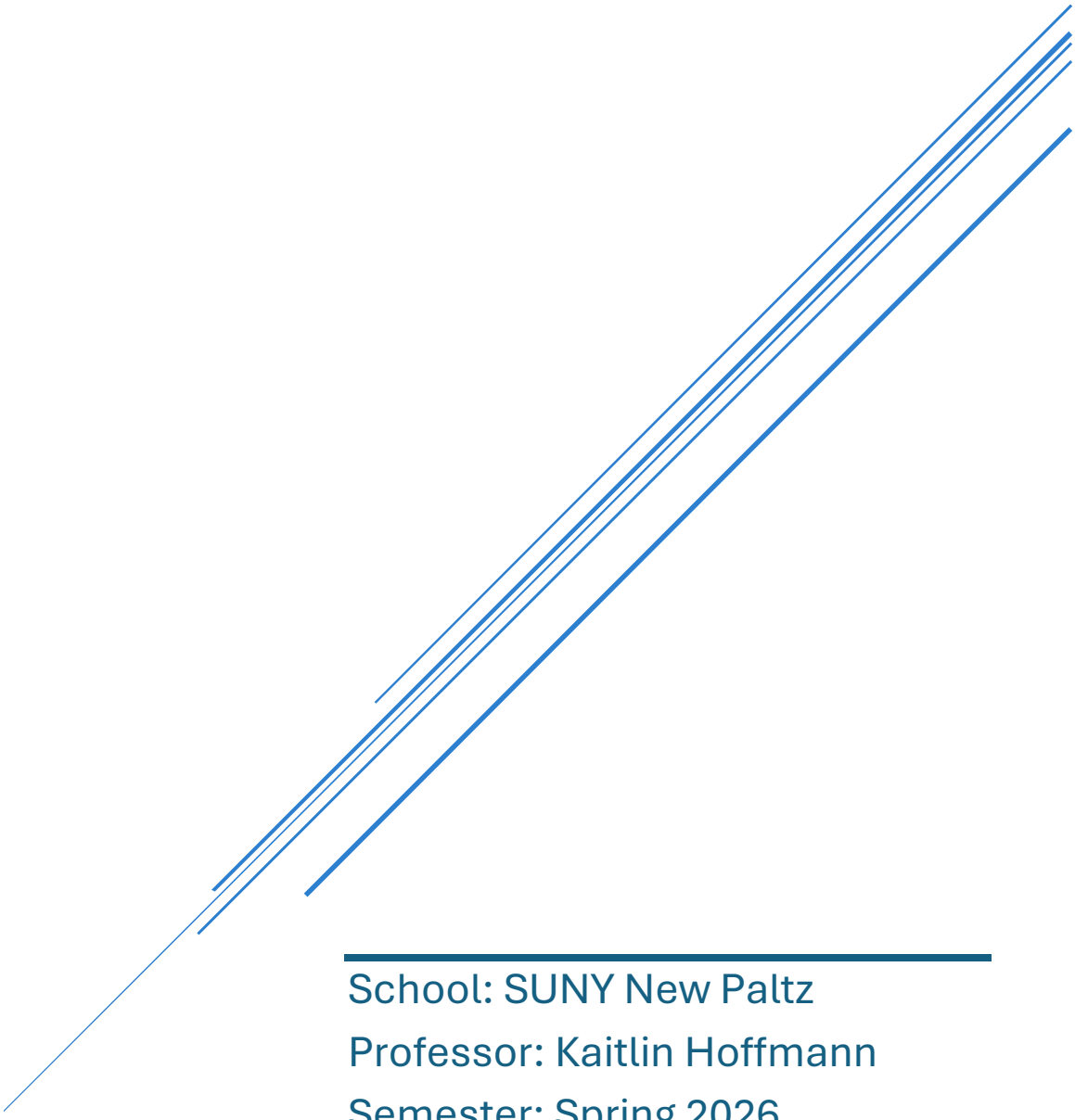
# LINUX SECURITY BASICS LAB

Student: Jennifer Elie
Course: CPS 593 Cybersecurity
Due: March 2nd 2026



School: SUNY New Paltz
Professor: Kaitlin Hoffmann
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# General System Tasks:

