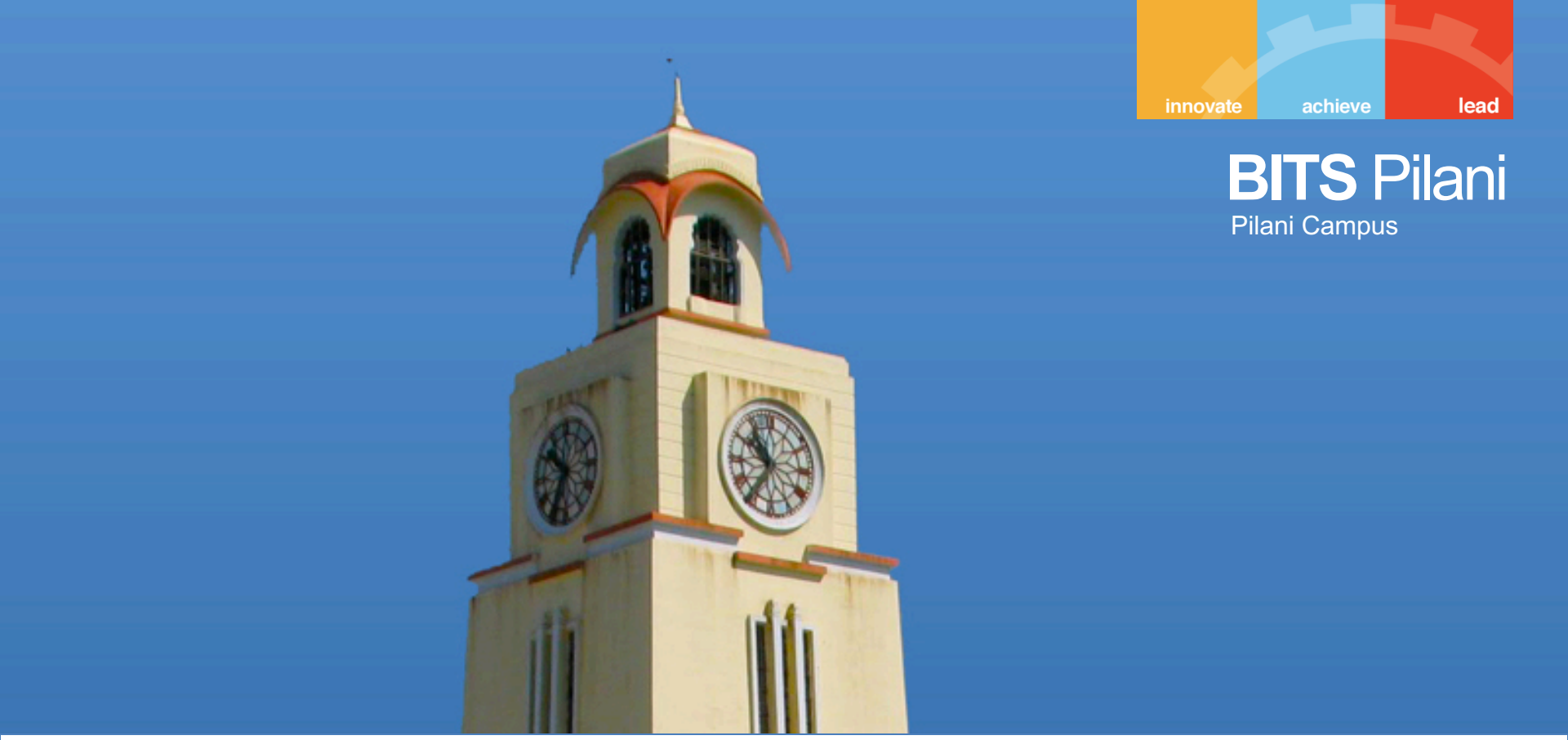
BITS Pilani Presentation

BITS Pilani
Pilani Campus

Jagdish Prasad
WILP



SSZG575: Ethical Hacking
Lecture No: 01

Agenda

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- Course description
  - Objective
  - Course content
  - Text books
  - Structure & schedule
  - Evaluation scheme
  - Lecture plan
- Introduction to Ethical Hacking
  - Service & Application
  - Device, System, Person
  - Lifecycle for attack
  - Understand boundaries

Course objectives

No	Objective
CO1	Introduce students to the techniques and tools for ethical hacking and countermeasures.
CO2	To develop skills of exploit approaches – social engineering, scanning, foot-printing, enumeration, sniffers, buffer overflows.
CO3	Understand service-specific hacking like DNS, Email, Web servers, Proxy; techniques of bypassing security mechanisms and hardening systems and networks for countermeasures of security analysis, monitoring and analysis tools including network traffic and system logs.
CO4	Also learn the security paradigms in cloud computing, mobile platforms and online social networks.

