# Web vulnerability scanning and exploitation tools

# Scaling vulnerability scanning

- **Companies with 1000+ web applications running**
  - Move to μ-services architectures making things worse
- **Huge shortage of skilled security engineers to perform red-team (adversarial) analysis**
- **Hackers employing automation to speed compromise**
  - Equifax (admin/admin) or Mirai default usernames and passwords discovery
  - Shodan scans and reveals the same
- **Must increasingly employ automation in security (i.e. use software to improve security)**

# Word of caution

- **Must not rely solely on what tools find**
- **Tools can not automatically solve all of your labs**
- **Tools are very loud**
  - Can crash stuff
  - Can do things like print 9000 pages on a printer
- **Penetration testing requires creative humans of diverse disciplines and modes of thinking**
  - Example: social engineering methods

# Kinds of tools

- **Command-line web vulnerability scanning and auditing**
  - nmap (via NSE scripts)
  - nessus (OpenVAS)
  - nikto
  - w3af
  - WPScan (WordPress)
- **Proxy-based web vulnerability scanners**
  - zap
- **Command-line exploitation tools**
  - metasploit (general)
  - sqlmap (database)
- **Command-line password brute-forcing**
  - hydra

# nmap

- **Open-source network scanner**
  - For target discovery typically
  - Scan huge networks of literally hundreds of thousands of machines
- **Portable, flexible, extensible**
  - Plug-in scripts to allow for web scanning
- **Uses raw IP packets in novel ways**
  - To determine what hosts are available on the network,
  - What services those hosts are offering
  - What operating systems and versions are running
  - What type of packet filters/firewalls are in use
  - Many of other characteristics.

# nessus (OpenVAS)

- **Free, open-source vulnerability scanner**
  - Free version of nessus at https://tenable.com/products/nessus-home
  - Does both operating system and web vulnerabilities
  - Vulnerability checks are modularized via plug-ins
    - 20,000+ plug-ins in Nessus vulnerability database
  - Customizable – user can write new plug-ins
    - In C
    - In Nessus Attack-Scripting Language (NASL)

# nikto

- **URL: http://cirt.net/nikto2**
- **Vulnerability scanner for web servers**
  - Similar to Nessus - runs off plug-ins
- **Tests for:**
  - Web server version
  - Known dangerous files/CGI scripts
  - Version-specific problems

# Web Application Attack Audit Framework

- **Python-based tool for securing web applications**
  - Portable across Windows, OS X, Linux, OpenBSD, etc.
- **Phases supported:**
  - Discovery: *Finding new URLs, forms, and other* “injection points”.
  - Audit: *Probe injection points by sending* crafted data into all of them to find vulnerabilities.
  - Attack: Exploit vulnerabilities found
- **Integrations with Metasploit and sqlmap**

# w3af

**audit**
- xsrf
- htaccessMethods
- sqli
- sslCertificate
- fileUpload
- mxInjection
- generic
- localFileInclude
- unSSL
- xpath
- osCommanding
- remoteFileInclude
- dav
- ssi
- eval
- buffOverflow
- xss
- xst
- blindSqli
- formatString
- preg_replace
- globalRedirect
- LDAPi
- phishingVector
- frontpage
- responseSplitting

**grep**
- dotNetEventValidation
- pathDisclosure
- codeDisclosure
- blankBody
- metaTags
- motw
- privateIP
- directoryIndexing
- svnUsers
- ssn
- fileUpload
- strangeHTTPCode
- hashFind
- getMails
- httpAuthDetect
- wsdlGreper
- newline
- passwordProfiling
- domXss
- ajax
- findComments
- httpInBody
- strangeHeaders
- lang
- errorPages

**collectCookies**
- strangeParameters
- error500
- objects
- creditCards
- oracle
- feeds

**Exploit**
- sqlmap
- osCommandingShell
- xssBeef
- localFileReader
- rfiProxy
- remoteFileIncludeShell
- davShell
- eval
- fileUploadShell
- sql_webshell

