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Jobduniya

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Technical Papers UNIX Concepts: File Management in Unix

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How are devices represented in UNIX?

All devices are represented by files called special files that are located in/dev directory. Thus, device files and other files are named and accessed in the same way. A 'regular file' is just an ordinary data file in the disk. A 'block special file' represents a device with characteristics similar to a disk (data transfer in terms of blocks). A 'character special file' represents a device with characteristics similar to a keyboard (data transfer is by stream of bits in sequential order).

What is 'inode'

All UNIX files have its description stored in a structure called 'inode' The inode contains info about the file-size, its location, time of last access, time of last modification, permission and so on. Directories are also represented as files and have an associated inode. In addition to descriptions about the file, the inode contains pointers to the data blocks of the file. If the file is large, inode has indirect pointer to a block of pointers to additional data blocks (this further aggregates for larger files). A block is typically 8k.

Inode consists of the following fields:

- File owner identifier

- File type

- File access permissions

- File access times

- Number of links

- File size

- Location of the file data

Brief about the directory representation in UNIX

A Unix directory is a file containing a correspondence between filenames and inodes. A directory is a special file that the kernel maintains. Only kernel modifies directories, but processes can read directories. The contents of a directory are a list of filename and inode number pairs. When new directories are created, kernel makes two entries named '' (refers to the directory itself) and '' (refers to parent directory).

System call for creating directory is mkdir (pathname, mode).

What are the Unix system calls for I/O?

- open (pathname, flag, mode) -open file

- creat (pathname, mode) -create file

- close (filedes) -close an open file

- read (filedes, buffer, bytes) -read data from an open file

- write (filedes, buffer, bytes) -write data to an open file

- lseek (filedes, offset, from) -position an open file

- dup (filedes) -duplicate an existing file descriptor

- dup2 (oldfd, newfd) -duplicate to a desired file descriptor

- fcntl (filedes, cmd, arg) -change properties of an open file

- ioctl (filedes, request, arg) -change the behaviour of an open file

The difference between fcntl anf ioctl is that the former is intended for any open file, while the latter is for device-specific operations.

How do you change File Access Permissions?

Every file has following attributes:

owner's user ID (16 bit integer)

owner's group ID (16 bit integer)

File access mode word

'r w x-r w x-r w x'

(user permission-group permission-others permission)

r-read, w-write, x-execute

To change the access mode, we use chmod (filename, mode).

Example 1:

To change mode of myfile to 'rw-rw-r--' (i.e.. Read, write permission for user-read, write permission for group-only read permission for others) we give the args as:

chmod (myfile, 0664).

Each operation is represented by discrete values

'r' is 4

'w' is 2

'x' is 1

Therefore, for 'rw' the value is 6 (4 + 2).

Example 2:

To change mode of myfile to 'rwxr--r--' we give the args as:

chmod (myfile, 0744).

What are links and symbolic links in UNIX file system?

A link is a second name (not a file) for a file. Links can be used to assign more than one name to a file, but cannot be used to assign a directory more than one name or link filenames on different computers.

Symbolic link 'is' a file that only contains the name of another file. Operation on the symbolic link is directed to the file pointed by the it. Both the limitations of links are eliminated in symbolic links.

Commands for linking files are:

Link ln filename1 filename2

Symbolic link ln-s filename1 filename2

What is a FIFO?

FIFO are otherwise called as 'named pipes' FIFO (first-in-first-out) is a special file which is said to be data transient. Once data is read from named pipe, it cannot be read again. Also, data can be read only in the order written. It is used in interprocess communication where a process writes to one end of the pipe (producer) and the other reads from the other end (consumer).

How do you create special files like named pipes and device files?

The system call mknod creates special files in the following sequence.

kernel assigns new inode.

sets the file type to indicate that the file is a pipe, directory or special file.

If it is a device file, it makes the other entries like major, minor device numbers.

For example:

If the device is a disk, major device number refers to the disk controller and minor device number is the disk.

Discuss the mount and unmount system calls

The privileged mount system call is used to attach a file system to a directory of another file system; the unmount system call detaches a file system. When you mount another file system on to your directory, you are essentially splicing one directory tree onto a branch in another directory tree. The first argument to mount call is the mount point, that is, a directory in the current file naming system. The second argument is the file system to mount to that point. When you insert a cdrom to your unix system's drive, the file system in the cdrom automatically mounts to/dev/cdrom in your system.

How does the inode map to data block of a file?

Inode has 13 block addresses. The first 10 are direct block addresses of the first 10 data blocks in the file. The 11th address points to a one-level index block. The 12th address points to a two-level (double in-direction) index block. The 13th address points to a three-level (triple in-direction) index block. This provides a very large maximum file size with efficient access to large files, but also small files are accessed directly in one disk read.

What is a shell?

A shell is an interactive user interface to an operating system services that allows an user to enter commands as character strings or through a graphical user interface. The shell converts them to system calls to the OS or forks off a process to execute the command. System call results and other information from the OS are presented to the user through an interactive interface. Commonly used shells are sh, csh, ks etc.