

Proudly sponsored by the DoD, IUP and BC3

# CYBERSECURITY WORKSHOP

**April 10 & 17, 2021**

## Planned Activities

- ◆ Introduction to the CySP Program
- ◆ Hands-on activities using the Raspberry Pi
- ◆ Guest speaker presentations by security experts
- ◆ Hands-on session on Social Engineering & Steganography
- ◆ Hands-on activities on Network Traffic Analysis

## Workshop Details

**9:00 a.m. to 3:00 p.m.**  
each Saturday

**Held Virtually via Zoom**

**Please visit**  
**[www.iup.edu/dodscholarship](http://www.iup.edu/dodscholarship)**  
**for more information**

- ◆ Space is limited, please act now!
- ◆ Open to all interested students and faculty.

## REGISTRATION INFORMATION

**Email [sherri.mack@bc3.edu](mailto:sherri.mack@bc3.edu)**

## PARTICIPATION ADVANTAGES

- ◆ Student participants receive a Raspberry Pi 4 Starter Kit with Fan Cooled Case
- ◆ Faculty participants receive a \$500 stipend

## **PARTICIPATION ADVANTAGES**

**Offered at no cost!**

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**Student participants  
receive a Raspberry Pi 4  
Starter Kit!**

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**Faculty participants  
receive a \$500 stipend**

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**Skills and knowledge  
for a growing career  
field!**

## **REGISTRATION INFORMATION**

**Email  
sherri.mack@bc3.edu**

## **WORKSHOP DETAILS**

**April 10 & 17, 2021**

The workshop is held over two  
consecutive Saturdays.

**Held Virtually via Zoom**

**Please visit  
[www.iup.edu/dods scholarship](http://www.iup.edu/dods scholarship)  
for more information**

## **PROJECT PI'S**

**Dr. Waleed Farag**

Director, Institute for Cybersecurity  
Professor, Computer Science

**Dr. Raj Ezekiel**

Professor, Computer Science

**Dr. Xinwen Wu**

Associate Professor, Computer Science

## **SPONSORED BY:**



**DoD, IUP, & BC3**

# **CYBER SECURITY WORKSHOP**

**Proudly Presented By:  
DoD, IUP & BC3**



## **DoD CySP & CAPACITY BUILDING PROJECT INFO**

### **DoD Cyber Scholarship Program**

The DoD CySP is a federally supported program to encourage the recruitment of cyber talent to support national infrastructure.

Under the leadership of the Project PI, Waleed Farag, IUP, along with a selected group of national universities, has been awarded funding in the 2020–21 academic year from the Department of Defense (DoD) in support of the Cyber Scholarship Program (CySP).

### **DoD CySP Capacity Building Project**

In addition to the scholarship recruitment award, IUP received a Capacity Building award for a project titled "A New Collaborative and Learner-Centered Pedagogy for Faculty and Student Development in Cybersecurity."

The goal of this capacity building project is to find additional ways to recruit more students to enter the cybersecurity workforce. This goal will be achieved through a unique blend of faculty development, hands-on workshops, and the continued cultivation of relationships with local community colleges. As a result, this project will hold a number of workshops at surrounding Community Colleges.

**Visit the [DoD CySP](#) page for more information**

## **WORKSHOP ACTIVITIES**

Introduction to the  
CySP Program

Hands-on activities  
using the  
Raspberry PI

Guest speaker  
presentations by  
security experts

Hands-on Social  
Engineering &  
Steganography

Hands-on  
Network Traffic  
Analysis

## WORKSHOP SCHEDULE - DAY 1

4/10/21

9:00 a.m. to 9:25 a.m.

**The DoD CySP, CAE program at IUP, and Cybersecurity Activities at IUP**  
Dr. Waleed Farag, Director, IUP Institute for Cybersecurity

9:25 a.m. to 9:30 a.m.

**BREAK**

9:30 a.m. to 11:20 a.m.

**Defense Against the Dark Hat**  
Dr. Larry Pearlstein  
Associate Professor, Department of Electrical and Computer Engineering, TCNJ

11:20 a.m. to 12:00 p.m.

**LUNCH BREAK**

12:00 p.m. to 1:30 p.m.

**Raspberry Pi and Security Applications**  
Dr. Waleed Farag, Director, IUP Institute for Cybersecurity

1:30 p.m. to 1:40 p.m.

**BREAK**

1:40 p.m. to 3:00 p.m.

**Social Engineering via Open Source Intelligence**  
Dr. Raj Ezekiel, Professor of Computer Science, IUP

## WORKSHOP SCHEDULE - DAY 2

4/17/21

9:00 a.m. to 10:40 a.m.

**Threats, Vulnerabilities and Attacks**  
Mr. Dom Glavach, Chief Security Officer and Chief Strategist at CyberSN

10:40 a.m. to 10:45 a.m.

**BREAK**

10:45 a.m. to 12:00 p.m.

**Network Traffic Investigation**  
Dr. Xinwen Wu, Associate Professor of Computer Science, IUP

12:00 p.m. to 12:30 p.m.

**LUNCH BREAK**

12:30 p.m. to 1:45 p.m.