**Also……**

**discovery, output, mangle, bruteforce, evasion**

# WPScan

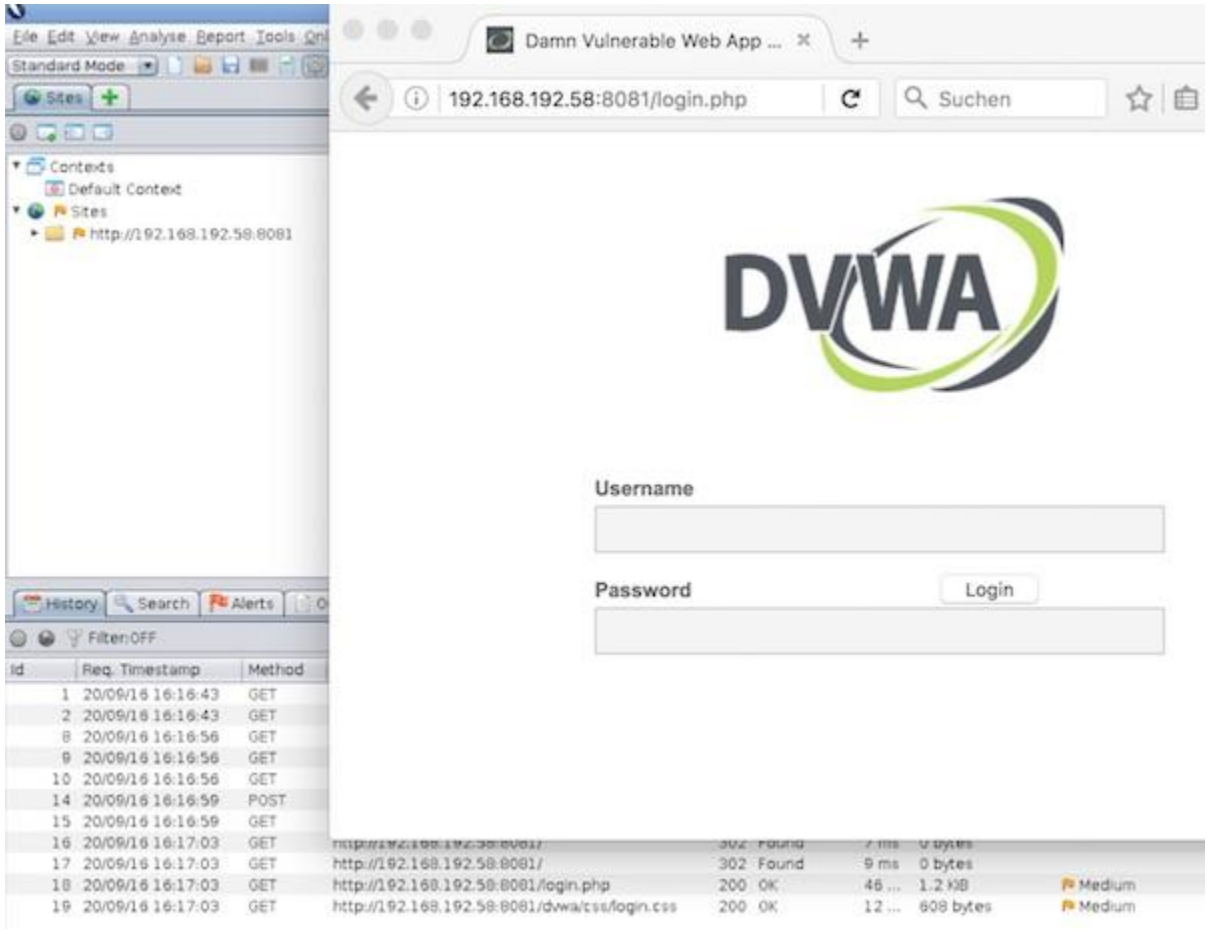
- **Black box WordPress vulnerability scanner**
  - https://wpscan.org/
  - WordPress and its plug-ins are extremely popular targes
  - Checks for CVEs specific to WordPress

```
[!] Includes directory has directory listing enabled: http://www.maherhackers
.com/wp-includes/

[+] WordPress version 4.7 identified from readme (Released on 2016-12-06)
[+] 12 vulnerabilities identified from the version number

[!] Title: WordPress 4.3-4.7 - Potential Remote Command Execution (RCE) in PH
PMailer
    Reference: https://wpvulndb.com/vulnerabilities/8714
    Reference: https://www.wordfence.com/blog/2016/12/phpmailer-vulnerability
/
    Reference: https://github.com/PHPMailer/PHPMailer/wiki/About-the-CVE-2016
-10033-and-CVE-2016-10045-vulnerabilities
    Reference: https://wordpress.org/news/2017/01/wordpress-4-7-1-security-an
d-maintenance-release/
    Fixed in: 4.7.1

[!] Title: WordPress 4.7 - User Information Disclosure via REST API
    Reference: https://wpvulndb.com/vulnerabilities/8715
    Reference: https://www.wordfence.com/blog/2016/12/wordfence-blocks-userna
me-harvesting-via-new-rest-api-wp-4-7/
    Reference: https://github.com/WordPress/WordPress/commit/daf358983cc1ce0c
77bf6d2de2ebbb43df2add60
    Reference: https://wordpress.org/news/2017/01/wordpress-4-7-1-security-an
```

