Attacking and Defending

Cybersecurity

Cybersecurity 101 Day 2

Class Objectives

By the end of today's class, you will be able to:

List different types of user, web, server, and database cybersecurity attacks.

Identify risk mitigation plan frameworks for user, web, server, and database cybersecurity attacks.

Set up a virtual machine lab environment that you will use throughout the course.

Let’s do a quick review!

Quick Review

Last class, we described cybersecurity as centering on **two concepts**.

What were they?

Quick Review

The **two concepts** cybersecurity is centered on are:

- **Threat assessment**
- **Risk mitigation**

Quick Review

How would you define these terms?

- Threat assessment
- Risk mitigation

Quick Review

Threat assessment:

Structured process of identifying the threats posed to a group or system.

Risk mitigation:

Systematic reduction of the impact and/or likely occurrence of a negative event.

Quick Review

In other words...

Threat assessment:
What could happen?

Risk mitigation:
How do we handle It?

Quick Review

Last class, we introduced a framework that captures the fundamental goal of information security.

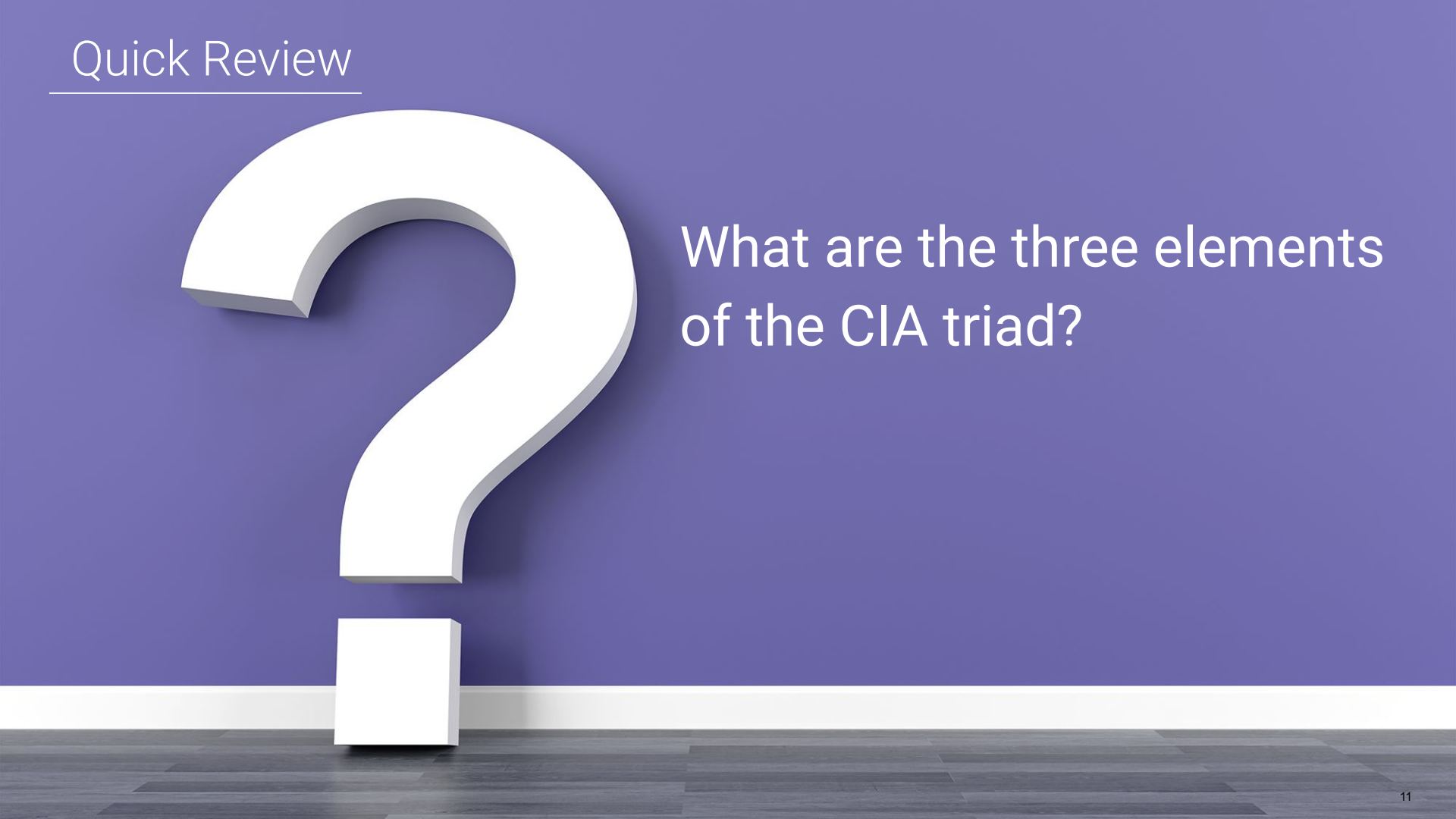
What was the framework?

Quick Review

The framework that captures the fundamental goal of information security is:

The CIA triad

Quick Review



What are the three elements of the CIA triad?

Quick Review

The three elements of the CIA triad are:

- **Availability**
- **Integrity**
- **Confidentiality**

Quick Review

Define each of the three elements in the context of information security:

- **Confidentiality**
- **Integrity**
- **Availability**

Quick Review

Confidentiality:

Ensuring sensitive information is protected from access by unauthorized persons.

Integrity:

Protecting information from being modified or tampered by unauthorized persons.

Availability:

Ensuring that all operating systems, equipment, and data are functioning correctly and accessible by those who need it.

Quick Review

Provide an example of how each of the three elements can be adversely affected:

- **Confidentiality**
- **Integrity**
- **Availability**

Quick Review

Confidentiality:

Banking breach releases credit card info into the public.

Integrity:

Students modify official grades for themselves and their friends.

Availability:

Attackers disable a website through a denial of service attack.

Quick Review

Activity: *Oh look, a phone!*
Suppose in the last class, two students left their phones unattended.

As a class, let's **identify as many exploits as possible** that could result from a stolen cell phone.

Hint: Be creative! Think like an attacker.

- What is the worst possible damage that could happen?
- Think about *real damage*.
- Think beyond the value of the phone itself.

Quick Review

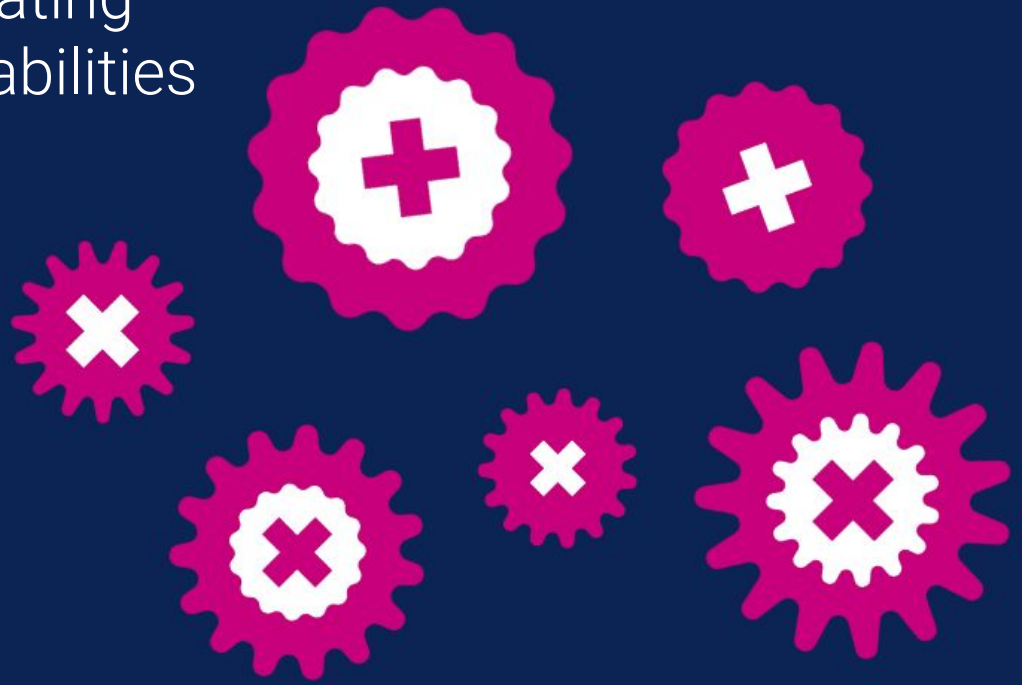
Activity Review: *Oh look, a phone!*

Potential Adverse Events

1. The phone is wiped and resold.
2. Phone memory is harvested and photos and sensitive material are used for blackmail.
3. Credentials for email and social media accounts are used to extract financial gain.
4. Installed applications are used to make purchases.
5. Malware software is directly installed to track future activity.
6. Phone contacts are socially engineered to provide money.
7. The phone is used to conduct illegal activity.
8. The owner's identity is stolen.

Today’s Class

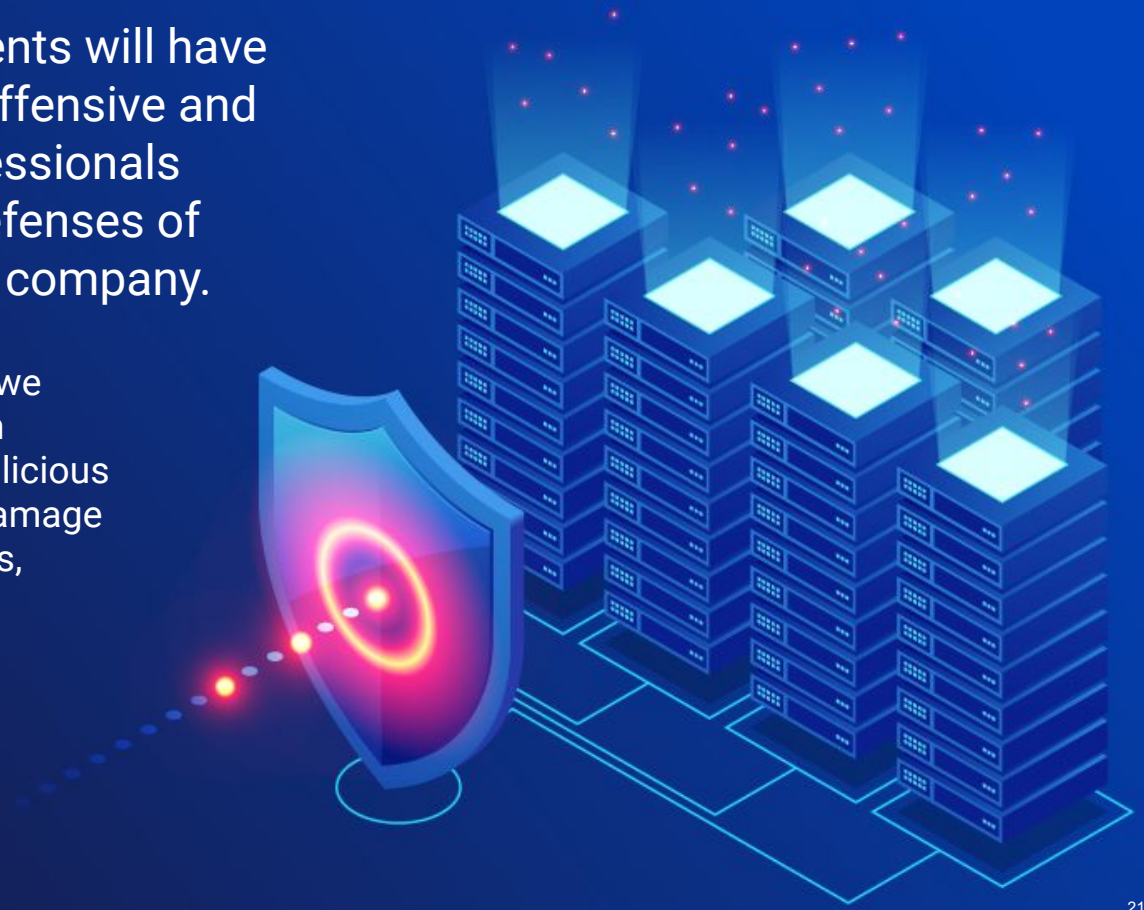
Today's class will continue with **assessing risk** and **mitigating threats** by evaluating specific attacks and vulnerabilities of users, web applications, servers and databases.



Today’s Class: Attacking and Defending

In the first half of class, students will have the opportunity to think like offensive and defensive cybersecurity professionals evaluating the attacks and defenses of levels of information within a company.

To assess threats and mitigate risks, we need to look at each component of an organization, and understand how malicious actors can exploit weaknesses and damage the stakeholders' finances, reputations, and well-being.



Today's Class: VM Setup

In the second half of class, students will set up VirtualBox and Vagrant, two programs needed to run VMs on local machines.

You should have a basic familiarity with the need for VMs from our technical overview in the first day of class.

Today, we will dive into more detailed instructions of installation.

A Note on Troubleshooting

As we set up our virtual machines, we may have issues that require troubleshooting.

Troubleshooting is the process of problem solving.

In this course, troubleshooting will often involve ensuring that our virtual machines and lab services are running smoothly.

A Note on Troubleshooting

Whether you are a penetration tester, system administrator, SOC analyst, network admin, or IT help desk, you will most likely have to troubleshoot technology on a regular basis.

Troubleshooting will be a common theme throughout this course, and we'll be doing it alongside various activities, such as tinkering with scripts, configuring Azure Lab setups, and navigating access controls.

Just as troubleshooting is necessary in the professional environment, it will be necessary in this learning environment.

Security Challenge #1: Attacking the Wall

We will now work on two **security challenges** related to assessing threats and mitigating risks.