Course content

- Introduction to Ethical Hacking
- Basic of Tools & Techniques for Ethical Hacking
- Vulnerabilities and Reverse Engineer Binaries
- Mobile Application Security
- Casing the Establishment
- Wireless Hacking and Hacking Hardware
- Remote Connectivity and VOIP
- Security Issues on Web Server and Database
- Processes and Tools used for Defense
- Recent Hack Reports

Text books

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- Text books

T1	Stuart McClure, Joel Scambray, George Kurtz, “Hacking Exposed 7: Network Security Secrets and Solutions, TMGH 2012

Reference books

R1	Joseph Muniz, Aamir Lakhani, “Web Penetration Testing with Kali Linux”, Shroff 2013
R2	Nipun Jaiswal, “Mastering Metasploit”, Shroff/Packt 2014
R3	Neil Bergman etc. “Hacking Exposed Mobile: Security Secrets & Solutions”, MGH 2013

Text books…

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Other References

O1	https://www.owasp.org/index.php/Category:OWASP_Top_Ten_Project
O2	https://www.stateoftheinternet.com/
O3	http://www.symantec.com/security_response/publications/threatreport.jsp
O4	http://www.kb.cert.org/vuls
O5	http://googleprojectzero.blogspot.in
O6	https://code.google.com/p/google-security-research/issues/list
O7	https://source.android.com/security/index.html and sublinks

Learning objectives

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No	Learning Objective
CO1	Understand the components of enterprise and consumer applications and systems that can be exploited for hacking.
CO2	Use tools and techniques to survey the target in the cyber world using foot printing, scanning and enumerating.
CO3	Learn about multiple approaches to find vulnerabilities and exploit them using (a) network based attacks (b) host level compromise across different platforms and (c) deployment/system-component level attacks.
CO4	Understand the weaknesses in wireless communications and execute some of the exploits in controlled environment.
L05	Learn about tools to defend against attacks or minimize the damage.

Course structure & schedule

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- 16 on-line lectures (2 hours each) + self study
- Schedule
  - Semester start (first lecture) : 09-Jan
  - Last lecture : 24-Apr
  - Mid Sem Test : 05, 06, 07 Mar
  - Mid Sem Test Makeup : 19, 20, 21 Mar
  - Comprehensive Exam : 30 Apr, 01, 02 May
  - Comprehensive Exam Makeup : 14, 15, 16 May

Evaluation scheme

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No	Name	Type	Duration	Weight	Date & Time
EC-1	Quiz-I	Online	-	5%	After 4th lecture
	Quiz-II	Online	-	5%	After 8th lecture
	Assignment / Lab	Offline	-	10%	TBA
EC-2	Mid-Semester Test	Closed Book	1.5 hours	30%	05-07 Mar / 19-21 Mar
EC-3	Comprehensive Exam	Open Book	2.5 hours	50%	30 Apr, 01,02 May / 14-16 May

Lecture plan

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Lecture #	Topic Covered	Date
LO1	Introduction to Ethical Hacking	09-Jan
LO2	Basic Tools and Techniques for Ethical Hacking	16-Jan
LO3	Vulnerabilities and Reverse Engineer Binaries	23-Jan
LO4	Vulnerabilities and Reverse Engineer Binaries	24-Jan
L05	Mobile Application Security	30-Jan
L06	Casing the Establishment	06-Feb
L07	Casing the Establishment	13-Feb
L08	Wireless Hacking and Hacking Hardware	20-Feb
L09	Wireless Hacking and Hacking Hardware	27-Feb
L10	Remote Connectivity and. VOIP	13-Mar
L11	Security Issues on Web Servers and Databases	27-Mar
L12	Security Issues on Web Servers and Databases	03-Apr
L13	Processes and Tools for Defense	04-Apr
L14	Processes and Tools for Defense	10-Apr
L15	Recent Hack Reports	17-Apr
L16	Recent Hack Reports	24-Apr

Lab plan

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Lab #	Topic Covered
LO1	Understanding the lab setup, isolated network, remote shell and related network protocols
LO2	Compilers, assemblers, disassemblers, debuggers, trace tools, environment, sniffers etc.
LO3	Linux password cracking exercises – different encryptions
LO4	Reverse engineering a firmware update
L05	Android tools, app development, and hacking an application to embed our code
L06	Executing OS exploits – Linux
L07	Executing OS exploits – Windows
L08	Understand tools in Kali Linux for survey attempts
L09	Executing protocol exploits – Web Server and Data Bases
L10	Trojans and Camouflage
L11	Wireless Hacking – HackRF One
L12	Tools to mine online social information
L13	Defense – Audit, discover and limit, detect malware, Honeypots, Firewalls, IDS/IPS, Log service
L14	Mock capture the flag exercise

Introduction

Hacking… Not a Rare News!

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6 TIMES CITY

Haldiram's hit by ransomware attack, hackers asked for $7.5L

FIR Lodged After 3 Mths, Say Officials

Shikha.Salaria
@timesgroup.com

Noida: Snacks manufacturer Haldiram's faced a ransomware attack on its servers by hackers who allegedly encrypted all its files, data, applications and systems and demanded a ransom of 7.5 lakh USD for giving access to the stolen data.

While a complaint was submitted to the cyber cell on July 17 this year, according to officials, an FIR was lodged in the case in October 14.