# zap

- **OWASP Zed Attack Proxy**
  - Open-source web proxy for capturing and modifying traffic from a browser
  - Provides automation for finding security vulnerabilities in web applications
  - Similar to Burp Suite
- **Setup**
  - Automatically listens on port 8080
  - Point web browser HTTP proxy settings to port 8080
  - Requests sent by browser captured in Zap for subsequent replay

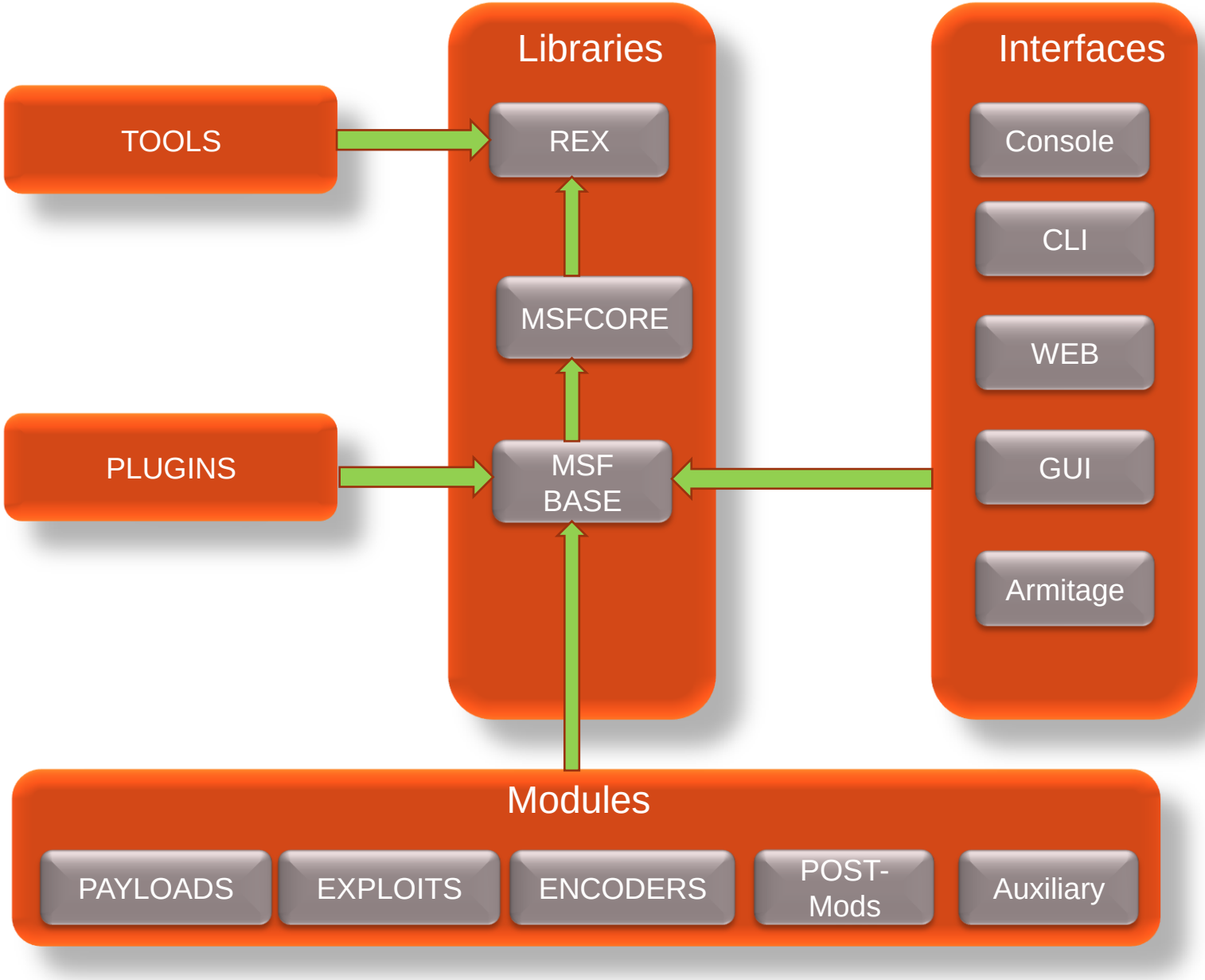
# zap


File Edit View Analyse Report Tools
Standard Mode
Sites
Contexts
Default Context
Sites
http://192.168.192.58:8081
History
Search
Alerts
Filter:OFF
Id
Req. Timestamp
Method
1 20/09/16 16:16:43 GET
2 20/09/16 16:16:43 GET
8 20/09/16 16:16:56 GET
9 20/09/16 16:16:56 GET
10 20/09/16 16:16:56 GET
14 20/09/16 16:16:59 POST
15 20/09/16 16:16:59 GET
16 20/09/16 16:17:03 GET
17 20/09/16 16:17:03 GET http://192.168.192.58:8081/ 302 Found 9 ms 0 bytes
18 20/09/16 16:17:03 GET http://192.168.192.58:8081/login.php 200 OK 46 ... 1.2 KB Medium
19 20/09/16 16:17:03 GET http://192.168.192.58:8081/dvwa/css/login.css 200 OK 12 ... 608 bytes Medium
Damn Vulnerable Web App ...
192.168.192.58:8081/login.php
Suchen
DVWA
Username
Password
Login

# Metasploit

- **Defacto tool for penetration testing**
- **Framework for exploiting vulnerabities**
- **Attack scripts written in Ruby**
- **Contains a rich set of modules organized in systematic manner**
- **1000 + exploits , 200 + Payloads, 500+ Auxiliary Modules**

# Architecture



# Metasploit CLI

```
Terminal
Datei  Bearbeiten  Ansicht  Suchen  Terminal  Hilfe
┌─[root@parrot]─[/]
└──╼ #msfconsole

      dBBBBBBb  dBBBP dBBBBBBP dBBBBBb  .                    o
        '   dB'                    BBP
    dB'dB'dB' dBBP     dBP     dBP BB
   dB'dB'dB' dBP      dBP     dBP  BB
  dB'dB'dB' dBBBBP   dBP     dBBBBBBB

                                 dBBBBBP  dBBBBBb  dBP    dBBBBP dBP dBBBBBBP
                                                 dB' dBP    dB'.BP
                                   |       dBP    dBBBB' dBP    dB'.BP dBP    dBP
                                --o--     dBP    dBP    dBP    dB'.BP dBP    dBP
                                   |     dBBBBP dBP    dBBBBP dBBBBP dBP    dBP

        o                  To boldly go where no
                            shell has gone before

Validate lots of vulnerabilities to demonstrate exposure
with Metasploit Pro -- Learn more on http://rapid7.com/metasploit

       =[ metasploit v4.14.22-dev                         ]
+ -- --=[ 1658 exploits - 947 auxiliary - 293 post        ]
+ -- --=[ 486 payloads - 40 encoders - 9 nops             ]
+ -- --=[ Free Metasploit Pro trial: http://r-7.co/trymsp ]

msf >
```

# Exploits

- **Actual code which works on the target vulnerability system.**
- **Modular organization based on OS and service classification**

`/usr/share/metasploit-framework/modules/exploits`

- Ranked to determine reliability of exploit for success
  - Manual, Low, Average, Normal, Good, Great, Excellent