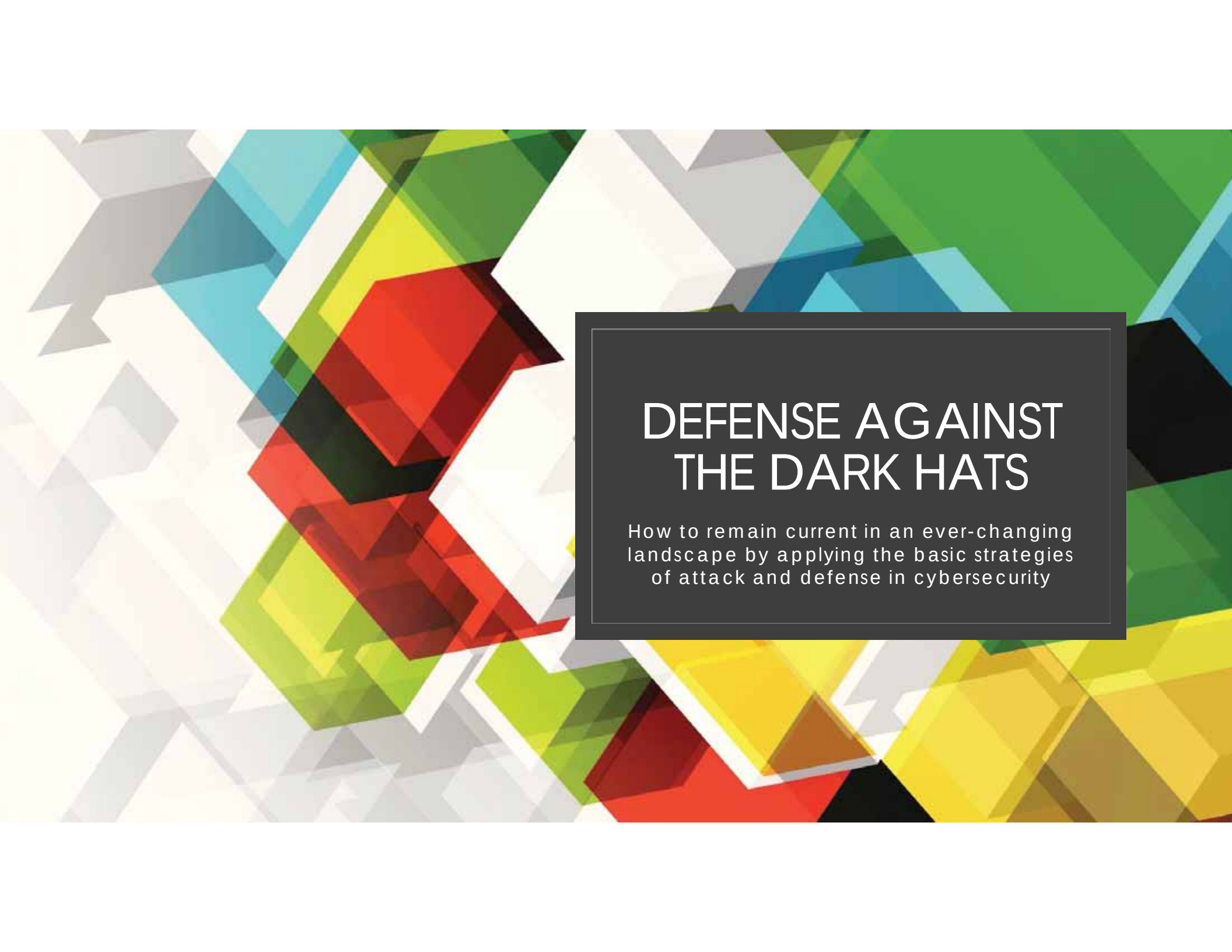
**Exploring Information Hiding (Steganography)**  
Dr. Raj Ezekiel, Professor of Computer Science, IUP

1:45 p.m. to 1:50 p.m.

**BREAK**

1:50 p.m. to 3:05 p.m.

**Software Security Assurance**  
Dr. Xinwen Wu, Associate Professor of Computer Science, IUP



# DEFENSE AGAINST THE DARK HATS

How to remain current in an ever-changing  
landscape by applying the basic strategies  
of attack and defense in cybersecurity

# Mapping our route



THE HISTORY OF  
CRYPTOGRAPHY AND OF  
HACKING

Crack a  
cypher



HACKING AROUND THE WORLD

Act a  
hack



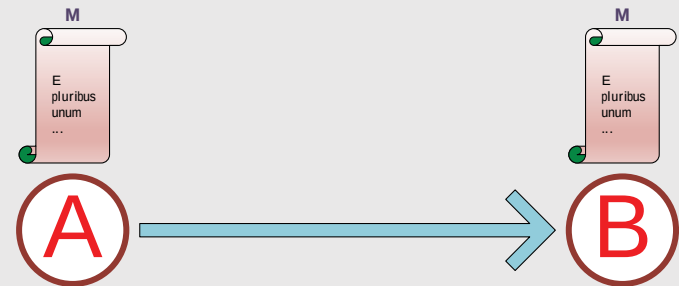
HOW TO BE A WHITE HAT

Defend  
with your  
white hat



# Cryptography

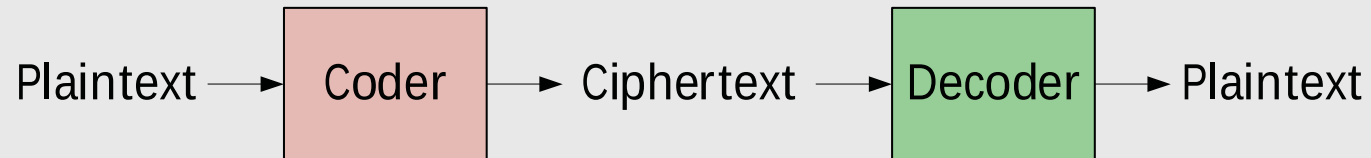
- Cryptography. n. The art of writing or solving codes.
- You want to send a message from point A to point B.
- But the message might be intentionally intercepted, accidentally lost, or peeked at by your messenger.
- You only want authorized recipients to be able to understand the message!



So – we use a *cipher*, meaning a secret code

# Cryptography Definitions

- Plaintext: Unencrypted input data
- Ciphertext: Output of the encryption process





# Cryptographic Key

- Many cryptographic systems are constructed as a *family* of ciphers.
- The family may be publicly known – everyone knows how to code and decode messages, but they need to know the **KEY** value.





# Cryptography – Ancient History

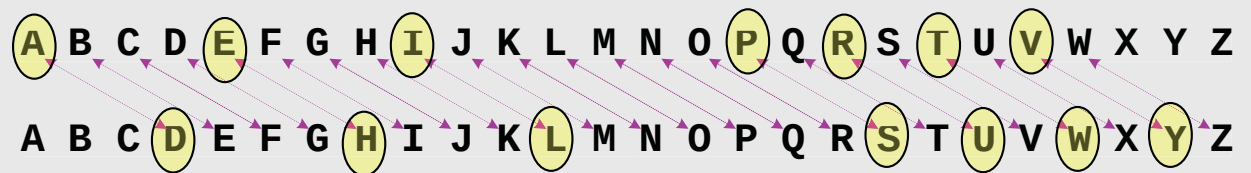
- The earliest known cryptosystem or cipher is the Polybios square (2150 years ago!)
  - Using a grid of letters, each letter of the message is replaced by the two numbers indicating the row and column for the original letter
- Julius Caesar (2100 years ago) used a cipher to protect messages of military significance
  - Caesar Cipher: each letter of the alphabet was coded by substituting using letters in a shifted alphabet

|   | 1 | 2 | 3 | 4   | 5 |
|---|---|---|---|-----|---|
| 1 | A | B | C | D   | E |
| 2 | F | G | H | I,J | K |
| 3 | L | M | N | O   | P |
| 4 | Q | R | S | T   | U |
| 5 | V | W | X | Y   | Z |