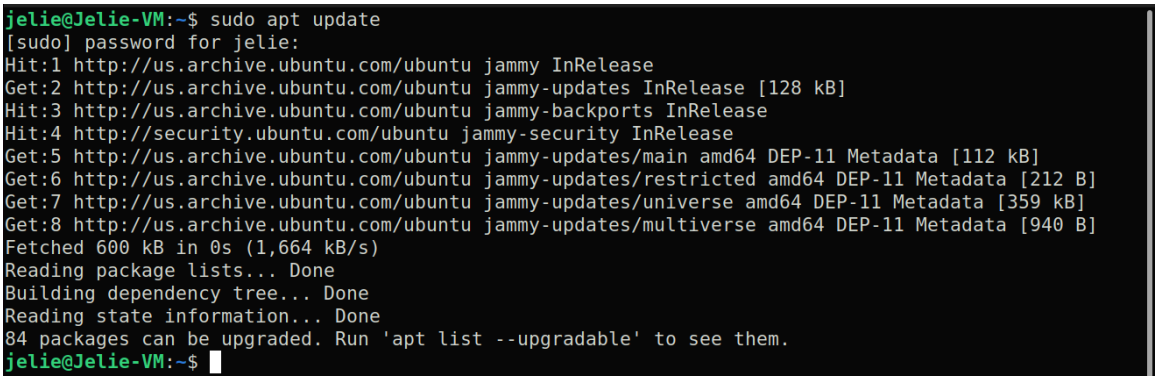
## 1. Open the terminal in your Virtual Machine (VM). Enter the command to retrieve available updates.

**Command: sudo apt update**

**Command explanation:**

- **Sudo:** Is short for superuser do. It is required for users who are not logged in as root to execute commands that require administrative privileges. It is best practice to use sudo instead of logging in as the root user for several reasons, including maintaining logs of users executing privileged commands, discouraging unauthorized access, and improving system security. It is also recommended to disable root login because root has full control over the system and is a prime target for attackers.
- **Apt:** Stands for Advanced Package Tool. It is a package manager used in some Linux distributions. It allows you to update (check for available updates), install (add new packages), upgrade (update already installed packages when used alongside the update command), and remove (uninstall specified packages).
- **Update:** As part of the apt command, instructs the system to check the repositories for any changes or updates to packages already installed on the system.

**Command line output:**




As shown above, 84 packages can be upgraded to newer versions on my system.

## 2. Upgrade your system.

**Command: sudo apt upgrade**

**Command explanation:**

- **Sudo**: Same as before. It temporarily grants administrator level permissions in order to execute a command.
- **Apt:** The Advanced Packaging Tool is used again because it is needed to upgrade the system packages.
- **Upgrade:** This keyword after the apt command checks for any packages that were logged as having changed repositories by the previously run apt update command and installs those logged upgrades.