# Encoders

- **How to encode payload and morph it to bypass anti-virus and detection**

`/usr/share/metasploit-framework/modules/encoders`

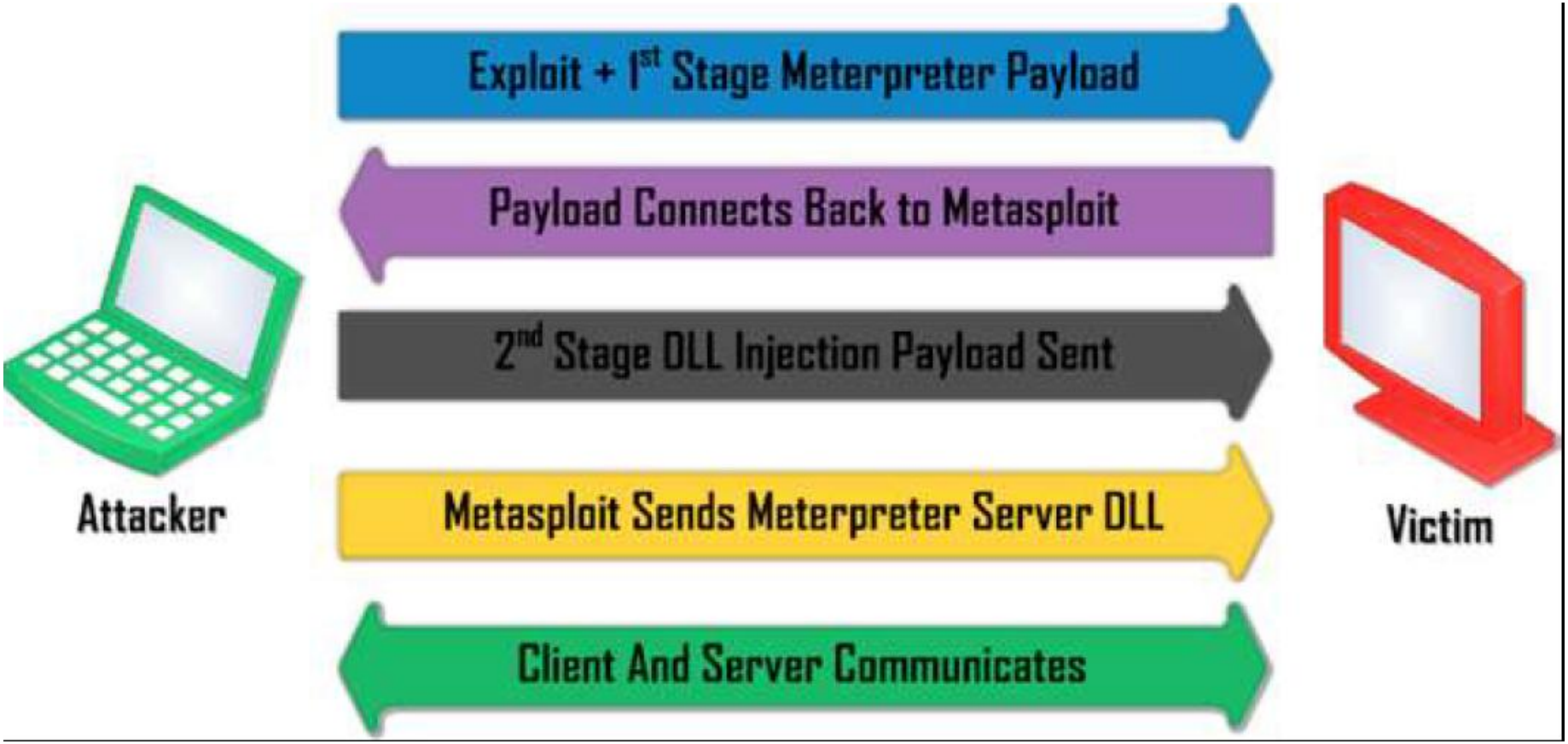
# Payloads

- **What to run on target after initial exploit**

`/usr/share/metasploit-framework/modules/payloads`

  - Web shell, stager to download additional code
  - Meterpreter
    - Common payload for Windows
    - Provide an enhanced, extensible shell for adversary
    - Delivers common post-exploitation functionality via an injected DLL onto victim machine

# Example use


Exploit + 1st Stage Meterpreter Payload
Payload Connects Back to Metasploit
2nd Stage DLL Injection Payload Sent
Metasploit Sends Meterpreter Server DLL
Client And Server Communicates
Attacker
Victim

# Post-exploitation

- **Perform additional operations after gaining access**

`/usr/share/metasploit-framework/modules/post`

- **Gather information about exploited system**
- **Enhance environment**
  - Privilege escalation
  - Credential stealing (password manager hacking)
  - Key-logging
  - Activity viewing
  - Web camera
  - Desktop capture (screen_spy)
- **Operating system specific**

# Auxiliary

- **Additional functionality for…**
  - Scanning
  - Fuzzing/brute-forcing
  - Crawling
  - Sniffing
  - Password guessing

`/usr/share/metasploit-framework/modules/auxiliary`

# Plug-ins

- **For popular third-party apps**
  - nessus
  - nexpose
  - OpenVAS

`/usr/share/metasploit-framework/modules/plug-ins`

# Demo video

# sqlmap

- **Automate detection and exploitation of SQL injections**
  - Form submission via GET

```
sqlmap –u <URL> -p <injection parameter>

$ sqlmap –u 'http://foo.com/view.php?id=1141' -p id
```

  - Form submission via POST

```
sqlmap –u <URL> --data=<POST_DATA> -p <injection parameter>
```

  - Will automatically try Blind SQL injection on all fields to dump entire database

