

# CSE 477: Introduction to Computer Security

## Lecture – 1

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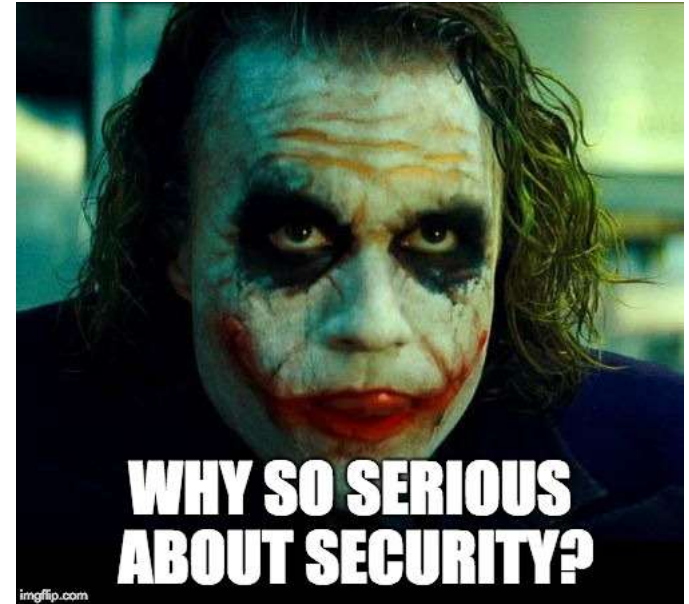
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# Outline

- Motivations
- Course Information
- Basic concepts

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- Security properties
- Security attacks
- Security failure & secure solutions



# Motivations

- Currently around 4.77 billions of mobiles and increasing
- Around 4 billions of Internet users
- Around 320 millions of domain names
- Around \$2300 billions of retail e-commerce sales and growing
- Almost all spheres of our lives are somehow dependent on the Internet and different web services
  - Mostly in developed countries, developing nations are catching up
- This trend will continue to grow

# Motivations

## Yahoo says all three billion accounts hacked in 2013 data theft

Jonathan Stempel, Jim Finkle

5 MIN READ



(Reuters) - Yahoo on Tuesday said that all 3 billion of its accounts were hacked in a 2013 data theft, tripling its earlier estimate of the size of the largest breach in history, in a disclosure that attorneys said sharply increased the legal exposure of its new owner, Verizon Communications Inc (VZ.N).

# Motivations

**Yahoo says all three billion accounts  
hacked in 2013 data theft**

**Cyber Thieves Took Data On 145 Million eBay Customers By Hacking 3 Corporate Employees**

Jim Finkle and Deepa Seetharaman

🕒 May. 27, 2014, 6:02 AM 🔥 8,757

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# Motivations

**Yahoo says all three billion accounts  
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## **Stuxnet: Cyber attack on Iran 'was carried out by Western powers and Israel'**

A British security expert has uncovered new evidence in the Stuxnet virus attack on Iran's nuclear programme.

# Motivations

## DDoS attack that disrupted internet was largest of its kind in history, experts say

Dyn, the victim of last week's denial of service attack, said it was orchestrated using a weapon called the Mirai botnet as the 'primary source of malicious attack'

● Major cyber attack disrupts internet service across Europe and US



▲ Dyn estimated that the attack had involved '100,000 malicious endpoints', and the company said there had been reports of an extraordinary attack strength of 1.2 terabits (1,200 gigabytes) per second. Photograph: Alamy