**C**ANDY → **13**11 33 14 54

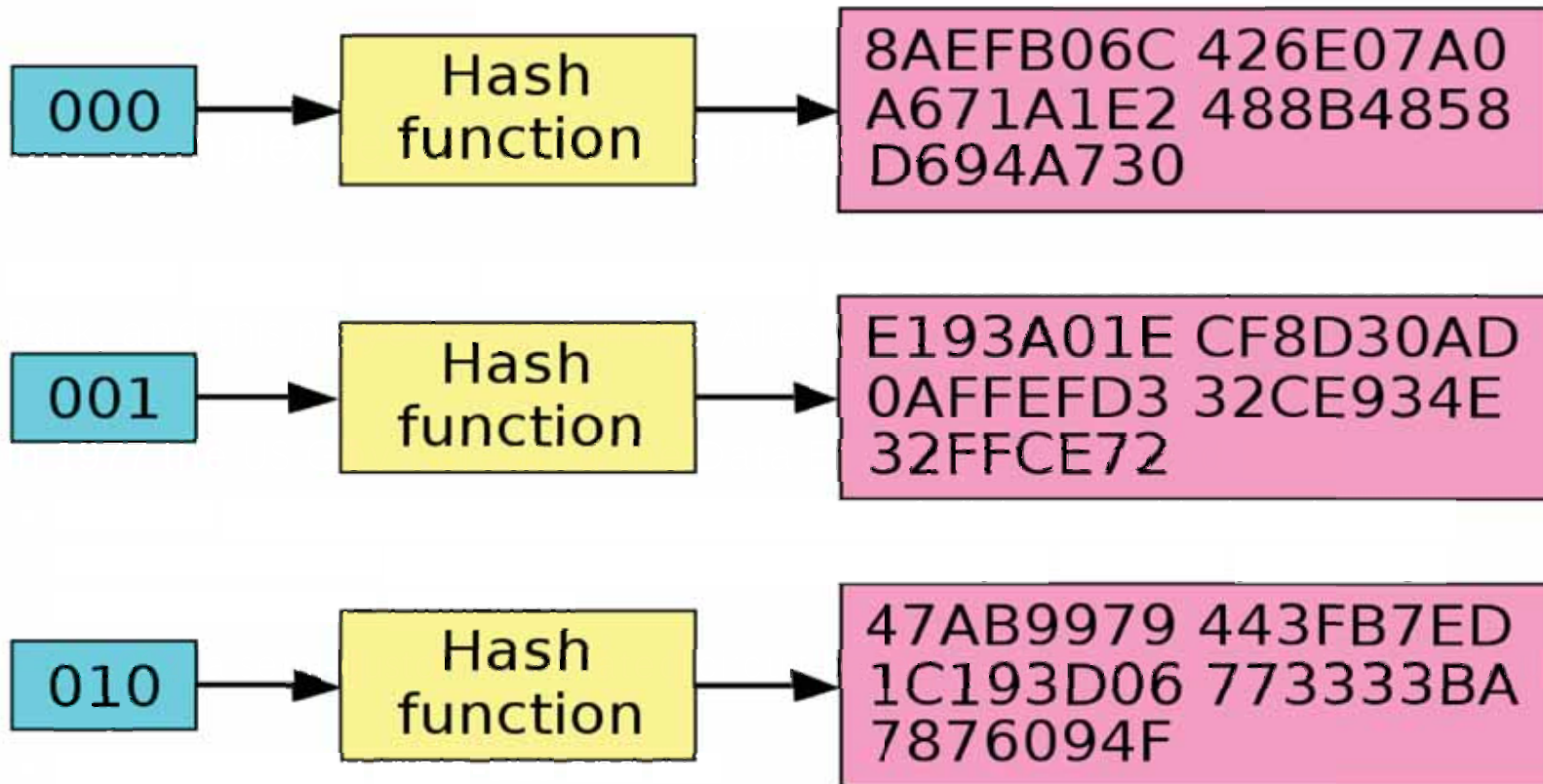
Example:

a → d: PRIVATE → SULYDWH



## Input

## Hash sum



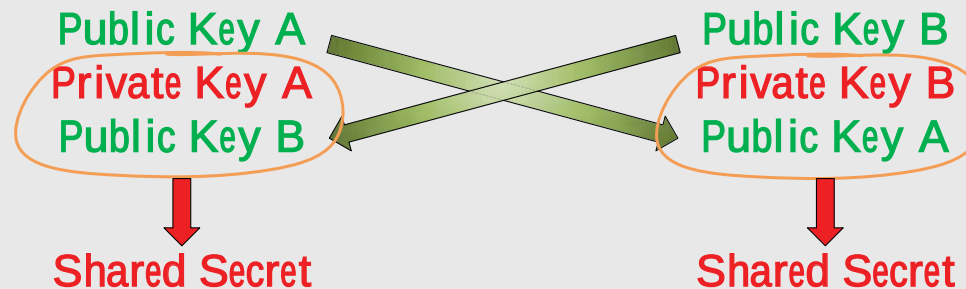
# Some Simple Ciphers

- ROT13
  - A Caesar cipher with a fixed alphabet shift. Used in the early days of the Internet to send spoilers and potentially offensive material. Not intended to be secure, but allow voluntary protection from being exposed to information.
- One-time pad
  - This is perhaps the only truly uncrackable code.
  - Each element is coded using a separate, randomly selected codebook. The sender and receiver must know the common codebook for each element. For example, one could create a Caesar cipher where the shift for each character is potentially different, and chosen at random (but shared between message sender and recipient). No set of codes is ever reused.



# Public Key Cryptography

- The [Diffie–Hellman Key Exchange](#) used Public-Key Cryptography:
  - Parties at Point A and Point B each have their own **Public Key + Private Key** pair.
  - They openly exchange **Public Key A** and **Public Key B**.
  - They each combine their own **Private Key** with the other's **Public Key** to produce the same shared secret.





