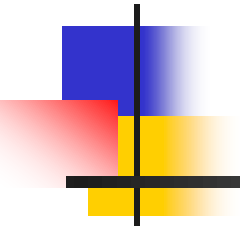
Penetration Testing



Lecture 08

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Penetration Testing

- Penetration Testing or Pen Testing:
  - a "*simulated*" ***cyberattack*** on a computer system/application
    - goals:
      1. identify *vulnerabilities* that could be exploited by malicious hackers
      2. uncover *security weaknesses* and provide recommendations to improve the system's security
  - also called: black box testing or ethical hacking
    - use automated *tools* and *manual techniques* to mimic the actions of real attackers

Penetration Testing (cont.)

- Pen Testing: the art of "*attacking*" a running application to find security vulnerabilities
  - *without knowing* the inner workings of the application itself
  - have access to an application as if they were users
    - given a valid account on the system
    - acts like an attacker and attempts to find and exploit vulnerabilities
- Pen testing helps
  - organizations understand how their systems can be compromised
  - allows organizations to take proactive measures to protect their data and assets

Penetration Testing (cont.)

- Advantages:
  - identifying vulnerabilities
  - improving security posture
  - can be fast (and therefore cheap)
  - requires a relatively lower skill-set than source code review
  - tests the code that is actually being exposed

- Disadvantages:
  - too late in the SDLC
  - front impact testing only
  - limited scope

Conduct Search Engine Discovery for Information Leakage: Summary

- Direct and indirect elements to search engine discovery
  - direct methods: searching the indexes and the associated content from caches
  - indirect methods: gleaning sensitive design and configuration information by searching forums, newsgroups, and etc.

Conduct Search Engine Discovery for Information Leakage: Test Objectives

- To understand
  - what *sensitive design and configuration information* of the application/system/organization is exposed both directly (on the organization's website) or indirectly (on a third party website)

Conduct Search Engine Discovery for Information Leakage: How to Test

- Use a search engine to search for:
  - Network diagrams and configurations
  - Archived posts and emails by administrators and other key staff
  - Log on procedures and username formats
  - Usernames and passwords
  - Error message content
  - Development, test, UAT and staging versions of the website

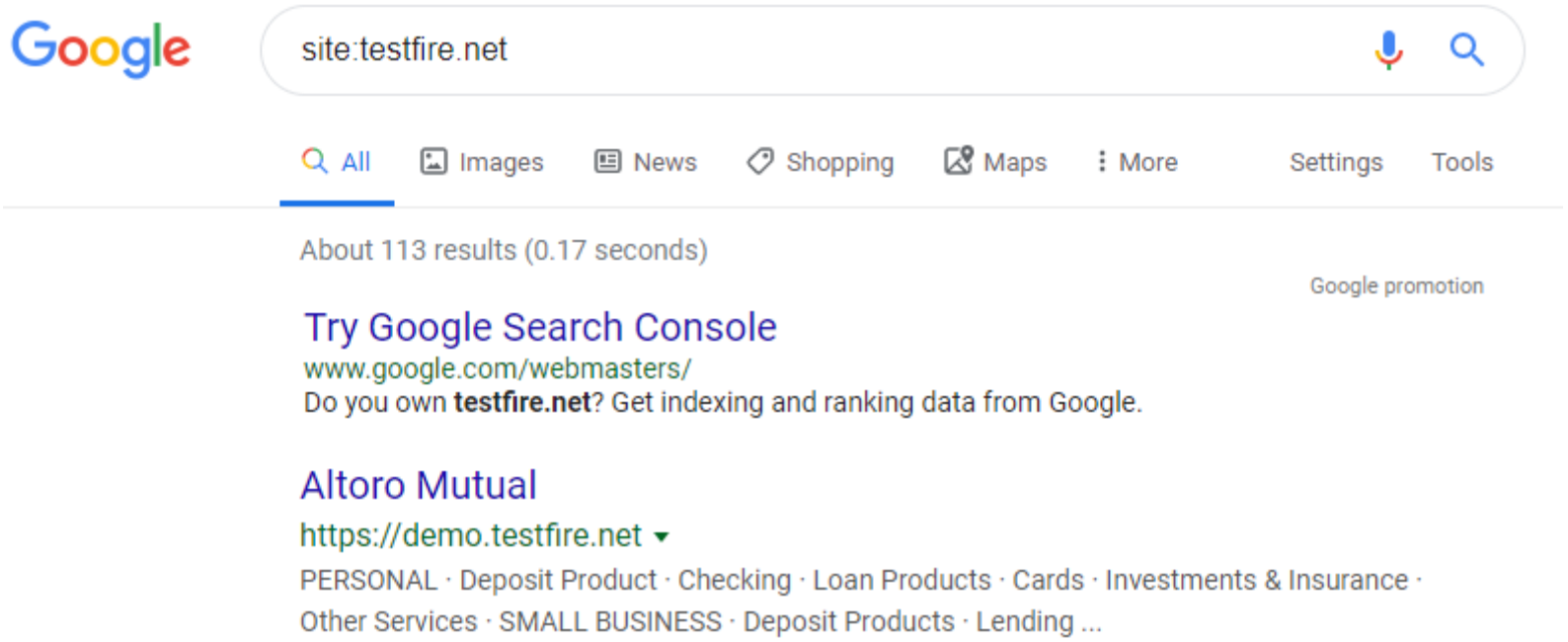
Conduct Search Engine Discovery for Information Leakage: Search Operators