## eBay Customers By Hacking 3 Corporate

arried out by Western

lence in the Stuxnet virus



# Motivations

## Mirai Botnet

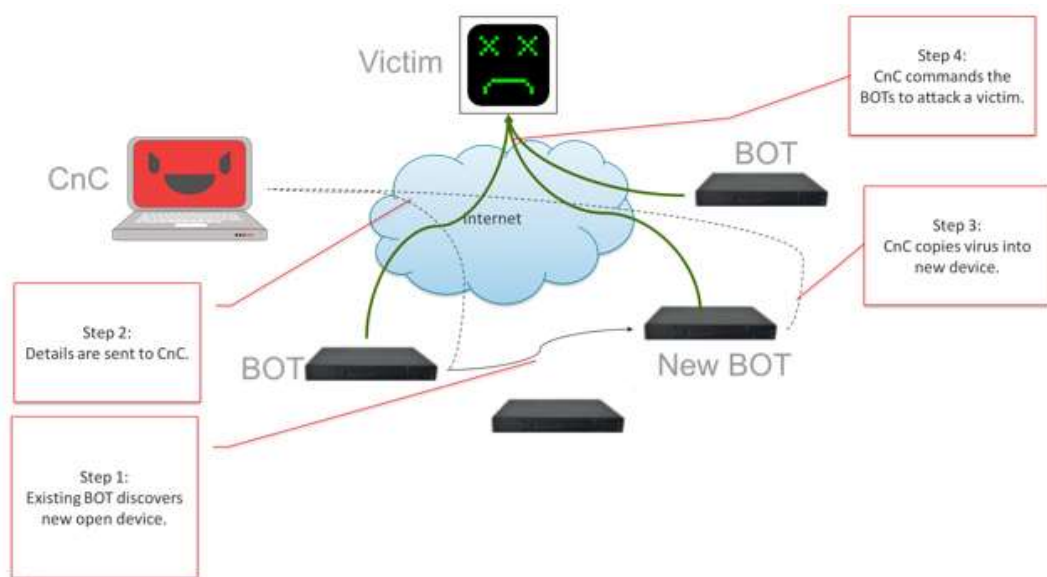
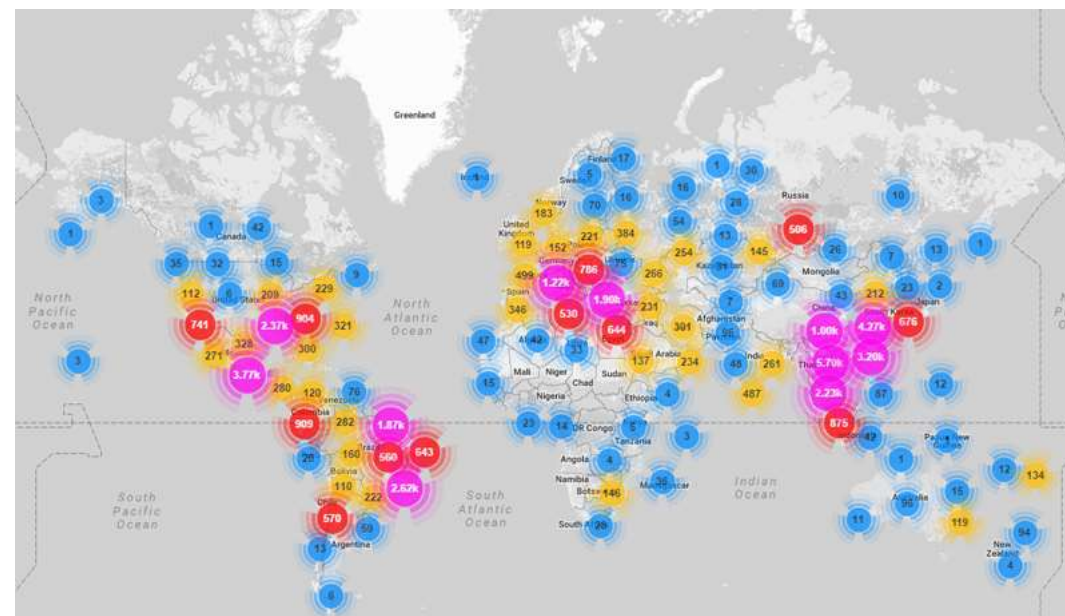