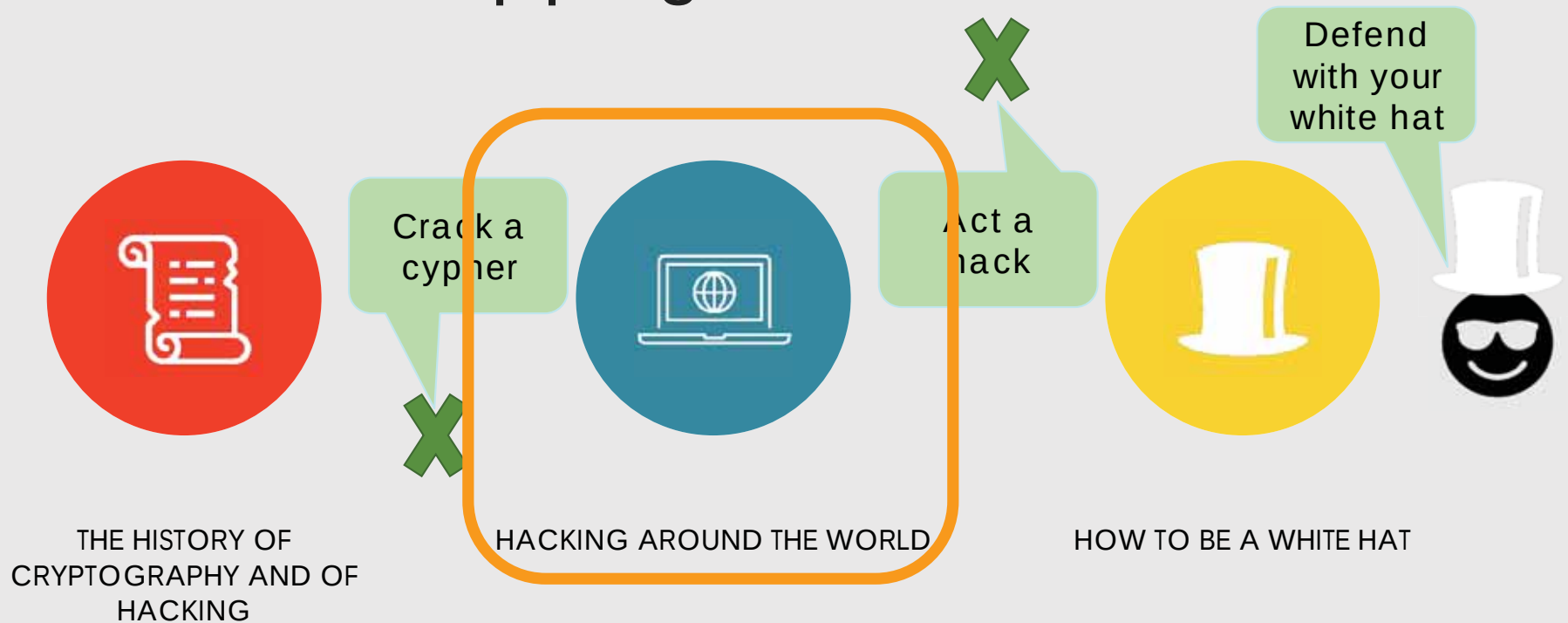
# Cryptography Activity

- I will direct you to the website: [picoctf.org](https://picoctf.org)
- Use the Username: DATDH (for Defense Against the Dark Hats)
- Guess the password!
- To decode each secret message, try an approach – the correct approach will give you a message that looks like English words (without spaces between them).

# Cryptography Activities

- [The Numbers](#) Cipher, entry format:
  - `PICOCTF{ALLCAPSNOSPACES}`
  - A pretty simple cipher, but not one that we talked about before.
- [Caesar](#) Cipher, entry format:
  - `picoCTF{lowercasenospaces}`
  - The answer may not entirely look legit.
- [Easy1](#) Cipher (one-time pad), entry format:
  - `picoCTF{ALLCAPSNOSPACES}`
  - Actually not that easy! HINT: the first coded message letter, U, along with the first KEY letter, S, can be decoded to the letter 'C'.
- [13](#) Cipher , entry format:
  - `picoCTF{lower_case_with_underscores}`

# Mapping our route

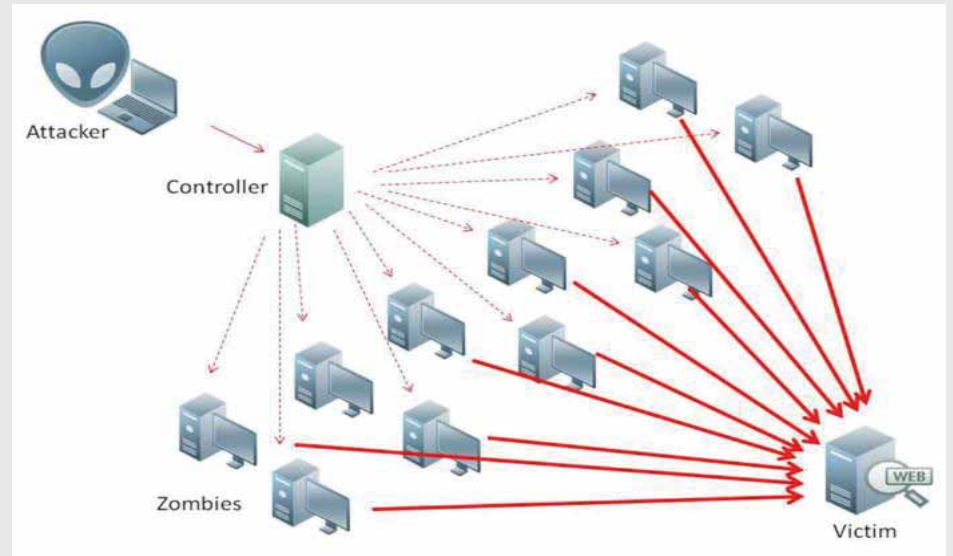
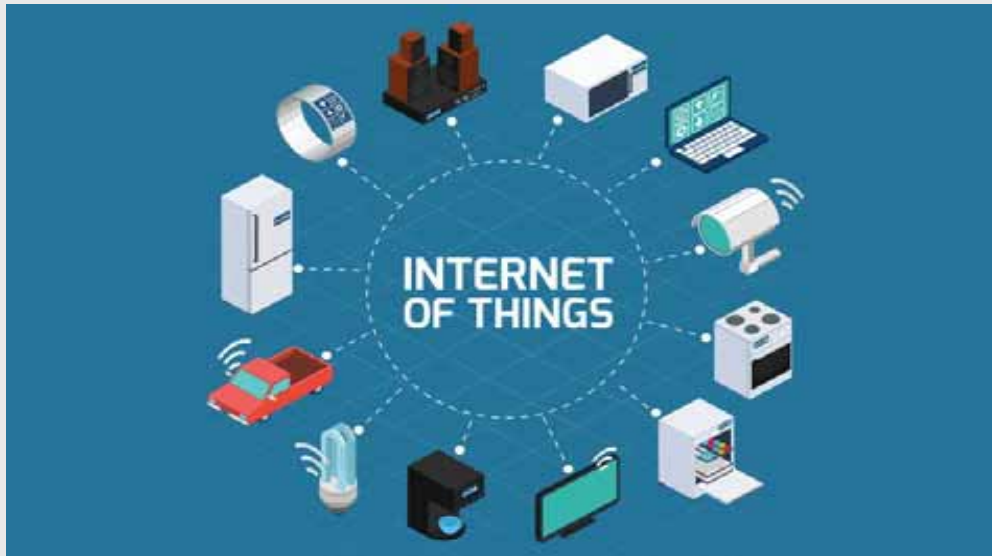


