**Week 3 - Supplementary Materials**

[Markdown](https://github.com/lawfareblog/hacking-cybersecurity/blob/main/week03/Week_03_Homework.md) | [PDF](https://raw.githubusercontent.com/lawfareblog/hacking-cybersecurity/main/week03/Week_03_Homework.pdf) | [MS Word DOCX](https://raw.githubusercontent.com/lawfareblog/hacking-cybersecurity/main/week03/Week_03_Homework.docx) | [Libre ODT](https://raw.githubusercontent.com/lawfareblog/hacking-cybersecurity/main/week03/Week_03_Homework.odt) | [HTML](https://raw.githubusercontent.com/lawfareblog/hacking-cybersecurity/main/week03/Week_03_Homework.html)

**Permissions Calculator**

chmod is the command used on Unix-like / GNU Linux systems to modify [filesystem permissions](https://en.wikipedia.org/wiki/File-system_permissions" \l "Permissions). These permissions are stored in [octal](https://en.wikipedia.org/wiki/Octal), in three columns from 0-7 for "Owner", "Group", and "Public". 000 equals no permission, 777 equals full permission for everyone to read, write, and execute the file or directory. The combinations in between can be calculated via addition or the calculator linked below.

* [CHMOD Calculator](https://chmod-calculator.com/)

**Filesystem permissions, root user, and sudo**

* Use ls -l to see detailed permissions and ownership of files and directories. See more options for ls with ls --help
* The chmod command changes permissions:
  1. chmod 400 file.txt gives read permission to the owner of file.txt
  2. chmod 644 file.txt gives read+write permission (6) to the owner of file.txt and gives read permission (4) to the group and public.
  3. Use the -R option to apply permissions recursively to a directory (i.e. to the directory and all of its contents): chmod 777 -R ~/Desktop gives read+write+execute permissions to everyone for /home/kali/Desktop and its contents.
  4. See more options for chmod with chmod --help
  5. Remember, write permission is permission to **delete** a file or directory as well.
* Each file or directory has an "owner" and a "group". Usually, a user also has a group with the same name (e.g., kali:kali). If we had groups for our class on a filesystem, each student might be a member of students and your instructors might be in a teachers group.
* Run the command groups to list all groups associated with your user. To see groups for other users, type the username afterword such as groups root
* The chown command changes ownership by users and groups:
  1. chown kali file.txt gives ownership of file.txt to user kali
  2. chown kali:root file.txt gives ownership of file.txt to user kali and assigns the group root to the file.
  3. Use the -R option to apply ownership recursively to a directory (i.e. to the directory and all of its contents): chown -R kali:kali ~/Desktop gives ownership of the /home/kali/Desktop directory and its contents to user kali and assigns the group kali to the directory and its contents.
  4. See more options for chown with chown --help
* Hidden files in the filesystem start with the . character such as .hidden-file To view all files including hidden files, use ls -la
* Activating the administrative superuser root is dangerous, but it may be necessary for certain tasks (and **definitely** something an attacker would like to do). To activate the root user, type sudo passwd -l root
* Then, you can set a password for the administrative superuser root user using sudo passwd root.
* These commands assume you have sudo permissions, which is the default in Kali Linux for your user kali. sudo allows you to temporarily act as the administrative superuser root and times out (depending on system settings). This protection means that you're only **escalating privileges** for a short time for a specific task or tasks, limiting the potential time-window for an attack against your system that does serious damage. It's also protection by the operating system **from you** - if you were instead running with root privileges all the time, it's more likely your (inevitable) mistakes would destroy the system.
* If you do want to switch into the root account, you can use su. This switch user command can also be used to switch into other user accounts such as su sean or su scott. To leave the session for that user, type exit which will bring you back to being the default user kali.

**Cracking Passwords with Dictionary Attacks**

These are commands we used in the livestream session for Week 3 using the "John the Ripper" program.

User account information is stored in two special text files:

* /etc/passwd
* /etc/shadow

To view these files try:

* cat passwd or cat passwd | less
* cat shadow or cat shadow | less

The passwd file contains information and settings for each user account. That includes many "users" that only exist to run system services or "daemons" e.g. printers, boot and init processes, audio services, and so on. This segmentation of the permissions for these services as a "pseudo-user" or system account named specifically for its purpose makes administering the system more comprehensible while also providing some basic security protections. For our purposes, the kali and root user are all that matter in this passwd file.