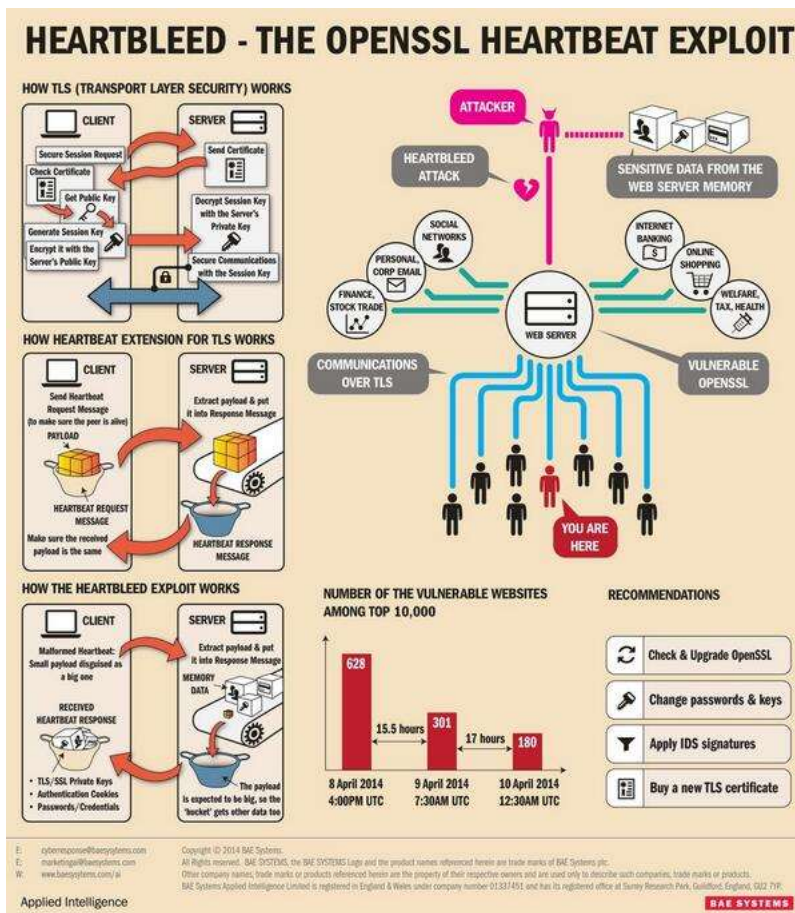
Figure 1 Mirai System



<https://www.corero.com/img/Diagrams/mirai-botnet-ddos-attack.jpg>

<https://www.incapsula.com/blog/wp-content/uploads/2016/10/mirai-botnet-map.png>

# Motivations



Source:

[https://storify.com/services/proxy/2/WJZ\\_9tf1AVAiKovh33lUA/http/pbs.twimg.com/media/Bk7vrLqIgAArRrS.jpg](https://storify.com/services/proxy/2/WJZ_9tf1AVAiKovh33lUA/http/pbs.twimg.com/media/Bk7vrLqIgAArRrS.jpg)

DOMAIN	VULNERABLE SITES	SAFE SITES	TOTAL NO. OF SITES USING SSL	TOTAL NO. OF SITES	PERCENTAGE
KR	57	45	102	2839	56%
JP	534	661	1195	17852	45%
RU	2708	3590	6298	38573	43%
CN	66	98	164	10430	40%
GOV	26	43	69	829	38%
BR	866	1782	2648	16328	33%
ALJ	553	1190	1743	7911	32%
UK	1073	2692	3765	19062	28%
DE	1544	4780	6324	34275	24%
FR	594	2474	3068	13033	19%
IN	611	2851	3462	13204	18%
Total	8632	20206	28838	174336	30%

Source: <https://i1.wp.com/securityaffairs.co/wordpress/wp-content/uploads/2014/04/heartbleed-SSL-scan-results.jpg>

# Motivations



## WannaCry Ransomware Statistics: The Numbers Behind the Outbreak



Source: <http://www.asuamaytinh.com/wp-content/uploads/2017/05/virus-wanna-cry-la-gi-cach-phong-chong-ra-sao-1888-660x330.jpg>

## More than 400,000 machines infected

# Historical timeline - 1

- 1962 File access controls in multiple-access systems.
- 1967 One-way functions to protect passwords.
- 1968 Multics security kernel (BLP model)
- 1969–89 ARPANET  $\rightsquigarrow$  Internet; TCP/IP in 1977.
- 1976 Public-key cryptography and digital signatures
- 1978 RSA public-key cryptosystem.
- 1978 First vulnerability study of passwords (intelligent search).
- 1978 E-cash protocols invented by David Chaum.
- 1983 Distributed domain naming system (DNS), vulnerable to spoofing.
- 1984 Viruses receive attention of researchers.
- 1985 Advanced password schemes.
- 1986 Wily hacker attack (Clifford Stoll's "Stalking...")
- 1988 Internet Worm: 6,000 computers (10% of Internet).
- 1988 Distributed authentication realised in Kerberos.
- 1989 Pretty Good Privacy (PGP) and Privacy Enhanced Mail (PEM).

# Historical timeline - 2

- 1990 Anonymous remailers (protocols prevent tracing).
- 1993 Packet spoofing; firewalls; network sniffing.
- 1994 Netscape designs SSL v1.0 (revised 1995).
- 1996 SYN flooding. Java exploits. Web-site hacking.
- 1997 DNSSec security extension for DNS proposed.
- 1998 Script kiddies' scanner tools. IPSec proposals.
- 1999 First DDoS attacks. DVD encryption broken
- 2000 VBscript worm ILOVEYOU (0.5 – 8 million infections). Cult of the Dead Cow's Back Orifice  
2000 Trojan.



# Historical timeline - 3

- 2001 Code Red, Nimbda worm infects Microsoft IIS.
- 2002 Palladium; chipped Xbox blocked from online play.
- 2003 W32/Blaster worm. Debian and FSF are cracked.
- 2004 First mobile phone virus Cabir
- 2005 Flaws in SHA-1. Sony's "rootkit" with broken DRM.
- 2006 RFID cracks.  
Microsoft Vista released; vulnerabilities discovered.
- 2007 Data breaches: TJX Inc (94m), UK HMRC (24m).  
iPhone released & cracked.
- 2008 Kaminsky discovers major DNS flaws. CIA reports power utility cyber-extortion. Oyster Cards cloned and UK e-passports faked.