# Hydra

- **Parallelized network authentication cracker**
- **Supports Cisco auth, HTTP, IMAP, RDP, SMB, SSH, LDAP, MySQL, VNC**
- **Uses dictionaries of dumped usernames and passwords**
- **Does brute-force attacks**

```
# hydra
Hydra v7.6 (c)2013 by van Hauser/THC & David Maciejak - for legal purposes only

Syntax: hydra [[[-l LOGIN|-L FILE] [-p PASS|-P FILE]] | [-C FILE]] [-e nsr] [-o FILE] [-t TASKS] [-M FILE [-T TASKS]] [-w
TIME] [-W TIME] [-f] [-s PORT] [-x MIN:MAX:CHARSET] [-SuvV46] [service://server[:PORT][/OPT]]

Options:
  -l LOGIN or -L FILE  login with LOGIN name, or load several logins from FILE
  -p PASS  or -P FILE  try password PASS, or load several passwords from FILE
  -C FILE   colon separated "login:pass" format, instead of -L/-P options
  -M FILE   list of servers to be attacked in parallel, one entry per line
  -t TASKS  run TASKS number of connects in parallel (per host, default: 16)
  -U        service module usage details
  -h        more command line options (COMPLETE HELP)
  server    the target server (use either this OR the -M option)
  service   the service to crack (see below for supported protocols)
  OPT       some service modules support additional input (-U for module help)

Supported services: asterisk afp cisco cisco-enable cvs firebird ftp ftps http[s]-{head|get} http[s]-{get|post}-form http-
proxy http-proxy-urlenum icq imap[s] irc ldap2[s] ldap3[-{cram|digest}md5][s] mssql mysql ncp nntp oracle-listener oracle-sid
pcanywhere pcnfs pop3[s] postgres rdp rexec rlogin rsh s7-300 sip smb smtp[s] smtp-enum snmp socks5 ssh sshkey svn teamspeak
telnet[s] vmauthd vnc xmpp
```

# Hydra

- **Hydra**
  - Can also supply a list of usernames and passwords to it

```
hydra -L users.txt -P pass.txt ssh://foo.com
```

  - HTTP basic-auth example

```
# hydra -L users.txt -P pass.txt http-get://localhost/
Hydra v7.6 (c)2013 by van Hauser/THC & David Maciejak - for legal
purposes only

Hydra (http://www.thc.org/thc-hydra) starting at 2015-02-10 15:11:57
[DATA] 1 task, 1 server, 1 login try (l:1/p:1), ~1 try per task
[DATA] attacking service http-get on port 80
[80][www] host: 1.2.3.4   login: user   password: tester
1 of 1 target successfully completed, 1 valid password found
```