- Using the advanced search operator: "site:"
  - restrict search results to a specific domain
- Do not limit testing to just one search engine provider
  - search engines: Baidu, Bing, Duck Duck Go, Startpage, Google, Shodan, PunkSpider
  - generate different results depending on when they crawled content and their own algorithms

Conduct Search Engine Discovery for Information Leakage: Example

- To find the web content of testfire.net indexed by a typical search engine, the syntax required is:

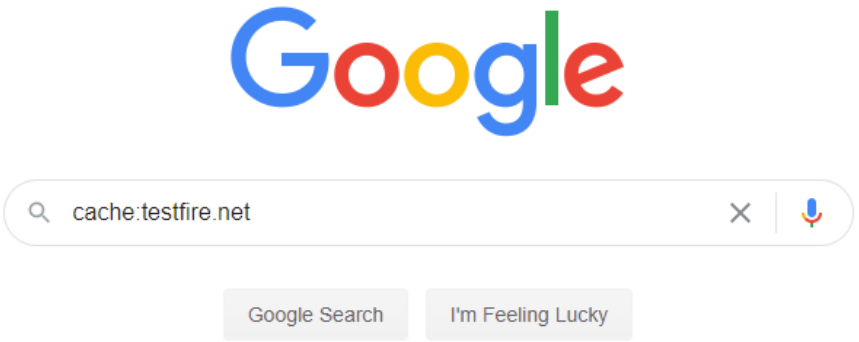
site: testfire.net



Conduct Search Engine Discovery for Information Leakage: Example

- To display the index.html of testfire.net as cached, the syntax is:

cache: testfire.net



This is Google's cache of https://demo.testfire.net/. It is a snapshot of the page as it appeared on Dec 20, 2019 11:08:47 GMT. The current page could have changed in the meantime. Learn more.

Full version Text-only version View source

Tip: To quickly find your search term on this page, press Ctrl+F or ⌘-F (Mac) and use the find bar.

Fingerprint Web Server: Summary

- Web server fingerprinting: a critical task for penetration testing
  - identifying the *version* and *type* of a running web server
    - determine known vulnerabilities and the appropriate exploits to use during testing
- Several different vendors and versions of web servers on the market today
  - knowing the type of web server that is being tested significantly helps in the testing process

Fingerprint Web Server: Summary

- Sending the web server specific commands and analyzing the output
  - each version of web server software may respond differently to these commands
  - knowing how each type of web server responds to specific commands

Fingerprint Web Server: Test Objectives

- Find the version and type of a running web server
  - determine known vulnerabilities and the appropriate exploits to use during testing