**Command line output:**

```
jelie@Jelie-VM:~$ sudo apt upgrade
[sudo] password for jelie:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
The following packages will be upgraded:
  alsa-ucm-conf apparmor apt apt-utils cpp-11 dconf-cli dconf-gsettings-backend dconf-service
  distro-info-data dmidecode dmsetup dns-root-data fonts-noto-color-emoji gcc-11-base
  gir1.2-mutter-10 gir1.2-nm-1.0 gir1.2-packagekitglib-1.0 gjs gnome-control-center
  gnome-control-center-data gnome-control-center-faces gnome-shell gnome-shell-common
  gnome-shell-extension-ubuntu-dock gstreamer1.0-packagekit initramfs-tools initramfs-tools-bin
  initramfs-tools-core libabsl20210324 libapparmor1 libapt-pkg6.0 libcryptsetup12 libdconf1
  libdevmapper1.02.1 libegl-mesa0 libgbm1 libgjs0g libgl1-mesa-dri libglapi-mesa libglx-mesa0
  libldap-2.5-0 libldap-common libmbim-glib4 libmbim-proxy libmm-glib0 libmutter-10-0
  libnautilus-extension1a libnm0 libpackagekit-glib2-18 libpam-sss libpcap0.8 libqpdf28
  libseccomp2 libxatracker2 linux-base linux-firmware mesa-vulkan-drivers modemmanager
  mutter-common nautilus nautilus-data network-manager network-manager-config-connectivity-ubuntu
  openvpn packagekit packagekit-tools pci.ids powermgmt-base python3-paramiko
  python3-update-manager snapd systemd-hwe-hwdb ubuntu-advantage-tools ubuntu-desktop
  ubuntu-desktop-minimal ubuntu-drivers-common ubuntu-minimal ubuntu-pro-client
  ubuntu-pro-client-l10n ubuntu-standard update-manager update-manager-core wpasupplicant
  xdg-desktop-portal
84 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
```

A prompt will appear asking whether to proceed with the upgrade. Enter “y” to continue or “n” to stop the upgrade.

## 3. Reboot your system.

**Command: sudo reboot**

**Command explanation:**

- **Sudo:** Temporarily allows administrator-level permissions for command execution. It is required for rebooting the system because not every user should have the ability to restart or temporarily take down the system.

- **Reboot**: This is the command used to restart the system.

**Command line output:**

```
jelie@Jelie-VM:~$ sudo reboot
[sudo] password for jelie:
```

# User Tasks:

## 4. Change the current user to root using the command sudo su root. What does the prompt look like?

**Command: sudo su root**

**Command explanation:**

- **Sudo:** Temporarily allows administrator level permission for command execution.
- **Su**: Stands for substitute user. This command allows switching to and running commands as another user. If no user is specified, the default user is root.
- **Root:** The user to switch to after executing the substitute user command. Root is the default user for this command, but explicitly specifying it is not an issue.

**Command line output:**

```
jelie@Jelie-VM:~$ sudo su root
[sudo] password for jelie:
root@Jelie-VM:/home/jelie#
```

As can be seen in the image, the username changes from jelie to root, and the shell changes from bash to shell. This indicates that the system is now signed in as the root user.

## 5. While logged in as root, create a new user with the name bobby using the command useradd. Next, create another user with the name sally using the command adduser. What is the difference between the two?

**Command:** **useradd bobby**

**Command:** **adduser sally**

**Command explanation:**

- **Useradd:** This command is the basic built-in Linux command used to add a new user. It only adds the user to the system and does not automatically create a home directory or prompt for a password during creation.
- **Bobby:** This argument specifies the name of the new user being created with the useradd command.
- **Adduser:** This is not a basic command but a Perl script that uses useradd internally. It performs additional steps automatically, such as creating a home directory, setting up a password, and prompting for additional user information (full name, room number, work phone, home phone, and other).
- **Sally:** This argument specifies the name of the new user being created with the adduser command.

**Command line output:**

```
root@Jelie-VM:/home/jelie# useradd bobby
root@Jelie-VM:/home/jelie# adduser sally
Adding user `sally' ...
Adding new group `sally' (1002) ...
Adding new user `sally' (1002) with group `sally' ...
Creating home directory `/home/sally' ...
Copying files from `/etc/skel' ...
New password:
BAD PASSWORD: The password is shorter than 8 characters
Retype new password:
passwd: password updated successfully
Changing the user information for sally
Enter the new value, or press ENTER for the default
        Full Name []:
        Room Number []:
        Work Phone []:
        Home Phone []:
        Other []:
Is the information correct? [Y/n] y
root@Jelie-VM:/home/jelie#
```