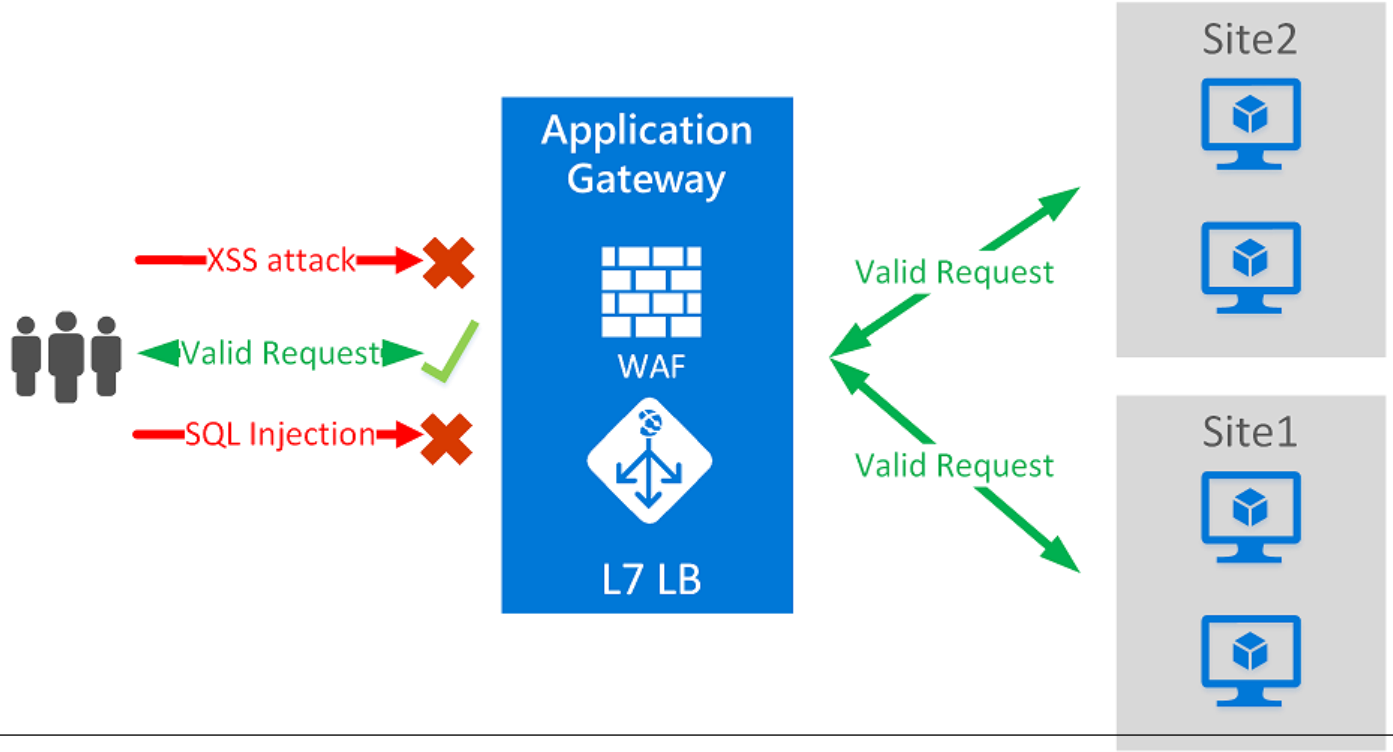
# Services

- **Third party sites for vulnerability scans**
- **Free**
  - https://www.scanmyserver.com/
  - https://www.qualys.com/forms/freescan/
  - https://app.webinspector.com/
- **Pay**
  - Tenable (Nessus Pro)
  - Netsparker
  - Acunetix
  - Rapid7 (Nexpose, Metasploit Pro)
- **SSL**
  - https://www.ssllabs.com/ssltest/

# Web application firewalls

# Web application firewalls

- **Function**
  - Proxy incoming connection
  - Pull in request
  - Examine request for common exploitation payloads and block automatically
  - Forward request to destination if OK
  - Often part of Layer-7 load balancing (i.e. application layer)



# Examples

- **Open-source**
  - modsecurity
    - https://modsecurity.org/
    - Prevent XSS, SQL injection, other common attacks
    - Toss requests based on OWASP's modsecurity core rule set
    - For efficiency, throw out rules your site does not need
  - NAXSI
    - https://github.com/nbs-system/naxsi
    - Prevents XSS and SQL Injection
  - Shadow Daemon
    - https://shadowd.zecure.org
    - Prevents SQL/XML/Code/Command injection, XSS, local/remote file inclusion
- **Commercial**
  - CloudFlare, Barracuda, AWS

# Labs

- **Handout walkthrough**

# GCP labs

- **Set up kali, wfp1, and wfp2 VMs**
- **Set up a VM to run a docker image of vulnerable Apache Struts server (cve-2017-5638)**
- **Lab #1: Use metasploit on kali VM to…**
  - Compromise Apache Struts server
  - Perform a directory scan of wfp1 VM
  - Brute-force the HTTP authentication on wfp2 VM's Authentication #1 example
- **Lab #2: Use sqlmap on kali VM to**
  - Solve wfp1's SQL injection #1 example
  - Solve wfp1's SQL injection #2 example
  - Solve natas15's Blind SQL injection level (please do in pairs)
- **Lab #3: Use hydra to**
  - Brute-force the HTTP authentication on wfp2 VM's Authentication #1 example

# linuxlab labs (for CS 510 students)

- **Download a kali VM image via BitTorrent**
