In Linux, permissions control who can read, write, or execute a file or directory.

These permissions are crucial for maintaining system security and ensuring that users and processes can only access resources they are allowed to.

Understanding Linux File Permissions

Each file or directory in Linux has an associated set of permissions for three categories of users:

1. **Owner (u)**: The user who owns the file.
2. **Group (g)**: A group of users who have permissions on the file.
3. **Others (o)**: All other users on the system.

There are three types of permissions:

- **Read (r)**: Permission to read the file or list a directory's contents.
- **Write (w)**: Permission to modify the file or add/delete files in a directory.
- **Execute (x)**: Permission to execute the file (if it's a script or a binary) or traverse a directory.

Permissions Representation

1. **Symbolic representation**: Permissions are displayed as a combination of characters:
    - r for read
    - w for write
    - x for execute
    - - for no permission

Example:

diff

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-rwxr-xr--

The first character indicates the type of file (- for a regular file, d for a directory). The next three characters (rwx) represent the permissions for the owner. The next three (r-x) are for the group. The final three (r--) are for others.

2. **Numeric (octal) representation**: Permissions can also be represented numerically:
    - Read (r) = 4
    - Write (w) = 2
    - Execute (x) = 1

The numeric permission is the sum of these values. For example, rwx for the owner (4+2+1 = 7), r-x for the group (4+0+1 = 5), and r-- for others (4+0+0 = 4) would be represented as 755.

Changing Permissions with chmod

The chmod command is used to change permissions of files and directories.

Example 1: Giving Read, Write, and Execute Permission to the Owner

bash

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chmod u+rwx filename

This gives the owner read, write, and execute permissions for the file filename.

Example 2: Removing Write Permission from Others

bash

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chmod o-w filename

This removes the write permission for others on the file filename.

Example 3: Setting Permissions Using Numeric Representation

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chmod 644 filename

This sets the permissions to rw-r--r--, meaning the owner can read and write, and others can only read the file.

Viewing Permissions with ls -l

To view the permissions of files in a directory, use the ls -l command:

bash

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ls -l

Example output:

csharp

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-rw-r--r-- 1 user group 4096 Sep 8 12:00 file.txt

This means:

- rw- → the owner can read and write.
- r-- → the group can only read.
- r-- → others can only read.

Directory Permissions

- **Read (r)**: Allows listing the contents of the directory.
- **Write (w)**: Allows adding, removing, or renaming files within the directory.
- **Execute (x)**: Allows entering (cd) into the directory and accessing files inside.

Example 4: Changing Permissions for a Directory

bash

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chmod 755 /mydirectory

This grants the owner full access (rwx), while the group and others can read and execute, but not write to the directory.

Special Permission Bits

1. **Setuid (Set User ID)**: When set on a file, the program runs with the permissions of the file owner rather than the user who runs it. Represented as s.
2. **Setgid (Set Group ID)**: When set on a directory, new files created within the directory inherit the group ID of the directory, not the creating user's group. Represented as s.
3. **Sticky Bit**: When set on a directory, it allows only the file's owner to delete or rename files within the directory, even if other users have write permissions. Represented as t.

Example:

bash

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chmod 1777 /mydir

This sets the sticky bit, making /mydir a shared directory where only file owners can delete or rename their files.

Summary of Permissions:

Symbolic	Numeric	Meaning
rwx	7	Read, write, and execute
rw-	6	Read and write
r-x	5	Read and execute
r--	4	Read only
-wx	3	Write and execute
-w-	2	Write only
--x	1	Execute only

Symbolic	Numeric	Meaning
---	0	No permission

This provides a comprehensive overview of Linux permissions and how they can be manipulated using symbolic and numeric methods.