According to the FIR lodged at Sector 58 police station, on July 13 around 1.30 am, the aforesaid information, senior manager (IT) Ashok Kumar Mohanty informed Aziz Khan, DGM (IT) to resolve the issue. However, on accessing the servers of the company, Mr. Aziz Khan, found out that all the servers of the company had been hacked and hit by a cyber-attack/ pany situated at C tor-62, Noida at abou to analyse the situa resolve the same," th ad. It added that the decided to call anotl ficial who found son being generated fr servers. They found me program was l

FILES ENCRYPTED, RANSOM SOUG

- Hackers attacked Haldiram's servers and encrypted all its files, data and applications
- The food giant later managed to restore all data internally

US$ 7.5 lakh ransom sought

3-month delay in FIR

July 13 | Error in server reported to Haldiram's IT department. They find the servers have been hacked as part of a "ransomware attack"

July 17 | Complaint filed with Noida cyber cell

Oct 17 | FIR lodged after probe

nectivity to all systems at the se and other data/informa-

Massive ransomware attack hits PTI, services resume

Hackers broke into the servers of news agency Press Trust of India (PTI) over the weekend, crippling its service for hours on Saturday night before they were resumed. read more...

Cyberattack on Dr Reddy's Labs sharp reminder to strengthen digital infrastructure: Analysts

The cyberattack on Dr Reddy's Labs came as a sharp reminder to strengthen its digital infrastructure and tighten cyber security control measures, according to analysts. read more...

After Haldirams, now Mithaas hit by ransomware

Barely 10 days after snack manufacturer Haldiram's was hit by ransomware, popular sweet seller Mithaas Sweets has claimed to have faced a similar attack on its servers by hackers who allegedly encrypted all its files and stole data. read more...

News about Hacking

•Google Faced the Largest DDoS Attack Seen Yet from Chinese State-backed Hackers in 2017 - 2.54 TBPS DDOS attack

Hacking News

Cyber Security News | Hacking News | News | Vulnerabilities

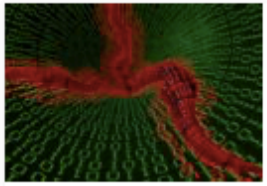
Over 100K Zyxel Firewall Devices Found With A Backdoor Account

January 4, 2021 Abeerah Hashim 0

Users of Zyxel Firewall and VPN devices should update their devices as the current firmware might have a backdoor account.

GenRx Pharmacy Ransomware Attack Resulted In Data Breach

January 4, 2021 0



New Golang Worm Targets Windows And Linux Systems To Mine Monero

January 3, 2021 0

Second T-Mobile Data Breach Reported Within A Year

January 3, 2021 0

Voyager Cryptocurrency Broker Suffered Brief Outage Following Cyber Attack

Global Attack Scenario

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Total WAF Trigger Rule Frequency

120,934,834

Attacks Observed for All Verticals

Top Country / Area by Attack Frequency

Russian Federation

34,101,558 Attacks Sent

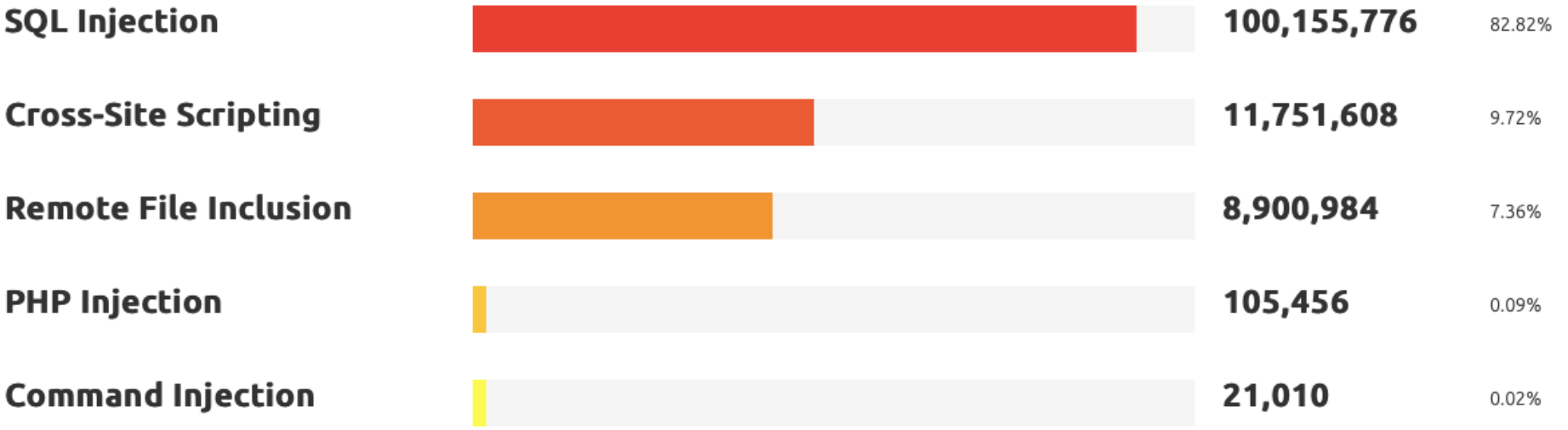
Attack Vector Frequency

SQL Injection

100,155,776 Attacks Observed

Attack Distribution by Type

During the reporting period, what was the distribution of the most common web attack types?