- **Bring kali VM up in VirtualBox**
- **Lab #1: Use WPScan on kali VM to**
  - Find all of the known vulnerabilities in a given WordPress installation
- **Lab #2: Use zap and firefox on kali VM to**
  - Solve wfp1's SQL injection #1 example
  - Solve one of the other SQL injection levels in wfp1 or wfp2
  - Solve a level in Google's XSS firing range
  - Solve wfp1's XSS #1 example
  - Launch a command injection on WebScantest's test page
- **Lab #3: Use w3af to**
  - Identify vulnerabilities on wfp1 in two OWASP categories
  - Identify one XSS vulnerability on Google's XSS firing range
- **Optional: https://flaws.cloud**

# linuxlab labs (CS 510)

- **Extra credit labs flaws.cloud**

# Questions

- https://sayat.me/wu4f

# Extra

# Homework: nmap

portscanner.py - C:/python_samples/portscanner.py

File Edit Format Run Options Windows Help

```python
import socket

target = input('Enter the IP address to scan: ')
portrange = input('Enter the port range to scan (es 5-200): ')

lowport = int(portrange.split('-')[0])
highport = int(portrange.split('-')[1])

print('Scanning host ', target, 'from port',lowport, 'to port', highport)


for port in range(lowport, highport):
    s = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
    status = s.connect_ex((target, port))
    if(status == 0):
        print('*** Port',port,'- OPEN ***')
    else:
        print('Port',port,'- CLOSED')
    s.close()
```

# Lab: nikto

- **Install nikto on linuxlab**
  - wget https://github.com/sullo/nikto/archive/master.zip
  - unzip master.zip
  - cd nikto-master/program
  - ./nikto.pl
    - Point it at several URLs in WFP1 and WFP2

# Lab: nikto

- **Run nikto on each of the instances deployed via its Internal IP address**
  - nikto –h http://w.x.y.z
- **Answer the following questions**
  - Briefly compare the outputs generated by each of the deployed web servers.
    - What software versions differ?
    - Are there any vulnerabilities?
  - Provide one screenshot of each tool's output