# The Cybersecurity Arms Race

- Nov 2, 1988 The first global cybersecurity attack the Morris Worm infected using [buffer-overflow](#) exploit in email protocols
  - About 10% of all computers on the internet were rendered useless
- Two new defense strategies emerged from the Morris Worm
  - Try to detect infected files (this led to anti-virus software)
  - Block all packets except the ones delivered in a controlled way (this led to firewalls)
- Response to firewalls - hackers started utilizing exploits on the servers with legitimate websites to attack normal users
- Response to anti-virus software - hackers changed how their malware would be identified (i.e. their signature) without changing its functionality

# The Cybersecurity Arms Race

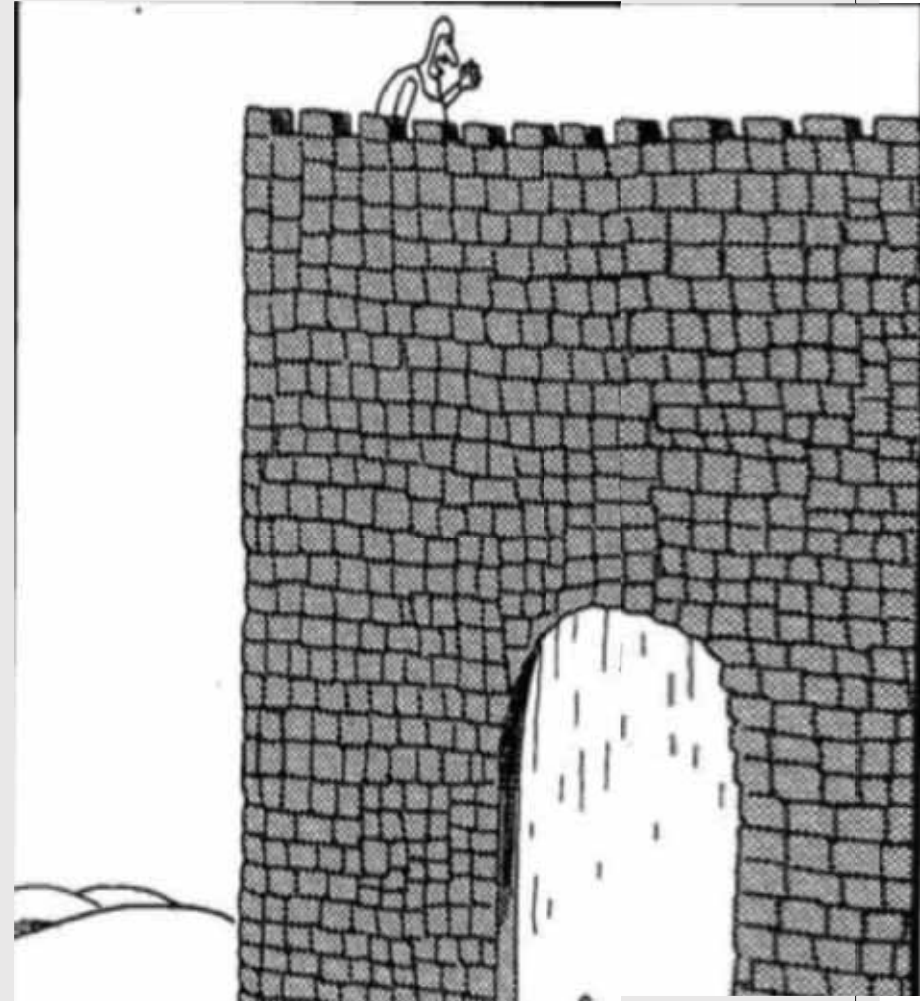
- Internet of Things (IoT) devices (e.g. smart toaster, fridge, watch, car, etc.) are simple, making them ideal targets for an exploit
- September 2016, the Mirai virus targeted IoT devices and used them in a spree of massive distributed denial-of-service (DDoS) attack



# Social Engineering

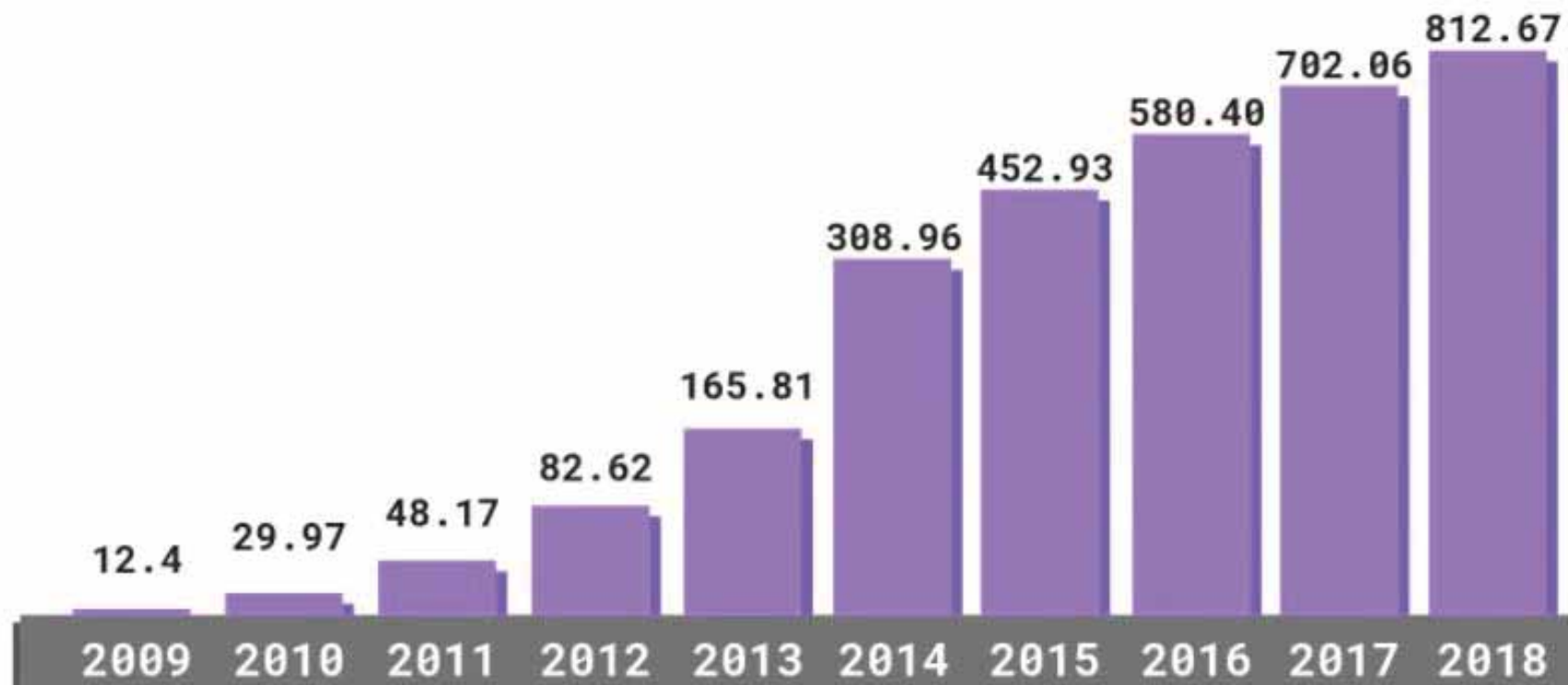
- **Phishing** (e.g. email with a fake link)
- **Pretexting** (e.g. fake security representative asks for your password to secure your account he claims has been breached)
- **Reverse Social Engineering** (e.g. fake tech support company uses search engine optimization to position their phone number at the top of a Google search of a malware they are secretly responsible for and then asks you to give access to your computer to solve it when you call)
- **Tailgating** (e.g. following a real employee through the secure door and dropping a flash drive with malware)
- **Whaling and Spear Phishing** (e.g. deep research into Yahoo Engineer to fool him and get access to everyone's email)
- Social engineering has been around long as there has been coveted information
- 2013, over 110 million customers had personal and credit card info stolen, because of Social engineering on an HVAC company with remote access to Target's network, which was then hacked
- 15 year old Kane Gamble obtained secure emails of the director of the CIA, by convincing Verizon to provide personal details, which allowed Kane to impersonate him and change his credentials





