

# Linux Server Security Assessment and High-Risk Remediation (NIST Cybersecurity Framework 2.0 Controls)

## Introduction:

This report documents the results of a security configuration and posture review performed against the target Linux system. The assessment was aligned to the NIST Cybersecurity Framework (CSF) 2.0, with findings mapped to the relevant controls. The goal of this exercise was to identify gaps, assess associated risks, and recommend practical remediation steps.

The review covered user authentication, package management, configuration management, data protection logging, and system hardening. Findings were categorized by risk severity and mapped to NIST CSF 2.0 functions (Identify, Protect, Detect, Respond, Recover).



## Target System:

Device / System Details	Description
Hostname	vm-ubuntu-test
IP Address	192.168.xx.xxx
Operating System / Version	Ubuntu 24.04
Kernel Version	6.8.0
Architecture	x86_64
Virtualization / Hypervisor	VirtualBox
Assessment Tool	Lynis 3.0.9
Assessment Date	2025-09-09

User / Assessor	Catherine Czarnonycz / System Administrator
Purpose / Notes	Evaluate the system against NIST CSF 2.0 controls, identify configuration and security gaps, assess associated risks, and provide actionable remediation guidance to improve overall security posture. Baseline remediation captured.

## Executive Summary:

The assessment identified several gaps across authentication, system configuration, and data protection.

- **High-risk issues (5 total):** Weak password enforcement, unprotected bootloader, outdated packages, insecure sudoers directory, and USB storage driver enabled.
- **Medium-risk issues (6 total):** Sysctl misconfigurations, unused firewall rules, lack of partition separation, missing integrity tools, unconfigured remote logging, and unrestricted core dumps.
- **Low-risk issue (1 total):** Absence of legal login banners.

Addressing the **high-risk items** should be prioritized to reduce the likelihood of unauthorized access and system compromise. Medium- and low-risk issues should be remediated as part of a structured hardening program.

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## Detailed Findings and Remediation:

The following table summarizes findings, mapped controls, risks, and recommended remediation actions:

Security Gap Analysis and Recommended Remediation					
System Category	Issue	Description	Risk	NIST CSF 2.0 Control	Remediation
Users, Authentication	Missing password strength module	Weak passwords can compromise accounts.	High	PR.AA-03: Users, services, and hardware are authenticated	Install and configure pam_pwquality:
Packages	Found vulnerable packages (PKGS-7392)	Outdated packages increase risk of compromise.	High	PR.PS-02: Software is maintained, replaced, and removed commensurate with risk	Update all packages to latest security versions

Security Gap Analysis and Recommended Remediation					
System Category	Issue	Description	Risk	NIST CSF 2.0 Control	Remediation
GRUB Boot	No password protection	Bootloader unprotected, allowing unauthorized system access.	High	PR.PS-01: Configuration management practices are established and applied	Set GRUB boot password
File Permissions	/etc/sudoers.d directory has insecure permissions	Directory permissions could allow privilege escalation	High	PR.AA-05: Access permissions, entitlements, and authorizations are defined in a policy, managed, enforced, and reviewed, and incorporate the principles of least privilege and separation of duties	Restrict permissions to root-only access
USB, External Media	USB storage driver not disabled	Unauthorized data transfer via USB is possible	High	PR.DS-01: The confidentiality, integrity, and availability of data-at-rest are protected	Disable USB storage driver
PAM Authentication	libpam-tmpdir not installed	User temporary files are shared, risking tampering between accounts	Medium	PR.AA-05: Access permissions, entitlements, and authorizations are defined in a policy, managed, enforced, and reviewed, and incorporate the principles of least privilege and separation of duties	Install and configure libpam-tmpdir to isolate /tmp per user. Verify PAM configuration and document
Kernel Hardening	Sysctl values differ from recommended profile	System hardening profile not fully applied, increasing exposure	Medium	PR.PS-01: Configuration management practices are established and applied	Adjust /etc/sysctl.conf to recommended security values
Firewalls	Check iptables for unused rules	Unused firewall rules may allow unintended access	Medium	PR.IR-01: Networks and environments are protected from unauthorized logical access and usage	Review iptables rules and remove unused entries
File Systems	/home, /tmp, /var not on separate partitions	Lack of partition separation increases risk of privilege escalation, data corruption, and resource exhaustion	Medium	PR.DS-01: The confidentiality, integrity, and availability of data-at-rest are protected	To decrease impact, place each on separate partitions according to best practice

Security Gap Analysis and Recommended Remediation					
System Category	Issue	Description	Risk	NIST CSF 2.0 Control	Remediation
Logging	External logging not enabled	Logs may be lost or destroyed, limiting incident detection	Medium	DE.CM-01: Networks and network services are monitored to find potentially adverse events	Configure remote logging for centralized archival; Enable logging to an external logging host for archiving purposes and additional protection
Core Dumps	Core dumps not restricted	Sensitive information may be exposed via core dumps	Medium	PR.AA-05: Access permissions, entitlements, and authorizations are defined in a policy, managed, enforced, and reviewed, and incorporate the principles of least privilege and separation of duties	Restrict access in /etc/security/limits.conf
File Integrity	Integrity tools missing or disabled (dm-integrity, dm-verity)	Lack of file or disk integrity tools increases risk of undetected system tampering or data corruption	Medium	PR.DS-01: The confidentiality, integrity, and availability of data-at-rest are protected	Install and enable file integrity tools (e.g., AIDE, dm-verity, dm-integrity) and configure regular checks
Banners	No legal banner on /etc/issue or /etc/issue.net	Lacks formal security/legal notification	Low	PR.AA-05: Access permissions, entitlements, and authorizations are defined in a policy, managed, enforced, and reviewed, and incorporate the principles of least privilege and separation of duties	Add standard security and legal banners

## Remediation of High-Risk Items:

Due to the sensitive nature of the high-risk items, remediation was carried out on these vulnerabilities during the audit review. To jump to a specific item and corresponding remediation steps, please click on the below corresponding link:

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- [Missing password strength module](#)  
Weak authentication controls  
Risk Level: **HIGH**
  
- [Vulnerable packages \(PKGS-7392\)](#)  
Outdated versions expose system to exploits  
Risk Level: **HIGH**
  
- [GRUB Boot - No password protection](#)  
System vulnerable to unauthorized access and changes during boot  
Risk Level: **HIGH**
  
- [Insecure file permission \(/etc/sudoers.d directory\)](#)  
Privilege escalation risk  
Risk Level: **HIGH**
  
- [USB storage driver not disabled](#)  
Unrestricted USB access may allow data exfiltration or malware installation  
Risk Level: **HIGH**

## Finding: Missing password strength module

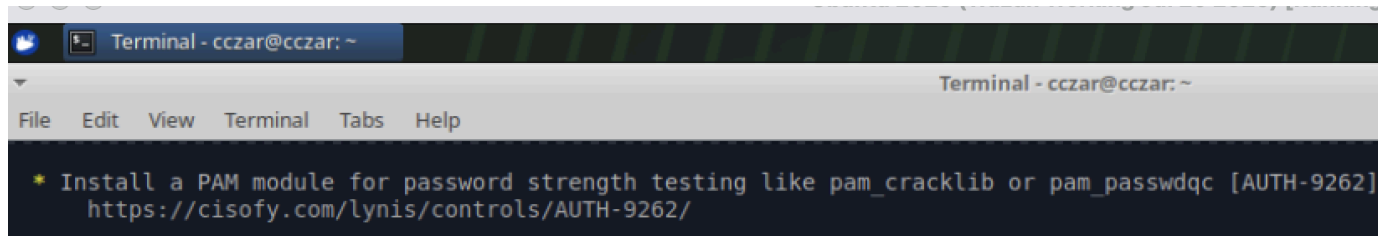
**NIST Control Mapping:** PR.AA-03 - Users, services, and hardware are authenticated

**Risk:** Weak passwords can compromise accounts.

**Severity:** High

**Remediation:** Implement a password strength module to enforce complexity requirements, including minimum length, a mix of uppercase and lowercase letters, numbers, and special characters.

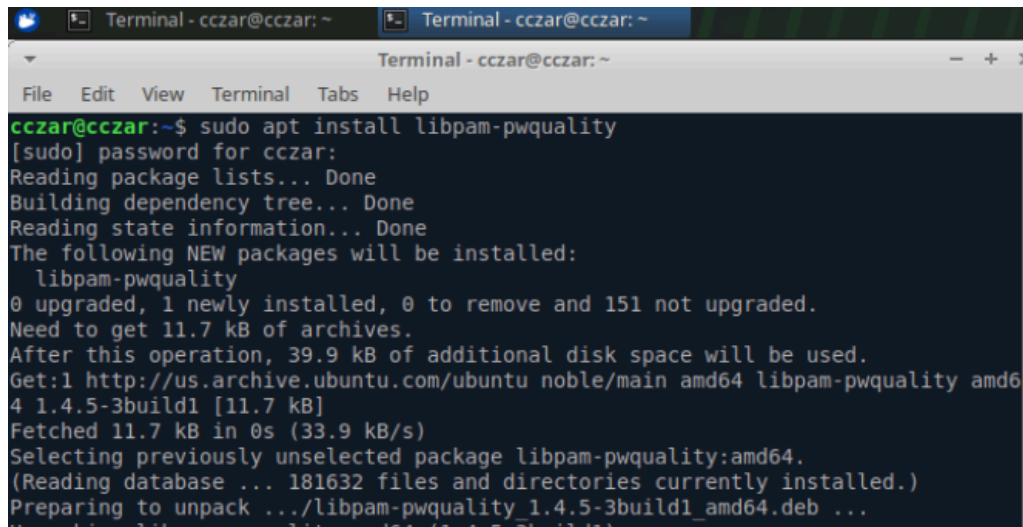
## INITIAL LYNIS SCAN RESULT



```
Terminal - cczar@cczar: ~  
File Edit View Terminal Tabs Help  
* Install a PAM module for password strength testing like pam_cracklib or pam_passwdqc [AUTH-9262]  
https://cisofy.com/lynis/controls/AUTH-9262/
```