# Do not use

- **Run w3af_console on a Web for Pentester 1 instance the instructor gives you**
  - Use tool to identify an XSS vulnerability and a command injection automatically

```
w3af>>> plugins audit xss
w3af>>> target set target http://10.138.0.2/xss/example1.php?name=hacker
The configuration has been saved.
w3af>>> start
A Cross Site Scripting vulnerability was found at: "http://10.138.0.2/xss/example1.php", using HTT
P method GET. The sent data was: "name=" The modified parameter was "name".This vulnerability was
found in the request with id 37.
Scan finished in 8 seconds.
Stopping the core...
w3af>>>
```

```
w3af>>> plugins audit os_commanding
w3af>>> target set target http://10.138.0.2/commandexec/example1.php?ip=127.0.0.1
The configuration has been saved.
w3af>>> start
OS Commanding was found at: "http://10.138.0.2/commandexec/example1.php", using HTTP method GET. T
he sent data was: "ip=%3B%2Fbin%2Fcat%20%2Fetc%2Fpasswd" The modified parameter was "ip".This vuln
erability was found in the request with id 45.
Scan finished in 23 seconds.
Stopping the core...
w3af>>>
```

# Add to Recon

# PTES

- **Penetration testing execution standard**
  - http://www.pentest-standard.org
- **Many tools across many protocols**

# Finding targets

- **DNS**
  - robtex, netcraft
    - Third-party services for finding subdomains
  - censys
    - Third-party service for finding subdomains via brute-forcing cloud IP addresses to get TLS certs
  - sublist3r
    - Tool for Google/Bing/Baidu searching for subdomains
  - knockpy
    - Tool for brute-forcing subdomains via dictionary

# Finding targets

- **Vulnerable users**
  - E-mail addresses (simplyemail)
    - HR and account/order management, accounts payable addresses
    - Example

tripwire

How a Single Email Stole $1.9 Million from Southern Oregon University

GRAHAM CLULEY Follow @gcluley

JUN 13, 2017 | IT SECURITY AND DATA PROTECTION

# Finding targets

- **Vulnerable users**
  - Social media profiles and job postings for security engineers in company
    - Reveals the technology (anti-virus) being run in enterprise
    - LinkedIn, Monster, Twitter, Google+, FB
  - Information on people in company
    - pipl.com
    - Great for monitoring if someone is stealing your ID?
  - Calling in to gather intelligence on technology
    - Mitnick: “The Art of Deception: Controlling the Human Element of Security”
  - Tailgating and implanting physical devices
    - Smokers and a Raspberry Pi with kali that phones home (Kim)

# Finding targets

- **API keys**
  - Searching “aws key” in github
  - Truffle Hog, Git-Secrets, GitAllSecrets
  - Google dorking
    - filezilla inurl:recentservers.xml to find creds that are remembered
    - filetype:pdf "Assessment Report" nessus to find vulnerability reports
    - inurl:login to find all login pages
    - Strings within https://github.com/JohnTroony/Google-dorks/blob/master/google-dorks.txt

# Finding targets

- **All-purpose tools (discover)**
  - Aggregates information found with
    - dnsrecon (includes squatting reports)
    - goofile, goog-mail, goohost
    - theharvester
    - urlcrazy, urlvoid
    - whois
    - dnssy
    - ewhois
    - myipneighbors
    - recon-ng (includes known breached usernames/passwords)
      - cnn.com

# Finding targets

- **All-purpose tools (discover)**
  - Example

```
mark.reed@cnn.com => Breach found! Seen in the River City
  Media Spam List breach that occurred on 2017-01-01.
[*] [contact] <blank> <blank> (mark.reed@cnn.com) - <blank>
[*] [credential] mark.reed@cnn.com: <blank>
[*] test@cnn.com => Breach found! Seen in the Adobe breach
  that occurred on 2013-10-04.
[*] test@cnn.com => Breach found! Seen in the iMesh breach
  that occurred on 2013-09-22.
[*] test@cnn.com => Breach found! Seen in the LinkedIn breach
  that occurred on 2012-05-05.
[*] test@cnn.com => Breach found! Seen in the MySpace breach
  that occurred on 2008-07-01.
[*] test@cnn.com => Breach found! Seen in the River City
  Media Spam List breach that occurred on 2017-01-01.
[*] test@cnn.com => Breach found! Seen in the vBulletin
  breach that occurred on 2015-11-03.
[*] [contact] <blank> <blank> (test@cnn.com) - <blank>
[*] [credential] test@cnn.com: <blank>
```