SECURITY CHALLENGE #1

Attacking the Wall

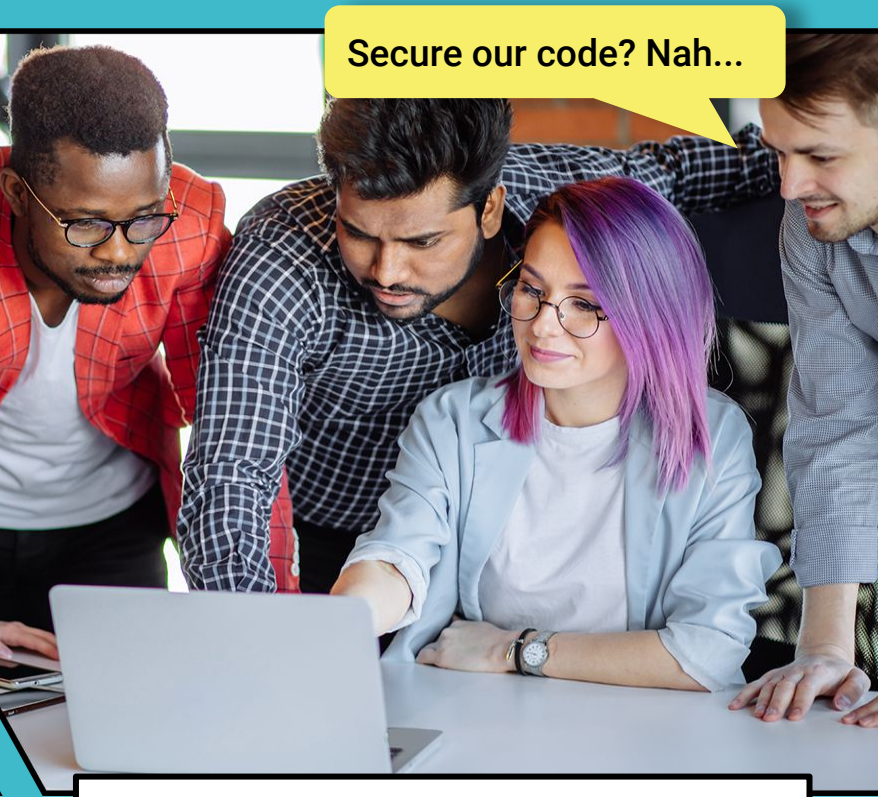
In this first activity, we will look at various attack strategies that attackers can use to penetrate an insecure login.

While you will be new to this type of thinking, this exercise should force you to think creatively about all the ways a system can be penetrated, from user attacks to physical break ins.

To successfully complete this exercise, you must think through creative options.

Let's take a look at the scenario...

SECURITY CHALLENGE #1



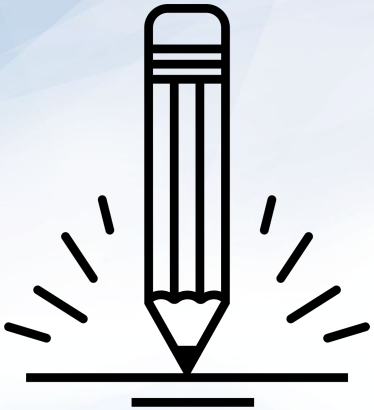
Congratulations! You and your team have just been hired by a very successful startup that runs a bitcoin dating exchange.

While their founding team is brilliant, like many startups, **they don't know the first thing about security.**

SECURITY CHALLENGE #1

They just handed you a lot of money to solve their **most critical problem.**

Their login process is **totally insecure.** Attackers are routinely logging in as users (and administrators) and gaining access to company data and financial assets.



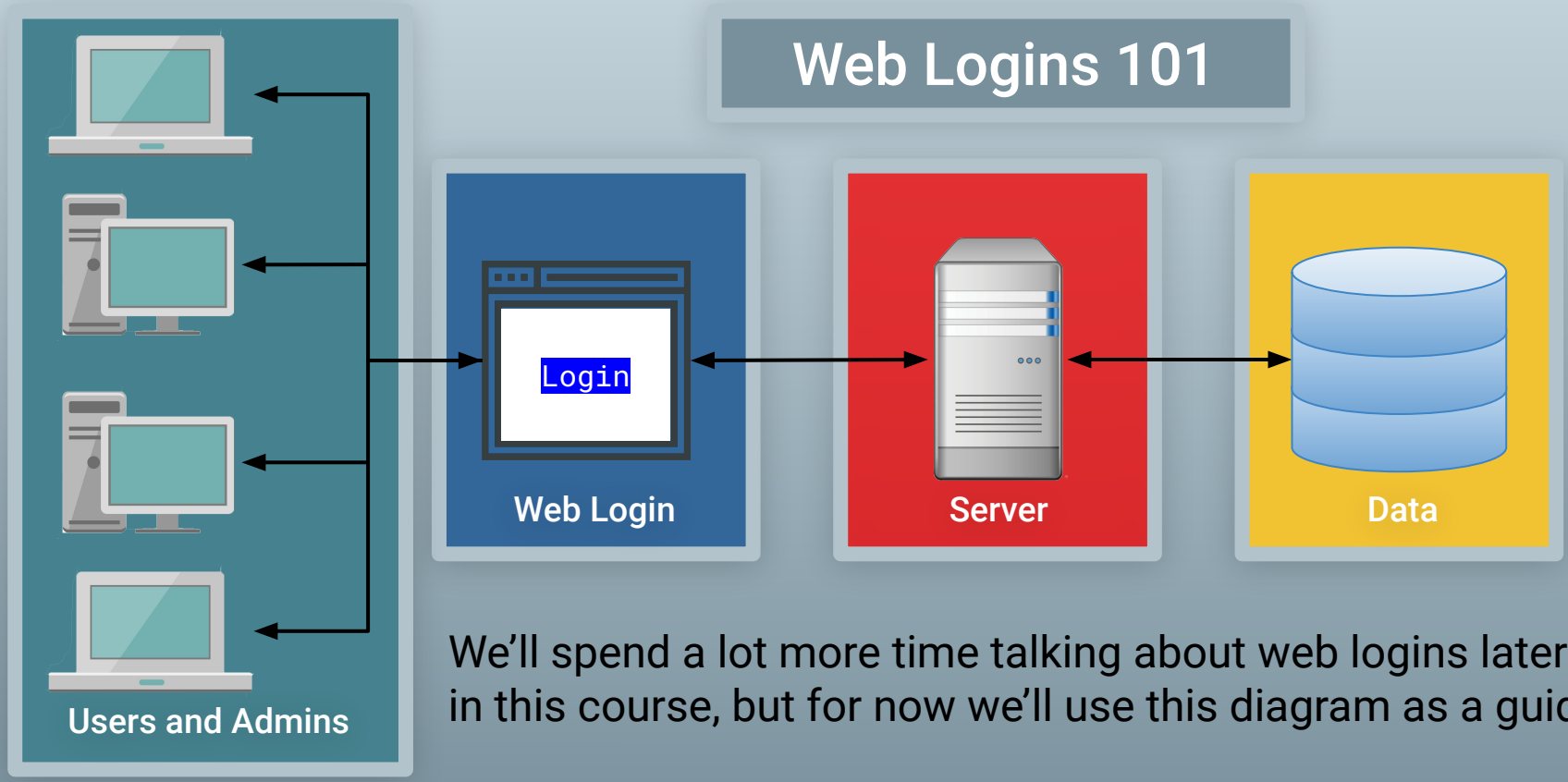
Activity: Security Challenge #1: Attacking the Wall

In this security challenge, you and your group will play the role of security professionals tasked with handling a real-world situation.

More instructions on the next two slides.

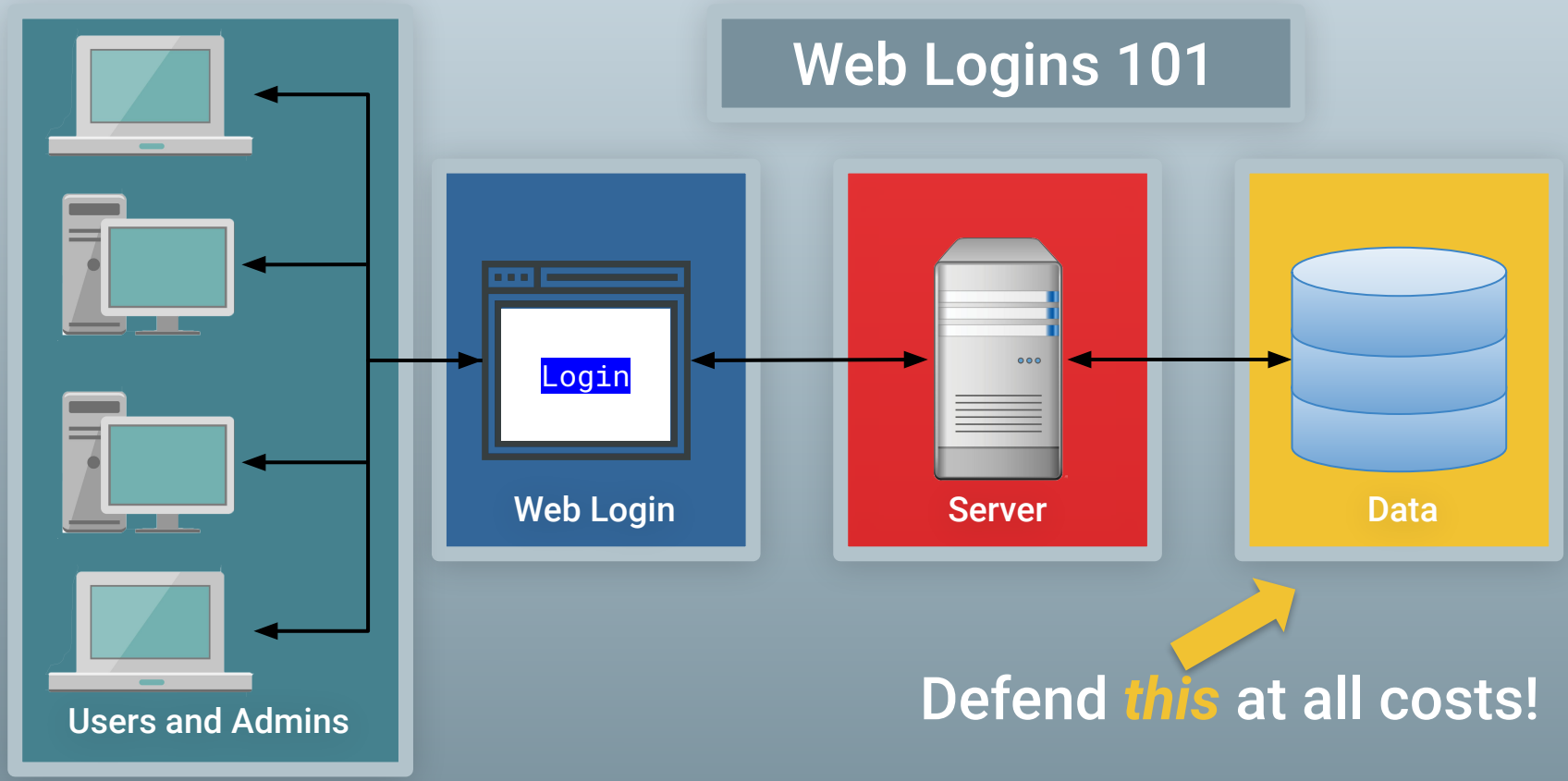
Suggested Time:
20 Minutes

Activity: Security Challenge #1: Attacking the Wall



We'll spend a lot more time talking about web logins later in this course, but for now we'll use this diagram as a guide.

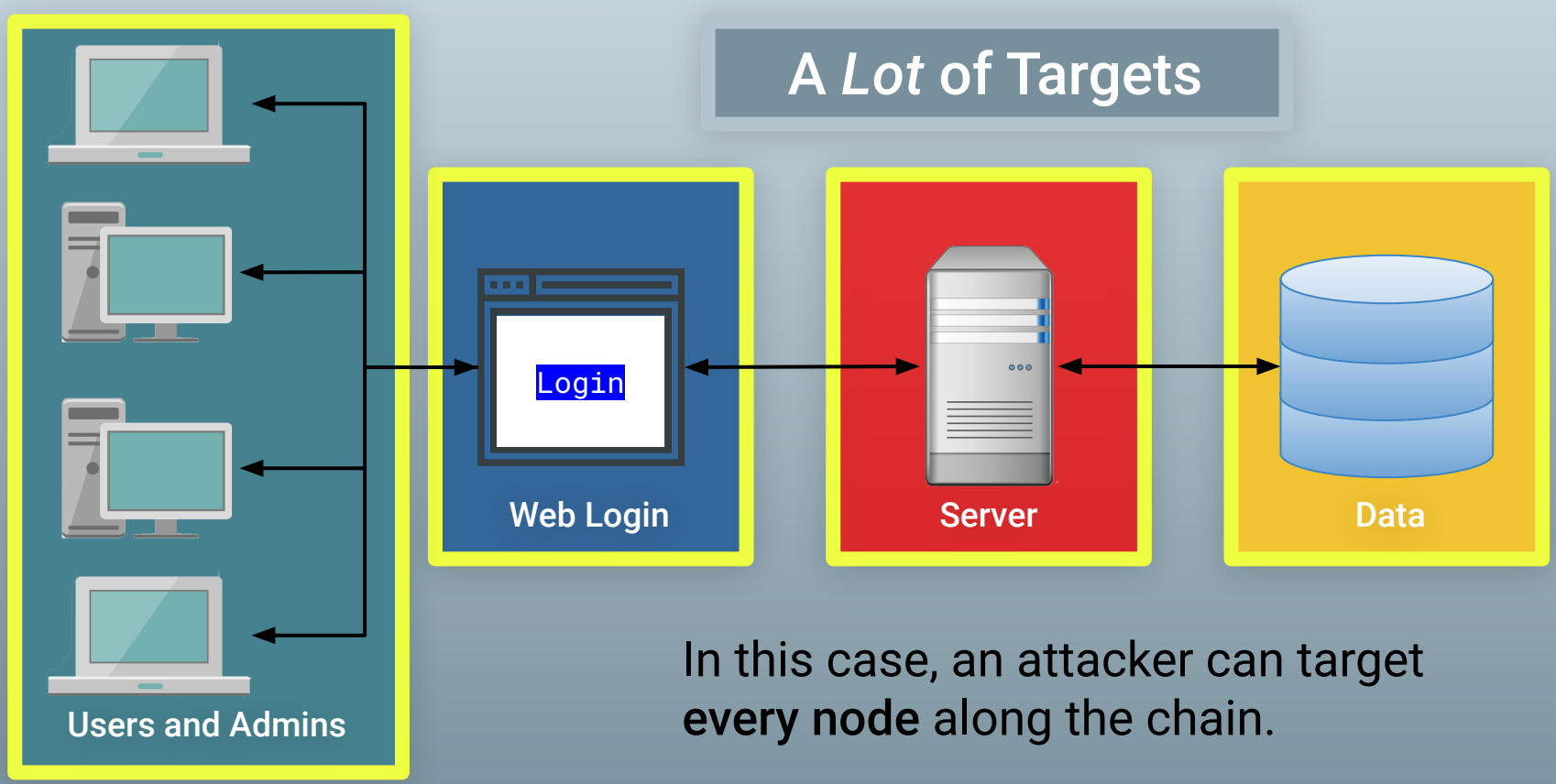
Activity: Security Challenge #1: Attacking the Wall



Time’s Up! Let’s Review.