# Major Updates in Cyber Security

- The problem has exploded in severity!
  - In 1988 there was virtually no cost to cybersecurity
  - The average cost of a security breach affecting small businesses rose from \$229k in 2018 to \$369k in 2019
  - According to Cybersecurity Ventures, cybercrime will cost the global economy \$6.1 trillion annually in 2021
- The complexity; AI and machine learning have made attacks and pre-attack research more effective and sophisticated
- The risk; in 2018 the FBI told The Wall Street Journal that every American citizen's data may be stolen and on [the dark web](#)
- The reward - the average cybersecurity salary is rising to just shy of \$100,000 dollars per year



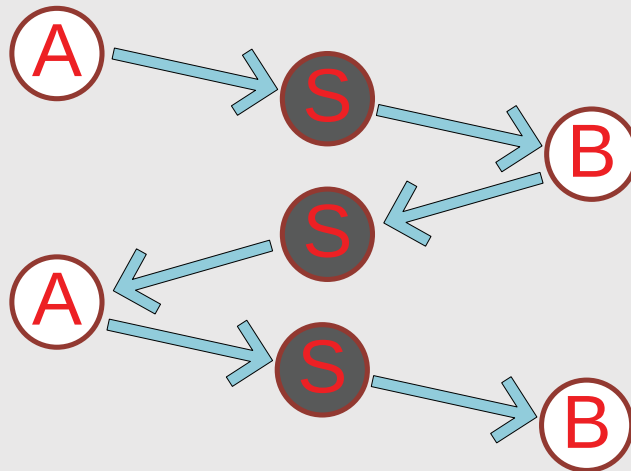
Total Malware Infection Growth Rate (In Millions)

# “Man-In-The-Middle” Attack

- Points A and B think that they’re just talking to each other, in private



- In reality, there is a **SPY, S**, in the middle, intercepting and forwarding messages.



# “Man-In-The-Middle” Attack

- You think that you click on a link (perhaps in an email, or online ad) to your favorite website, maybe “Instagram.com”
- It actually takes you to 1nstagram.com, or instogram.com
- This MITM (man-in-the-middle) actually goes to the real website, and pretends to be you. On your behalf it requests web pages, and returns them to you.
  - Almost everything looks normal to you!
  - The MITM can capture your usernames, passwords, and any other information that you exchange!
- How to spot a problem:
  1. The URL shown in your browser doesn’t look right – either misspelled, or funny characters
  2. The URL starts with http:// rather than https://
- How to avoid getting tricked:
  - Do not click on links in any suspicious emails. The safest way is to copy the link and examine it before going to the site, or manually type the correct link into your browser.

## Exploit Activity

- Write a script, and act out an example of a “Man in the Middle” attack.
- Could be cyber-ish scenario or real-world scenario.

# Act Out a Man-in-the-Middle Scenario

Cast: Joe Browser (wants to browse their favorite web site)

Bette Midler (intercepts the website request, forwards the request, but intercepts keystrokes)

Ender Wiggin (legitimate web site, does not know that anything is wrong)

Example dialogue:

Joe: Hi Ender, how are you doing today?

Bette (intercepting the greeting, to Ender): Hi Ender, how are you doing today?

Ender (thinking they are communicating with Joe, but are actually communicating with Bette): Hi Joe, I've got many things to show you, but first I'd like you to log in, just like you always do.

Bette (to Joe): Hi Joe, I've got many things to show you, but first I'd like you to log in, just like you always do.

NOTE: Have the narrator tell us what the person in the middle is doing. For example, writing down usernames and passwords.

Change the names, to protect the innocent. Do not ever use your real passwords in any examples. 😊

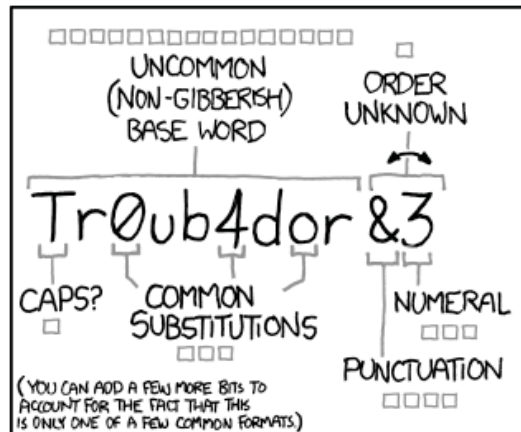


# Cracking Passwords

- Passwords are used as keys to access things that you consider valuable:
  - Your GMail, Instagram, Snapchat, Twitter and Facebook accounts
  - Your Amazon and other shopping accounts
  - Your Fortnite, Warcraft, Minecraft, League of Legends, etc.
- Passwords are often stored using encryption
  - But - when a service is cracked, hackers can often guess your password by trying every possible combination of dictionary words and other common decorations.
  - When they produce ciphertext that matches your password's ciphertext, they've got a crack, and you're toast!

## PASSWORD STRENGTH

From <https://xkcd.com/936/>



~28 BITS OF ENTROPY

□□□□□□□□  
□□□□□□□□ □  
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$2^{28} = 3 \text{ DAYS AT } 1000 \text{ GUESSES/SEC}$

(PLAUSIBLE ATTACK ON A WEAK REMOTE WEB SERVICE. YES, CRACKING A STOLEN HASH IS FASTER, BUT IT'S NOT WHAT THE AVERAGE USER SHOULD WORRY ABOUT.)