## REMEDIATION PROCESS

### 1. Installed `pam_pwquality`



```
Terminal - cczar@cczar: ~  
File Edit View Terminal Tabs Help  
cczar@cczar:~$ sudo apt install libpam-pwquality  
[sudo] password for cczar:  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
The following NEW packages will be installed:  
  libpam-pwquality  
0 upgraded, 1 newly installed, 0 to remove and 151 not upgraded.  
Need to get 11.7 kB of archives.  
After this operation, 39.9 kB of additional disk space will be used.  
Get:1 http://us.archive.ubuntu.com/ubuntu noble/main amd64 libpam-pwquality amd64 1.4.5-3build1 [11.7 kB]  
Fetched 11.7 kB in 0s (33.9 kB/s)  
Selecting previously unselected package libpam-pwquality:amd64.  
(Reading database ... 181632 files and directories currently installed.)  
Preparing to unpack .../libpam-pwquality_1.4.5-3build1_amd64.deb ...  
Unpacking libpam-pwquality:amd64 (1.4.5-3build1)
```

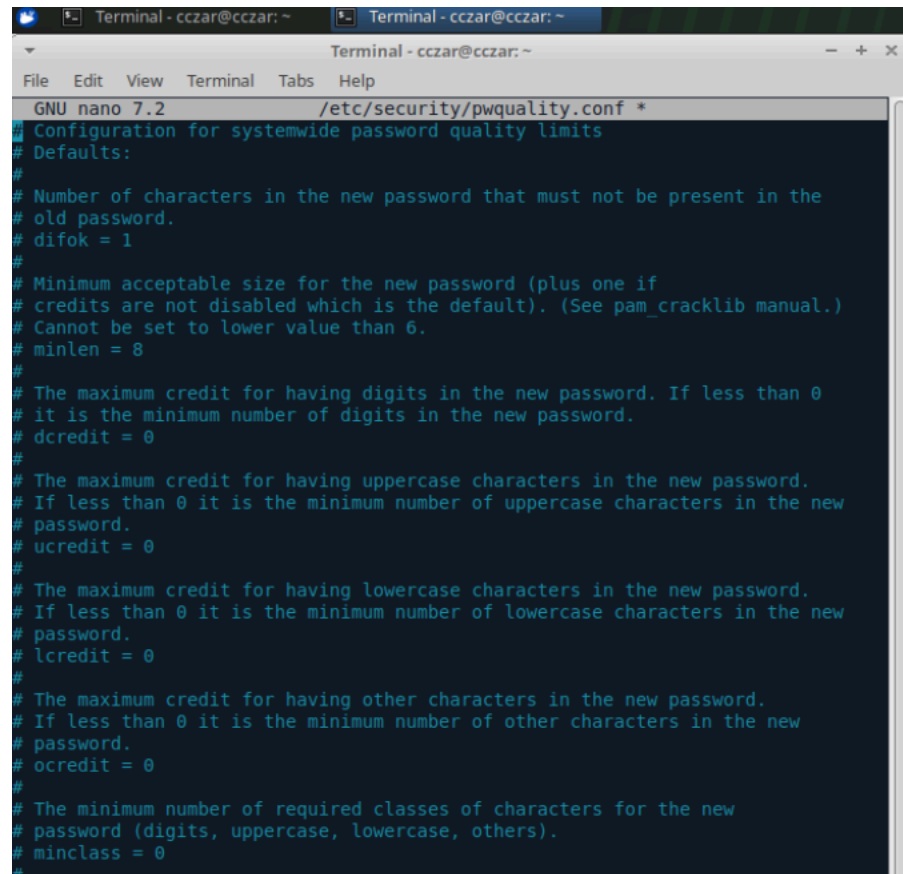
## Note on Password Quality Modules:

During remediation, `pam_pwquality` was installed and configured to enforce strong password policies. Although `pam_passwdqc` is an alternative PAM module for password quality, `pam_pwquality` was chosen for the following reasons:

- Modern and actively maintained – `pam_pwquality` is the preferred module on current Linux distributions, including Ubuntu 22.04 LTS.
- Centralized configuration – settings are stored in `/etc/security/pwquality.conf`, allowing clear control of password length, character classes, and differences from previous passwords.
- Ease of enforcement – integrates seamlessly with PAM (`/etc/pam.d/common-password`) to enforce policies system-wide.
- Legacy module – `pam_passwdqc` is primarily used for older or legacy systems

## 2. Configured `/etc/security/pwquality.conf`

Initial configuration:



```
Terminal - cczar@cczar: ~
GNU nano 7.2 /etc/security/pwquality.conf *
# Configuration for systemwide password quality limits
# Defaults:
#
# Number of characters in the new password that must not be present in the
# old password.
# difok = 1
#
# Minimum acceptable size for the new password (plus one if
# credits are not disabled which is the default). (See pam_cracklib manual.)
# Cannot be set to lower value than 6.
# minlen = 8
#
# The maximum credit for having digits in the new password. If less than 0
# it is the minimum number of digits in the new password.
# dcredit = 0
#
# The maximum credit for having uppercase characters in the new password.
# If less than 0 it is the minimum number of uppercase characters in the new
# password.
# ucredit = 0
#
# The maximum credit for having lowercase characters in the new password.
# If less than 0 it is the minimum number of lowercase characters in the new
# password.
# lcredit = 0
#
# The maximum credit for having other characters in the new password.
# If less than 0 it is the minimum number of other characters in the new
# password.
# ocredit = 0
#
# The minimum number of required classes of characters for the new
# password (digits, uppercase, lowercase, others).
# minclass = 0
#
```

The following configurations were updated:

**difok = 5**

- The new password must differ by at least **5 characters** from the previous one.

**minlen = 12**

- Minimum password length = **12 characters**.

**ucredit = -1**

- Requires at least **1 uppercase letter**.
- Negative values mean “at least this many must exist.”

**lcredit = -1**

- Requires at least **1 lowercase letter**.

**dcredit = -1**

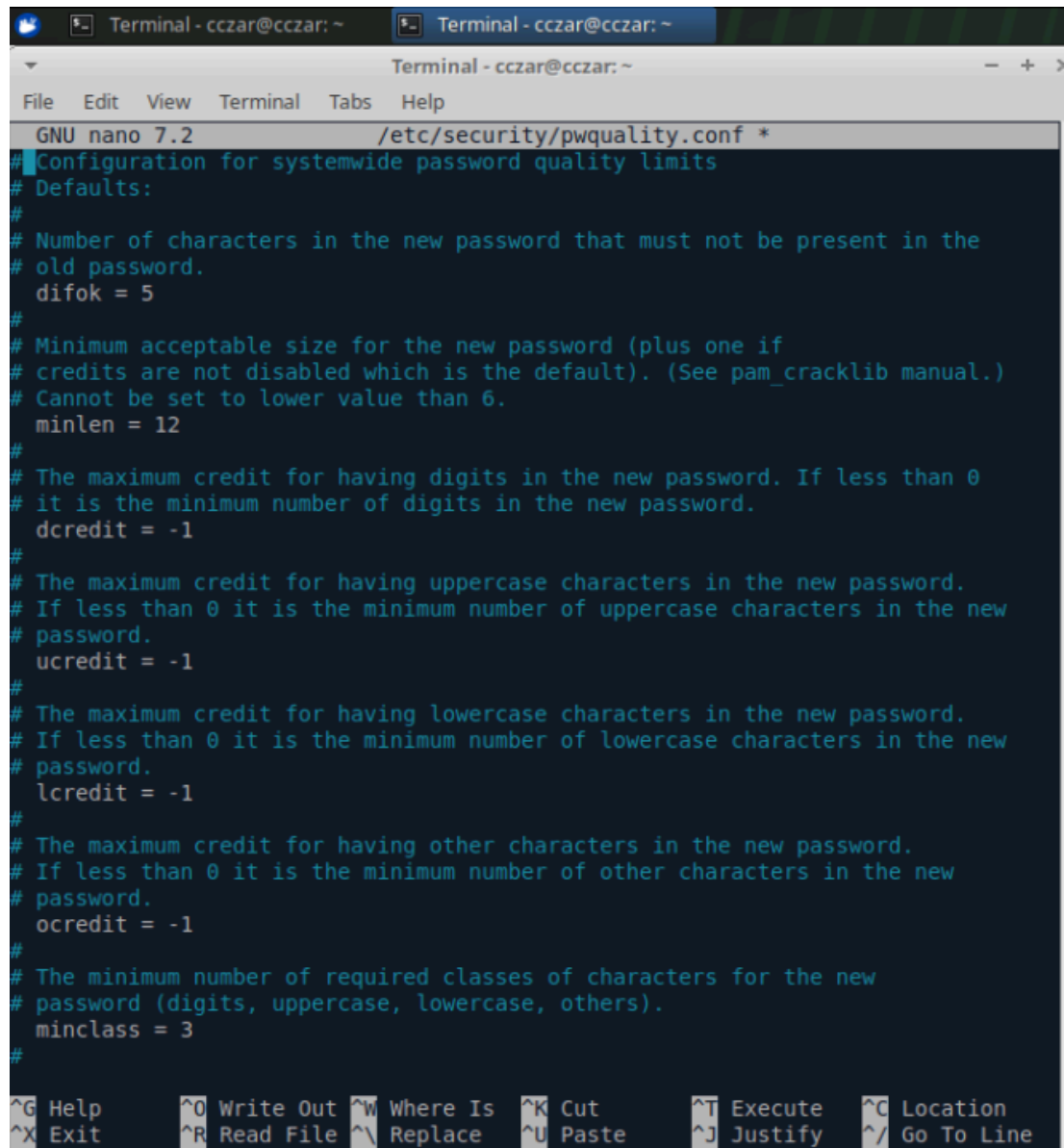
- Requires at least **1 digit**.