On-going Threat Maps

- Ongoing threats maps - top targeted countries, industries, malware, daily attacks etc.

http://threatmap.checkpoint.com

https://cybermap.Kaspersky.com

Computer Security

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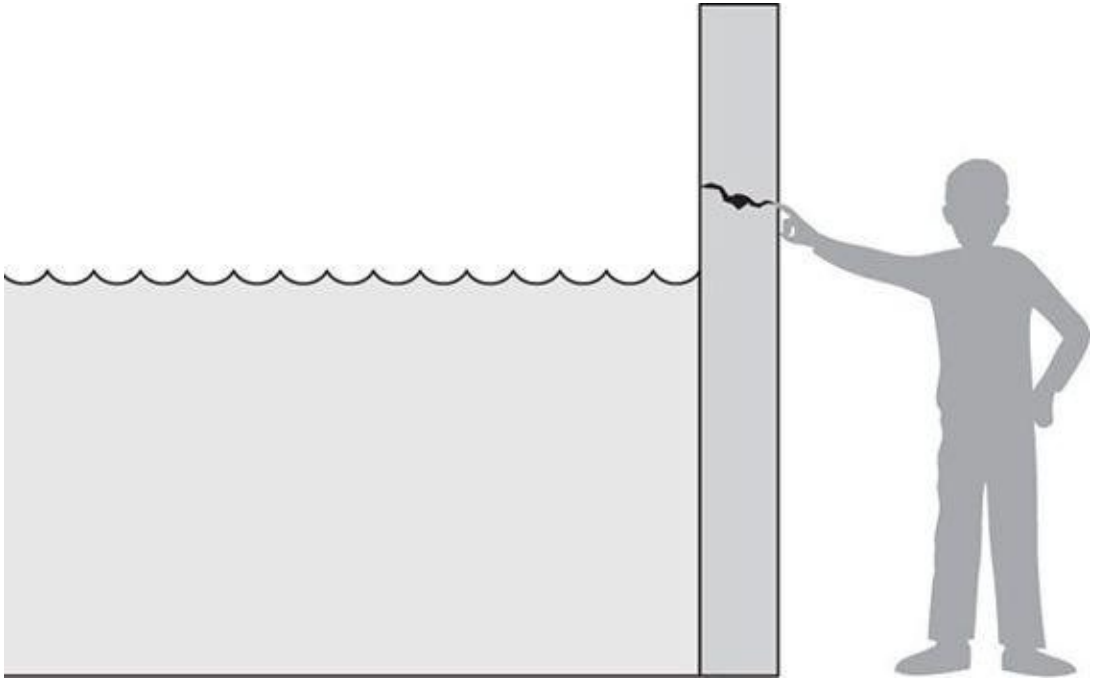
- Computer security is protection of items or ASSETS of a computer or computer system
- ASSETS are of following types:
  - **Hardware:** Computers, Devices (disk drives, memory cards, printers etc), Networks
  - **Software:** Operating system, utilities, commercial applications (MS-Office, Oracle apps, SAP etc), individual applications
  - **Data:** Documents, photos, emails, projects, corporate data etc
- ASSETS have a value to an individual
  - Has an owner or user perspective
  - May be monetary or non-monetary
  - Is personal, time dependent & often imprecise
- ASSETS are target for an attack and require security protection

Vulnerability – Threat - Control Paradigm

- '**Vulnerability**' is a weakness in the system that might be exploited to cause loss or harm
- '**Threat**' is a set of circumstances that has a potential to cause loss or harm to system
- A person who exploits the vulnerability perpetrates an '**Attack**'
- '**Control**' is an action, device, procedure of technique that removes or reduces the vulnerability

Example: Vulnerability - Threat - Control



- **Vulnerability:** Crack in the wall
- **Threat:** Rising water level
- **Attack:** Someone pumping more water
- **Control:** Fill the gap, strengthen the wall

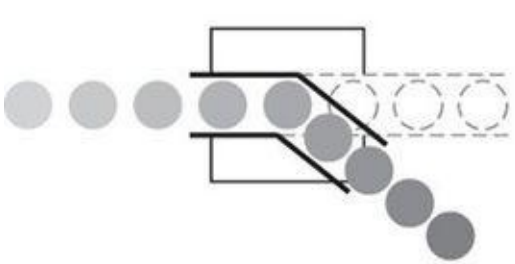
Security Triad - CIA

- **Confidentiality:** Ability of a system to ensure that an asset is viewed by only authorized parties
- **Integrity:** Ability of a system to ensure that an asset is modified by only authorized parties
- **Availability:** Ability of a system to ensure that an asset can be used by any authorized parties