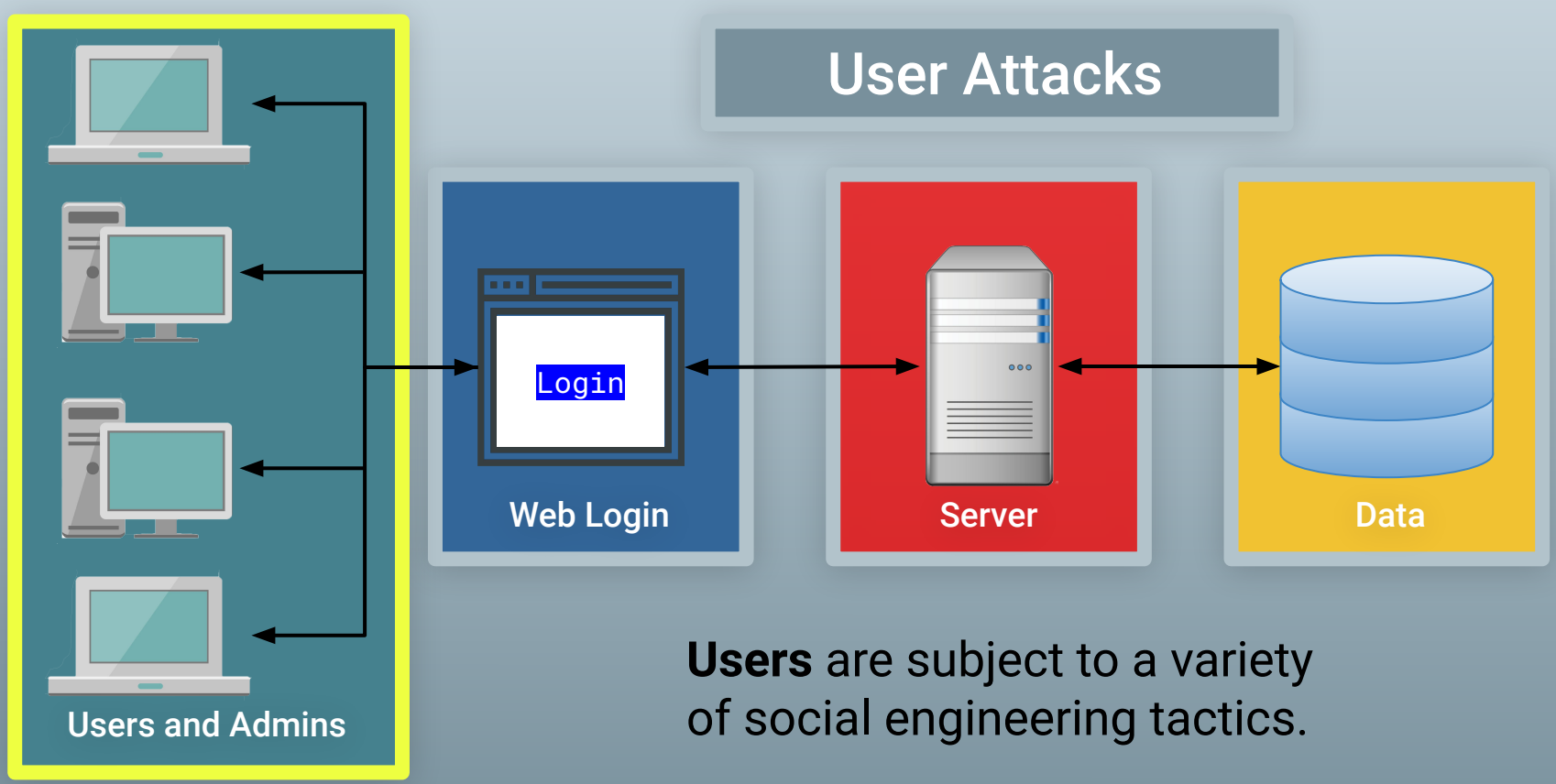
Step #1:
Assess the Target

Activity: Security Challenge #1: Attacking the Wall



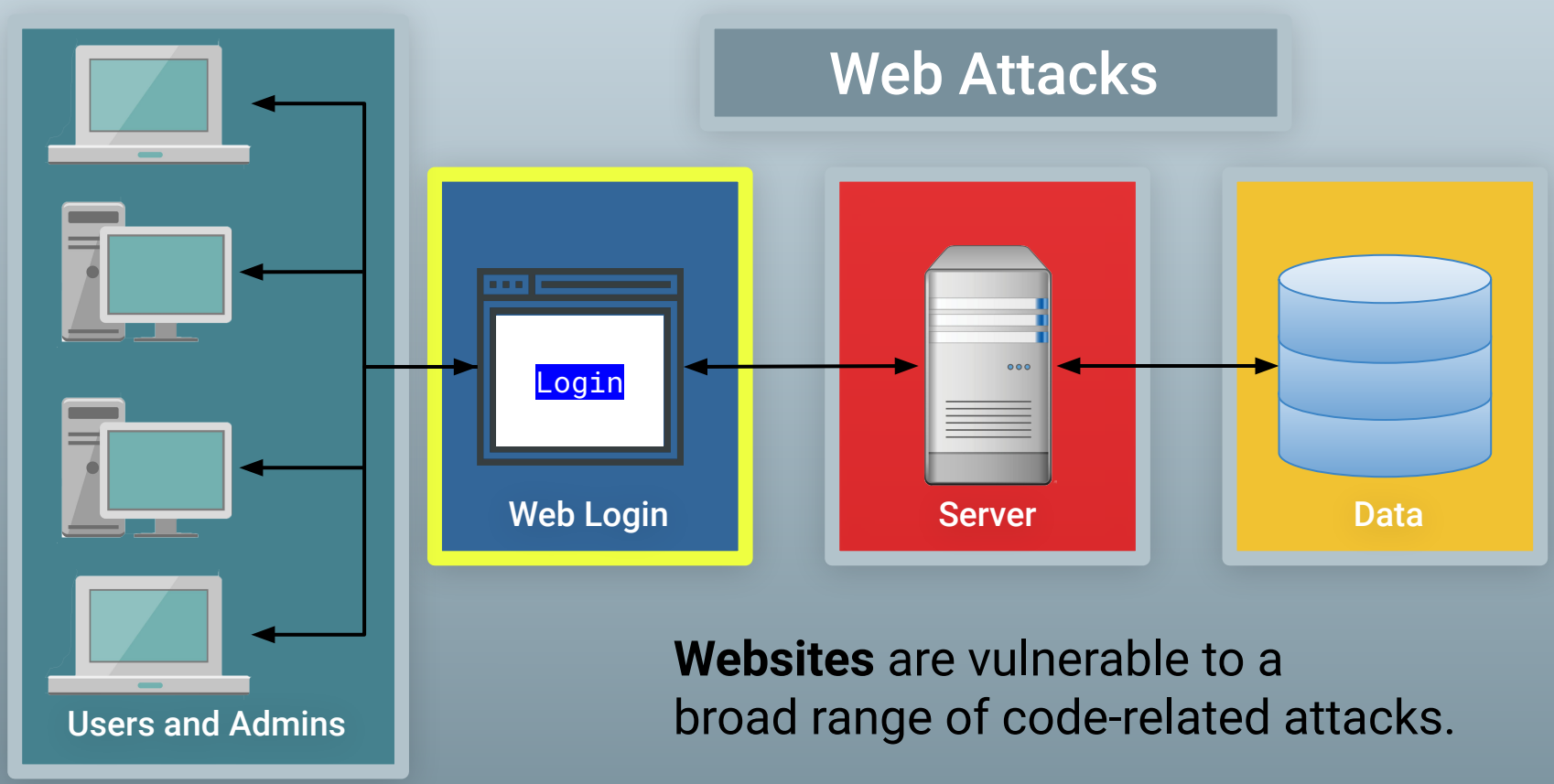
In this case, an attacker can target **every node** along the chain.

Activity: Security Challenge #1: Attacking the Wall



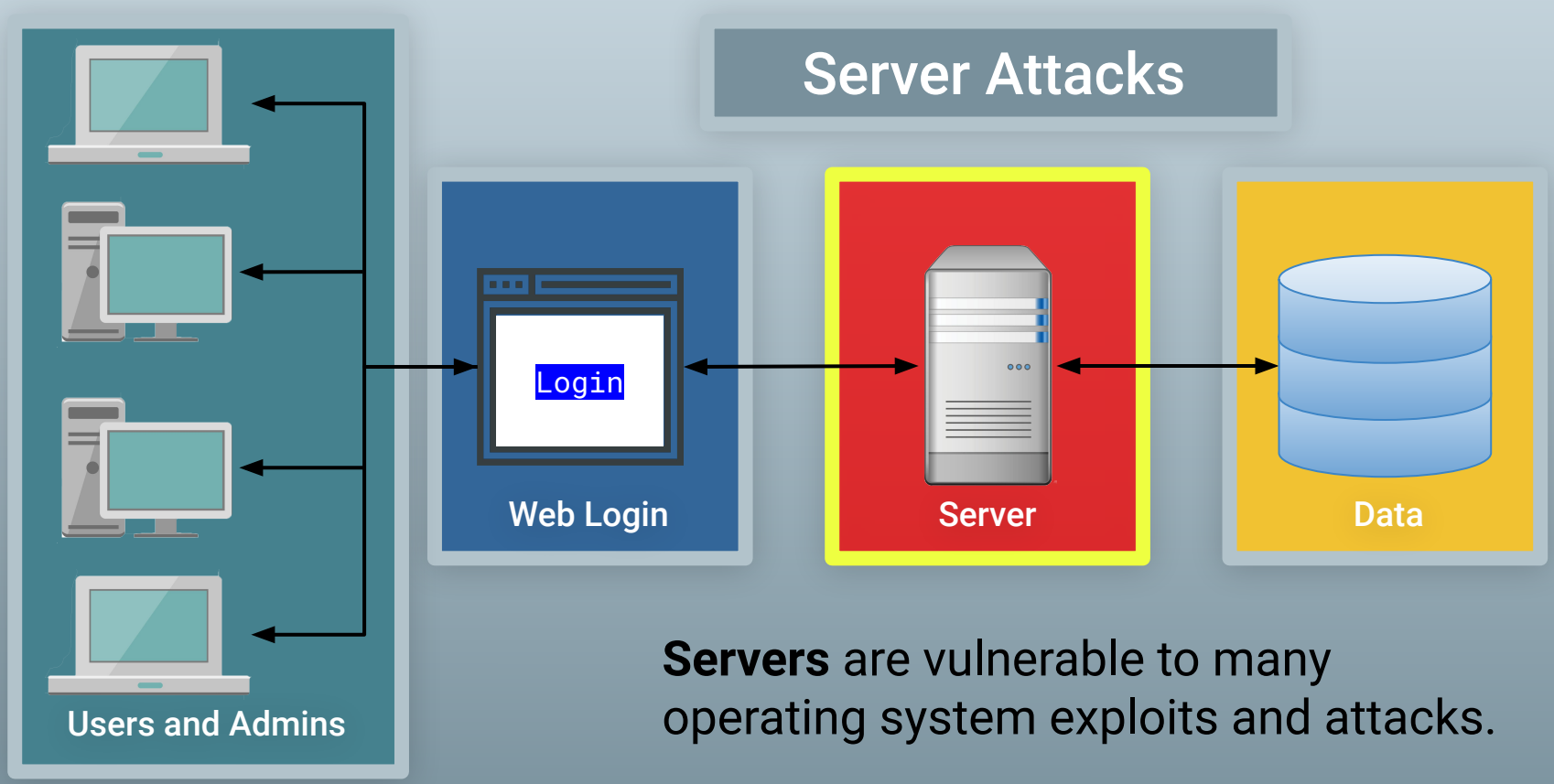
Users are subject to a variety of social engineering tactics.