**ocredit = -1**

- Requires at least **1 special character** (non-letter, non-digit).



## Secure updated configuration:



The image shows a terminal window with two tabs, both titled "Terminal - cczar@cczar: ~". The active tab displays the GNU nano 7.2 editor editing the file /etc/security/pwquality.conf. The file contains configuration for systemwide password quality limits. The configuration includes several commented-out lines and active settings: difok = 5, minlen = 12, dcredit = -1, ucredit = -1, lcredit = -1, ocredit = -1, and minclass = 3. The bottom of the terminal shows a status bar with various keyboard shortcuts for nano, such as ^G Help, ^O Write Out, ^W Where Is, ^K Cut, ^T Execute, ^C Location, ^X Exit, ^R Read File, ^\ Replace, ^U Paste, ^J Justify, and ^\_ Go To Line.

```
GNU nano 7.2 /etc/security/pwquality.conf *
# Configuration for systemwide password quality limits
# Defaults:
#
# Number of characters in the new password that must not be present in the
# old password.
difok = 5
#
# Minimum acceptable size for the new password (plus one if
# credits are not disabled which is the default). (See pam_cracklib manual.)
# Cannot be set to lower value than 6.
minlen = 12
#
# The maximum credit for having digits in the new password. If less than 0
# it is the minimum number of digits in the new password.
dcredit = -1
#
# The maximum credit for having uppercase characters in the new password.
# If less than 0 it is the minimum number of uppercase characters in the new
# password.
ucredit = -1
#
# The maximum credit for having lowercase characters in the new password.
# If less than 0 it is the minimum number of lowercase characters in the new
# password.
lcredit = -1
#
# The maximum credit for having other characters in the new password.
# If less than 0 it is the minimum number of other characters in the new
# password.
ocredit = -1
#
# The minimum number of required classes of characters for the new
# password (digits, uppercase, lowercase, others).
minclass = 3
#
^G Help  ^O Write Out  ^W Where Is  ^K Cut       ^T Execute   ^C Location
^X Exit  ^R Read File  ^\ Replace   ^U Paste     ^J Justify   ^_ Go To Line
```

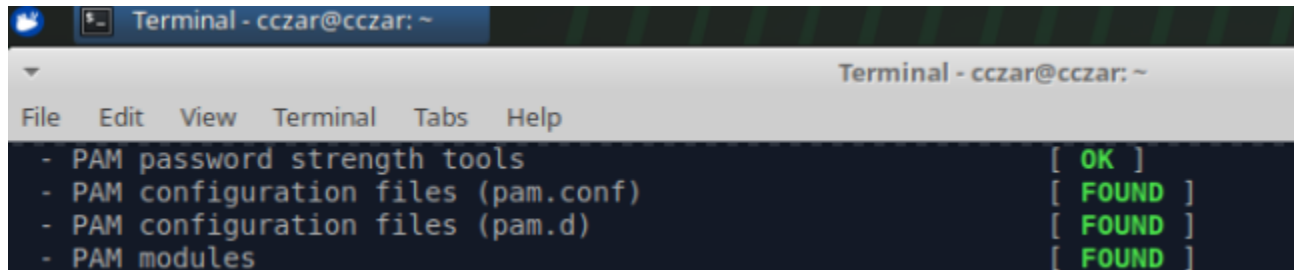
### 3. Validated configuration updates

- Attempted to set weak passwords 'testpass123!', Testpass1234, Testpass12!' → rejected, confirming enforcement.
- Successfully set password with required parameters.

```
cczar@cczar:~$ sudo nano /etc/security/pwquality.conf
[sudo] password for cczar:
cczar@cczar:~$ passwd cczar
Changing password for cczar.
Current password:
New password:
BAD PASSWORD: The password contains less than 1 uppercase letters
New password:
BAD PASSWORD: The password contains less than 1 non-alphanumeric characters
New password:
BAD PASSWORD: The password is shorter than 12 characters
passwd: Have exhausted maximum number of retries for service
passwd: password unchanged
cczar@cczar:~$
```

```
cczar@cczar:~$ passwd cczar
Changing password for cczar.
Current password:
New password:
Retype new password:
Sorry, passwords do not match.
New password:
Retype new password:
passwd: password updated successfully
cczar@cczar:~$
```

## LYNIS SCAN RESULT AFTER REMEDIATION



A terminal window titled "Terminal - cczar@cczar: ~" displays the output of a Lynis scan. The window has a menu bar with "File", "Edit", "View", "Terminal", "Tabs", and "Help". The scan results are listed as follows:

```
- PAM password strength tools [ OK ]  
- PAM configuration files (pam.conf) [ FOUND ]  
- PAM configuration files (pam.d) [ FOUND ]  
- PAM modules [ FOUND ]
```

## Finding: Vulnerable Packages (PKGS-7392)

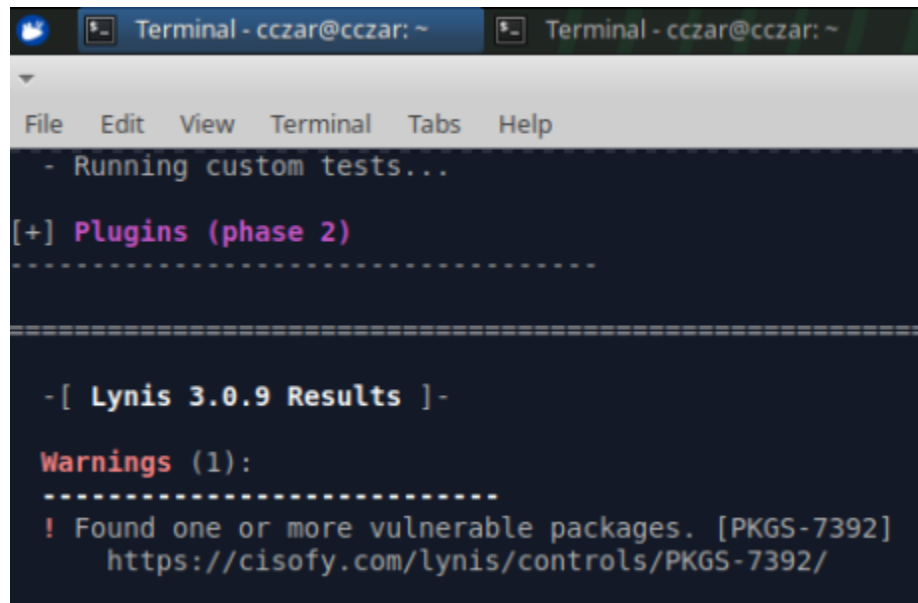
**NIST Control Mapping:** PR.PS-02 - Software is maintained, replaced, and removed commensurate with risk

**Risk:** Outdated packages increase the likelihood of compromise, as known vulnerabilities could be exploited.

**Severity:** High

**Remediation:** Identify and update all vulnerable packages to the latest stable versions.

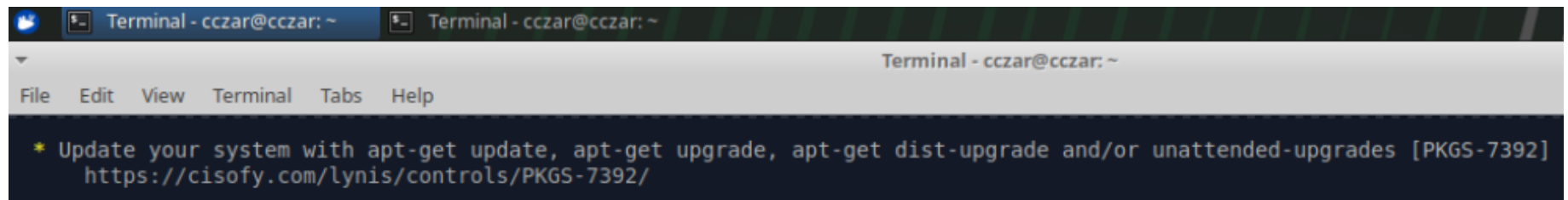
### INITIAL LYNIS SCAN RESULT



```
Terminal - cczar@cczar: ~
File Edit View Terminal Tabs Help
- Running custom tests...
[+] Plugins (phase 2)
-----

-[ Lynis 3.0.9 Results ]-

Warnings (1):
-----
! Found one or more vulnerable packages. [PKGS-7392]
  https://cisofy.com/lynis/controls/PKGS-7392/
```