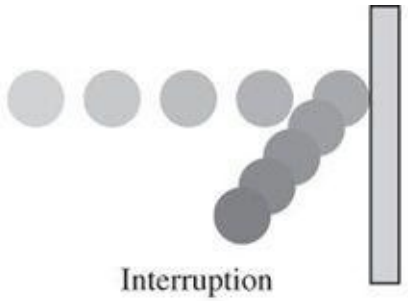
Additional two properties:

- **Authentication:** Ability of a system to validate the identity of a sender
- **Non-repudiation or Accountability:** Ability of a system to confirm that a sender can not convincingly deny having sent something

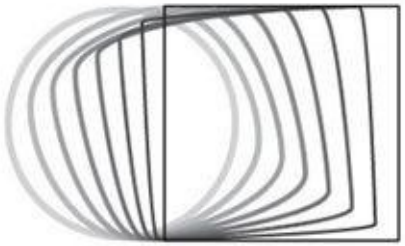
Acts of Harm



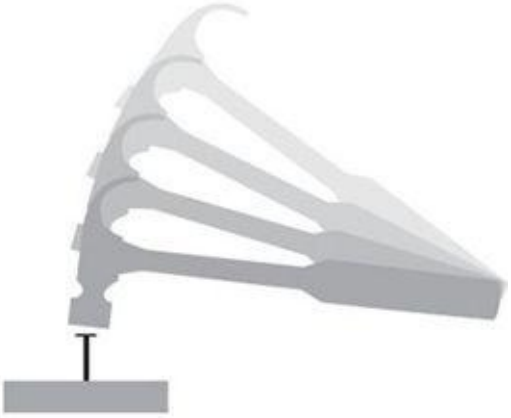
Interception



Interruption



Modification



Fabrication

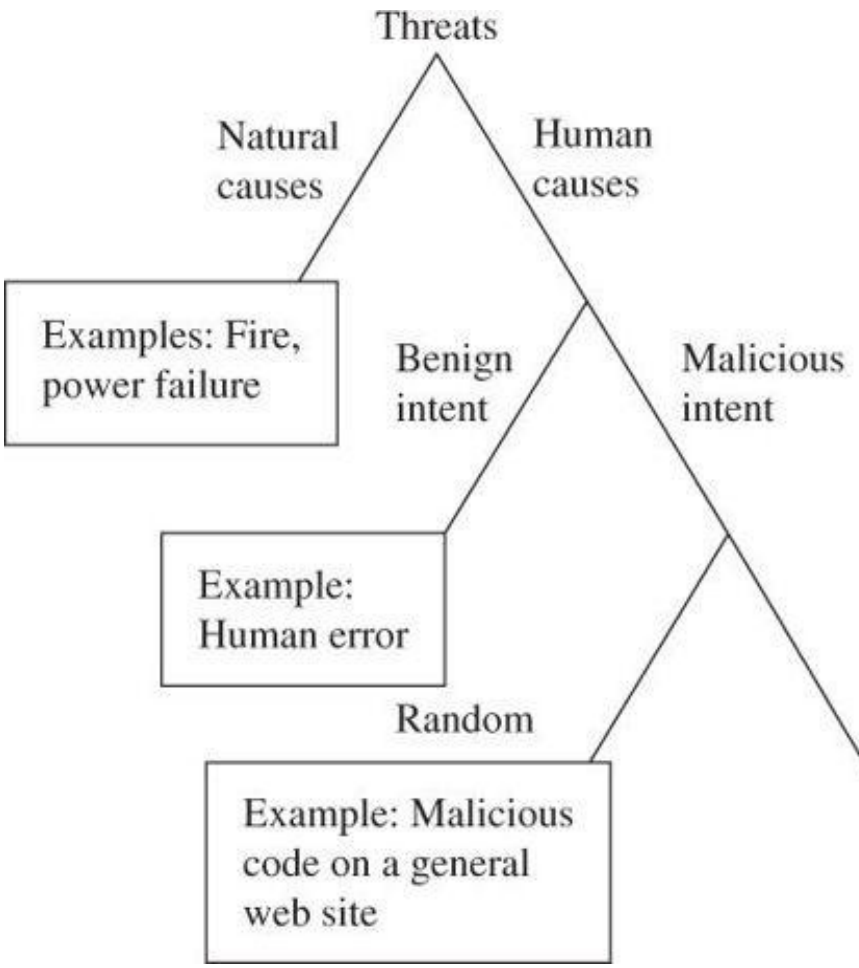
Interception: Confidentiality lost

Interruption: Availability lost

Modification: Integrity lost

Fabrication: Integrity lost

Security Threats

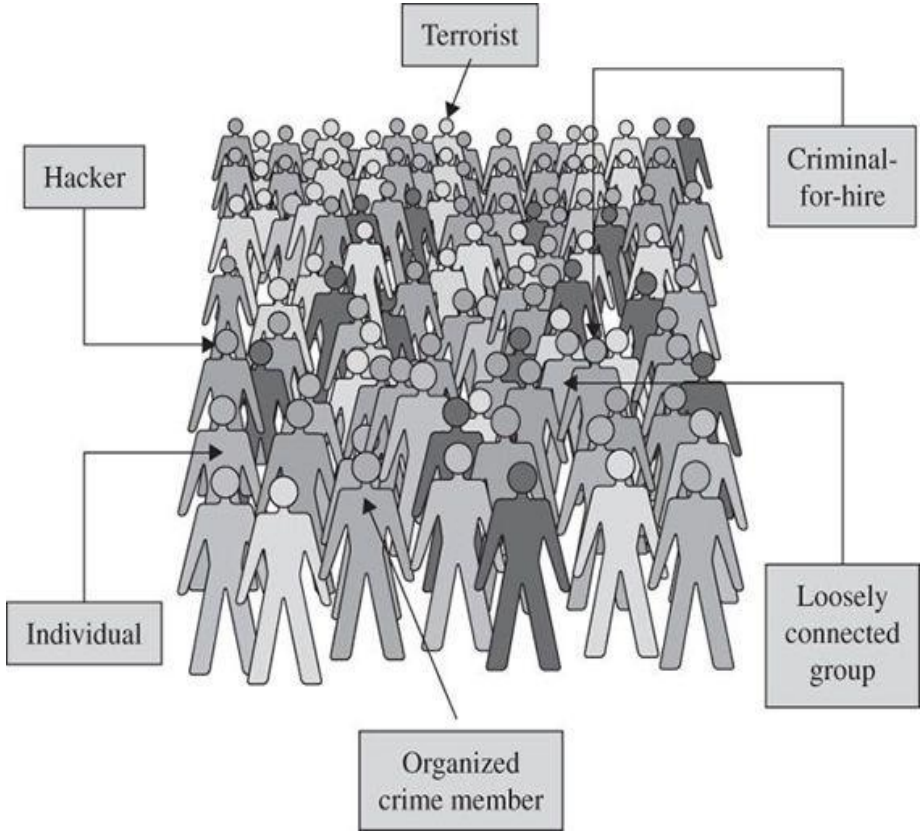


- Threats are caused both by human and other sources
- Threats can be malicious or not
- Threats can be random or targeted
- Advance persistent threat attacks come from organized, well financed, patient and often govt or quasi-govt affiliated groups

Security Threats

Who are the Attackers?

- Individual
- **Hackers**
- Terrorist
- Criminal for hire
- Loosely connected group
- Organized crime member
  - cyber crime is lucrative



Hacking

- Act committed toward breaking into a computer and/or network
- Hacking is any technical effort to manipulate the normal behavior of network connections and connected systems
- A hacker is any person engaged in hacking
- Purpose
  - Greed
  - Power
  - Publicity
  - Revenge
  - Adventure
  - Desire to access forbidden information
  - Destructive mindset

History of Hacking

- The term "hacking" historically referred to constructive, clever technical work that was not necessarily related to computer systems.
- MIT engineers in the 1950s and 1960s first popularized the term and concept of hacking.
- The so-called "hacks" perpetrated by these hackers were intended to be harmless technical experiments and fun learning activities.
- Later others began applying the term to less honorable pursuits.
  - For example, hackers in US experimented with methods to modify telephones for making free long-distance calls over the phone network illegally.
- As computer networking and the Internet exploded in popularity, data networks became by far the most common target of hacking.