Activity: Security Challenge #1: Attacking the Wall



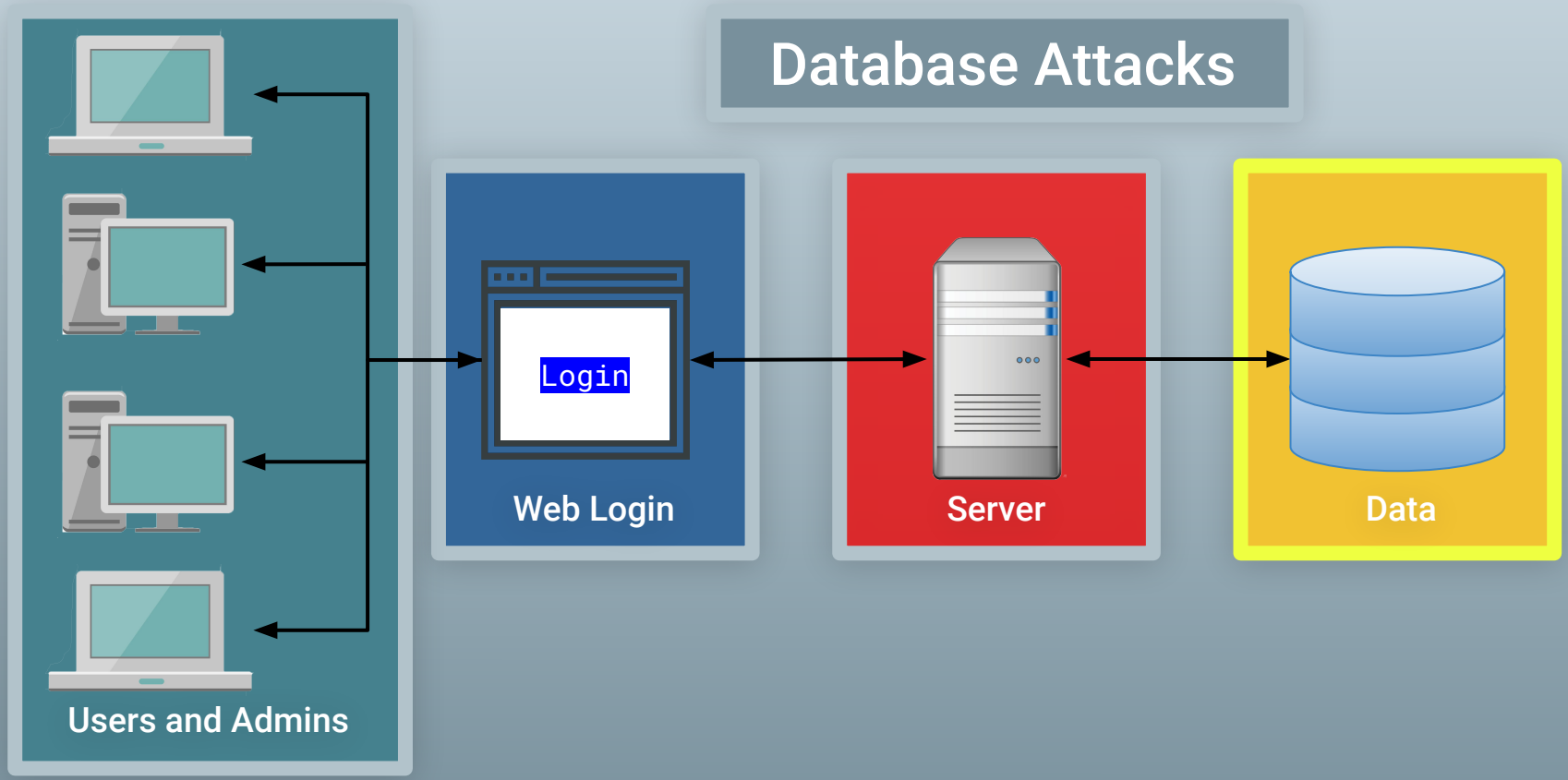
Websites are vulnerable to a broad range of code-related attacks.

Activity: Security Challenge #1: Attacking the Wall



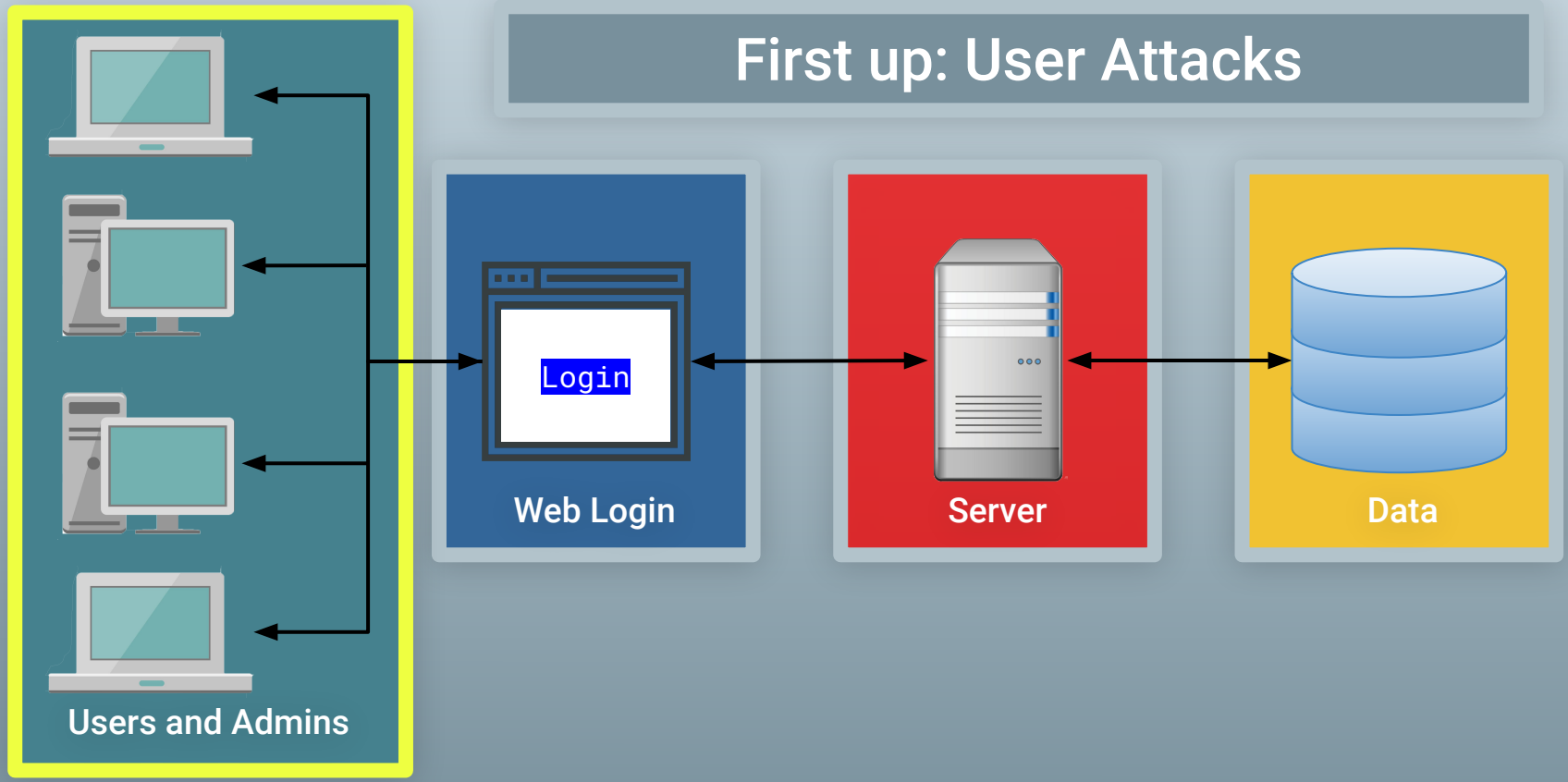
Servers are vulnerable to many operating system exploits and attacks.

Activity: Security Challenge #1: Attacking the Wall



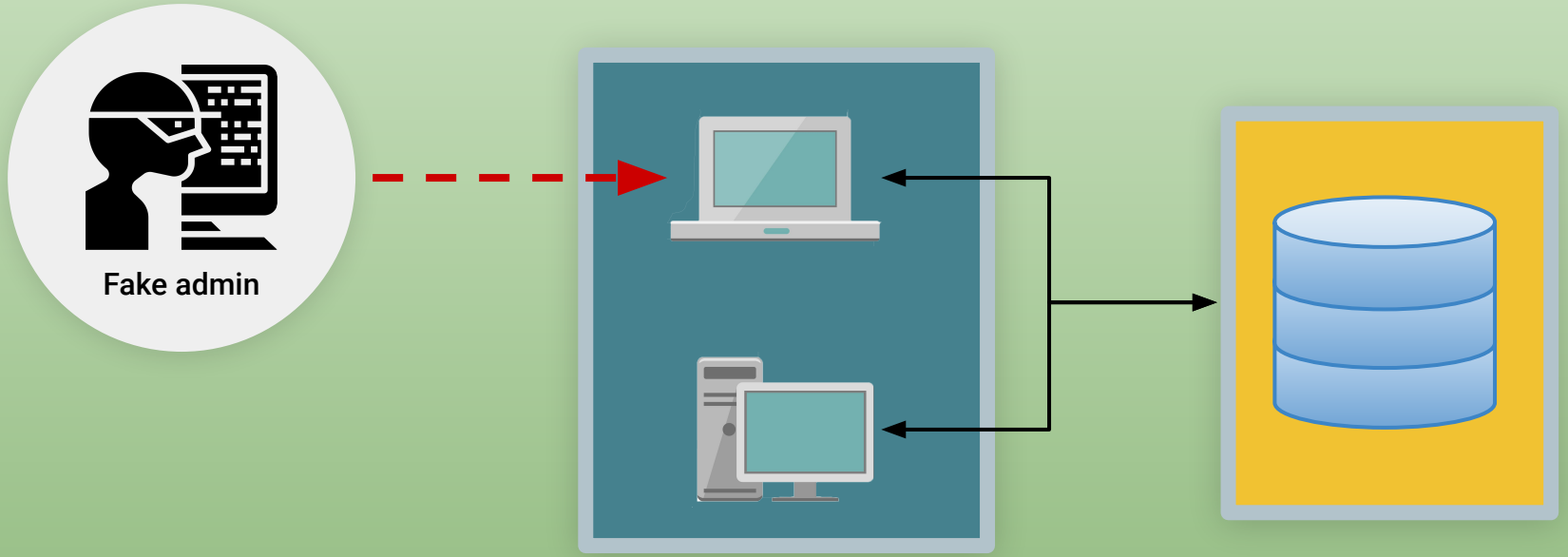
Step #2:
Define Attack Strategy

Activity: Security Challenge #1: Attacking the Wall



Step 2: Defining Attack Strategies

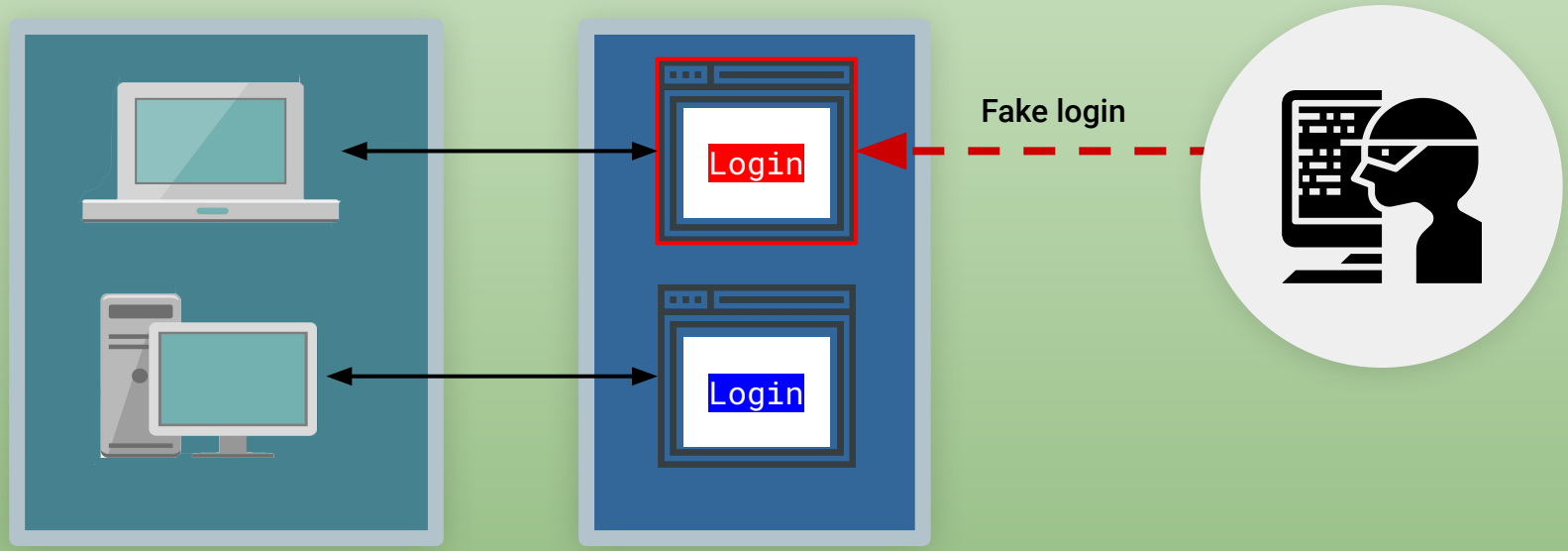
Attack Option #1: Social Engineering
An attacker can ask users for their credentials by pretending to be an administrator.



Step 2: Defining Attack Strategies

Attack Option #2: Phishing

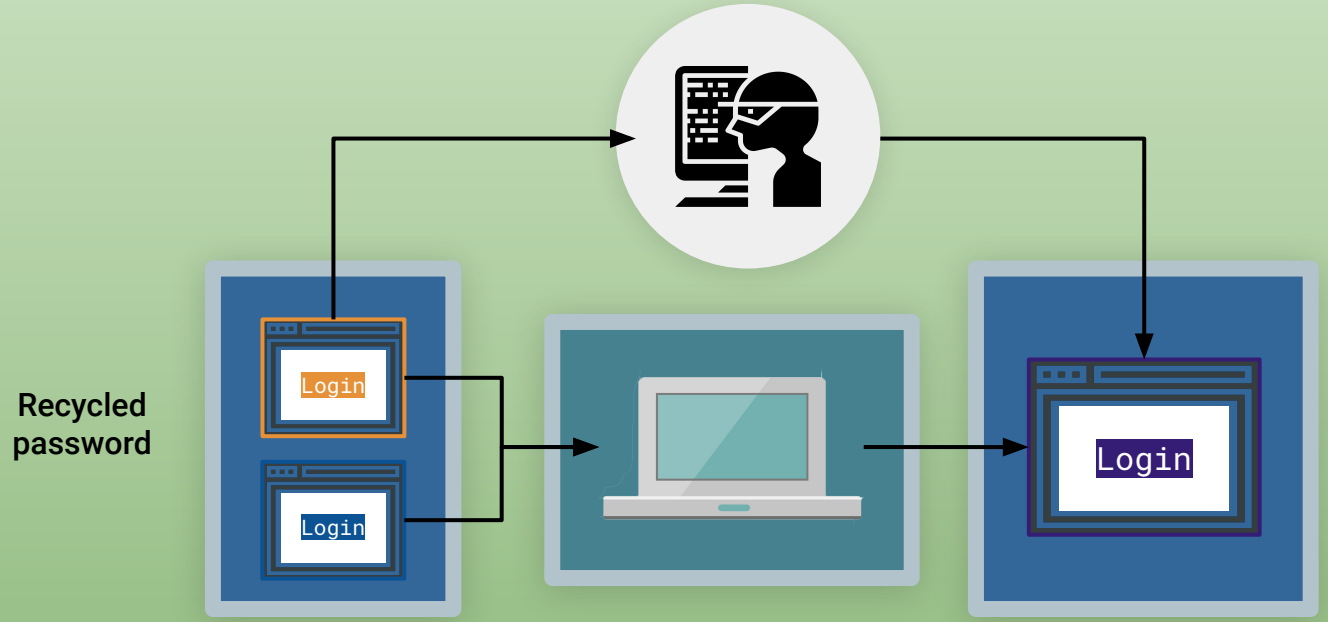
An attacker can attempt a phishing attack, where users are redirected to fake login pages that capture user credentials.