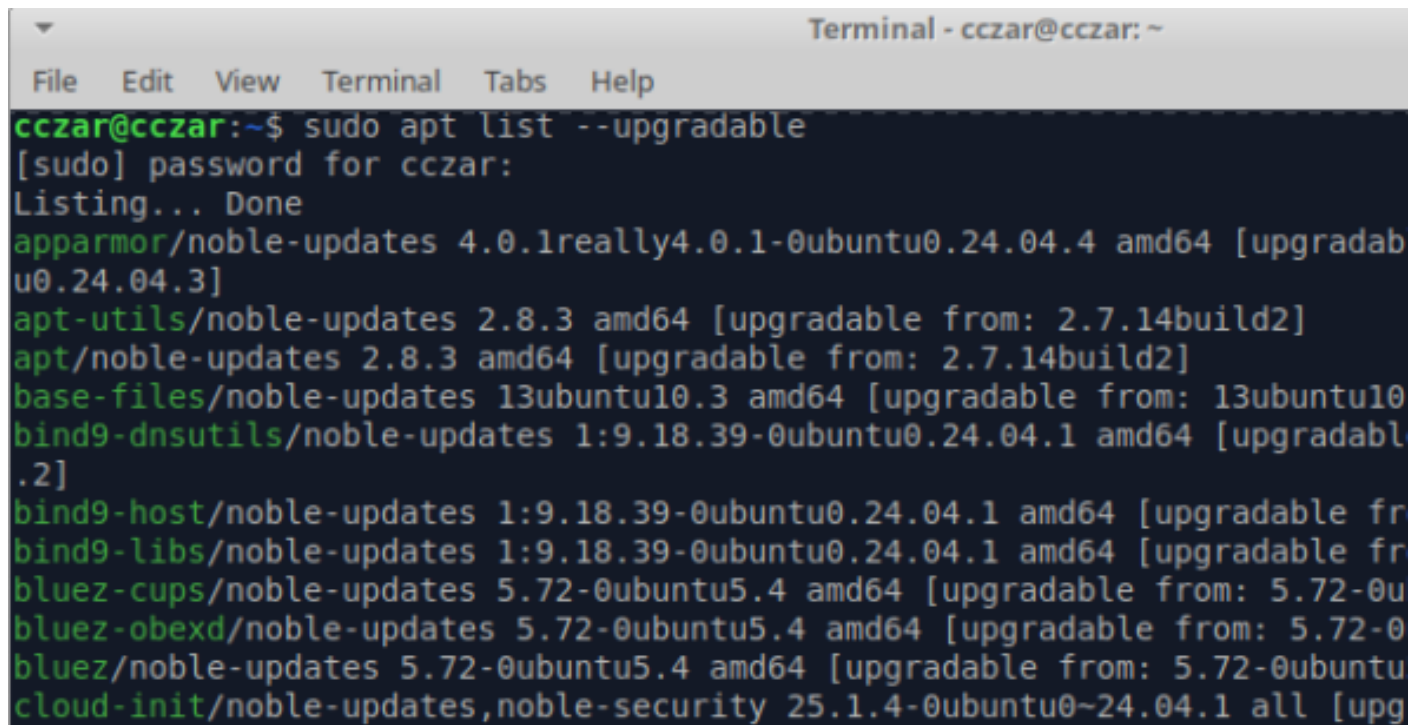
```
Terminal - cczar@cczar: ~
File Edit View Terminal Tabs Help

* Update your system with apt-get update, apt-get upgrade, apt-get dist-upgrade and/or unattended-upgrades [PKGS-7392]
  https://cisofy.com/lynis/controls/PKGS-7392/
```

## REMEDIATION PROCESS

### 1. Searched all vulnerable packages

- A total of 162 packages were found to have upgrades available, including critical system libraries, networking tools, and application utilities. Notable packages included [linux-image-generic](#), [cups](#), [python3.12](#), and [systemd](#).

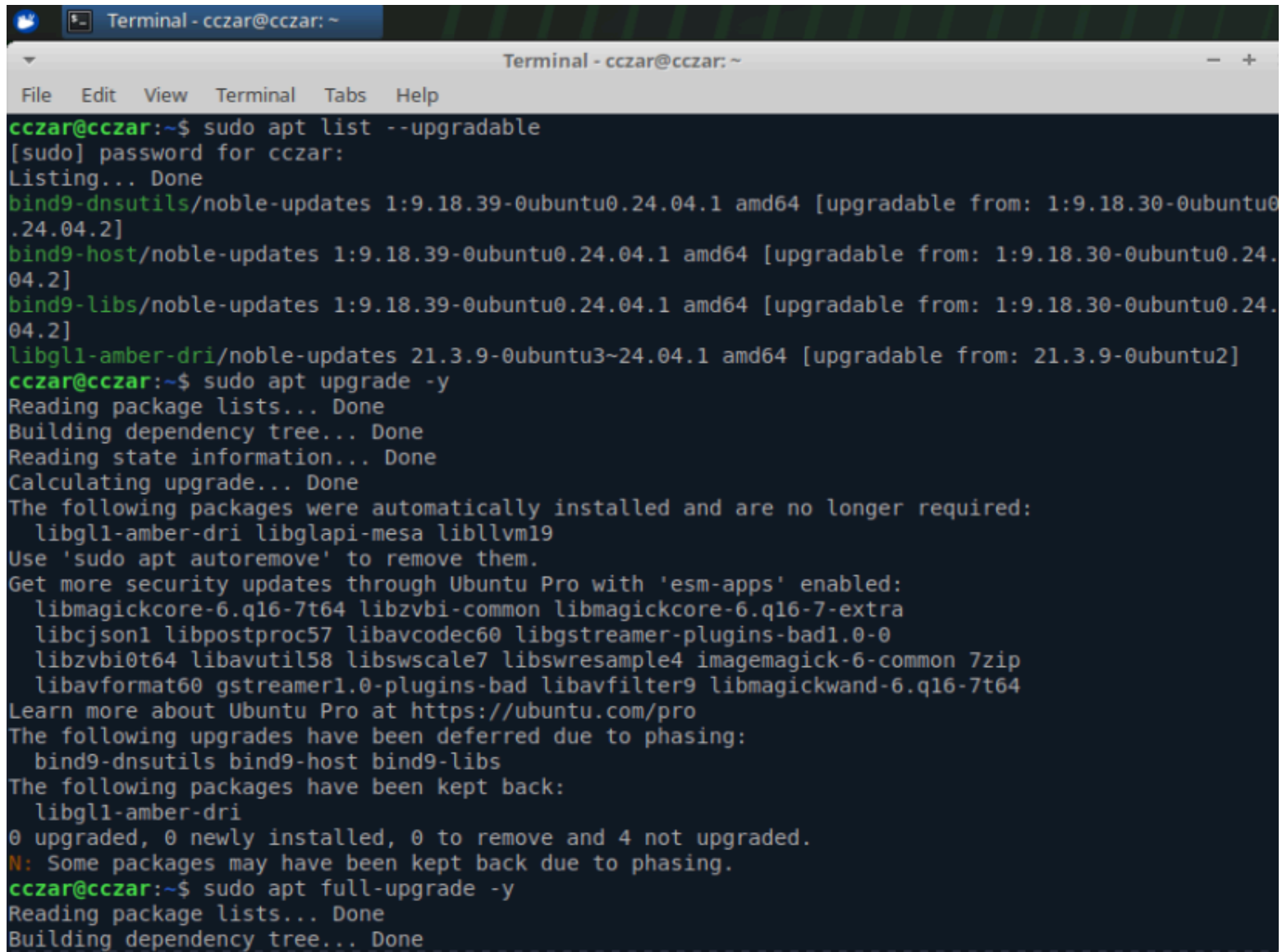


```
Terminal - cczar@cczar: ~
File Edit View Terminal Tabs Help
cczar@cczar:~$ sudo apt list --upgradable
[sudo] password for cczar:
Listing... Done
apparmor/noble-updates 4.0.1really4.0.1-0ubuntu0.24.04.4 amd64 [upgradab
u0.24.04.3]
apt-utils/noble-updates 2.8.3 amd64 [upgradable from: 2.7.14build2]
apt/noble-updates 2.8.3 amd64 [upgradable from: 2.7.14build2]
base-files/noble-updates 13ubuntu10.3 amd64 [upgradable from: 13ubuntu10
bind9-dnsutils/noble-updates 1:9.18.39-0ubuntu0.24.04.1 amd64 [upgradabl
.2]
bind9-host/noble-updates 1:9.18.39-0ubuntu0.24.04.1 amd64 [upgradable fr
bind9-libs/noble-updates 1:9.18.39-0ubuntu0.24.04.1 amd64 [upgradable fr
bluez-cups/noble-updates 5.72-0ubuntu5.4 amd64 [upgradable from: 5.72-0u
bluez-obexd/noble-updates 5.72-0ubuntu5.4 amd64 [upgradable from: 5.72-0
bluez/noble-updates 5.72-0ubuntu5.4 amd64 [upgradable from: 5.72-0ubuntu
cloud-init/noble-updates,noble-security 25.1.4-0ubuntu0~24.04.1 all [upg
```

## 2. Upgraded all installed packages to the latest security versions

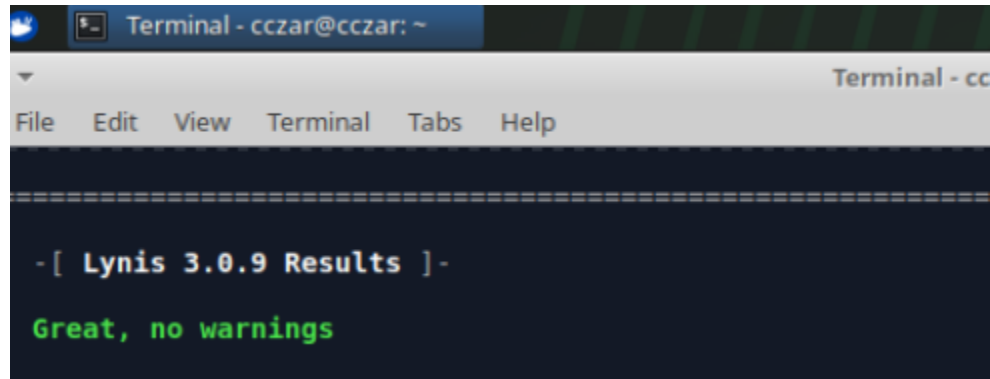
```
Terminal - cczar@cczar: ~
File Edit View Terminal Tabs Help
Get:16 http://us.archive.ubuntu.com/ubuntu noble-backports/restricted amd64 Components [216 B]
Get:17 http://us.archive.ubuntu.com/ubuntu noble-backports/universe amd64 Components [19.2 kB]
Get:18 http://us.archive.ubuntu.com/ubuntu noble-backports/multiverse amd64 Components [212 B]
Fetched 3,904 kB in 2s (1,874 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
162 packages can be upgraded. Run 'apt list --upgradable' to see them.
cczar@cczar:~$ sudo apt update
Hit:1 http://security.ubuntu.com/ubuntu noble-security InRelease
Hit:2 http://us.archive.ubuntu.com/ubuntu noble InRelease
Hit:3 http://us.archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:4 http://us.archive.ubuntu.com/ubuntu noble-backports InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
162 packages can be upgraded. Run 'apt list --upgradable' to see them.
cczar@cczar:~$ sudo apt upgrade -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
```