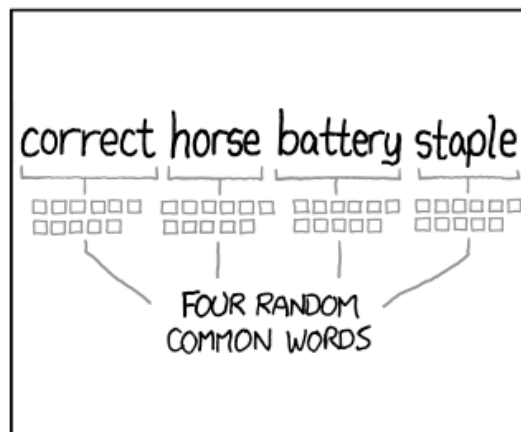
DIFFICULTY TO GUESS:  
**EASY**

WAS IT TROMBONE? NO, TROUBADOR. AND ONE OF THE 0s WAS A ZERO?

AND THERE WAS SOME SYMBOL...



DIFFICULTY TO REMEMBER:  
**HARD**

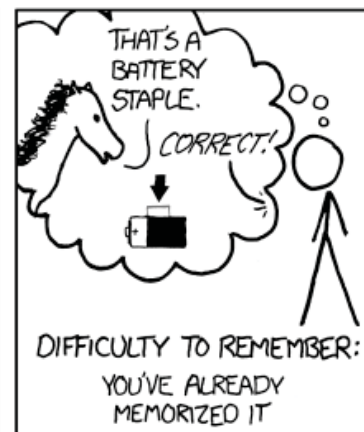


~44 BITS OF ENTROPY

□□□□□□□□□□  
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$2^{44} = 550 \text{ YEARS AT } 1000 \text{ GUESSES/SEC}$

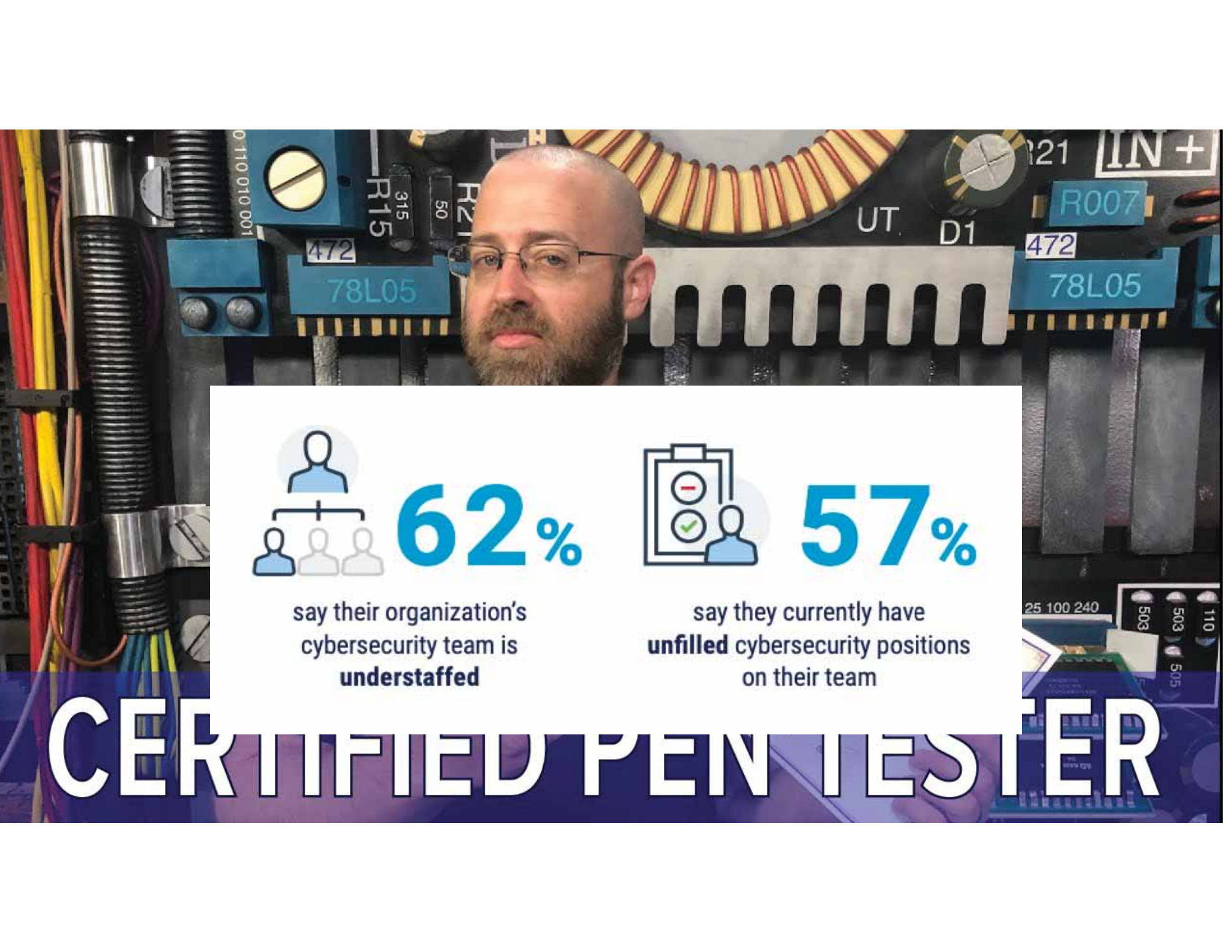
DIFFICULTY TO GUESS:  
**HARD**



THROUGH 20 YEARS OF EFFORT, WE'VE SUCCESSFULLY TRAINED EVERYONE TO USE PASSWORDS THAT ARE HARD FOR HUMANS TO REMEMBER, BUT EASY FOR COMPUTERS TO GUESS.