Step 2: Defining Attack Strategies

Attack Option #3: Credential Reuse

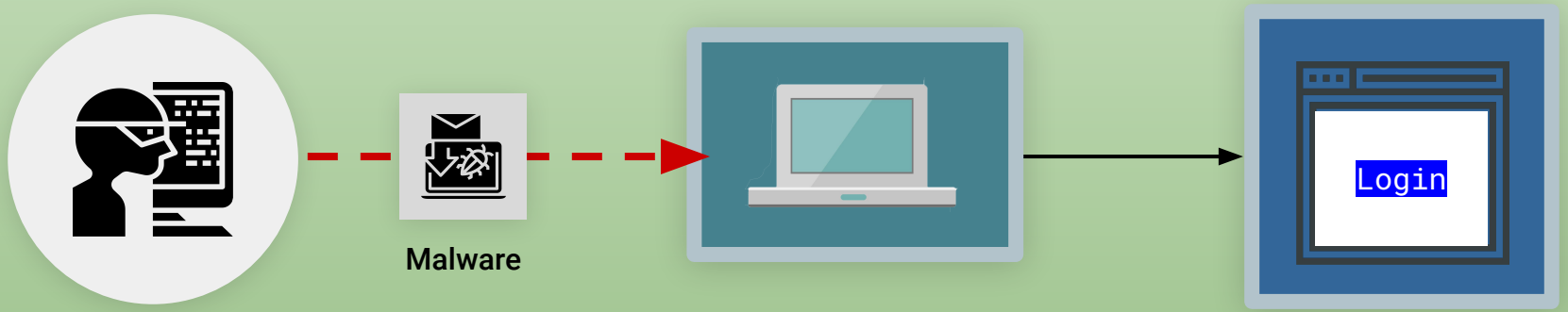
An attacker can find users' login and password information on other websites.



Step 2: Defining Attack Strategies

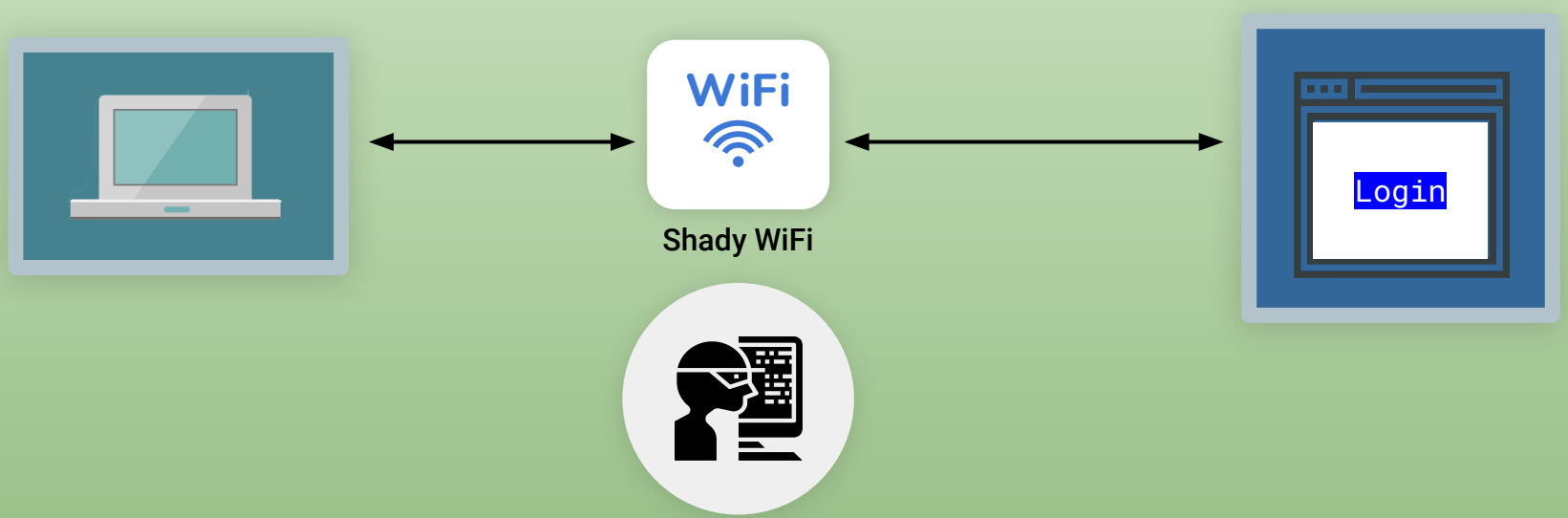
Attack Option #4: Malware

An attacker can deploy malware such as spyware or keyloggers to capture daily user activity.



Step 2: Defining Attack Strategies

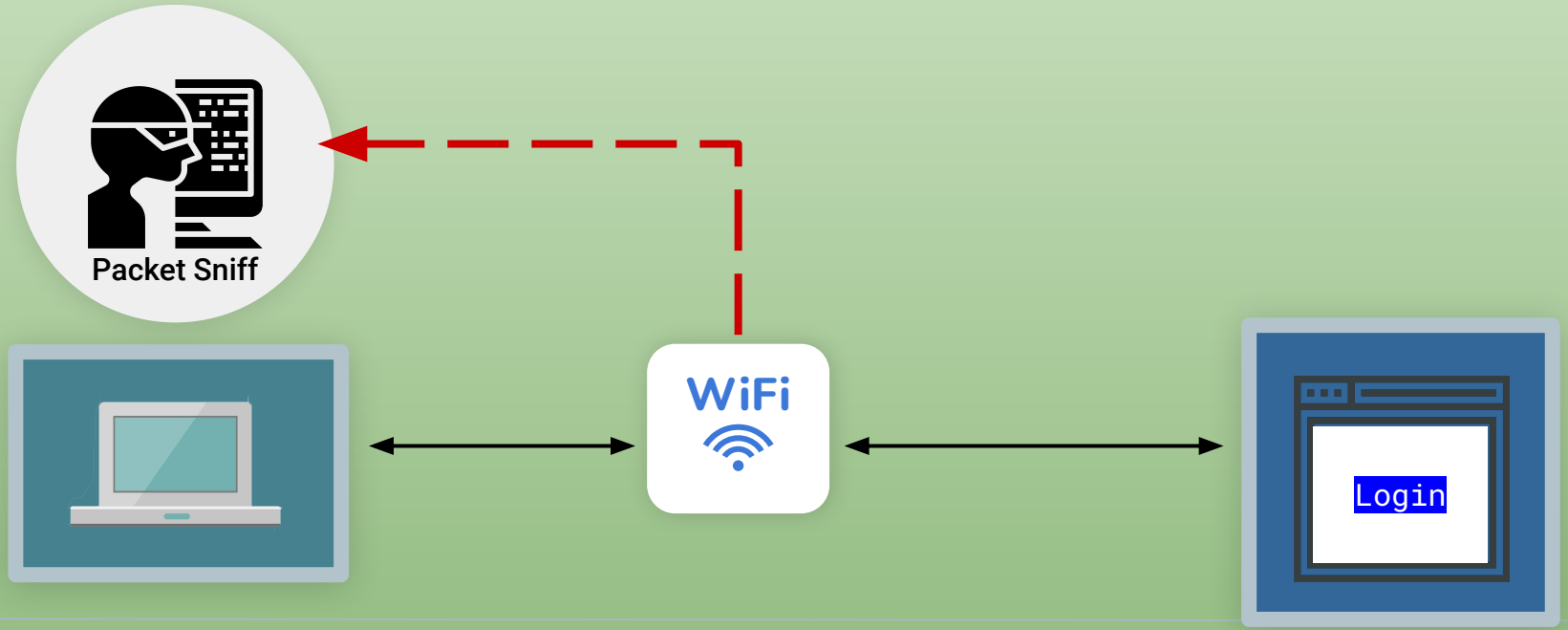
Attack Option #5: Man in the Middle Attack
An attacker can create a man in the middle attack by providing a free WiFi hotspot to capture user credentials.



Step 2: Defining Attack Strategies

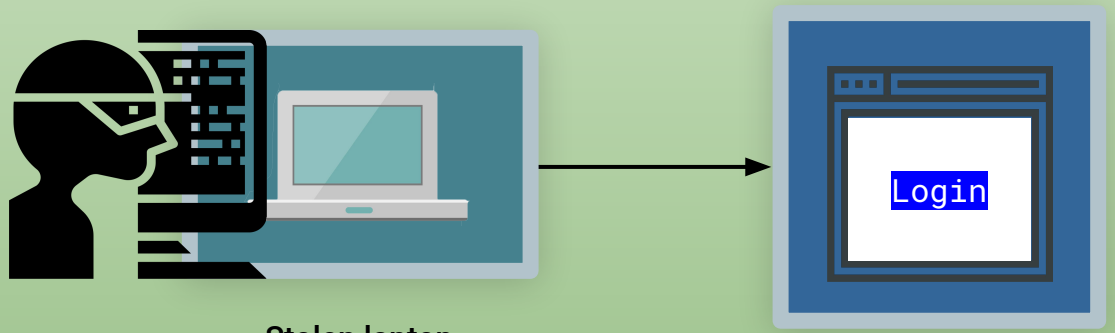
Attack Option #6: Sniff Packet

An attacker can sniff packet traffic across insecure wireless networks such as a cafe or restaurant.



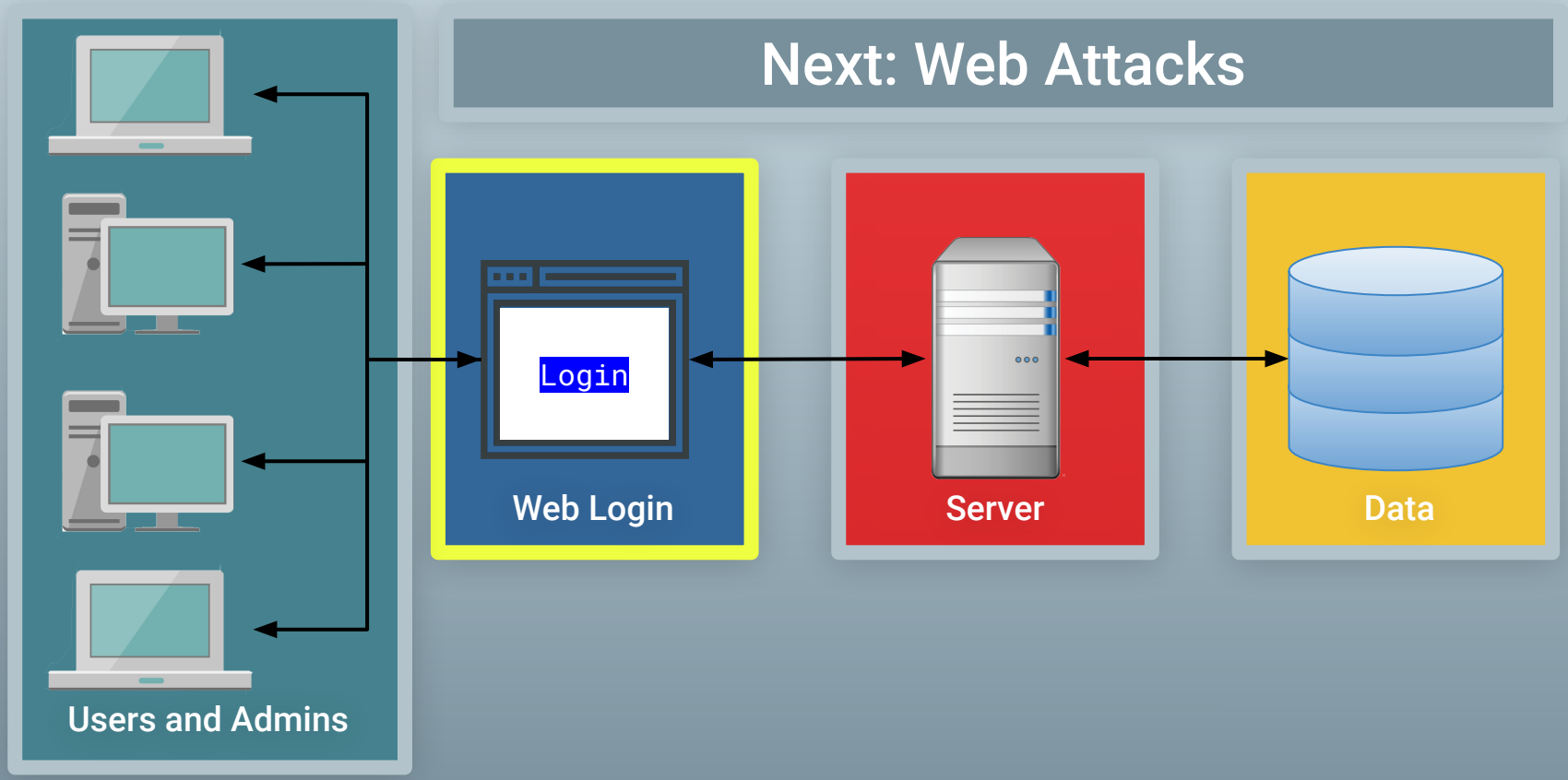
Step 2: Defining Attack Strategies

Attack Option #7: Stolen Hardware
An attacker can simply steal a computer and use the saved credentials to login.