### 3. Verified that all packages were upgraded

A terminal window titled "Terminal - cczar@cczar: ~" with a menu bar (File, Edit, View, Terminal, Tabs, Help). The terminal shows the execution of 'sudo apt list --upgradable' and 'sudo apt upgrade -y'. It lists upgradable packages like bind9-dnsutils, bind9-host, bind9-libs, and libgll-amber-dri. After the upgrade, it lists packages to be removed (libgll-amber-dri, libglapi-mesa, libllvm19) and security updates available (libmagickcore-6.q16-7t64, libzvti-common, etc.). It also shows deferred upgrades (bind9-dnsutils, bind9-host, bind9-libs) and packages kept back (libgll-amber-dri). The final status is "0 upgraded, 0 newly installed, 0 to remove and 4 not upgraded." and the command 'sudo apt full-upgrade -y' is partially shown.

```
cczar@cczar:~$ sudo apt list --upgradable
[sudo] password for cczar:
Listing... Done
bind9-dnsutils/noble-updates 1:9.18.39-0ubuntu0.24.04.1 amd64 [upgradable from: 1:9.18.30-0ubuntu0.24.04.2]
bind9-host/noble-updates 1:9.18.39-0ubuntu0.24.04.1 amd64 [upgradable from: 1:9.18.30-0ubuntu0.24.04.2]
bind9-libs/noble-updates 1:9.18.39-0ubuntu0.24.04.1 amd64 [upgradable from: 1:9.18.30-0ubuntu0.24.04.2]
libgll-amber-dri/noble-updates 21.3.9-0ubuntu3~24.04.1 amd64 [upgradable from: 21.3.9-0ubuntu2]
cczar@cczar:~$ sudo apt upgrade -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
The following packages were automatically installed and are no longer required:
  libgll-amber-dri libglapi-mesa libllvm19
Use 'sudo apt autoremove' to remove them.
Get more security updates through Ubuntu Pro with 'esm-apps' enabled:
  libmagickcore-6.q16-7t64 libzvti-common libmagickcore-6.q16-7-extra
  libcjson1 libpostproc57 libavcodec60 libgstreamer-plugins-bad1.0-0
  libzvti0t64 libavutil58 libswscale7 libswresample4 imagemagick-6-common 7zip
  libavformat60 gstreamer1.0-plugins-bad libavfilter9 libmagickwand-6.q16-7t64
Learn more about Ubuntu Pro at https://ubuntu.com/pro
The following upgrades have been deferred due to phasing:
  bind9-dnsutils bind9-host bind9-libs
The following packages have been kept back:
  libgll-amber-dri
0 upgraded, 0 newly installed, 0 to remove and 4 not upgraded.
N: Some packages may have been kept back due to phasing.
cczar@cczar:~$ sudo apt full-upgrade -y
Reading package lists... Done
Building dependency tree... Done
```

## LYNIS SCAN RESULT AFTER REMEDIATION



A terminal window titled "Terminal - cczar@cczar: ~" with a menu bar containing "File", "Edit", "View", "Terminal", "Tabs", and "Help". The terminal output shows a separator line of equals signs, followed by the text "-[ Lynis 3.0.9 Results ]-", and then "Great, no warnings" in green text.

```
=====
-[ Lynis 3.0.9 Results ]-
Great, no warnings
```



## Finding: GRUB Bootloader Unprotected (BOOT-1003)

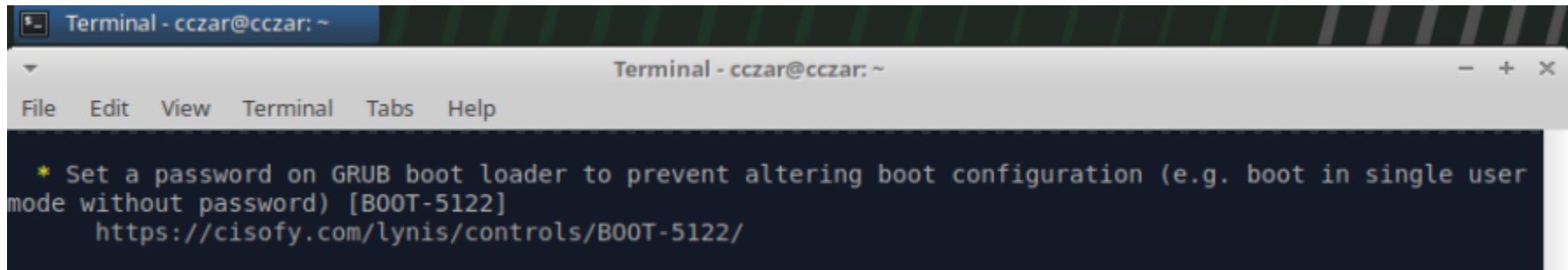
**NIST Control Mapping:** PR.PS-01: Configuration management practices are established and applied

**Risk:** Without a GRUB boot password, an attacker with physical access could modify boot parameters to bypass authentication controls, disable security mechanisms, or gain root access.

**Severity:** High

**Remediation:** Configure a GRUB boot password to ensure that only authorized administrators can modify boot parameters.

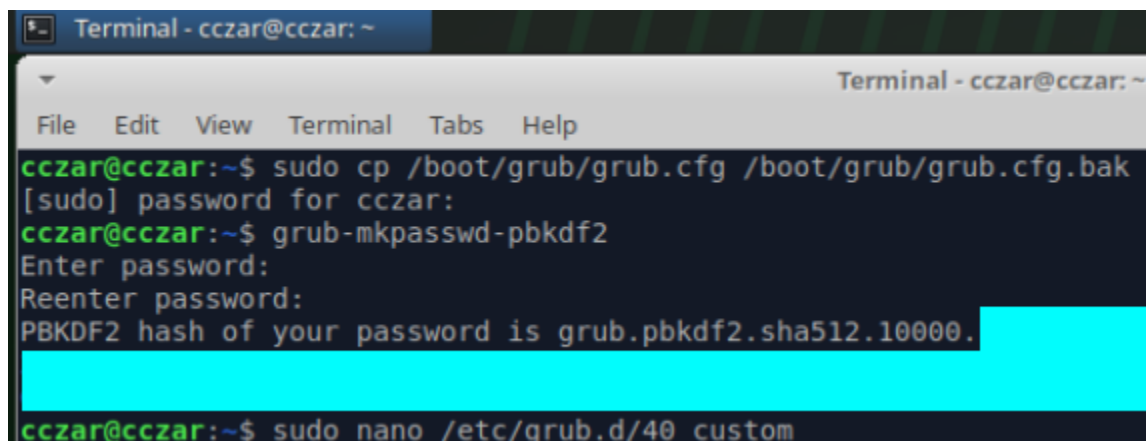
### INITIAL LYNIS SCAN RESULT



```
Terminal - cczar@cczar: ~  
File Edit View Terminal Tabs Help  
* Set a password on GRUB boot loader to prevent altering boot configuration (e.g. boot in single user  
mode without password) [BOOT-5122]  
https://cisofy.com/lynis/controls/BOOT-5122/
```

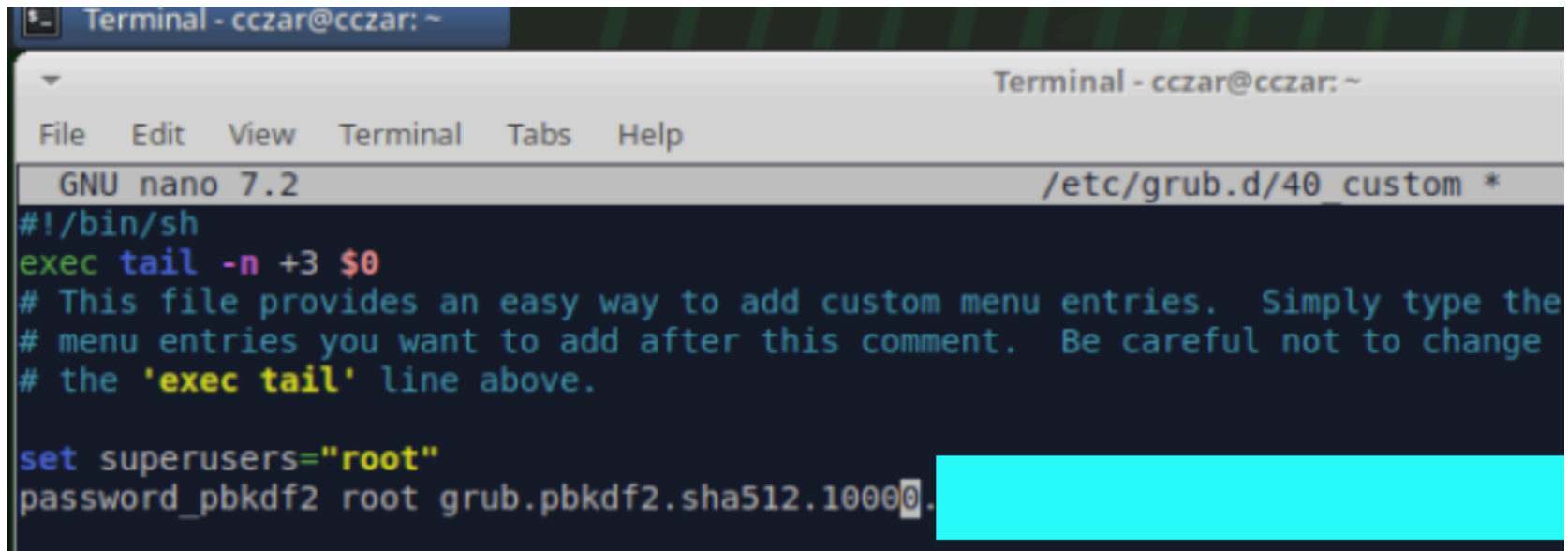
### REMEDIATION PROCESS

1. Generated a GRUB Password Hash (hash is hidden for security purposes)



```
Terminal - cczar@cczar: ~  
File Edit View Terminal Tabs Help  
cczar@cczar:~$ sudo cp /boot/grub/grub.cfg /boot/grub/grub.cfg.bak  
[sudo] password for cczar:  
cczar@cczar:~$ grub-mkpasswd-pbkdf2  
Enter password:  
Reenter password:  
PBKDF2 hash of your password is grub.pbkdf2.sha512.10000.  
cczar@cczar:~$ sudo nano /etc/grub.d/40_custom
```