As can be seen in the next image, sally has a home directory while bobby does not.

```
root@Jelie-VM:/home# ls
jelie  sally
root@Jelie-VM:/home#
```

It is also confirmed in the passwd file that both users, bobby and sally, exist in the system.

```
jelie:x:1000:1000:Jennifer Elie,,,:/home/jelie:/bin/bash
bobby:x:1001:1001::/home/bobby:/bin/sh
sally:x:1002:1002:,,,:/home/sally:/bin/bash
root@Jelie-VM:/etc#
```

## 6. Change the current user to sally. What does the prompt look like now?

**Command: su sally**

**Command explanation:**

- **Su**: Stands for substitute user. This command allows commands to be run as a specified user.
- **Sally**: The argument passed to the substitute user command. It specifies the user account to switch to. In this case, the session is being switched to the user sally.

**Command line output:**

```
root@Jelie-VM:/# su sally
sally@Jelie-VM:/$
```

As shown in the image, the username in the command prompt changes from root to sally, indicating that the system is no longer operating under the root account. The shell also changes from shell back to bash. This confirms that the active session is now running under the sally user account rather than the root user.

## 7. While still logged in as sally, try to create a new user with the name earl. What happens? Why? What could you do to allow her to create a new user?

**Command: sudo adduser earl**

**Command explanation:**

- **Sudo:** Temporarily allows administrator level permission for command execution.
- **Adduser:** A Perl script that utilizes the useradd command internally and automatically performs additional steps such as creating a home directory and prompting for additional user details during account creation.

- **Earl:** This argument specifies the name of the new user being created with the adduser command.

**Command line output:**

```
sally@Jelie-VM:/$ sudo addduser earl
[sudo] password for sally:
sally is not in the sudoers file.  This incident will be reported.
sally@Jelie-VM:/$
```

As shown in the command line output, the command fails because sally is not a member of the sudo group and therefore does not have permission to execute commands with elevated privileges.

```
sally@Jelie-VM:/$ groups
sally
sally@Jelie-VM:/$ id
uid=1002(sally) gid=1002(sally) groups=1002(sally)
sally@Jelie-VM:/$
```

To allow sally to execute the adduser command, she would need to be added to the sudo group. Alternatively, a group with limited sudo privileges could be created and sally could be added to that group.

## 8. Enter exit until you are logged into your own account again. Delete the user bobby.

**Command:** **exit**

**Command:** **exit**

**Command:** **sudo userdel bobby**

**Command explanation:**

- **Exit:** This command is used to exit the current shell session. Running it multiple times returns to the previous user session until logged back into the original account.
- **Sudo:** Temporarily allows administrator level permission for command execution.
- **Userdel:** This command deletes a user account from the system. It does not automatically remove files associated with the user. Additional arguments such as -f can be used to force deletion and -r can be used to remove the user's home directory. However, since bobby was created using the useradd command and does not have a home directory, there are no associated home directory files to remove.

- **Bobby:** This argument specifies the name of the user account to delete using the userdel command.

**Command line output:**

```
sally@Jelie-VM:/$ exit
exit
root@Jelie-VM:/home/jelie# exit
exit
jelie@Jelie-VM:~$ sudo userdel bobby
jelie@Jelie-VM:~$
```

```
jelie:x:1000:1000:Jennifer Elie,,,:/home/jelie:/bin/bash
sally:x:1002:1002:,,,:/home/sally:/bin/bash
jelie@Jelie-VM:/etc$
```

When checking the passwd file, it can be seen that bobby has been deleted from the system.

## 9. Change the password of sally to something you can remember using sudo passwd sally

**Command: sudo passwd sally**

**Command explanation:**

- **Sudo:** Temporarily allows administrator level permission for command execution.
- **Passwd:** Short for password. This command is used to manage user account passwords.
- **Sally:** This argument specifies the user account for which the password is being changed.