# Historical timeline - 4

2009 Conficker virus  
iPhone worm  
DoS attacks on social networks (Twitter, Facebook)  
Numerous data breaches  
Hacktivism  
TJX Hacker indicted  
BT & Phorm  
“Privacy” at Facebook, Google, ...  
Cloud computing  
...

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- **Course Information**
- Basic concepts
- Security properties
- Security attacks
- Security failure & secure solutions





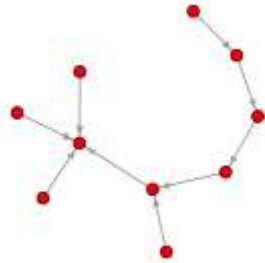
# What is computer security?

- Computer security is the protection of computer systems
  - operating in adversarial environments
  - with possible adversaries
- Protection aims to:
  - allow intended use
  - prevent unintended use

# What is computer security?



tries to break in



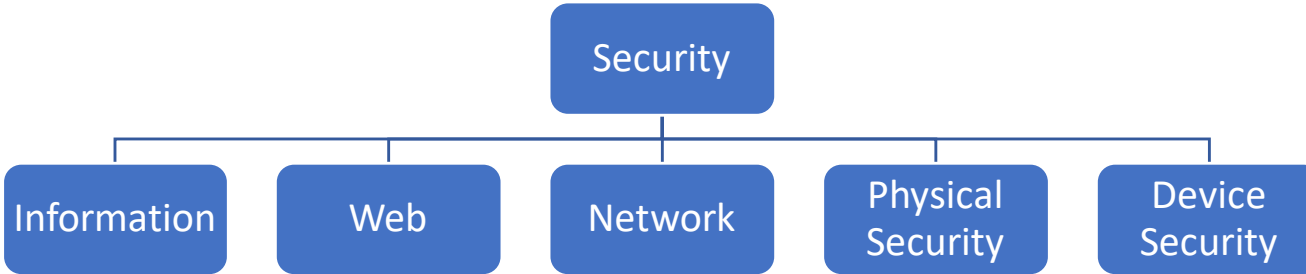
having security properties

- Personal motivation (Ex spouse/employee)
- Financial motivation
- Political motivation

- Confidentiality
- Integrity
- Availability
- Authenticity
- Anonymity
- ....

- In this course
  - why systems are **insecure**?
  - how to make them **secure**?

# Course Information



Source: [https://d2gg9evh47fn9z.cloudfront.net/800px\\_COLOURBOX18770823.jpg](https://d2gg9evh47fn9z.cloudfront.net/800px_COLOURBOX18770823.jpg)



Source: <http://itak.aitam.org/wp-content/uploads/sites/2/2015/06/Can-Mega-Data-Breaches-be-Prevented-%E2%80%93-What-ITAM-Can-Learn-from-Target-and-Home-Depot.jpg>

# Course Information

- Brief introduction to Computer Security
  - Physical Security
  - Operating System Security
  - Basic crypto & Security Protocols
  - Internet and network security
  - Web and email security
  - Malware
  - Bitcoin (if time permits)
- Will not cover
  - Deep mathematical study of modern cryptography
    - However, basic cryptography will be covered



# Assessment (tentative)

- Class Attendance: 10%
- Homework + Assignment: 5%
- Term Test: 15%
- Final exam: 70%

# Resources

- Textbook
  - Introduction to Computer Security - Michael Goodrich & Roberto Tamassia, First Edition
- Additional Resources:
  - Introduction to Computer Security – Matt Bishop
  - Handbook of Applied Cryptography - Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone. <http://cacr.uwaterloo.ca/hac/>
- Additional research papers will be supplied throughout the course

# Advisory: Ethical code of conduct



- With great power comes great responsibility!
- Course materials and knowledge gained in this course should not be considered as an incitement to crack!
- Breaking into system to demonstrate security problems might cause irreversible damages to many innocent users and might lead to **prosecution**!
- If you spot a security hole in a running system, **don't exploit it**, instead consider contacting the relevant administrators confidentially
- Sysadmins might not act quickly as it is difficult to keep up with latest security patches
- Especially true in the university setting:
  - traditional approach: open access above security,
  - resources for sysadmin are very tight



# Advisory: Ethical code of conduct

- If you want to experiment with security holes, play with your own machine, in your **own private network of machines**.
  - e.g. using a form of *virtualisation*: e.g., VMWare, Virtual Box, etc.
- If you discover a new security hole in a standard and popular application, or operating system
  - consider contacting the vendor of the software/OS in the first case
  - consider suggesting a fix, if you can
- You might also raise the issue in a security forum for discussion
  - without providing complete details of the hole
- The software vendor or other security experts will be able to confirm or deny, and work can begin on fixing the problem



Google classroom code

# CSE 477: Introduction to Computer Security

Class code q36uja7 