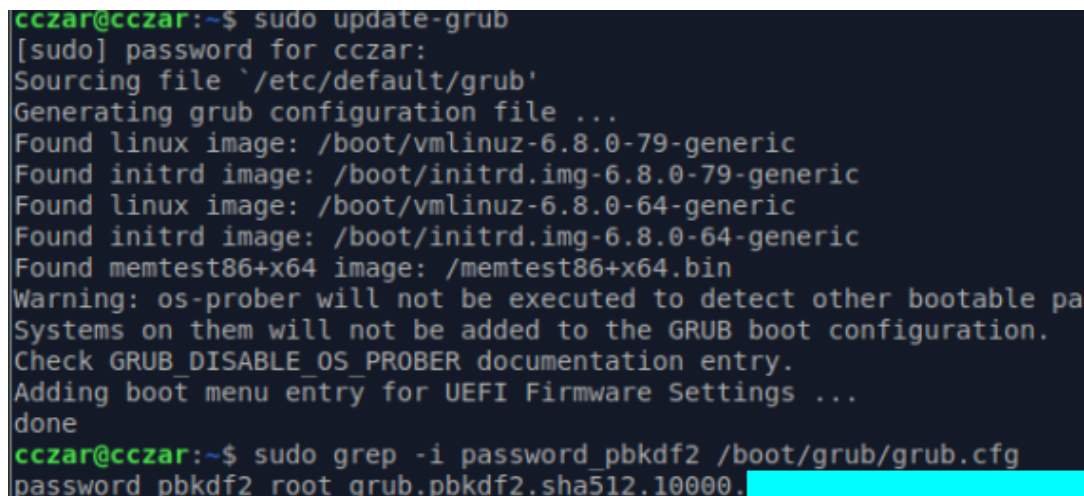
## 2. Configured GRUB



```
Terminal - cczar@cczar: ~
GNU nano 7.2 /etc/grub.d/40_custom *
#!/bin/sh
exec tail -n +3 $0
# This file provides an easy way to add custom menu entries.  Simply type the
# menu entries you want to add after this comment.  Be careful not to change
# the 'exec tail' line above.

set superusers="root"
password_pbkdf2 root grub.pbkdf2.sha512.10000. [REDACTED]
```

3. Rebuilt the GRUB configuration to incorporate the changes from [40\\_custom](#), ran the update command, and verified password line was applied



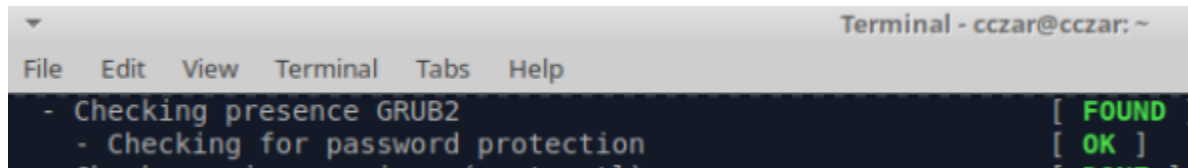
```
cczar@cczar:~$ sudo update-grub
[sudo] password for cczar:
Sourcing file `/etc/default/grub'
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-6.8.0-79-generic
Found initrd image: /boot/initrd.img-6.8.0-79-generic
Found linux image: /boot/vmlinuz-6.8.0-64-generic
Found initrd image: /boot/initrd.img-6.8.0-64-generic
Found memtest86+x64 image: /memtest86+x64.bin
Warning: os-prober will not be executed to detect other bootable pa
Systems on them will not be added to the GRUB boot configuration.
Check GRUB_DISABLE_OS_PROBER documentation entry.
Adding boot menu entry for UEFI Firmware Settings ...
done
cczar@cczar:~$ sudo grep -i password_pbkdf2 /boot/grub/grub.cfg
password_pbkdf2 root grub.pbkdf2.sha512.10000. [REDACTED]
```

#### 4. Tested GRUB configuration

- After reboot, at the GRUB menu, pressing “e” to edit boot entry prompted for the password configured in [/etc/grub.d/40\\_custom](#). Entering the correct password allowed the system to boot normally, confirming that GRUB hardening is in effect.

**Note:** To further secure the system against unauthorized physical access, it is recommended to restrict root login on virtual and physical consoles (TTYs).

#### LYNIS SCAN RESULT AFTER REMEDIATION



```
Terminal - cczar@cczar: ~  
File Edit View Terminal Tabs Help  
- Checking presence GRUB2 [ FOUND ]  
- Checking for password protection [ OK ]  
- Checking for GRUB2 password protection [ FOUND ]
```

## Finding: Insecure Permissions on /etc/sudoers.d (PERM-1005)

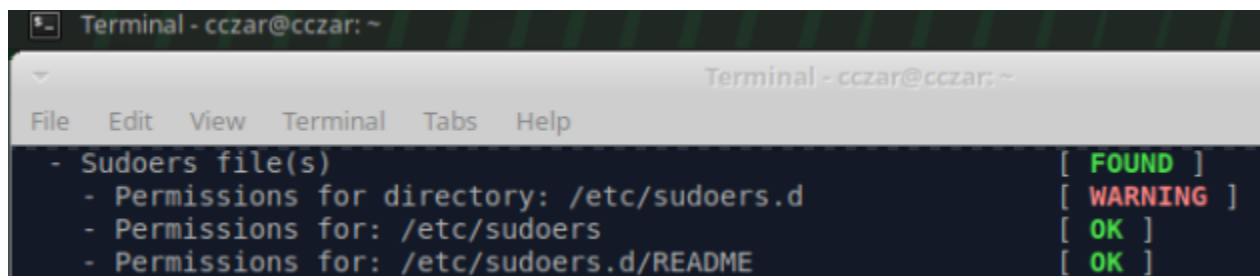
**NIST Control Mapping:** PR.AA-05 – Access permissions, entitlements, and authorizations are defined in a policy, managed, enforced, and reviewed, and incorporate the principles of least privilege and separation of duties

**Risk:** The [/etc/sudoers.d](#) directory has insecure permissions, which could allow unauthorized users to modify sudo configuration files, potentially leading to privilege escalation.

**Severity:** High

**Remediation:** Review and correct the permissions on the [/etc/sudoers.d](#) directory to ensure only authorized users can modify them.

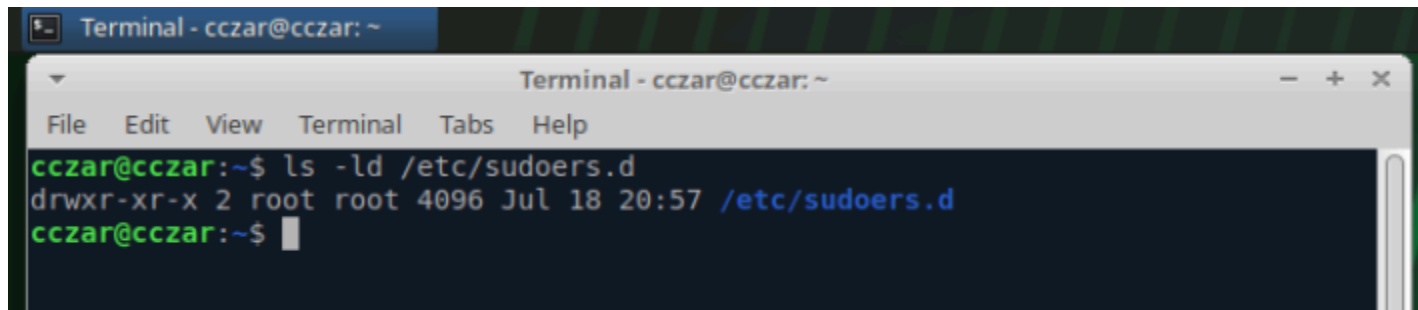
## INITIAL LYNIS SCAN RESULT

A terminal window titled "Terminal - cczar@cczar: ~" showing the output of a Lynis scan. The output lists the sudoers file(s) as [ FOUND ], permissions for the directory /etc/sudoers.d as [ WARNING ], and permissions for /etc/sudoers and /etc/sudoers.d/README as [ OK ].

```
Terminal - cczar@cczar: ~  
File Edit View Terminal Tabs Help  
- Sudoers file(s) [ FOUND ]  
- Permissions for directory: /etc/sudoers.d [ WARNING ]  
- Permissions for: /etc/sudoers [ OK ]  
- Permissions for: /etc/sudoers.d/README [ OK ]
```