**Command line output:**

```
jelie@Jelie-VM:/etc$ sudo passwd sally
New password:
BAD PASSWORD: The password is shorter than 8 characters
Retype new password:
passwd: password updated successfully
jelie@Jelie-VM:/etc$
```

## 10. Even though it's easier to complete tasks/commands, why is it bad practice to stay logged in as root?

Some of the reasons were mentioned earlier in the explanation of sudo, but to reiterate, the common reasons to avoid logging in as the root user are:

1. It allows for logging and tracking of each user's executed commands when using sudo.

2. By default, sudo requires a user's password to execute privileged commands. This helps prevent unauthorized actions and reduces the risk of misuse.
3. Logging in as the root user grants full system privileges at all times, whereas sudo and group-based privileges can be configured to allow only a restricted set of commands.
4. Keeping the root account enabled and actively used poses a security risk because it is a prime target for attackers. If root-level access is compromised, the entire system is exposed.

### 11. Enter the command to see what your user id is.

**Command: id**

**Command explanation:**

- **Id:** This command outputs the UID (user identification) and the GID (group identification) information. If no user is specified, the output will reflect the current shell's user.

**Command line output:**

```
jelie@Jelie-VM:/etc$ id
uid=1000(jelie) gid=1000(jelie) groups=1000(jelie),4(adm),24(cdrom),27(sudo),
30(dip),46(plugdev),122(lpadmin),135(lxd),136(sambashare)
jelie@Jelie-VM:/etc$
```

## Group Tasks:

### 12. What groups does the user jelie belong to?

**Command: id**

**Command: groups**

**Command explanation:**

- **Id:** This command outputs the UID (user identification) and the GID (group identification) information. If no user is specified, the output will reflect the current shell's user.
- **Groups:** This command displays the groups that a specified user belongs to. If no user is specified, the output will reflect the current shell's user.

**Command line output:**

```
jelie@Jelie-VM:~$ id
uid=1000(jelie) gid=1000(jelie) groups=1000(jelie),4(adm),24(cdrom),
27(sudo),30(dip),46(plugdev),122(lpadmin),135(lxd),136(sambashare)
jelie@Jelie-VM:~$ groups
jelie adm cdrom sudo dip plugdev lpadmin lxd sambashare
jelie@Jelie-VM:~$
```

The groups that I am a part of are jelie, adm, cdrom, sudo, dip, plugdev, lpadmin, lxd, and sambashare.

## 13. Give sally the ability to execute sudo commands. Next, try to create a new user while logged in as sally.

**Command: sudo usermod -a -G sudo sally**

**Command: sudo useradd ava**

**Command explanation:**

- **Sudo:** Temporarily allows administrator level permission for command execution.
- **Usermod:** This command modifies an existing user account.
- **-aG or -a -G:** The -a flag appends the user to a group, and the -G flag specifies the group. Together, they add the user to the specified group without removing them from other groups.
- **Sudo:** This argument specifies the group to append to the user specified by the next argument of the usermod command. This group grants sudo privileges.
- **Sally:** This argument specifies the user account being modified.
- **useradd:** This command creates a new user account on the system.
- **Ava:** This argument specifies the name of the new user being created.

**Command line output:**

```
jelie@Jelie-VM:/$ sudo usermod -a -G sudo sally
[sudo] password for jelie:
jelie@Jelie-VM:/$ groups sally
sally : sally sudo
jelie@Jelie-VM:/$
```

```
sally@Jelie-VM:~$ sudo useradd ava
[sudo] password for sally:
sally@Jelie-VM:~$
```

## 14. Log out of Sally and back into your own account. Create a new group called cybersec.

**Command: sudo groupadd cybersec**

**Command explanation:**

- **sudo:** Temporarily allows administrator level permission for command execution.
- **Groupadd**: This command is used to create a new group on the system.
- **Cybersec:** This argument specifies the name of the new group being created.

