# Project Week: ELK Stack

## Cybersecurity
### Project Week 1

Welcome to Project Week!

This week, you will set up an ELK stack server to monitor your cloud network.

# Project Week 1: ELK Stack

Placing an ELK monitoring stack within your virtual network will allow you to:

01

Easily collect logs from multiple machines into a single database.

02

Quickly execute complex searches, such as:

*Find the 12 internal IP addresses that sent the most HTTP traffic to my gateway between 4 a.m. and 8 a.m. in April this year.*

03

Build graphs, charts, and other visualizations from network data.

# Day 1: Configuring an ELK Stack

# ELK Stack

- Deploying and configuring an ELK stack is a common task for network engineers.
- SOC analysts and other security professionals use it often.

Completing this project will provide convincing proof of your skills, which you can present to hiring managers.

# ELK Stack

- The ELK stack is commonly used in network production.
- You'll likely work for organizations that use either ELK or Splunk, covered later in the course.
- Experience with both tools is a valuable addition to any job application.

# ELK Stack

You can expand this network with additional machines on your own time to generate a lot of interesting log information.

This sort of independent research is useful for learning, and hiring managers love to know about it.

splunk>®

# Project Week 1: ELK Stack

You'll develop the following deliverables, which you can present in job interviews:

01

**Network Diagram**

An architecture diagram describing the topology of your network.

02

**Technical Brief**

Answers to a series of questions explaining the important features of the suite, completed after deploying the stack. This brief is often referred to as a README document.

03

**GitHub Repository**

When complete, you will save your work to a Git repository, along with an in-depth description. This makes it easy to redeploy your work in the future, and share it with others.

# The Elastic Stack (formerly ELK)

# ELK

ELK is an acronym. Each letter stands for an open-source technology:


(elastic.co)

# Elastic Stack

The tools in the Elastic stack are collectively (and historically) known as **ELK.**


Search and analytics engine.

Server-side data processing pipeline that sends data Elasticsearch.

Tool for visualizing Elasticsearch data with charts and graphs.

# ELK

## Elasticsearch

- ELK started with Elasticsearch.
- It was initially designed to handle *any* kind of information. This means that logs and arbitrary file formats, such as PCAPs, can be easily stored and saved.

# ELK

## Logstash

- After Elasticsearch became popular for logging, Logstash was added to make it easier to save logs from different machines into the Elasticsearch database.
- Logstash also processes logs before saving them, to ensure data from multiple sources has the same format before it is added to the database.

(elastic.co)

# ELK

## Kibana

- Since Elasticsearch can store so much data, analysts often use visualizations to better understand the data at a glance.
- Kibana is designed to make it easy to visualize massive amounts of data in Elasticsearch.
- Kibana is known for its complex dashboards.

(elastic.co)

# The Beats Family

# Beats

The ELK stack worked by storing log data in Elasticsearch with the help of Logstash.

- While functional, this approach is not ideal because it requires administrators to collect all data reported by tools like `syslog`, even if they only need a small portion of it.

**For example:** Administrators often need to monitor changes to specific files, such as `/etc/passwd`, or track specific information, such as a machine's uptime.

In cases like this, it is wasteful to collect all of the machine's log data in order to only inspect a fraction of it.

# Beats

Recently, ELK addressed this issue by adding an additional tool to its data collection suite, called **Beats**.

- Beats are special-purpose data collection modules. Rather than collecting all a machine's log data, Beats allow you to collect only the very specific pieces you're interested in.
- ELK officially supports seven Beats, and there are a large collection of community beats. We will use two of them in this project:
    - **Filebeat** collects data about the file system.
    - **Metricbeat** collects machine metrics, such as uptime.