## REMEDIATION PROCESS

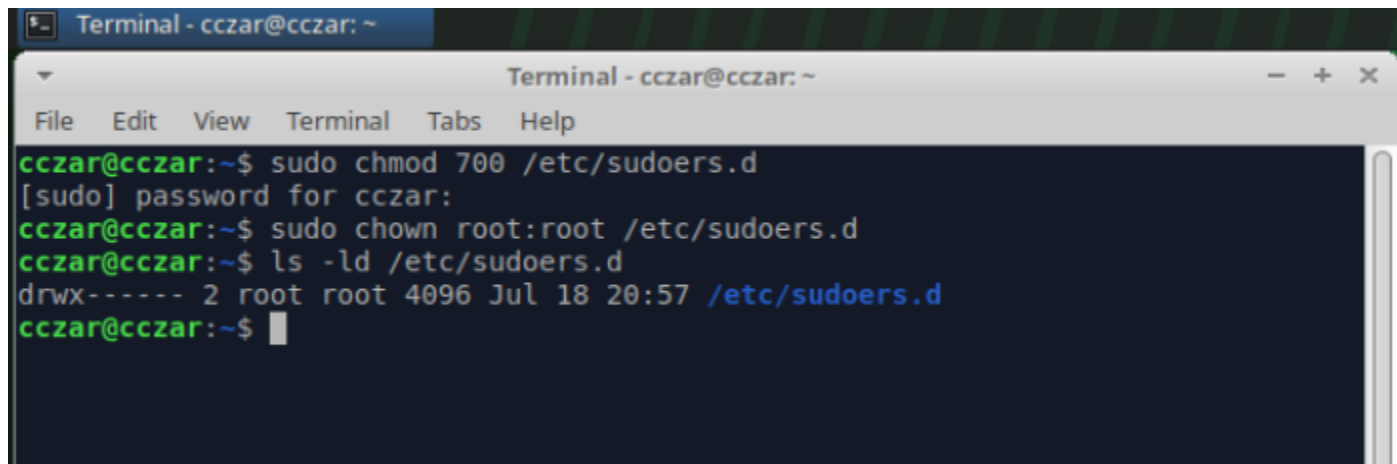
1. Reviewed current permissions, verifying that group and others have read/execute access to [/etc/sudoers.d](#) directory

A terminal window titled "Terminal - cczar@cczar: ~" showing the command "ls -ld /etc/sudoers.d" being executed. The output shows the permissions as "drwxr-xr-x 2 root root 4096 Jul 18 20:57 /etc/sudoers.d".

```
Terminal - cczar@cczar: ~  
File Edit View Terminal Tabs Help  
cczar@cczar:~$ ls -ld /etc/sudoers.d  
drwxr-xr-x 2 root root 4096 Jul 18 20:57 /etc/sudoers.d  
cczar@cczar:~$
```

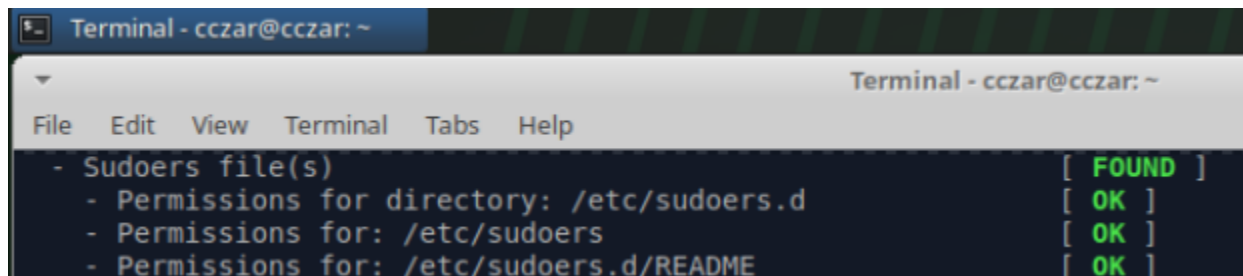
## 2. Restricted permissions to root-only, with group and others having no access, and verified permission change.

**Note:** Restricted the `/etc/sudoers.d` directory permissions so that only root can read, write, or execute. After updating permissions, `/etc/sudoers.d` is owned by root with access limited to root-only. Listing the directory confirms permissions set to `700`, ensuring that unauthorized users cannot modify sudo configuration files and mitigating the risk of privilege escalation.



```
Terminal - cczar@cczar: ~
File Edit View Terminal Tabs Help
cczar@cczar:~$ sudo chmod 700 /etc/sudoers.d
[sudo] password for cczar:
cczar@cczar:~$ sudo chown root:root /etc/sudoers.d
cczar@cczar:~$ ls -ld /etc/sudoers.d
drwx----- 2 root root 4096 Jul 18 20:57 /etc/sudoers.d
cczar@cczar:~$
```

### LYNIS SCAN RESULT AFTER REMEDIATION



```
Terminal - cczar@cczar: ~
File Edit View Terminal Tabs Help
- Sudoers file(s) [ FOUND ]
- Permissions for directory: /etc/sudoers.d [ OK ]
- Permissions for: /etc/sudoers [ OK ]
- Permissions for: /etc/sudoers.d/README [ OK ]
```

## Finding: USB Storage Driver Enabled (USB-1001)

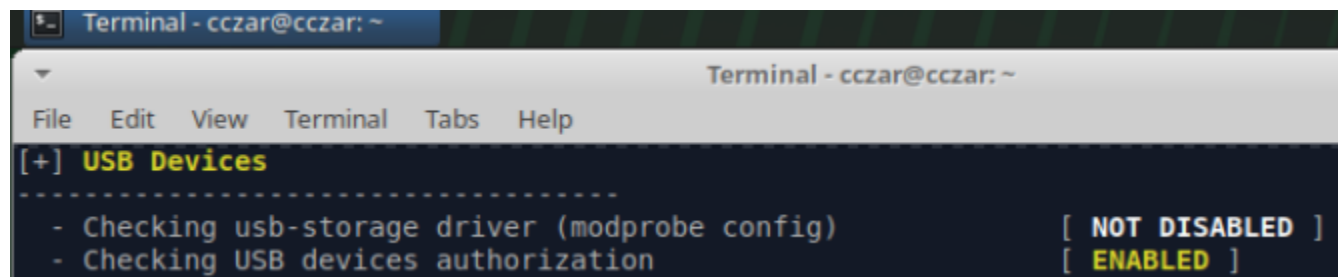
**NIST Control Mapping:** PR.DS-01 – The confidentiality, integrity, and availability of data-at-rest are protected

**Risk:** The USB storage driver is enabled, allowing unauthorized users to transfer sensitive data via USB devices.

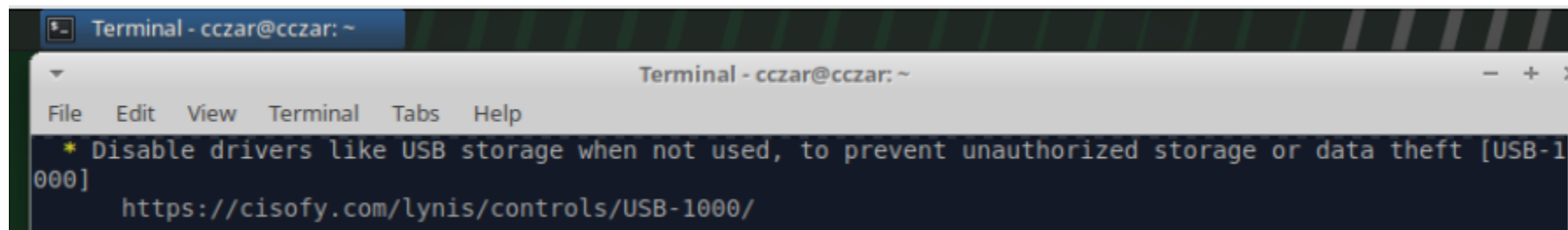
**Severity:** High

**Remediation:** Disable the USB storage driver to prevent data exfiltration via USB.

### INITIAL LYNIS SCAN RESULT



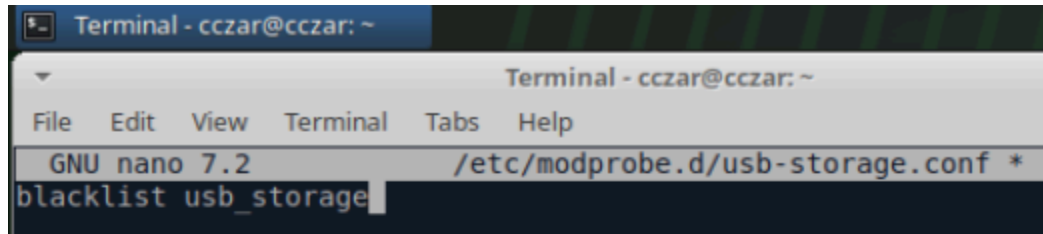
```
Terminal - cczar@cczar: ~  
Terminal - cczar@cczar: ~  
File Edit View Terminal Tabs Help  
[+] USB Devices  
-----  
- Checking usb-storage driver (modprobe config) [ NOT DISABLED ]  
- Checking USB devices authorization [ ENABLED ]
```



```
Terminal - cczar@cczar: ~  
Terminal - cczar@cczar: ~  
File Edit View Terminal Tabs Help  
* Disable drivers like USB storage when not used, to prevent unauthorized storage or data theft [USB-1000]  
https://cisofy.com/lynis/controls/USB-1000/
```