Stolen laptop

Activity: Security Challenge #1: Attacking the Wall



Step 2: Defining Attack Strategies

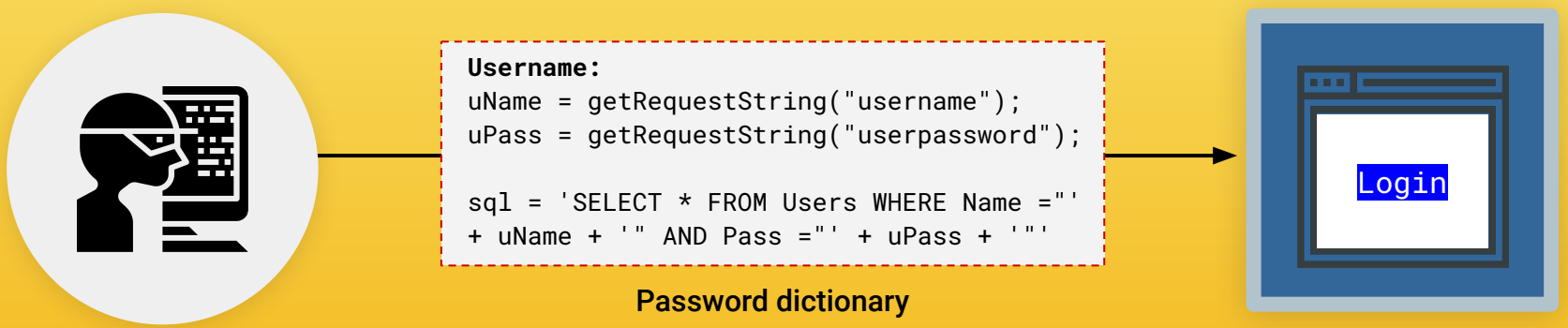
Attack Option #8: Brute Force Attack

An attacker can use a brute force attack to continuously attempt username and password combinations.

Step 2: Defining Attack Strategies

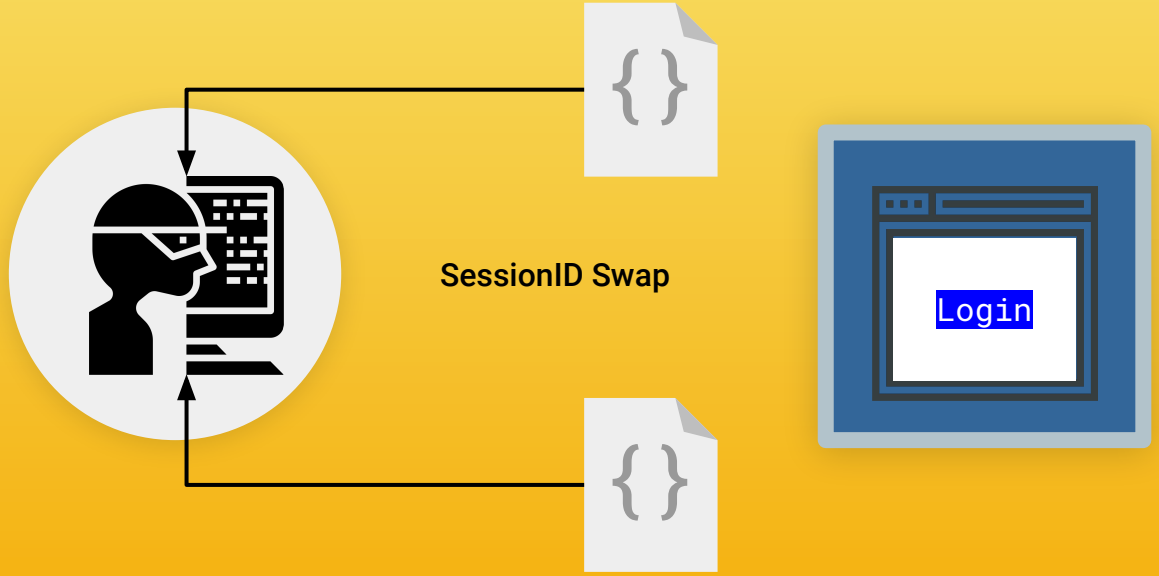
Attack Option #9: Code Injection

An attacker can use a code-injection attack to inject malicious code directly into username or password fields.

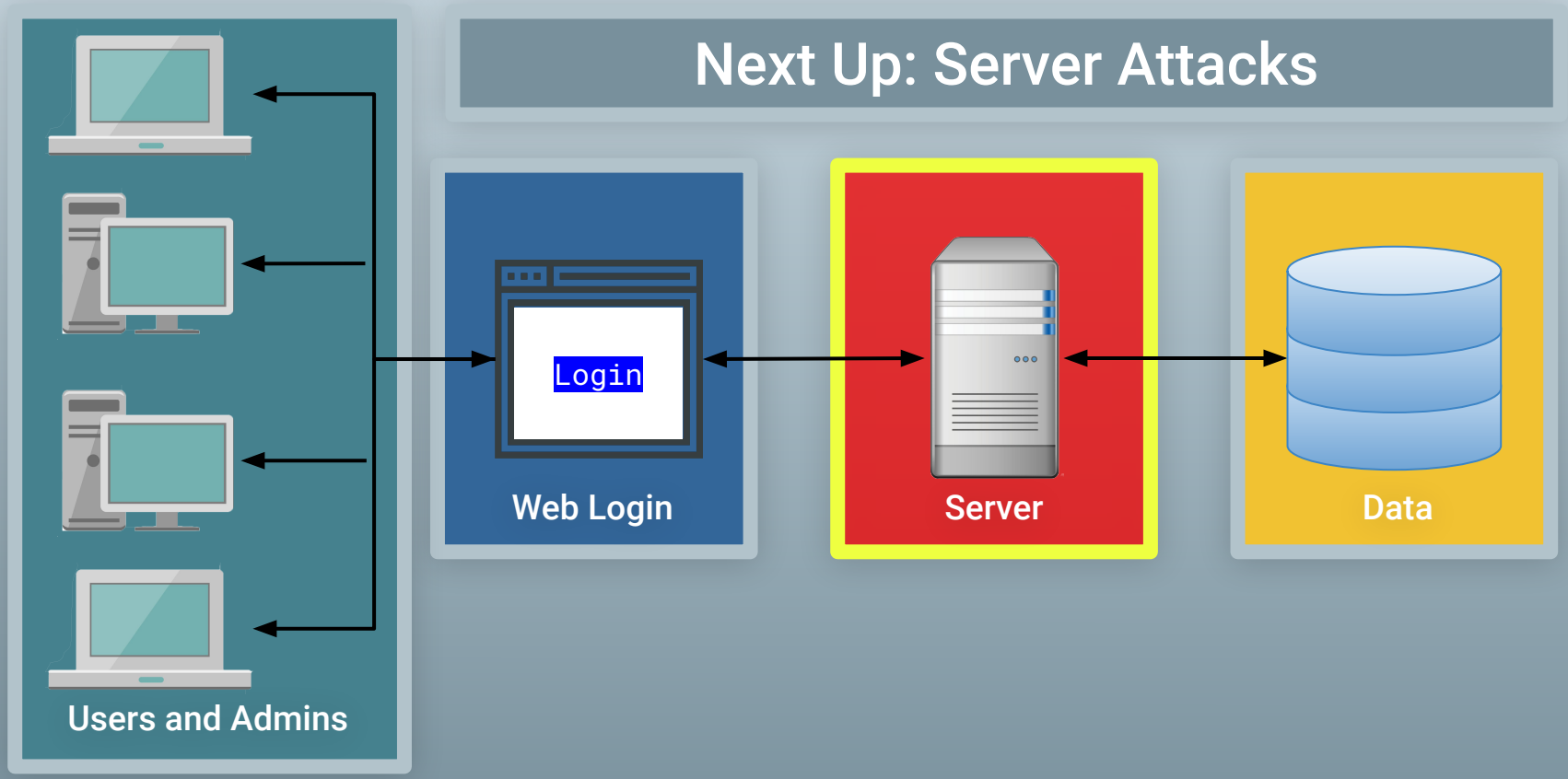


Step 2: Defining Attack Strategies

Attack Option #10: Faulty Session Management
An attacker can exploit faulty session management, when developers incorrectly implement code used to maintain login and logouts.



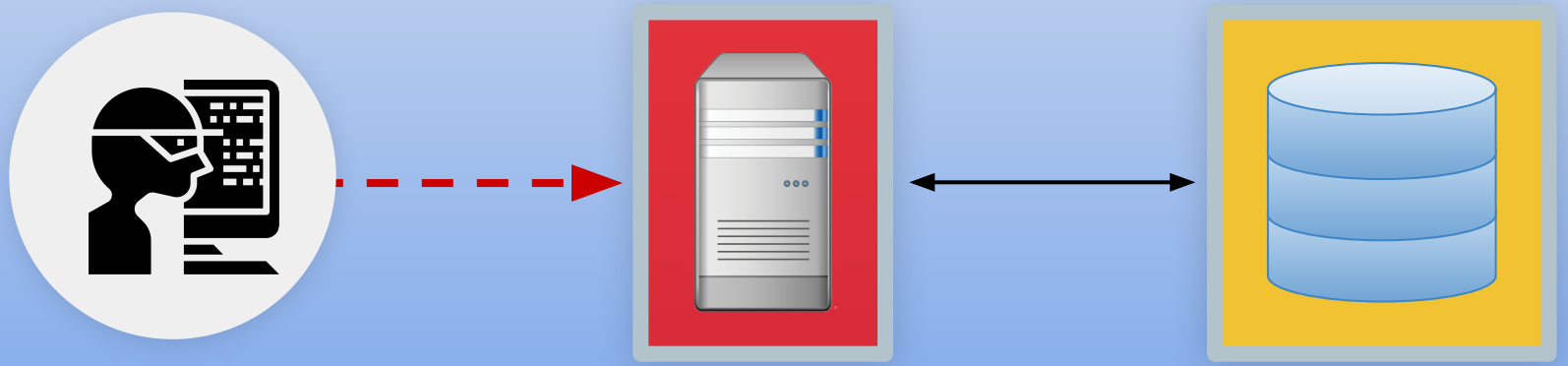
Activity: Security Challenge #1: Attacking the Wall



Step 2: Defining Attack Strategies

Attack Option #11: OS Exploits

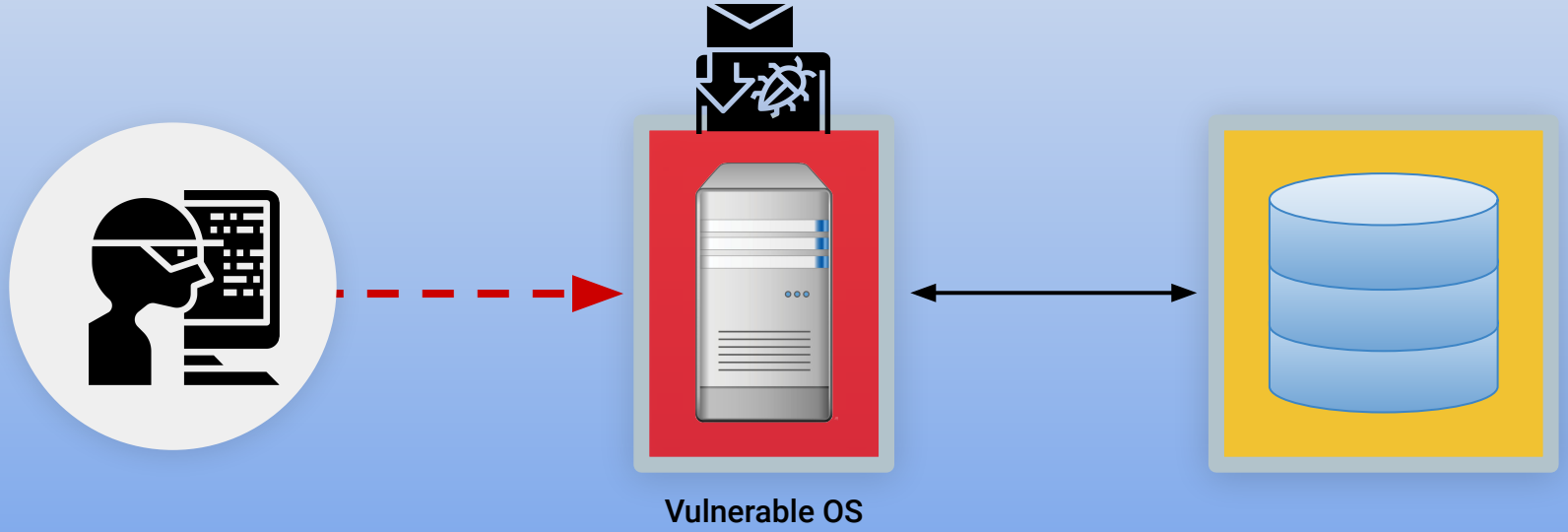
Servers, which run on operating systems like Windows and Linux, are subject to OS exploits when incorrectly patched.