beats

elastic.co/beats/

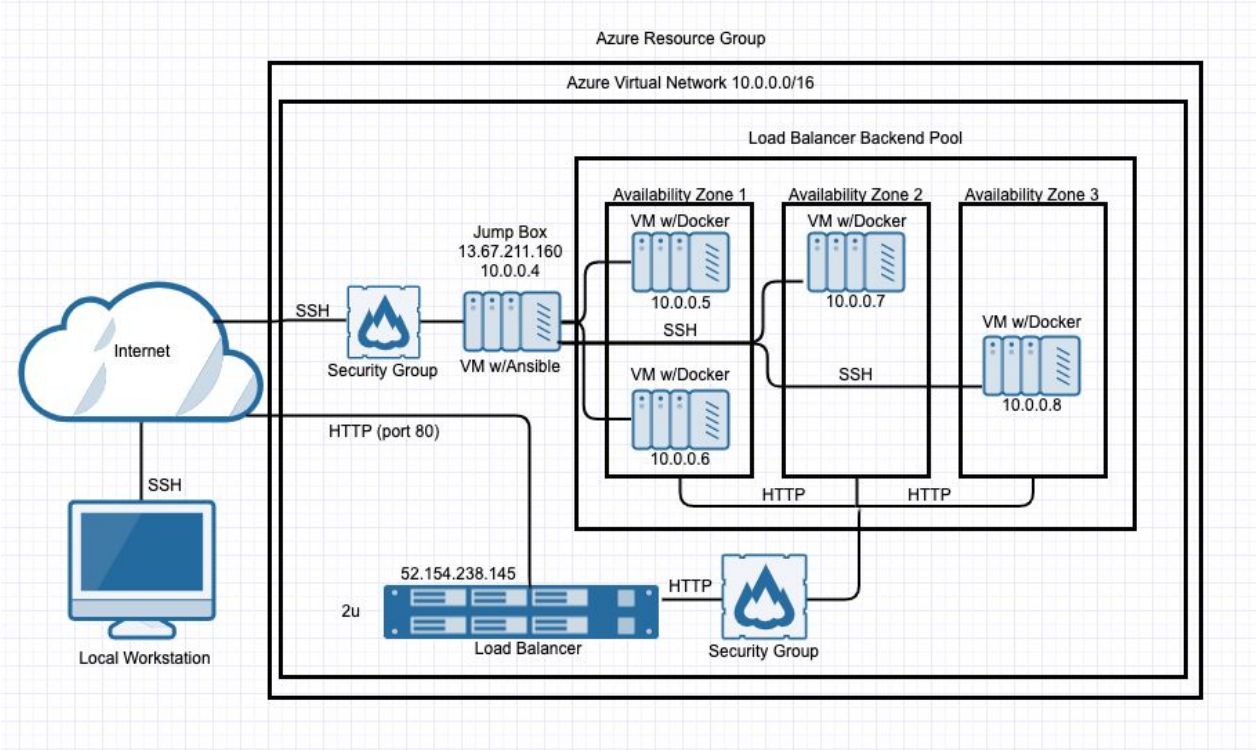
# Project Overview

*Now it’s time to begin deploying*.

Make sure you’re logged into your **personal Azure account**, *not* your cyberxsecurity account.

# Project Setup

We'll continue to build off the cloud week architecture.




This network has:

**A gateway:** the jump box configured during the cloud week.

**Three additional VMs:** one configuring the others, and two functioning as load-balanced web servers.

# Project Milestones

- **Day 1:** Configure the ELK server.
- **Day 2:** Install Filebeat and Metricbeat.
- **Day 3:** Finish leftover work, and create a network diagram and documentation.

# Configure the ELK Server

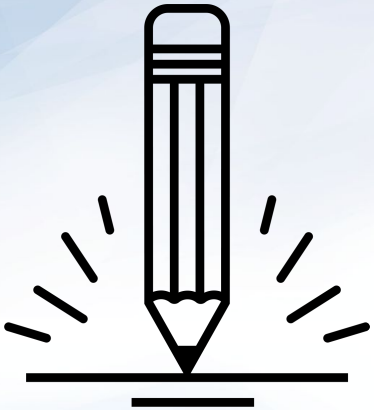
The rest of today will consist of the following:

01 **Create a VM.** Deploy a new VM onto the network to host the ELK server.

02 **Download and configure the container.** Download and configure the `elk-docker` container on the new VM.

03 **Launch and expose the container.** Launch the `elk-docker` container to start the ELK server.

04 **Implement identity and access management.** Configure your preexisting security group so you can connect to ELK via HTTP and observe it through the browser.



# **Day 1 Activity:** ELK Installation

For the remainder of class, you will work on the ELK installation, configuration, launch.

**Suggested Time:**
Full Class Time

# Time's Up

By the end of this class, you should have completed the following:


Completing these steps required you to leverage your systems administration, virtualization, cloud, and automation skills. This is an impressive set of tools to have in your toolkit.

# Day 2: Filebeat

You completed installing the ELK server and will now install data collection tools called Beats.