# Password Recommendations

- Use 12-character minimum
- Use passphrases, and mix in symbols and numbers
- Avoid combining fewer than 4 dictionary words or names
- Don't reuse passwords, if you can avoid it
- Use a different password for each service
- Don't use too many repeated characters
- A good password looks like random letters, but is easy for you to remember:
  - Otywsse!1778SSE



62%

say their organization's  
cybersecurity team is  
**understaffed**



57%

say they currently have  
**unfilled** cybersecurity positions  
on their team

# CERTIFIED PEN TESTER



# YOU MADE IT!

Let's play a [game](#) to celebrate

# Works Cited

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# Threats, Vulnerabilities and Attacks

WCCC Workshop  
May 17, 2021  
9:00AM – 10:40AM

Mr. Dom Glavach  
Chief Security Officer and Chief Strategist

# Today's Session



**Cybersecurity Background**



**Red, Blue and You**



**Threats**



**Vulnerabilities**



**Attacks**



**Lab**



# Cybersecurity Background

## Career in Cybersecurity

Passion  
Curiosity  
Education  
Responsibility

## Jobs

45 Job Categories  
700+ Job titles  
More attacks than professionals

## Today's Session

Interactive  
The best defense is a good offense

# Red, Blue and You

|                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p><b>RED TEAM</b></p>                                                                                                                                                    |  <p><b>BLUE TEAM</b></p>                                                                                                                                                     |
| <ul style="list-style-type: none"> <li>• Offensive Security</li> <li>• Ethical Hacking</li> <li>• Exploiting vulnerabilities</li> <li>• Penetration Tests</li> <li>• Black Box Testing</li> <li>• Social Engineering</li> <li>• Web App Scanning</li> </ul> | <ul style="list-style-type: none"> <li>• Defensive Security</li> <li>• Infrastructure protection</li> <li>• Damage Control</li> <li>• Incident Response(IR)</li> <li>• Operational Security</li> <li>• Threat Hunters</li> <li>• Digital Forensics</li> </ul> |
|                                                                                                                                                                                                                                                             |                                                                                                                                                                            |

## Example resources

RED TEAM - <https://www.exploit-db.com/>

BLUE TEAM - <https://isc.sans.edu/>

EVERONE - <https://www.kali.org/>



# Threats

## Threat

An activity intended to compromise the security of an information system by altering the availability, integrity, or confidentiality of a system or the information it contains.

## Threat Environment

Online space where cyber threat actors conduct malicious cyber threat activity.

## Threat Actor

Groups or individuals who aim to take advantage of vulnerabilities, low cyber security awareness, or technological developments to gain unauthorized access to information systems in order to access or otherwise affect victims' data, devices, systems, and networks.

## Motivation

Threat actors value access to devices, processing power, computing resources, and information for different reasons. **Profit, Espionage, Satisfaction, Discontent, Ideologic, Curiosity**

# Threat Actors

→ Nation-states

(APT) **Motivation:** Espionage

Cybercriminals

(Organized Crime) **Motivation:** Profit

Hacktivists

(Groups) **Motivation:** Satisfaction

Terrorist Groups

(Cyber Terrorists) **Motivation:** Disruption

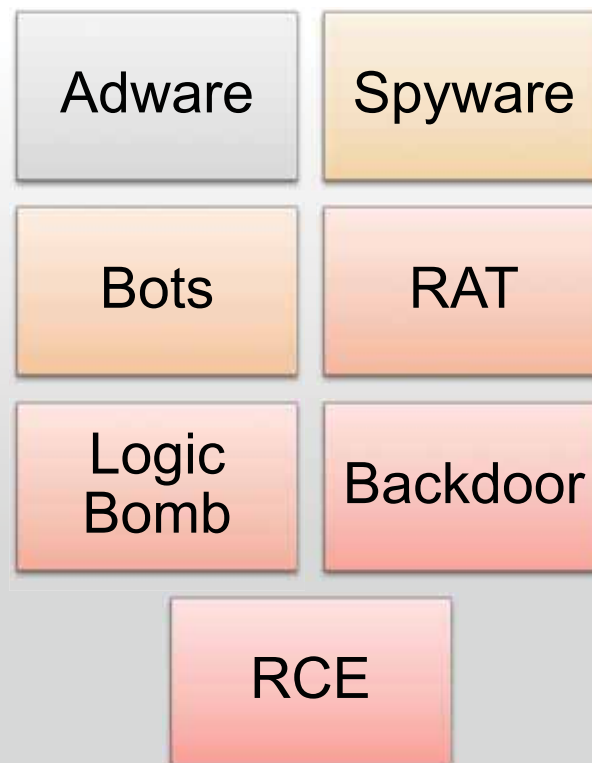
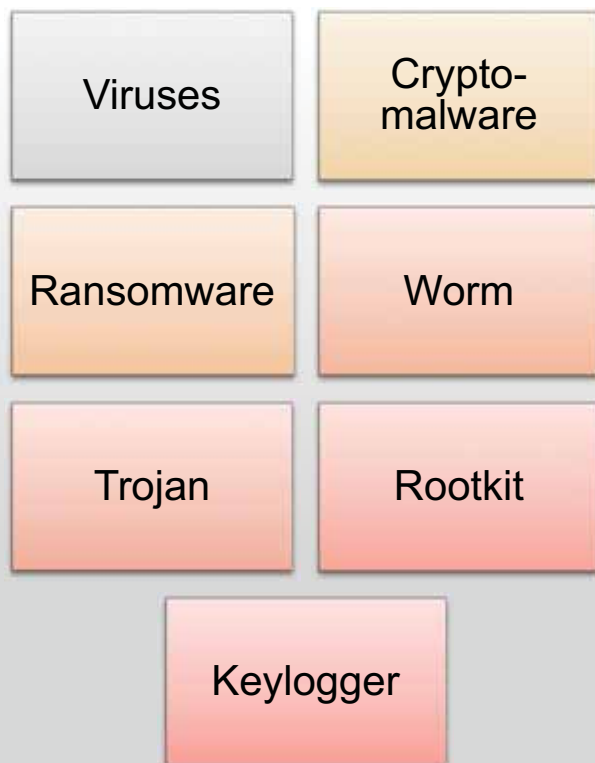
Thrill-seekers

(Lone Wolves) **Motivation:** Curiosity/Satisfaction

Insider

(People) **Motivation:** None/Discontent

# Threat Types



# Vulnerabilities

Race Conditions

Vulnerabilities Due to:

- End-of-Life Systems
- Embedded Systems
- Lack of Vendor Support

Untrained People

Improperly  
Configured  
Accounts

Improper Input/Error  
Handling

Misconfiguration/Default  
Configuration

Weak Cipher Suites  
and  
Implementations

Memory/Buffer  
Vulnerability

Resource Exhaustion

Architecture/Design  
Weaknesses

New Threats/Zero  
Day

# Attacks

Denial-of-service  
(DoS) and distributed  
denial-of-service  
(DDoS) attacks

Man-in-the-middle  
(MitM) attack

Phishing and spear  
phishing attacks

Drive-by attack

Password attack

SQL injection attack

Cross-site scripting  
(XSS) attack

Eavesdropping  
attack

Birthday attack

Malware attack



# Interactive Lab

Capture the  
Flag (CTF) lab

Simulated attack space for  
learning and competitions

Tools needed

Web browser and curiosity

Target

Natas

//Begin

<https://overthewire.org/wargames/natas/>



Level 0 - Together

## //Steps

Bookmark: <https://overthewire.org/wargames/natas/>

Username: natus0

Password natus0

Web Application Security CTF (each level requires login)