Likewise, the shadow file stores user settings **and hashes of passwords** for those users. Again, we only care about the kali and root entries in this file.

John the Ripper or the command john combines brute force attacks against a password hash with password dictionaries. It is a time versus memory tradeoff because many of these dictionaries or "wordlists" can get large. However, brute forcing can be near-impossible in many circumstances unless a password is extremely weak and/or short.

* To combine the /etc/passwd and /etc/shadow files for john to process, run:

sudo unshadow /etc/passwd /etc/shadow > unshadow.txt

This will create an unshadow.txt file in the folder you are currently in.

* Now, we try to crack the password(s) in this file using one of the wordlists in /usr/share/wordlists called john.lst

sudo john --format=crypt --wordlist=/usr/share/wordlists/john.lst unshadow.txt

**THAT'S IT!** After letting john run, you should see the cracked passwords for these users.

If you set your password for the kali or root user to something weak and/or short (such as "kali" or "password") you will see the cracking takes approx. two minutes or less.

**NOTE:** If you are running a system that does not have the john.lst wordlist, please [download it here](https://raw.githubusercontent.com/lawfareblog/hacking-cybersecurity/main/week03/wordlists/john.lst), for example by using Firefox inside of Kali Linux or using wget:

wget https://raw.githubusercontent.com/lawfareblog/hacking-cybersecurity/main/week03/wordlists/john.lst

Then change the path for the --wordlist option for the john command. If john.lst is in the current directory, for example:

sudo john --format=crypt --wordlist=john.lst unshadow.txt

...or use the mv command to move the file to /usr/share/wordlists/:

sudo mv john.lst /usr/share/wordlists/

...and then run:

sudo john --format=crypt --wordlist=/usr/share/wordlists/john.lst unshadow.txt

**Further Reading**

**Common passwords and wordlists**

Beware, some of the entries in these lists are English swear words [NSFW](https://en.wikipedia.org/wiki/Not_safe_for_work)

* https://hashtoolkit.com/common-passwords/
* https://en.wikipedia.org/wiki/Wikipedia:10,000\_most\_common\_passwords
* https://github.com/danielmiessler/SecLists/blob/master/Passwords/Common-Credentials/10-million-password-list-top-10000.txt
* https://www.geeksforgeeks.org/how-to-extract-rockyou-txt-gz-file-in-kali-linux/
* https://github.com/ohmybahgosh/RockYou2021.txt

**Password Tips**

Here are some password strength, storage, and retention strategies.

* **Passphrases:** Can be a favorite song lyric, movie quote, or joke. Add numbers and special characters to increase the "keyspace": Cecil+Harambe4ever
* **Strength:** [General guidelines](https://en.wikipedia.org/wiki/Password_strength" \l "Guidelines_for_strong_passwords) | [Diceware method](https://theintercept.com/2015/03/26/passphrases-can-memorize-attackers-cant-guess/)
* [EFF diceware wordlists](https://github.com/micahflee/passphraseme)
* [**KeePass**](http://keepass.info/) (Windows/Linux) or [**KeePassX**](https://www.keepassx.org/) (Mac): Organize your passwords in an encrypted database.
* **Browser Password Manager:** [In Firefox](https://support.mozilla.org/en-US/kb/use-master-password-protect-stored-logins) | [In Chromium](http://www.ghacks.net/2013/12/04/google-chrome-gets-master-password-protection/)
* **(2FA/MFA):** One-time Pass (OTP) authenticator apps for [Android](https://search.f-droid.org/?q=authenticator&lang=en) or [iOS](https://www.igeeksblog.com/best-two-factor-authentication-apps-for-iphone/) | Physical key tokens [Nitrokey](https://www.nitrokey.com/) or [YubiKey](https://www.yubico.com/)

**NOTE:** Using a cloud-based password manager puts trust in the organization or company that runs that cloud. As with all of these recommendations, [YMMV](https://www.howtogeek.com/693183/what-does-ymmv-mean-and-how-do-you-use-it/). Our word is not gospel - ultimately, you need to decide who to trust.

**Hashes & Message Digests**

* https://www.youtube.com/watch?v=b4b8ktEV4Bg
* https://en.wikipedia.org/wiki/Cryptographic\_hash\_function
* https://en.wikipedia.org/wiki/Cryptographic\_hash\_function#/media/File:Cryptographic\_Hash\_Function.svg