**Command line output:**

```
jelie@Jelie-VM:~$ sudo groupadd cybersec
[sudo] password for jelie:
jelie@Jelie-VM:~$
```

## 15. Add sally to the group, cybersec

**Command: sudo usermod -a -G cybersec sally**

**Command explanation:**

- **Sudo:** Temporarily allows administrator level permission for command execution.
- **Usermod:** This command modifies an existing user account.
- **-aG or -a -G:** The -a flag appends the user to a group, and the -G flag specifies the group. Together, they add the user to the specified group without removing them from other groups.
- **Cybersec:** This argument specifies the group to append to the user specified by the next argument of the usermod command.
- **Sally:** This argument specifies the user account being modified.

**Command line output:**

```
jelie@Jelie-VM:~$ sudo usermod -a -G cybersec sally
```

## 16. Check to see which groups sally belongs to.

**Command: id sally**

**Command: groups sally**

**Command explanation:**

- **Id:** This command displays the user ID (UID), group ID (GID), and all groups associated with the specified user.

- **Sally:** This argument specifies the user whose identification and group information is being displayed.
- **Groups:** This command displays the groups that a specified user belongs to.
- **Sally:** This argument specifies the user whose groups are being displayed.

**Command line output:**

```
jelie@Jelie-VM:~$ id sally
uid=1002(sally) gid=1002(sally) groups=1002(sally),27(sudo),1004(cybersec)
jelie@Jelie-VM:~$ groups sally
sally : sally sudo cybersec
jelie@Jelie-VM:~$
```

# Permission and Access Control Lists:

## 17. Create a new directory called lab1. Enter the command to find the permissions of the directory. Who is the owner and group owner of this directory? What permissions does the owner, group and other have?

**Command: mkdir lab1**

**Command: ls -ld lab1**

**Command explanation:**

- ***Mkdir*:** Short for make directory. It is used to create folders to organize the file structure of the system.
- ***Lab1:*** *This argument specifies the name of the directory being created.*
- ***Ls:*** *Lists the files and directories in the current directory.*
- ***-ld:*** The -l flag displays detailed information in long format, including the permissions, owner,and group owner. The -d flag tells the command to show information about the directory itself. When used together as -ld, the command shows the detailed information for the specified directory only.
- ***Lab1:*** *This argument specifies the name of the directory for which you want to view the permissions and detailed information when used with command ls -ld.*

**Command line output:**

```
jelie@Jelie-VM:~/Downloads$ mkdir lab1
jelie@Jelie-VM:~/Downloads$ ls -ld lab1
drwxrwxr-x 2 jelie jelie 4096 Feb 28 11:27 lab1
jelie@Jelie-VM:~/Downloads$
```

The owner is jelie. The group is jelie. The permissions are as follows:

**Owner:** rwx

**Group:** rwx

**Other:** r-x

## 18. Change your directory to lab1. Create a new bash file called, helloWorld. When ran, your program should just print “Hello World!”. (Don’t forget to make your bash file executable).

**Command: cd lab1**

**Command: nano helloWorld**

**Command: chmod +x helloWorld**

**Command explanation:**

- **cd:** Changes the current directory.
- **lab1:** The directory being changed into.
- **nano:** A text editor used to create and edit files directly in the terminal. In this case, it is used to create and edit the bash script.
- **helloWorld:** The name of the bash file being created.
- **chmod:** Is short for change mode. This command is used to change or modify the permissions of a file or directory. The permissions are read, write, and execute.
- **+x:** This argument adds executable permissions to the specified file, allowing it to be run as a program.
- **helloWorld:** The name of the file being having its permissions modified.