Hacker Types…

- **White Hat:** White hats are ethical hackers.
  - They use their knowledge and skill to thwart the black hats and secure the integrity of computer systems or networks.
  - They use hacking to identify vulnerabilities and inform the owners of systems so that the vulnerabilities can be plugged-in.
  - If a black hat decides to target you, it's a great thing to have a white hat around.

- **Black Hat:** These are the bad guys. A black hat is a cracker and usage hacking with malicious intent
  - Black hats may also share information about the "break in" with other black hat crackers so they can exploit the same vulnerabilities before the victim becomes aware and takes appropriate measures.

Hacker Types…

- **Gray Hat –** A gray hat is a bit of both a white hat and a black hat.
  - Their main objective is not to do damage to a system or network, but to expose flaws in system security.
  - The black hat part of the mix is that they may very well use illegal means to gain access to the targeted system or network, but not for the purpose of damaging or destroying data:
  - They want to expose the security weaknesses of a particular system and then notify the “victim” of their success.
  - Often this is done with the intent of then selling their services to help correct the security failure so black hats can not gain entry and/or access for more devious and harmful purposes.

Vulnerabilities Exploited by Hackers

- Systems with inadequate border protection
- Systems with weak authentication credentials
- Systems with out of date patching
- Remote Access Servers (RASs) with weak access controls.
- Applications with known vulnerabilities
- Open source applications with no protection
- Poorly protected data and websites
- Mis-configured or default configured systems

Examples of Hacking

- One of the biggest examples is Stuxnet - a virus attack on the Nuclear program of Iran, which is suspected to be carried out jointly by USA and Israel.
- Some of the other victims of hacking are organizations such as:
  - Adobe hack: 2013
  - Yahoo Hack: 2013
  - eBay hack: 2014
  - Sony hack: 2014
  - Mariott hack: 2018
  - Dubsmash hack: 2019
  - ….