*If you have not completed all Day 1 activities, you can continue working on those tasks.*

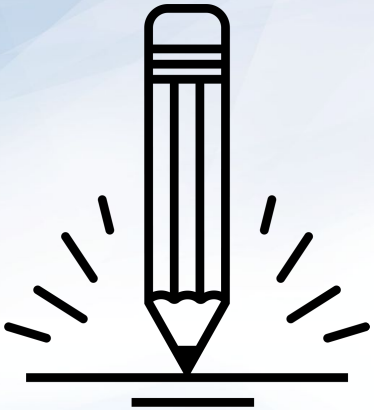
# Filebeat

**Filebeat helps generate and organize log files to send to Logstash and Elasticsearch. Specifically, it logs information about the file system, including which files have changed and when.**

FILEBEAT

- Filebeat is often used to collect log files from very specific files, such as those generated by Apache, Microsoft Azure tools, the Nginx web server, and MySQL databases.
- Since Filebeat is built to collect data about specific files on remote machines, it must be installed on the VMs you want to monitor.

(elastic.co)



# **Day 2 Activity:** Filebeat and Metricbeat

Today, you will install Filebeat on the DVWA container you created during the cloud week.

This will provide a rich source of logs when you complete you deployment.

If you have time, you can also install Metricbeat.

**Suggested Time:**
Full Class Time

# Time's Up

By the end of this class, your ELK server should be receiving logs. You have:


*(Completing the Metricbeat installation was a similar process.)*

# Day 3:
# Exploration, Diagramming and Documentation

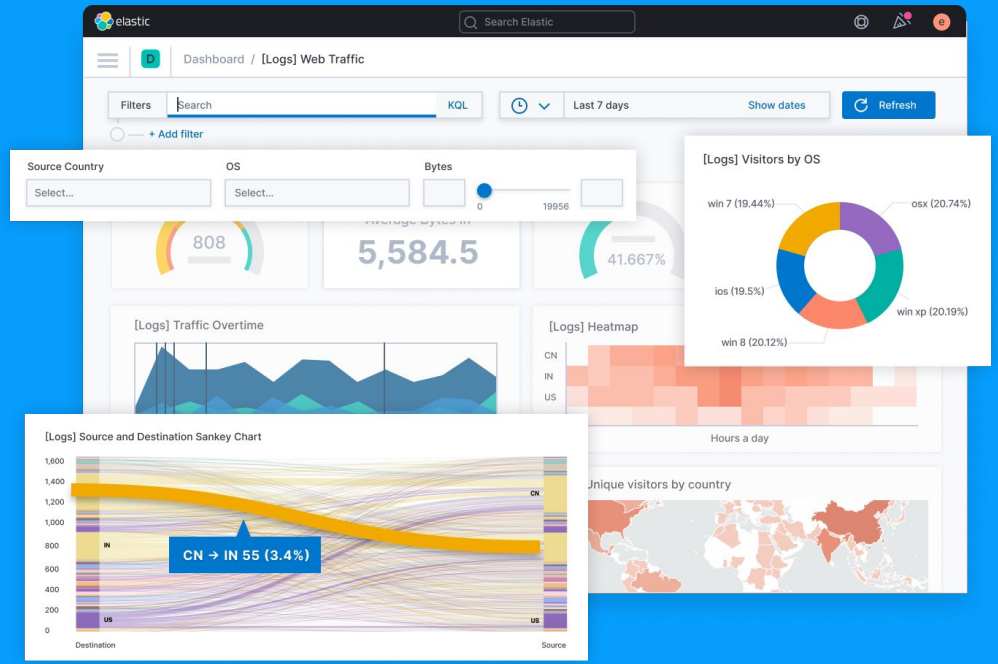
In the final day of the project, you will use Kibana to navigate logs. Then, you will have the option to create a network diagram, complete a README to document the information of the project, answer interview-style questions about your project, or further explore Kibana's capabilities.