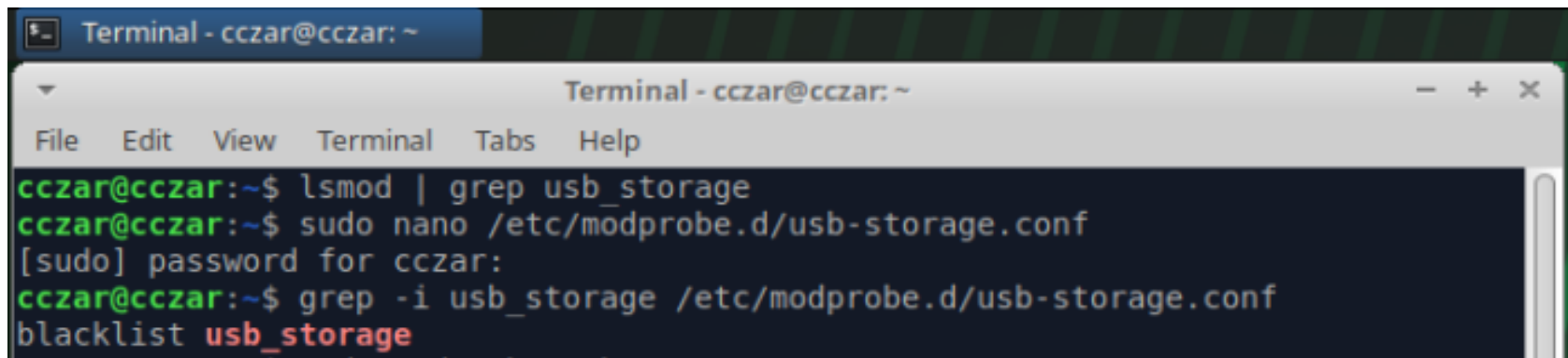
## REMEDIATION PROCESS

1. Verified USB storage driver was unloaded and created blacklist file for modprobe to prevent USB storage driver from loading



```
Terminal - cczar@cczar: ~
GNU nano 7.2 /etc/modprobe.d/usb-storage.conf *
blacklist usb_storage
```

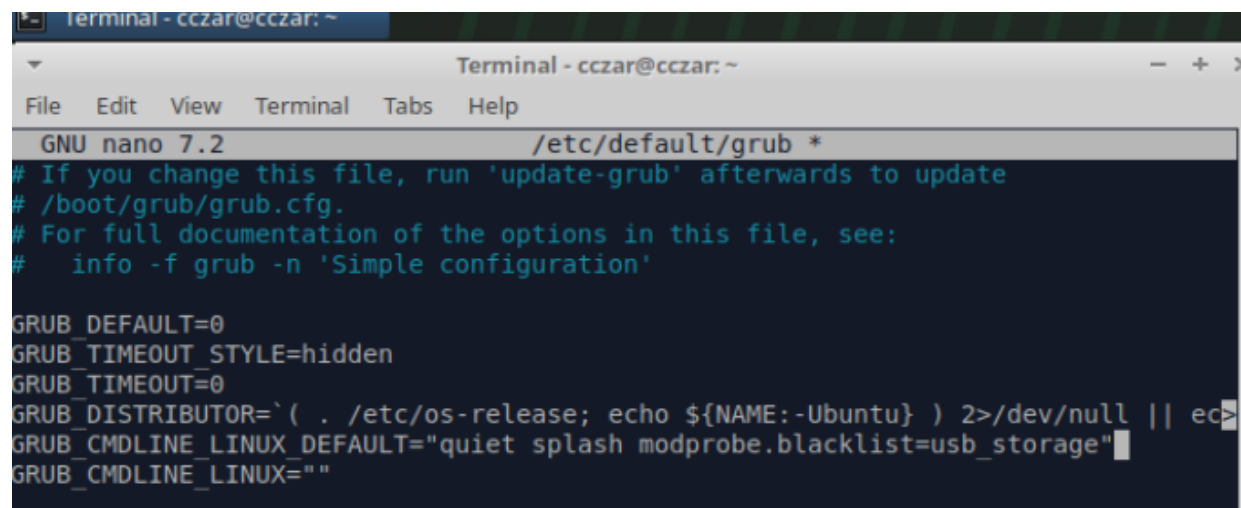
2. Confirmed blacklist status of USB storage driver



```
Terminal - cczar@cczar: ~
cczar@cczar:~$ lsmod | grep usb_storage
cczar@cczar:~$ sudo nano /etc/modprobe.d/usb-storage.conf
[sudo] password for cczar:
cczar@cczar:~$ grep -i usb_storage /etc/modprobe.d/usb-storage.conf
blacklist usb_storage
```

### 3. Disabled the USB module via kernel parameters

```
cczar@cczar:~$ grep -i usb_storage /etc/modprobe.d/usb-storage.conf
blacklist usb_storage
cczar@cczar:~$ sudo modprobe usb_storage
cczar@cczar:~$ lsmod | grep usb_storage
usb_storage      86016  0
cczar@cczar:~$ sudo nano /etc/default/grub
cczar@cczar:~$ lsmod | grep usb_storage
usb_storage      86016  0
cczar@cczar:~$ sudo update-grub
Sourcing file `/etc/default/grub'
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-6.8.0-79-generic
Found initrd image: /boot/initrd.img-6.8.0-79-generic
Found linux image: /boot/vmlinuz-6.8.0-64-generic
Found initrd image: /boot/initrd.img-6.8.0-64-generic
Found memtest86+x64 image: /memtest86+x64.bin
Warning: os-prober will not be executed to detect other bootable partitions.
Systems on them will not be added to the GRUB boot configuration.
Check GRUB_DISABLE_OS_PROBER documentation entry.
Adding boot menu entry for UEFI Firmware Settings ...
done
```

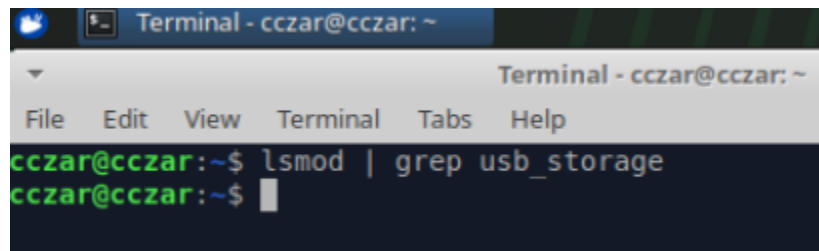


```
Terminal - cczar@cczar: ~
GNU nano 7.2 /etc/default/grub *
# If you change this file, run 'update-grub' afterwards to update
# /boot/grub/grub.cfg.
# For full documentation of the options in this file, see:
# info -f grub -n 'Simple configuration'

GRUB_DEFAULT=0
GRUB_TIMEOUT_STYLE=hidden
GRUB_TIMEOUT=0
GRUB_DISTRIBUTOR=`(. /etc/os-release; echo ${NAME:-Ubuntu}) 2>/dev/null || ec>
GRUB_CMDLINE_LINUX_DEFAULT="quiet splash modprobe.blacklist=usb_storage"
GRUB_CMDLINE_LINUX=""
```

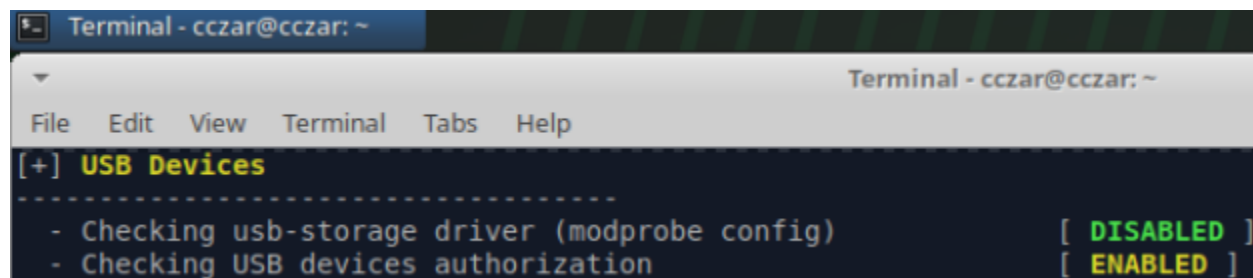


4. After applying the USB storage module blacklist and updating the kernel parameters, a reboot shows `lsmod | grep usb_storage` does not return the module, confirming the module is no longer loaded at boot and the hardening is effective.



```
Terminal - cczar@cczar: ~  
File Edit View Terminal Tabs Help  
cczar@cczar:~$ lsmod | grep usb_storage  
cczar@cczar:~$
```

#### LYNIS SCAN RESULT AFTER REMEDIATION



```
Terminal - cczar@cczar: ~  
File Edit View Terminal Tabs Help  
[+] USB Devices  
-----  
- Checking usb-storage driver (modprobe config) [ DISABLED ]  
- Checking USB devices authorization [ ENABLED ]
```

# Conclusion

The assessment evaluated the overall security posture of the environment, identifying risks across authentication, package management, bootloader security, access controls, and peripheral device use. Several high-risk findings—including authentication hardening, package updates, GRUB boot protection, restricted console access, and USB storage controls—have been remediated and verified.

## Key Improvements

- Improved alignment with NIST CSF 2.0 and CIS benchmarks.
- Reduced the attack surface and enhanced system resilience.
- Established a foundation for ongoing security governance and monitoring.

## Action Items

1. Enforce secure password standards for all accounts; regularly review and update the module to align with current best practices.
2. Remove unnecessary or unsupported software and implement a regular patch management process to mitigate exposure to known vulnerabilities.
3. Configure GRUB so only authorized users can modify boot options or enter single-user mode; verify password configuration and restrict console access.
4. Enforce least privilege for `/etc/sudoers.d` and regularly audit sudo configuration to detect unauthorized changes.
5. Restrict USB device use through endpoint controls and monitoring; regularly review USB access policies to protect sensitive data.

## Remaining Risks

System issues persist that could compromise security if not addressed promptly. Immediate remediation is recommended to maintain a hardened environment.

## Future Recommendations

- Regular patching and configuration audits.
- Integration of configuration management and monitoring tools.
- Continuous adherence to industry security standards and best practices.