What is Ethical Hacking?

- Ethical hacking involves an authorized attempt to gain unauthorized access to a computer system, application, or data.
- Ethical hack involves duplicating strategies and actions of malicious attackers.
  - Helps to identify security vulnerabilities which can then be resolved before a malicious attacker has the opportunity to exploit them.
- Ethical hackers ("white hats") are security experts that perform these assessments.
  - The proactive work they do helps to improve an organization's security posture.
  - With prior approval from the organization or owner of the IT asset, the mission of ethical hacking is opposite from malicious hacking.

Key Concepts of Ethical Hacking

- Ethical Hacking follows four key protocol concepts:
  - **Stay legal**. Obtain proper approval before accessing and performing a security assessment.
  - **Define the scope**. Determine the scope of the assessment so that the ethical hacker's work remains legal and within the organization's approved boundaries.
  - **Report vulnerabilities**. Notify the organization of all vulnerabilities discovered during the assessment. Provide remediation advice for resolving these vulnerabilities.
  - **Respect data sensitivity**. Depending on the data sensitivity, ethical hackers may have to agree to a non-disclosure agreement, in addition to other terms and conditions required by the assessed organization.

Ethical Hackers v/s Malicious Hackers

- Ethical hackers:
  - Use their knowledge to secure and improve the technology of organizations.
  - They provide an essential service to these organizations by looking for vulnerabilities that can lead to a security breach.
  - An ethical hacker reports the identified vulnerabilities to the organization. Additionally, they provide remediation advice.
  - With the organization's consent, the ethical hacker performs a re-test to ensure the vulnerabilities are fully resolved.
- Malicious hackers:
  - Intend to gain unauthorized access to a resource (the more sensitive the better) for financial gain or personal recognition.
  - Deface websites or crash backend servers for fun, reputation damage, or to cause financial loss.
  - The methods used and vulnerabilities found remain unreported.
  - They aren't concerned with improving the organizations security posture.

Skills for Ethical Hacking

- Overall require a wide range of computer skills.
- All ethical hackers should have:
  - Expertise in scripting languages.
  - Proficiency in operating systems.
  - A thorough knowledge of networking.
  - A solid foundation in the principles of information security.
  - specialize to be subject matter experts (SME) on a particular area within the ethical hacking domain

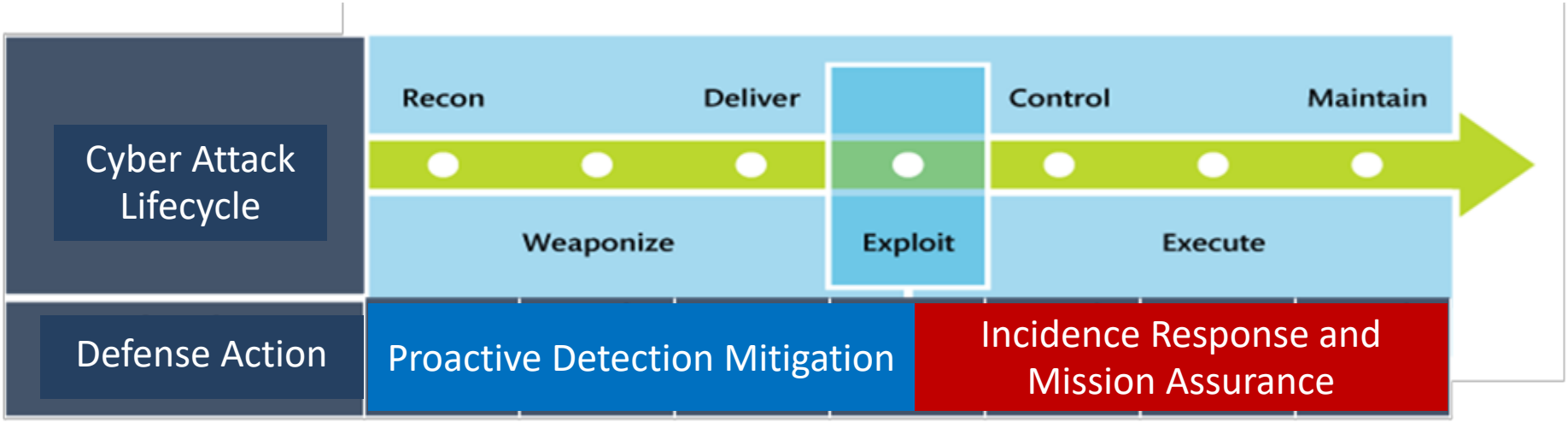
What Problems does Hacking Identify?

- Ethical hacking aims to mimic an attacker and looks for attack vectors against the target.
- Once the ethical hacker gathers enough information, they use it to look for vulnerabilities against the asset.
- As next step, ethical hackers use exploits against the vulnerabilities to demonstrate how a malicious attacker could exploit it.
- Some of the common vulnerabilities discovered by ethical hackers include:
  - Injection attacks
  - Broken authentication
  - Security misconfigurations
  - Use of components with known vulnerabilities
  - Sensitive data exposure
- After the testing, ethical hackers prepare a detailed report. This includes steps to compromise the identified vulnerabilities and steps to patch/mitigate the same.