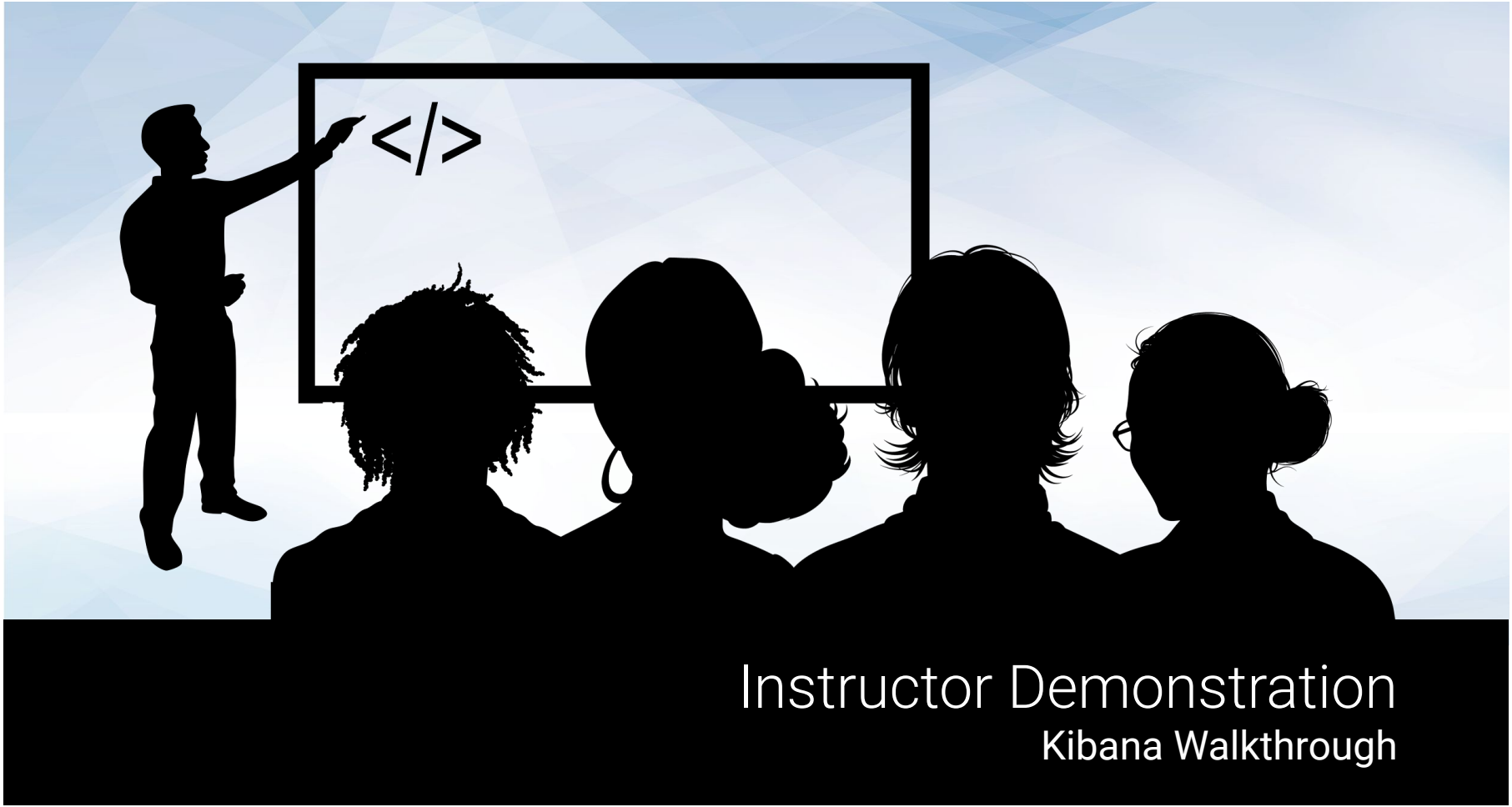
# Exploring Kibana

# Kibana

Companies use tools like Kibana to research events that have happened on their network

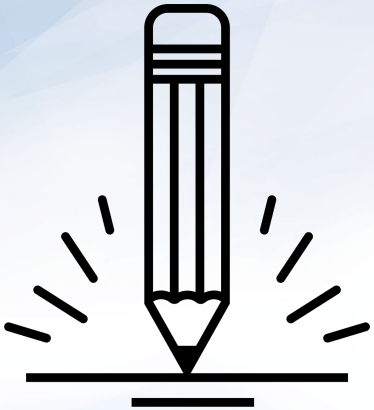
- Any attack leaves a trace that can be followed and investigated using logs.
- Kibana is an interface to observe and gain insight from that type of data that would other be unmanageable.






# Instructor Demonstration

## Kibana Walkthrough



# Exploring Kibana

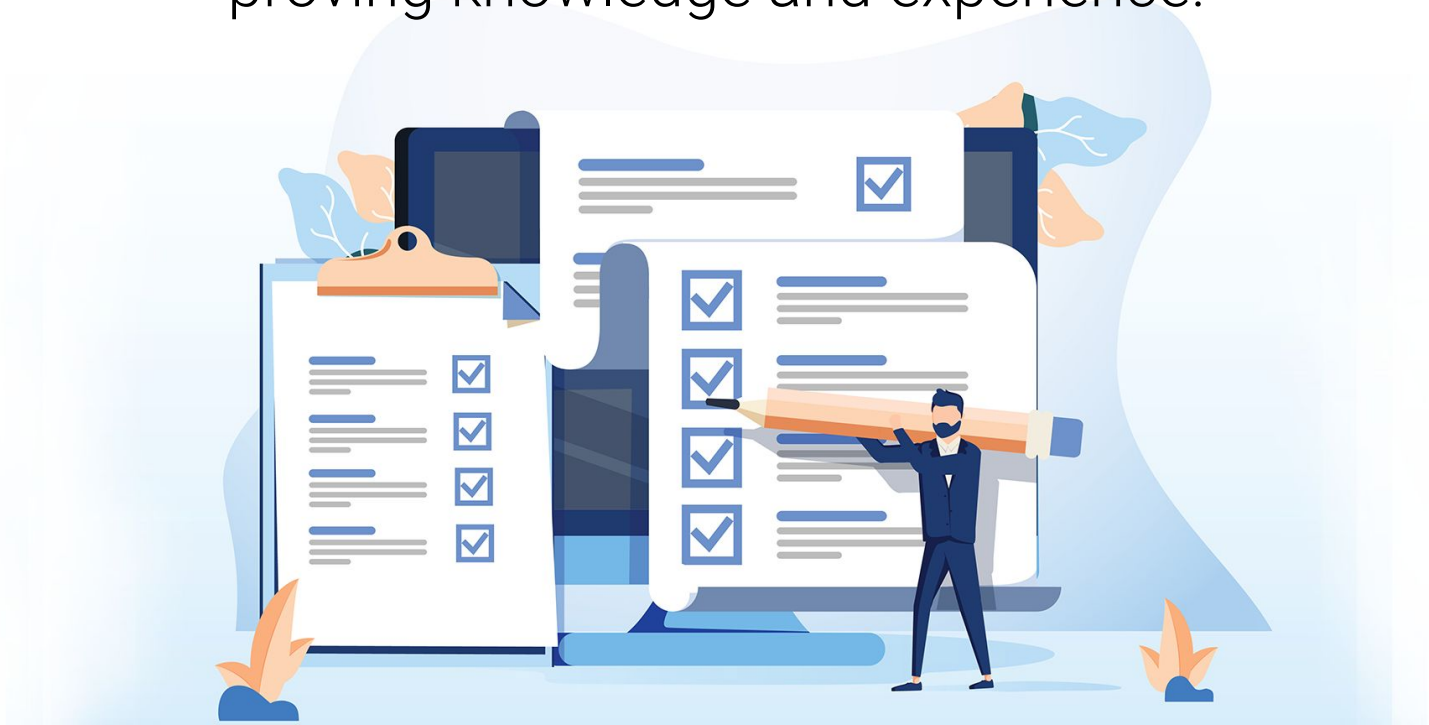
In this activity, you will use Kibana to explore web servers logs and analyze packet data for potential issues

**Suggested Time:**
0:25

**Time’s Up!** Let’s Review.

# Project Communication: Documenting, Diagramming and Discussions

Along with the GitHub repository you will complete for homework, the project documentation and diagram will be valuable **deliverables** to provide to **employers**, proving knowledge and experience.



# Domain-Specific Interview Responses

Along with providing the visual deliverables, you should also be able to verbally communicate the work you did on your project in order to address specific interview questions or to demonstrate your skills within a specific domain.

In this section, we will introduce an optional section of the project in which you will answer mock interview questions about your project and how they relate to various security domains.

# Domain-Specific Interview Responses

Along with providing the visual deliverables, you should also be able to verbally communicate the work you did on your project in order to address specific interview questions or to demonstrate your skills within a specific domain.

First, we will examine at the general structure you can use when answering common technical interview questions. We will explore examples that use this general structure and also use specific examples from Project 1.

Then, you will answer questions about your project as they relate to security domains that align with your career interests.

# Responding to Technical Questions

In this section, we will go through the process of answering technical interview questions.

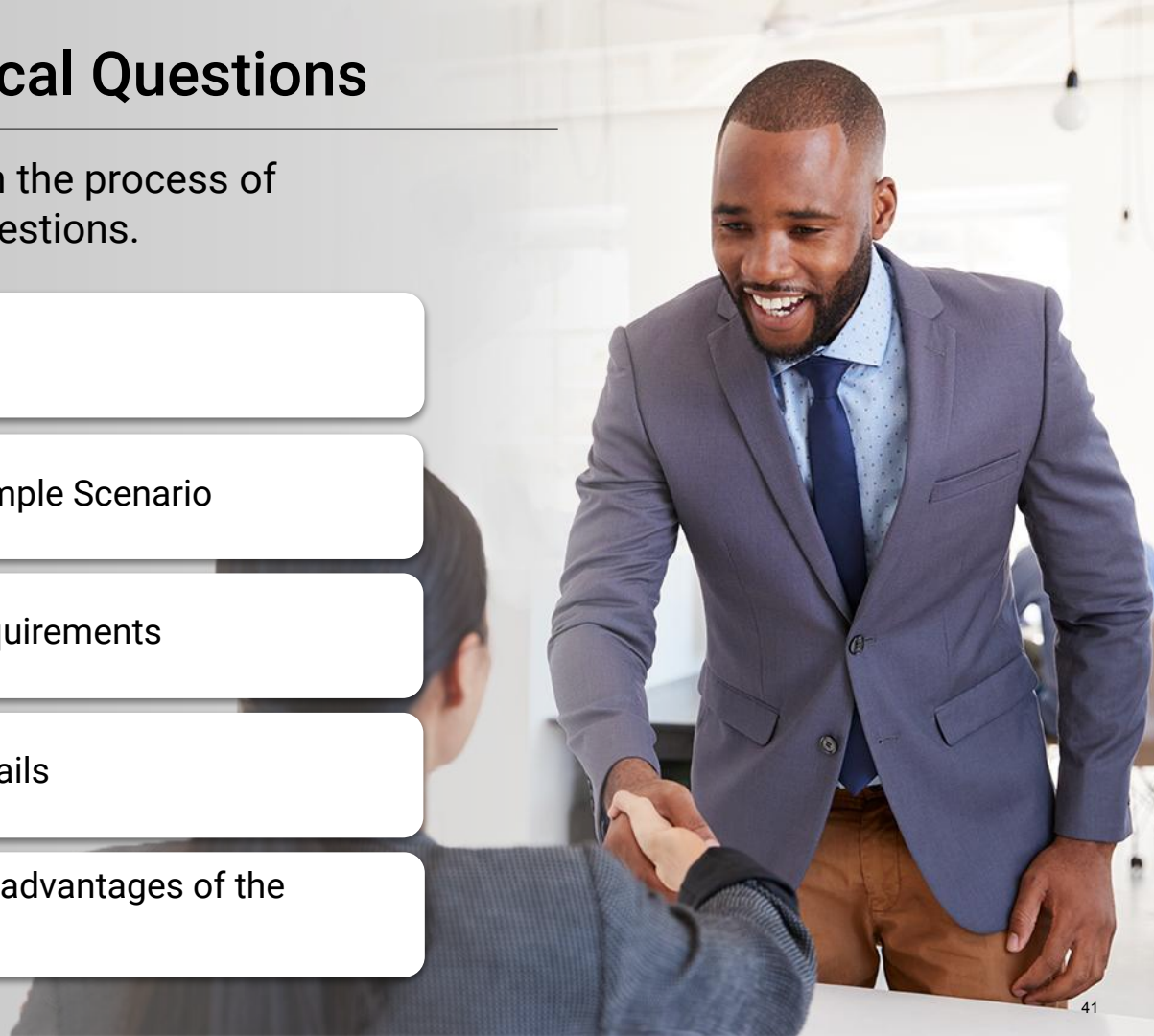
01 Restate the Problem

02 Provide a Concrete Example Scenario

03 Explain the Solution Requirements

04 Explain the Solution Details

05 Identify Advantages/Disadvantages of the Solution



# Sample Question

*“How would you control access to a cloud network?”*

01 **Restate the Problem**

When restating the question in your own words, add additional details to demonstrate you understand what is being asked and why.