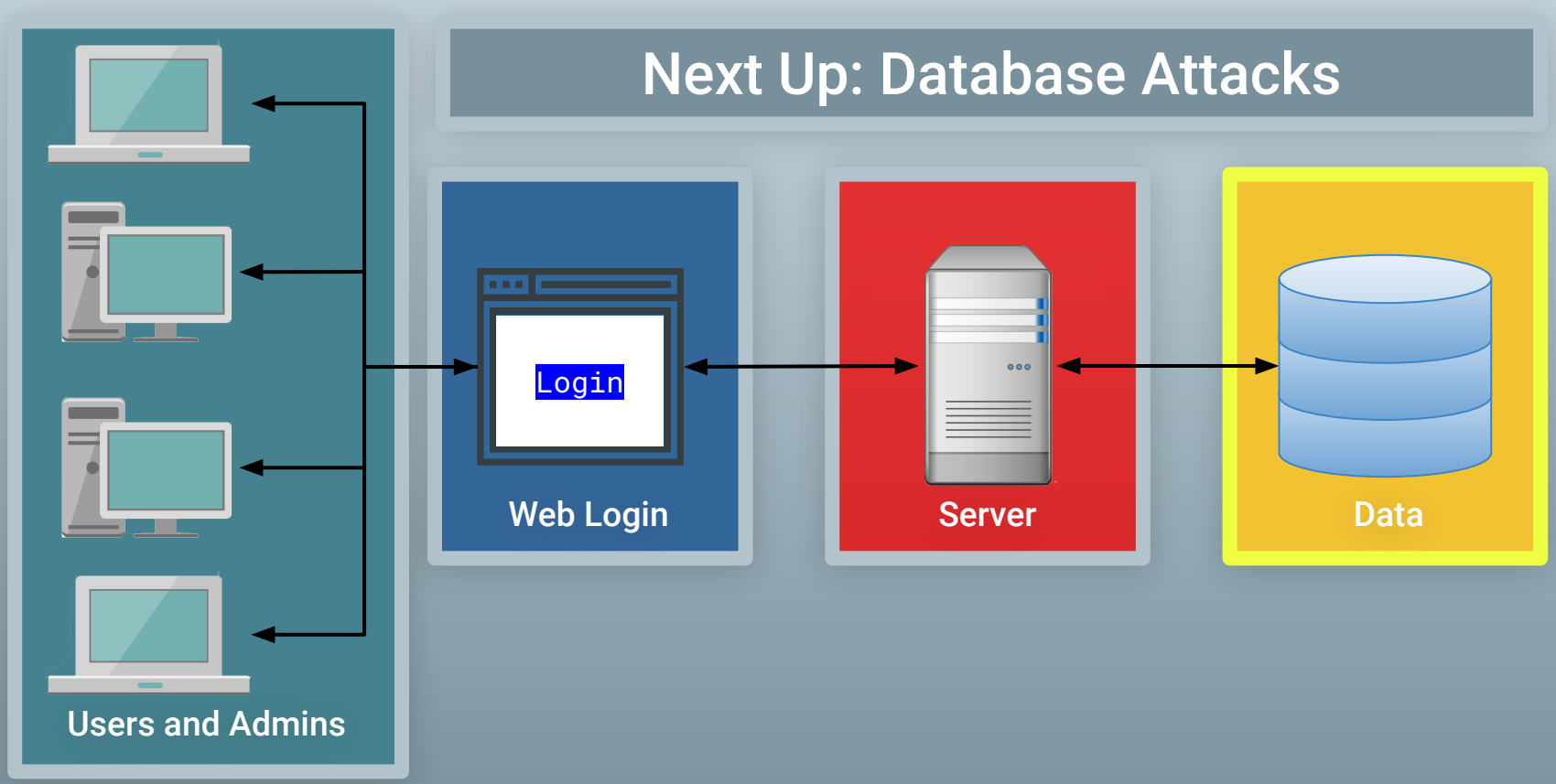
Step 2: Defining Attack Strategies

Attack Option #12: Malicious Software

Malicious software can be directly loaded onto the server by USB or other means.



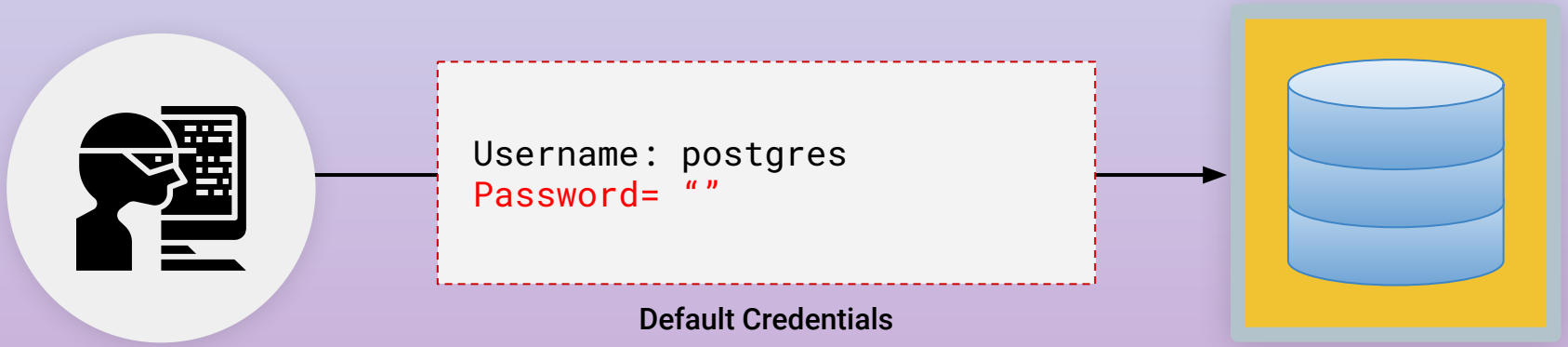
Activity: Security Challenge #1: Attacking the Wall



Step 2: Defining Attack Strategies

Attack Option #13: Default Credentials

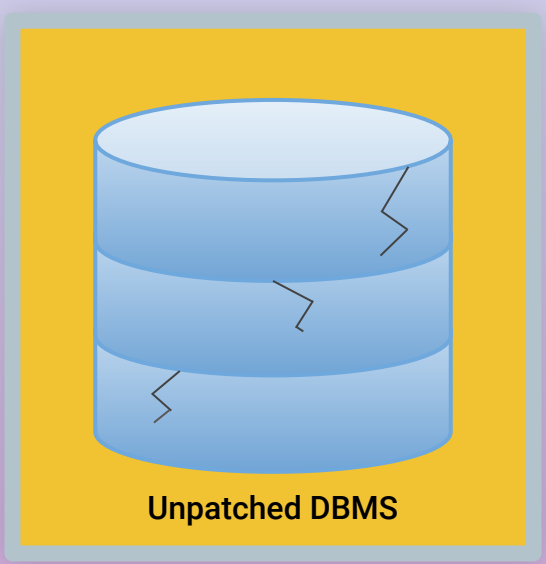
Database management systems often come with default credentials, which might be left unchanged.



Step 2: Defining Attack Strategies

Attack Option #14: Unpatched Database

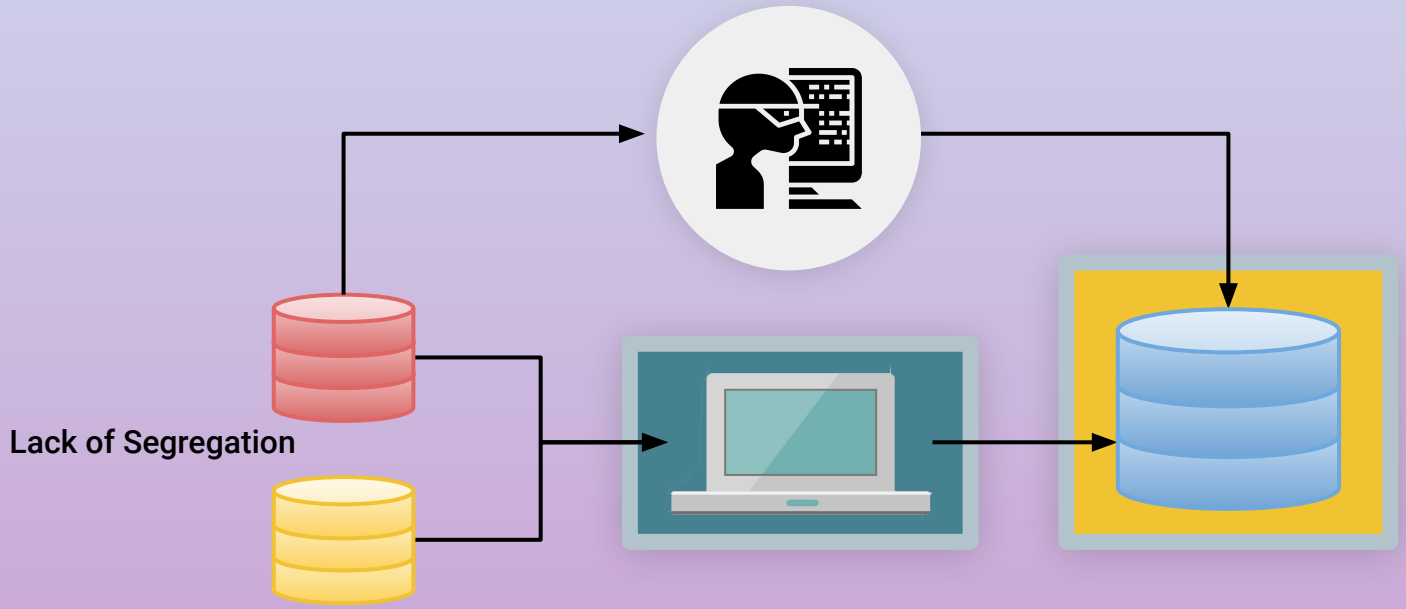
Database management systems might be unpatched against publicly known vulnerabilities.



Step 2: Defining Attack Strategies

Attack Option #15: Lack of Segregation

The database might allow a client to look at another client's data.



Security Challenge #2

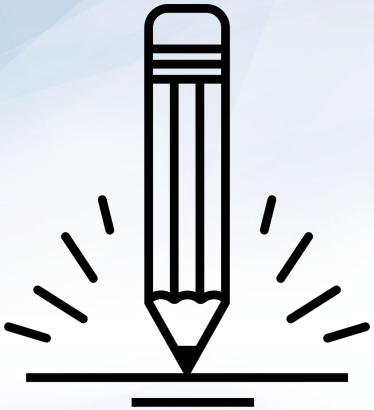
SECURITY CHALLENGE #2

Defending the Wall

In the same groups, you will now use your list of potential attacks from the previous activity to develop a list of at least 10 strategies to mitigate the website's risk.

As you work through this scenario, consider the following:

Can any mitigation strategies be used to handle multiple threats at once?



Activity: Security Challenge #2: Defending the Wall

Now that we've assembled a list of potential attacks, your next task is to develop a list of at least 10 strategies to mitigate the website's risk of unauthorized access. *Be prepared to share!*

Suggested Time:
20 Minutes

Time’s Up! Let’s Review.

Activity: Security Challenge #2: Defending the Wall

User Attacks	Web Attacks	Database Attacks
Social engineering	Brute force attacks	Default credentials
Phishing attacks	Code injection	Unpatched database
Credential reuse	Faulty sessions	Lack of segregation
Malware attacks		
Man in the middle	**Server Attacks**	
Packet sniffing	OS exploits	
Computer theft	Malicious software	

To get started, review this list of identified attack types.

Step Three:
Risk Mitigation Plan

Step 3: Risk Mitigation Plan

User Attacks	Web Attacks	Database Attacks
Social engineering	Brute force attacks	Default credentials
Phishing attacks	Code injection	Unpatched database
Credential reuse	Faulty sessions	Lack of segregation
Malware attacks		
Man in the middle	**Server Attacks**	
Packet sniffing	OS exploits	
Computer theft	Malicious software	

Risk mitigation begins by assessing all risks and looking for parallels.

Step 3: Risk Mitigation Plan

User Attacks
Social engineering
Phishing attacks
Credential reuse
Malware attacks
Man in the middle
Packet sniffing
Computer theft

User Risk Mitigation

1. Educate all users on the danger of phishing and social engineering.
2. Use randomly generated passwords.
3. Ensure users are using multi-factor authentication (password + phone confirmation).
4. Use HTTPS and only access sensitive content over secure channels.

Step 3: Risk Mitigation Plan

Web Attacks

Brute force attacks

Code injection

Faulty sessions

Server Attacks

OS exploits

Malicious software

Web and Server Risk Mitigation

1. Ensure *strong* passwords are used (alphanumeric + symbol + special characters).
2. Sanitize any input in the web application form fields and filter the output.
3. Ensure users are immediately logged out when closing a browser. (Logins are erased after 30 seconds of inactivity.)
4. Ensure all servers are routinely patched against latest known vulnerabilities.
5. Incorporate antivirus and user education.

Step 3: Risk Mitigation Plan

Suggested Plan

1. Educate all users on the dangers of phishing and social engineering.
2. Require randomly generated passwords.
3. Ensure users have multi-factor authentication (password + phone confirmation).
4. Use HTTPS and only access sensitive content over secure channels.
5. Ensure *strong* passwords are used (alphanumeric + symbols).
6. Sanitize any input in the web application form fields and filter the output.
7. Ensure users are immediately logged off when closing a browser.
8. Ensure all servers are routinely patched against latest known vulnerabilities.
9. Ensure physical access to servers is protected by multiple forms of authentication (login + biometric).
10. Ensure all data stored in the database is encrypted and cannot be read without additional login information.
11. Provide database access on need-to-know basis.
12. Log and monitor all database access.
13. Ensure all cloud security platforms follow best practices for security implementation.


15:00
Break

For the rest of today’s class, we will be setting up the **virtual environments** that we’ll use for the majority of technical activities in the course.