Fingerprint Web Server: How to Test

- Simplest and most basic form of identifying a web server: check the Server field in the HTTP response header
- Netcat
  - a networking utility which reads and writes data across network connections, using the TCP/IP protocol
  - a reliable "back-end" tool that can be used directly or easily driven by other programs and scripts
  - a feature-rich network debugging and exploration tool
    - create almost any kind of connection you would need and has several interesting built-in capabilities

Fingerprint Web Server: Netcat

- We will use the following syntax for nc command.

netcat options destination port

  - options used to set some special behavior like timeout, help, etc.
  - destination is used to specify remote system IP or Hostname
  - port is the remote system port number

Fingerprint Web Server: Netcat

- Help

netcat -h

- netcat command provides a lot or different potions

Fingerprint Web Server: Netcat

- Port Scan

netcat -z -v destination port#_range

  - -z option: zero-I/O mode
  - -v option: detailed information

Fingerprint Web Server: Example

- Look at the Server field in the HTTP response header to identify a web server

```
root@kali:~# nc testfire.net 80
HEAD / HTTP/1.0

HTTP/1.1 200 OK
Server: Apache-Coyote/1.1
Set-Cookie: JSESSIONID=9D783EDD4942C2463C18CAF1092DABE8; Path=/; HttpOnly
Content-Type: text/html;charset=ISO-8859-1
Date: Sat, 21 Dec 2019 21:00:52 GMT
Connection: close

root@kali:~#
```

Fingerprint Web Server: Example

- Look at the Server field in the HTTP response header to identify a web server

```
root@kali:~# nc testfire.net 80
GET / HTTP/3.0

HTTP/1.1 505 HTTP Version Not Supported
Server: Apache-Coyote/1.1
Date: Sat, 21 Dec 2019 21:03:07 GMT
Connection: close

root@kali:~#
```

Fingerprint Web Server: Example

- Look at the Server field in the HTTP response header to identify a web server

```
root@kali:~# nc testfire.net 80
GET / HTTP/1.0

HTTP/1.1 200 OK
Server: Apache-Coyote/1.1
Set-Cookie: JSESSIONID=8C66E7204E09212B5BF9D6A5CDA4C476; Path=/; HttpOnly
Content-Type: text/html;charset=ISO-8859-1
Date: Sat, 21 Dec 2019 21:04:03 GMT
Connection: close

<!-- BEGIN HEADER -->
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/
DTD/xhtml1-transitional.dtd">

<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" >
```

Enumerate Applications on Webserver: Summary

- A paramount step in testing for web application vulnerabilities: find out which particular applications are hosted on a web server
  - many applications have known vulnerabilities and known attack strategies that can be exploited
    - gain remote control or to exploit data
  - many applications are often misconfigured or not updated, due to
    - the perception that they are only used "internally" and therefore no threat exists

Enumerate Applications on Webserver: Test Objectives

- Enumerate the applications within scope that exist on a web server

Enumerate Applications on Webserver: How to Test

- While web applications usually live on port 80 (http) and 443 (https)
  - in fact, web applications may be associated with arbitrary TCP ports, and can be referenced by specifying the port number as follows: http[s]://www.example.com:port/.
    - e.g., http://www.example.com:20000/

Enumerate Applications on Webserver: How to Test

- Check for the existence of web applications on non-standard ports.
- A port scanner such as nmap is capable of performing service recognition
  - -sV option
    - identify http[s] services on arbitrary ports

Enumerate Applications on Webserver: Example

- Check for the existence of web applications on non-standard ports.
- A port scanner such as nmap is capable of performing service recognition by means of the -sV option, and will identify http[s] services on arbitrary ports.

```
root@kali:~# nmap -sV testfire.net
Starting Nmap 7.80 ( https://nmap.org ) at 2019-12-21 16:20 EST
Nmap scan report for testfire.net (65.61.137.117)
Host is up (0.015s latency).
Not shown: 997 filtered ports
PORT     STATE SERVICE    VERSION
80/tcp   open  http       Apache Tomcat/Coyote JSP engine 1.1
443/tcp  open  ssl/https?
8080/tcp open  http       Apache Tomcat/Coyote JSP engine 1.1

Service detection performed. Please report any incorrect results at https://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 73.74 seconds
root@kali:~#
```