Key Limitations of Ethical Hacking

- **Limited scope:**
  - Ethical hackers cannot progress beyond a defined scope to make an attack successful.
  - However, it's not unreasonable to discuss out of scope attack potential with the organization.
- **Resource constraints:**
  - Time constraints - limited.
  - Computing power and budget constraints.
- **Restricted methods:**
  - Some organizations ask experts to avoid test cases that lead the servers to crash (i.e. Denial of Service - DDoS attacks).

Cyber Attack Lifecycle (Kill Chain)



The cyber attack lifecycle, first articulated by Lockheed Martin as the "kill chain," depicts the phases of a cyber attack:

- **Recon**—the adversary develops a target;
- **Weaponize**—the attack is put in a form to be executed on the victim's computer/network;
- **Deliver**—the means by which the vulnerability is weaponized;
- **Exploit**—the initial attack on target is executed;
- **Control**—mechanisms are employed to manage the initial victims;
- **Execute**—leveraging numerous techniques, the adversary executes the plan;
- **Maintain**—long-term access is achieved.

Cyber Attack Lifecycle

Source: Lockheed Martin Cyber Kill Chain

What is OWASP?

- Open Web Application Security Project (OWASP) is a non-profit foundation that works to improve the security of software.
- OWASP programs include:
  - Community-led open source software projects
  - Over 275 local chapters worldwide
  - Tens of thousands of members
  - Industry-leading educational and training conferences
- OWASP is an open community dedicated to enabling organizations to conceive, develop, acquire, operate, and maintain applications that can be trusted.
- OWASP projects, tools, documents, forums, and chapters are free and open to anyone interested in improving application security.
- OWASP Foundation was launched on December 1st, 2001 and incorporated as a United States non-profit charity on April 21, 2004.

What is OWASP Top 10?

- OWASP Top 10 is an online document on OWASP's website that provides ranking of and remediation guidance for the top 10 most critical web application security risks.
- The risks are ranked and based on the frequency of discovered security defects, the severity of the vulnerabilities, and the magnitude of their potential impacts.
- This is to enable them to incorporate the report's findings and recommendations into their security practices, thereby minimizing the presence of these known risks in their applications

OWASP Top 10

- **Injection:** Injection flaws, such as SQL, NoSQL, OS, and LDAP injection, occur when untrusted data is sent to an interpreter as part of a command or query.
- **Broken Authentication:** Incorrect implementation of authentication and session management functions, allowing attackers to compromise passwords, keys, or session tokens etc.
- **Sensitive Data Exposure:** Inadequate protection of sensitive data, such as financial, healthcare, and PII, by web applications and APIs.
- **XML External Entities (XXE):** Older or poorly configured XML processors evaluate external entity references within XML documents.
- **Broken Access Control:** Poor enforcement of restrictions on what authenticated users are allowed to do.
- **Security Misconfiguration:** A result of insecure default configurations, incomplete or ad hoc configurations, open cloud storage, misconfigured HTTP headers, and verbose error messages containing sensitive information.
- **Cross-Site Scripting XSS:** XSS flaws occur whenever an application includes untrusted data in a new web page without proper validation or escaping, or updates an existing web page with user-supplied data using a browser API that can create HTML or JavaScript.
- **Insecure Deserialization:** Insecure deserialization often leads to remote code execution.

OWASP Top 10…

- **Using Components with Known Vulnerabilities:** Components, such as libraries, frameworks, and other software modules, run with the same privileges as the application.
- **Insufficient Logging & Monitoring:** Insufficient logging and monitoring, coupled with missing or ineffective integration with incident response, allows attackers to further attack systems, maintain persistence, pivot to more systems, and tamper, extract, or destroy data.

It Takes Time to Become a Hacker

- This class alone won't make you a hacker, or an expert
  - It might make you a script kiddie
- It usually takes years of study and experience to earn respect in the hacker community
- It's a hobby, a lifestyle, and an attitude
  - A drive to figure out how things work

What You Can Do Legally?

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- Laws involving technology change as rapidly as technology itself
- Find what is legal for you locally
  - Laws change from place to place
- Be aware of what is allowed and what is not allowed
- Governments are getting more serious about punishment for cybercrimes

What You Cannot Do Legally?

- Accessing a computer without permission is illegal
- Other illegal actions
  - Installing worms or viruses
  - Denial of Service attacks
  - Denying users access to network resources
- Be careful your actions do not prevent customers from doing their jobs

Get It in Writing

- Using a contract is just good business
- Contracts may be useful in court
- Internet can also be a useful resource
- Have an attorney read over your contract before sending or signing it

Useful Sites

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- OWASP

  https://www.owasp.org/index.php/Category:OWASP_Top_Ten_Project

- Symentec

  http://www.symantec.com/security_response/publications/threatreport.jsp

- Akmai

  https://www.stateoftheinternet.com/

- Hacker news

  https://thehackernews.com

Thank You