accept-all-ips`**
- Analyze web traffic with **`burpsuite`**, **`mitmproxy`**, **`CapTipper`**, and **`NetworkMiner`**
- Implement common network services using **`fakedns`**, **`fakesmtp`**, **`inetsim`**, **`ircd start`**, and **`httpd start`**

Examine Browser Malware

- Deobfuscate JavaScript with **`SpiderMonkey (js)`**, **`d8`**, **`rhino-debugger`**, and **`Firebug`**
- Define JavaScript objects for SpiderMonkey using **`/usr/share/remnux/objects.js`**
- Clean up JavaScript with **`js-beautify`**
- Retrieve web pages with **`wget`** and **`curl`**
- Examine malicious Flash files with **`swfdump`**, **`flare`**, **`RABCDAsm`**, **`xxxswf.py`**, and **`extract_swf`**
- Analyze Java malware using **`idx_parser.py`**, **`cfr`**, **`jad`**, **`jd-gui`**, and **`Javassist`**
- Inspect malicious websites and domains using **`thug`**, **`Automater`**, **`pdnstool.py`**, and **`passive.py`**

Examine Document Files

- Analyze suspicious Microsoft Office documents with **`officeparser.py`**, **`oletools`**, **`libolecf`**, and **`oledump.py`**
- Examine PDFs using **`pdfid`**, **`pdfwalker`**, **`pdf-parser`**, **`pdfdecompress`**, **`pdfxray_lite`**, **`pyew`**, and **`peepdf`**
- Extract JavaScript or SWFs from PDFs using **`pdfextract`**, **`pdfwalker`**, **`pdf-parser`**, and **`swf_mastah`**
- Examine shellcode using **`shellcode2exe.py`**, **`sctest`**, **`dism-this`**, **`unicode2hex-escaped`**, **`m2elf`**, and **`dism-this.py`**

Investigate Linux Malware

- Disassemble and debug binaries using **`bokken`**, **`vivbin`**, **`edb`**, **`gdb`**, **`udcli`**, **`radare2`**, and **`objdump`**
- Examine the system during behavioral analysis with **`sysdig`**, **`unhide`**, **`strace`**, and **`ltrace`**
- Examine memory snapshots using **`Rekall`** and **`Volatility`**
- Decode Android malware using **`Androwarn`** and **`AndroGuard`**

Windows Memory Analysis – Rogue Processes Detection

psxview Find hidden processes using cross-view `# vol.py psxview`

pstree Display parent-process relationships `# vol.py pstree`

Windows Memory Analysis – Code Injection Detection

malfind Find injected code and dump sections
- **`-p`** Show information only for specific PIDs
- **`-o`** Provide physical offset of single process to scan
- **`--dump-dir`** Directory to save memory sections

```
# vol.py malfind --dump-dir ./output_dir
```

ldrmodules Detect unlinked DLLs
- **`-p`** Show information only for specific PIDs
- **`-v`** Verbose: show full paths from three DLL lists

```
# vol.py ldrmodules –p 868 -v
```

Windows Memory Analysis – Dump Suspicious Processes

dlldump Extract DLLs from specific processes
- **`-p`** Dump DLLs only for specific PIDs
- **`-b`** Dump DLLs from process at base offset
- **`-r`** Dump DLLs matching REGEX name
- **`--dump-dir`** Directory to save extracted files

```
# vol.py dlldump --dump-dir=./output –r metsrv
```

moddump - Extract kernel drivers
- **`-b`** Dump driver using base address (from modscan)
- **`-r`** Dump drivers matching REGEX name
- **`--dump-dir`** Directory to save extracted files

```
# vol.py moddump --dump-dir=./output –r gaopdx
```

procdump Dump process to executable sample
- **`-p`** Dump only specific PIDs
- **`-o`** Specify process by physical memory offset
- **`-n`** Use REGEX to specify process
- **`--dump-dir`** Directory to save extracted files

```
# vol.py procdump --dump-dir=./output –p 868
```

memdump Dump every memory section into a single file
- **`-p`** Dump memory sections from these PIDs
- **`-n`** Use REGEX to specify process
- **`--dump-dir`** Directory to save extracted files

```
# vol.py memdump –dump-dir=./output –p 868
```

dumpfiles Dump File_Objects from file cache
- **`-Q`** Extract using physical offset
- **`-r`** Extract using REGEX (-i for case insensitive)
- **`--dump-dir`** Directory to save extracted files

```
# vol.py dumpfiles –dump-dir=./output –r \\.exe
```