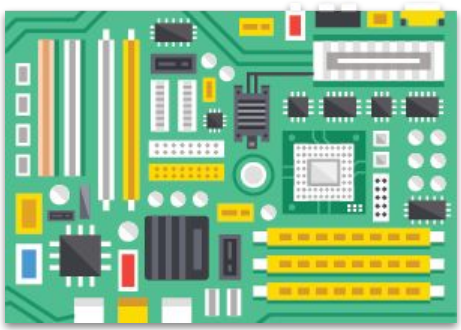
Introduction to Virtual Machines

Physical Machines

To most people, a computer means a physical laptop or desktop computer made of hardware, such as:

Monitors

Graphic Cards

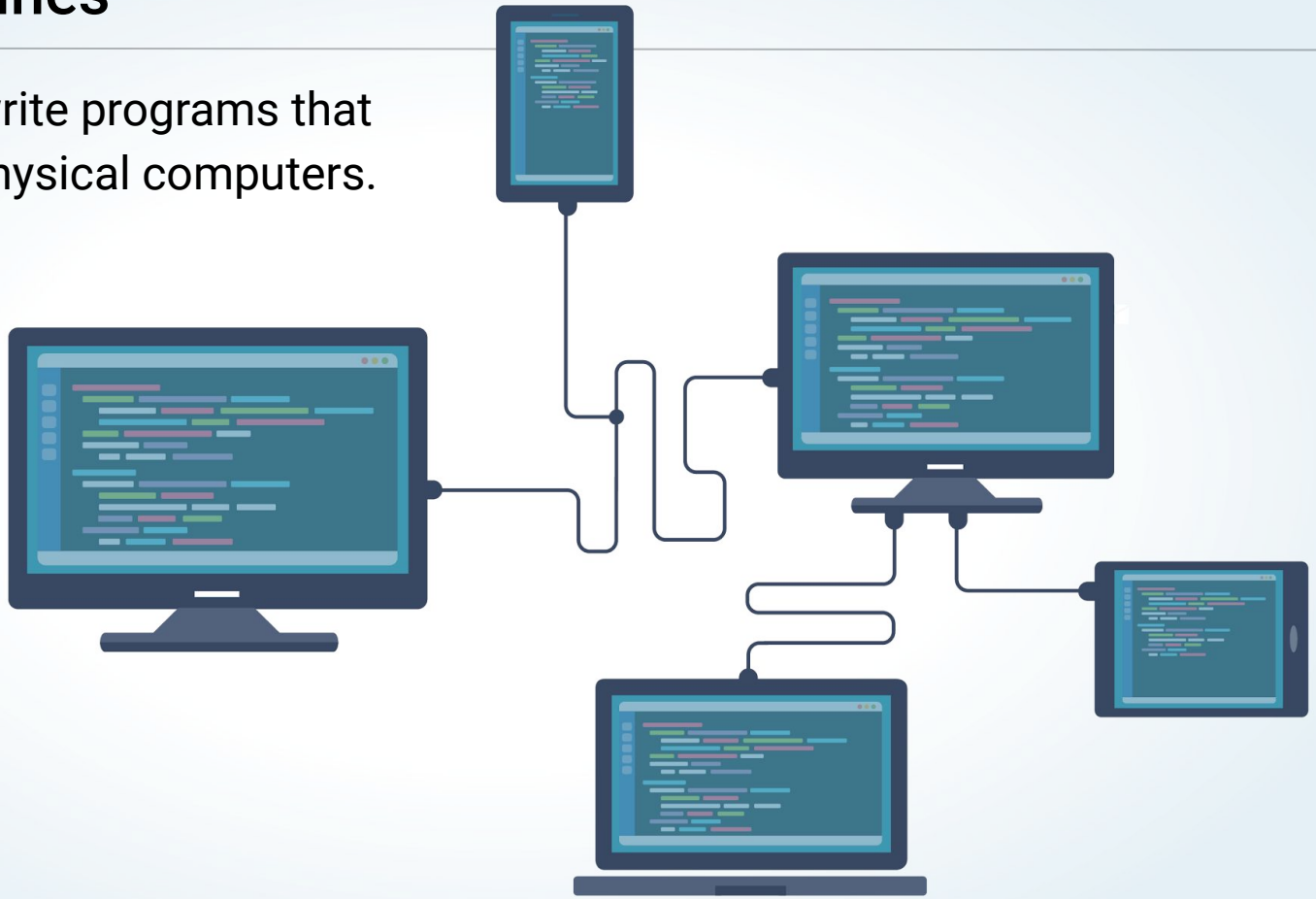


Hard Drives

etc.

Virtual Machines

It is possible to write programs that simulate entire physical computers.



Virtual Machines

Virtual machines are programs that simulate entire computers.

- Virtual machines (VMs) can operate as entirely different computers than the one they're running on.
- We can run many different VMs on a single physical computer.

Physical vs. Virtual Machines

Virtual

- Easy and inexpensive (or free) to set up.
- Easily distributed. In this class, we'll be distributing VMs so each student is running the exact same setup.
- Multiple VMs can be placed on a single physical machine.

vs.

Physical

- Typically more efficient because they have direct access to hardware components.

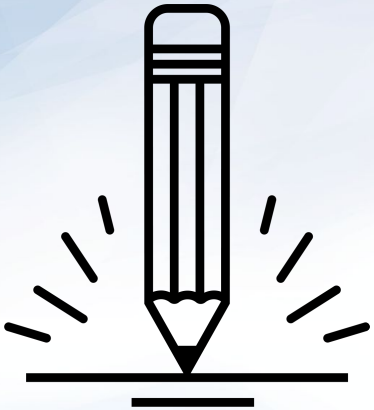
Setting Up Our Virtual Machines

Let's get started setting up our virtual environments. For the rest of the class, we'll focus on the three-step installation process outlined in the **Using Vagrant** document:

01 Accessing the command line and downloading VirtualBox and Vagrant.

02 Downloading the virtual machine using Vagrant files and scripts.

03 Accessing the virtual machine.



Everyone Do: Local Machine Setup

As a class, we will set up our virtual machines. Make sure you have access to the **Using Vagrant** documentation.

Suggested Time:

Step 1

Accessing the command line and downloading VirtualBox and Vagrant.

To run virtual machines, we will first need to make sure that we have the following tools installed:

Git Bash
for Windows users

Terminal
for Mac users

VirtualBox
A virtualization tool we will use to run various lab activities. VirtualBox allows us to run different operating systems on our local machines.

Vagrant
A tool we'll use to build and set up these virtual environments. Vagrant will allow us to run scripts that install these virtual machines, which will then be run using VirtualBox. We will run these scripts using Git Bash or Terminal.


Does everyone have Git Bash or Terminal, VirtualBox, and Vagrant installed?
If so, let’s move on.

Step 2

Downloading the virtual machine using Vagrant files and scripts.

Now that we have our tools installed, we need to download the following files:

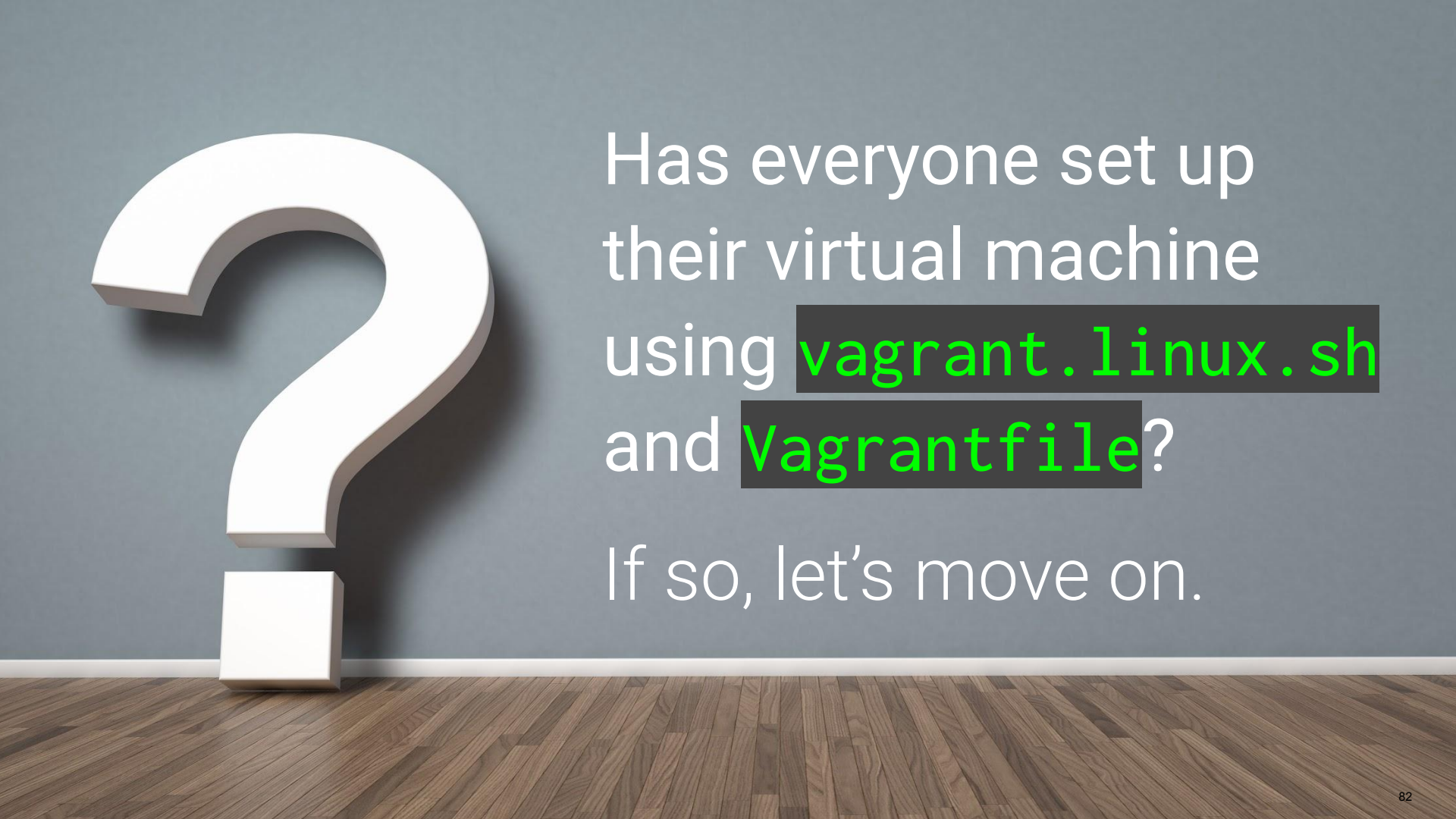
`vagrant-linux.sh`

A script file that ensures your virtual machine is installed properly on your computer.

`Vagrantfile`

A file that configures and defines your virtual machine setup. In our case, this Vagrantfile, when executed via the `vagrant-linux.sh` script, configures the custom Linux Ubuntu machine you are using.

Once you have these files on your machine, work through Part 2 of the **Using Vagrant** documentation.

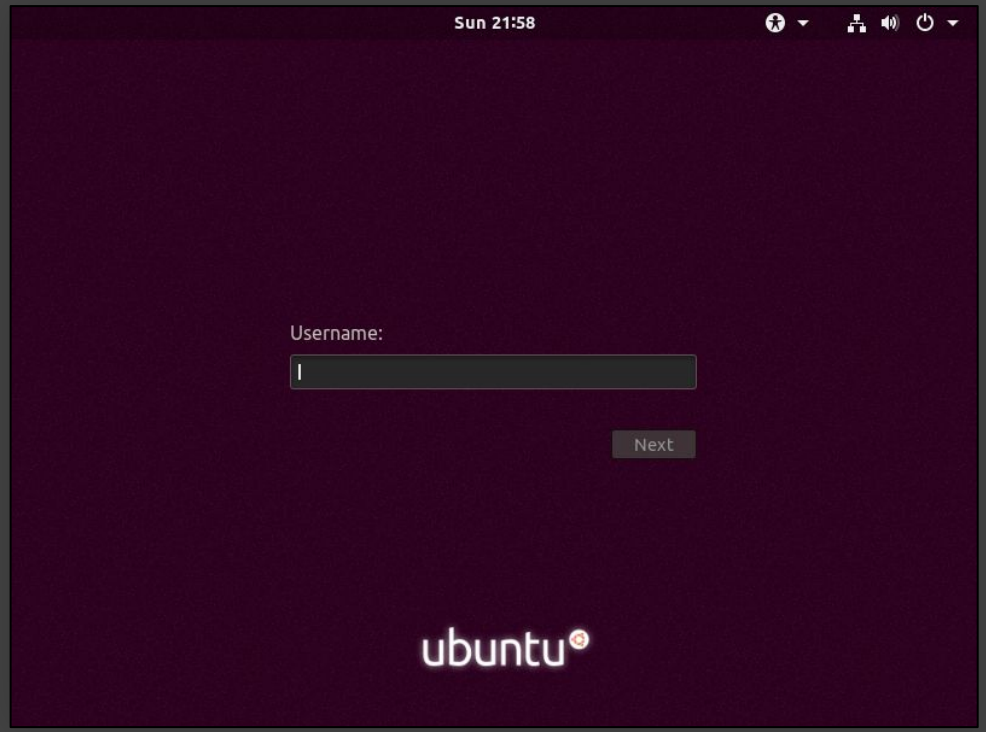

Has everyone set up their virtual machine using vagrant.linux.sh and Vagrantfile?
If so, let's move on.

Step 3

Accessing the virtual machine.

Now we will access the **graphical user interface (GUI)** of our virtual machine.

Use **Part 3** of the Using Vagrant documentation to access your virtual machine.



VM Setup Confirmation

At this point, everyone should have:

01

Accessed the command line and downloaded VirtualBox and Vagrant.

02

Downloaded the virtual machine using Vagrant files and scripts.

03

Accessed the virtual machine.

VM Maintenance
(If time allows)

VM Maintenance

After Step 3 in the **Using Vagrant** documentation are instructions and guidelines for advanced virtual machine setup and maintenance.

You are encouraged to review this material.

Once we begin using our virtual machines in Week 3, we will need to complete these instructions to make sure our VMs have the latest updates.

VM Maintenance

Specifically, we will run the following commands to get our VMs up to date:

`vagrant box update`, to get the most recently updated virtual machine.
This might take several minutes or longer, depending on your internet connection.

`vagrant destroy` within the directories where your Vagrantfiles are installed, to ensure that the virtual machines are stopped and all associated files are removed.

`vagrant up`, to launch the newer version.

`vagrant box prune` (optional) afterwards, to delete all old, unused versions of the virtual machine.

Any Questions?


The End