**Example:** *“It's important that organizations control access to a cloud network, especially since it has resources that only the engineering team should be able to access. In the interest of the Principle of Least Privilege, you want to make sure engineers can access it easily, but no one else can.”*

# Sample Question

*“How would you control access to a cloud network?”*

02

**Provide a Concrete Example Scenario**

Use the parameters of the question to create an example scenario of the problem you just restated. This makes the problem easier to discuss and further demonstrates your experience with the topic.

**Example:** *“In Project 1 of my Cybersecurity boot camp, we solved an almost identical problem. In that project, we deployed a virtual network containing several VMs to Azure, which only we and our instructional team were supposed to be able to access. Just as an organization would limit cloud network access to only engineers, we had to implement remote access controls limiting access to only a handful of authorized individuals.”*

# Sample Question

*“How would you control access to a cloud network?”*

03

**Explain the Solution Requirements**

Before explaining the details of your solution, explain the requirements of the solution and (optionally at this stage) the high-level steps taken to address each.

**Example:** *“After deploying the network, I first had to block access to all machines except one on the internal network, called the Jump Box. I did this by configuring a Network Security Group (NSG) around the whole subnet. This blocked traffic from all IP addresses, except for mine.* ***Then****, I needed to allow connections only between the jump box and other local IP addresses. I did this by configuring additional NSG rules.* ***Finally****, I was required to eliminate vulnerability to password-based brute-force, so I forced the use of SSH keys to authenticate to all VMs.”*

# Sample Question

*“How would you control access to a cloud network?”*

04

**Explain the Solution Details**

Now that you laid out the high-level steps, use this time to explain the specifics of how you would implement the solution. The following examples are shortened for brevity, but real answers would typically include considerably more detail.

**Example:** *“To configure access controls around the entire subnet, I created an NSG with the following ruleset: [Omitted…] These rules allow access to the jump box from only the specified IP addresses.* ***Then****, to configure access controls within the subnet, I created NSG rules as follows: […] These rules allow each VM within the network to communicate only the jump box. To force the use of SSH keys, the VM accounts were created without passwords: [...] This ensures that password brute-force attacks (which would require SSH access not allowed by the NSG) will always fail.*

# Sample Question

*“How would you control access to a cloud network?”*

05

**Identify Advantages and Disadvantages**

Acknowledge any potential shortcomings of the specifics of your design (as they say, the Devil is in the details), and how you might address them..

**Example:** *“This solution worked well for my project because it ensured only the selected users have access. However, it is difficult to maintain and scale because it requires updating the NSG every time a new user requires access to the network. In addition, securely using SSH keys can be tricky in the long-run. An alternative solution that addresses these shortcomings would be implementing a VPN gateway to the private network. This would allow us to manage and monitor users more safely and scalably.”*

# Your Turn: Project Communication and Further Exploration

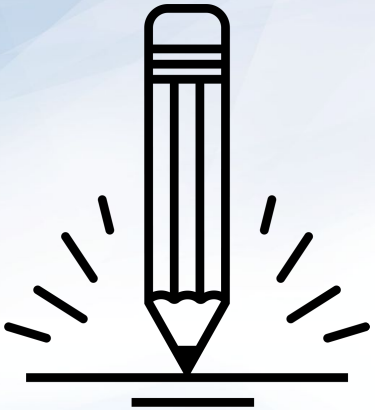
For the rest of the allotted project time, you will have the ability to focus on any of the following activities:

01 Finalize the network diagram you began during the cloud security week.

02 Draft a README explaining what you've built.

03 Answer mock interview questions.

04 Continue exploring Kibana’s features.



## **Day 3 Activity:** Project Communication and Further Exploration

You will be provided four supplemental activity files.

- Additional Kibana Exploration
- Network Diagram (Part of homework)
- Project Readme (Part of Homework)
- Interview Responses

**Suggested Time:**
Remaining Class Time

# Homework

Create a GitHub repository where you will save your project files and the README. You can use this repo to easily share the following with colleagues and employers:

01 Network diagram

02 Description of the deployment

03 Tables specifying access policies and network addresses

04 Usage instructions

# Don’t forget to power off your machine!

- Navigate to portal.azure.com.
- Search for and select **Virtual Machines**.
- Select every VM in the list.
- Click **Stop**. This will ensure you’re not charged for any of the machines used in the project (with the exception of recurring charges for storage).