**Command line output:**

```
jelie@Jelie-VM:~/Downloads$ cd lab1
jelie@Jelie-VM:~/Downloads/lab1$ nano helloWorld
```

**File Input:**

**#!/bin/bash:** This line tells the system to use bash to run the script. It is also called a shebang.

**echo “Hello World!”:** This line prints Hello World! to the terminal.

```
  GNU nano 6.2                        helloWorld *
#!/bin/bash
echo "Hello World!"

^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
```

```
jelie@Jelie-VM:~/Downloads/lab1$ chmod +x helloWorld
jelie@Jelie-VM:~/Downloads/lab1$
```

```
jelie@Jelie-VM:~/Downloads/lab1$ ./helloWorld
Hello World!
jelie@Jelie-VM:~/Downloads/lab1$
```

## 19. Enter the command ls -l helloWorld. What are the reading, writing, and executing permissions for the owner, group and other? Change the permissions so the group also has w and x permissions.

**Command: ls -l helloWorld**

**Command: chmod g+wx helloWorld**

**Command explanation:**

- **Ls:** Lists files and directories with detailed information when used with the -l option.
- **-l:** Displays the file in long format showing permissions, owner, group, size, and modification date.
- **HelloWorld:** This is the file whose permission information will be displayed.
- **Chmod:** Is short for change mode. It is used to change the permissions of a file or directory by modifying the read (r), write (w), and execute (x) access rights for the owner, group, and others.
- **G+wx:** This argument is used with the chmod command, where g specifies the group, + means to add permissions, and w and x represent write and execute permissions; together, g+wx adds write and execute permissions to the group for the specified file.
- **HelloWorld:** This argument specifies the file whose permissions are being modified by the chmod command.

**Command line output:**

For the first ls -l command, the rwx permissions were as follows:

**Owner:** read, write, execute
**Group:** read, write, execute
**Other:** execute
Because the group already had full permissions, the command chmod g-wx helloWorld was run to adjust the permissions as directed in the lab. After running that command, the permissions were:
Owner: read, write, execute
Group: read

Other: execute
The group permissions were then set back to rwx to restore the original configuration.

```
jelie@Jelie-VM:~/Downloads/lab1$ ls -l helloWorld
-rwxrwxr-x 1 jelie jelie 32 Feb 28 11:53 helloWorld
jelie@Jelie-VM:~/Downloads/lab1$ chmod g-wx helloWorld
jelie@Jelie-VM:~/Downloads/lab1$ ls -l helloWorld
-rwxr--r-x 1 jelie jelie 32 Feb 28 11:53 helloWorld
jelie@Jelie-VM:~/Downloads/lab1$ chmod g+wx helloWorld
jelie@Jelie-VM:~/Downloads/lab1$ ls -l helloWorld
-rwxrwxr-x 1 jelie jelie 32 Feb 28 11:53 helloWorld
jelie@Jelie-VM:~/Downloads/lab1$
```

## 20. Use the getfacl command to view the ACL of the file.

**Command: getfacl helloWorld**

**Command explanation:**

- **getfacl:** This command displays the Access Control List (ACL) permissions of a file or directory. It shows both the standard permissions and any additional ACL entries that have been set.
- **helloWorld:** This argument specifies the file whose ACL information is being displayed.

**Command line output:**

```
jelie@Jelie-VM:~/Downloads/lab1$ getfacl helloWorld
# file: helloWorld
# owner: jelie
# group: jelie
user::rwx
group::rwx
other::r-x

jelie@Jelie-VM:~/Downloads/lab1$
```

## 21. Using the setfacl command, allow the user, sally, the ability to read and write to the file.

**Command: setfacl -m u:sally:rw- helloWorld**

**Command explanation:**

- **setfacl:** Modifies the Access Control List (ACL) permissions for a file or directory. It allows for groups and users to be given individualized permissions beyond standard owner/group/other permissions.
- **-m:** Stands for modify. It is used to modify or add a new ACL entry to a file.
- **u::** Specifies that the permission is being assigned to a specific user. Got a group the flag would be g.

- **sally::** The username of the user receiving the specified permissions.
- **rw-:** Grants read and write permissions and no execute permissions
- **helloWorld:** The file to which the setfacl command is targeting.

### Command line output: