Linux Module 1 (Revision Series)

Sem 4 BCA/B.Sc. Computer Science MGU

Module 1 Overview

- What is Linux?
- Linux's root in Unix
- Common Linux Features
- advantage of Linux
- Overview of Unix and Linux architectures,
- Linux files system,
- hardware requirements for Linux,
- Linux standard directories.
- Commands for files and directories cd, ls, cp, rm, mkdir, rmdir, pwd, file, more, less, Creating and viewing files using cat, file comparisons.

What is Linux?

- Linux is an OS or a kernel which provides an environment such that the user can execute programs in efficient and convenient manner.
- Linux is a free Open Source Operating System.
- Created by Linux Torvalds in 1991.
- Based on UNIX.

Linux’s root in Unix

- Unix is the operating system which laid foundation to Linux
- Unix is designed for mainframes, enterprises & universities.
- Commands used in both Linux and Unix is same.

Features of Linux

- Portable – can work on different types of hardware in same way.
- Open Source – Source code of Linux is freely available.
- Multi User Support – Multiple users can access the system resources at same time.
- Multi Programming - Multiple programs can be run at same time.
- Shell – Special Interpreter program - used to execute commands.
- Application Support – Has it’s own software repository and also allows user to run Windows Applications.

Features of Linux (Cont.)

- Hierarchical File System: Provides a standard file structure where the system/user files are arranged.
- Security – provides user security using authentication such as passwords, encryption & access control to specific files.
- GUI – Supports GUI by installing GUI Packages.
- Live Boot – All Linux distributions allows user to run OS without installing it on the system.
- Custom Keyboard Support – Supports different languages keyboards.

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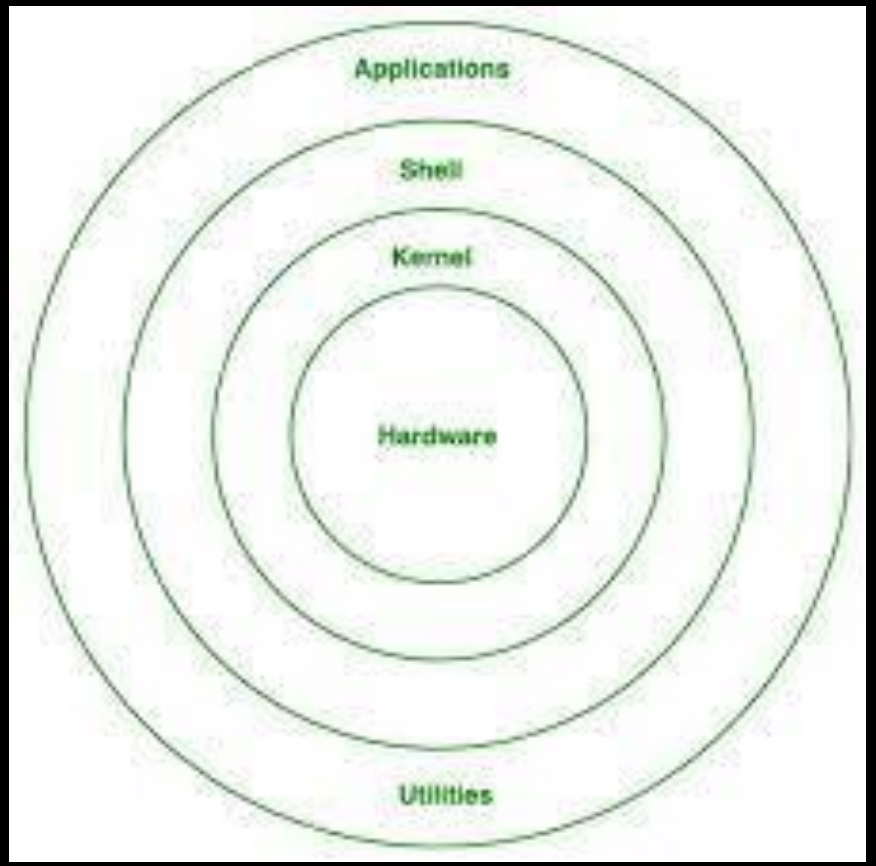
Advantages of Linux

- Open Source – Redistribute, free to use
- Low cost – no need to spend time & huge amount to obtain License.
- Stability – More stable compared to other OS.
- Performance – Ability to handle large number of users simultaneously.
- Flexibility – Used for server applications, desktop applications
- Compatibility – Supports all common Unix Software & able to process all common file formats
- Security – Provides encryption, file ownership and permission.
- Better usage of hard disk – Linux uses its resources well even when hard disk is almost full.

Architecture of Linux

- Hardware: Actual parts of computer
- Kernel:
  - Responsible for all major activities.
  - Interacts directly with hardware
  - There is only one Kernel for each system
  - Core component of OS
  - Has various functionalities such as, file system, memory management, interrupt handling
- Shell: Acts as mediator between kernel & user. Shell reads command prompt & send request to execute a program, Hence known as command interpreter. Shell program stored at file having extension as sh.
- Tools & Applications: this layer includes user written application using shell programming, C, C++ applications etc.



Linux File System

- File System – logic collection of files on a partition / disk
- Defines the way how the files are organized on the disk
- When a disk is formatted, the sectors in the hard disk are first divided into small groups.
- Group of these sectors is known as blocks.
- Size of each block is 512 bytes.
- All blocks are logically divided into 4 parts.
  - Boot Block
  - Super Block
  - Inode Table
  - Data Block

Linux File System (Cont.)

- Boot Block
  - Located in the first few sectors of a file system.
  - Contains the initial bootstrap program – used to load the operating system
- Super Block
  - Describes the state of the filesystem
  - To access a file in a file system requires access to the super block to get information about the file..
  - Contains information about:
    - Total size of the partition
    - Block size of the file system
    - No. of files it can store.
- Inode Table
  - Information related to a file (not the contents) is stored in an inode table.
  - For each file there is an inode entry in the table.
  - Inode is a data structure containing metadata about the files.
  - Information stored in inode are: Size of the file, User ID of the owner who owns the fie, Group ID of the file, file access permission, location

Linux File System (Cont.)

- Data Block
  - Starts at the send of the inode table
  - Contains actual file contents.
  - Contains several types of files.
  - Contains user files, directory files, symbolic link, block files etc.

Linux Supported File System

- Ext
  - Stands for “Extended file system”
  - Created specifically for Linux
  - Had 4 major revisions.
- Ext 2,Ext3,Ext4
  - Ext2 was default filesystem under 2.2 Kernel
  - Ext3 is the default filesystem for RHEL 3 & 4
  - Ext3 offers best performance combined with data security of file system, due to it’s journaling feature
  - Ext4 was developed as the successor of ext3.
  - Ext4 provides features for large filesystems, performance, reliability.
- XFS
  - XFS is designed for high scalability
  - provides almost native I/O performance even when the file system spans multiple storage device.

Linux Supported File System

- OCFS
  - Oracle Cluster File System (OCFS)
  - It’s a shared file system designed for Oracle Application Cluster (RAC)
  - OCFS volumes can span one shared disk or multiple shared disks for redundancy and performance.
- OCFS2
  - Next Generation of OCFS
  - OCFS2 is a general purpose file system
  - Makes management of RAC installations even easier.
- JFS
  - Developed by IBM for IBM AIX OS, but later ported to Linux
  - enhance low CPU usage & good performance for both large & small files
  - Able to dynamically resized, but wont support shrunk
- NFS
  - Network filesystem used to access remote disks

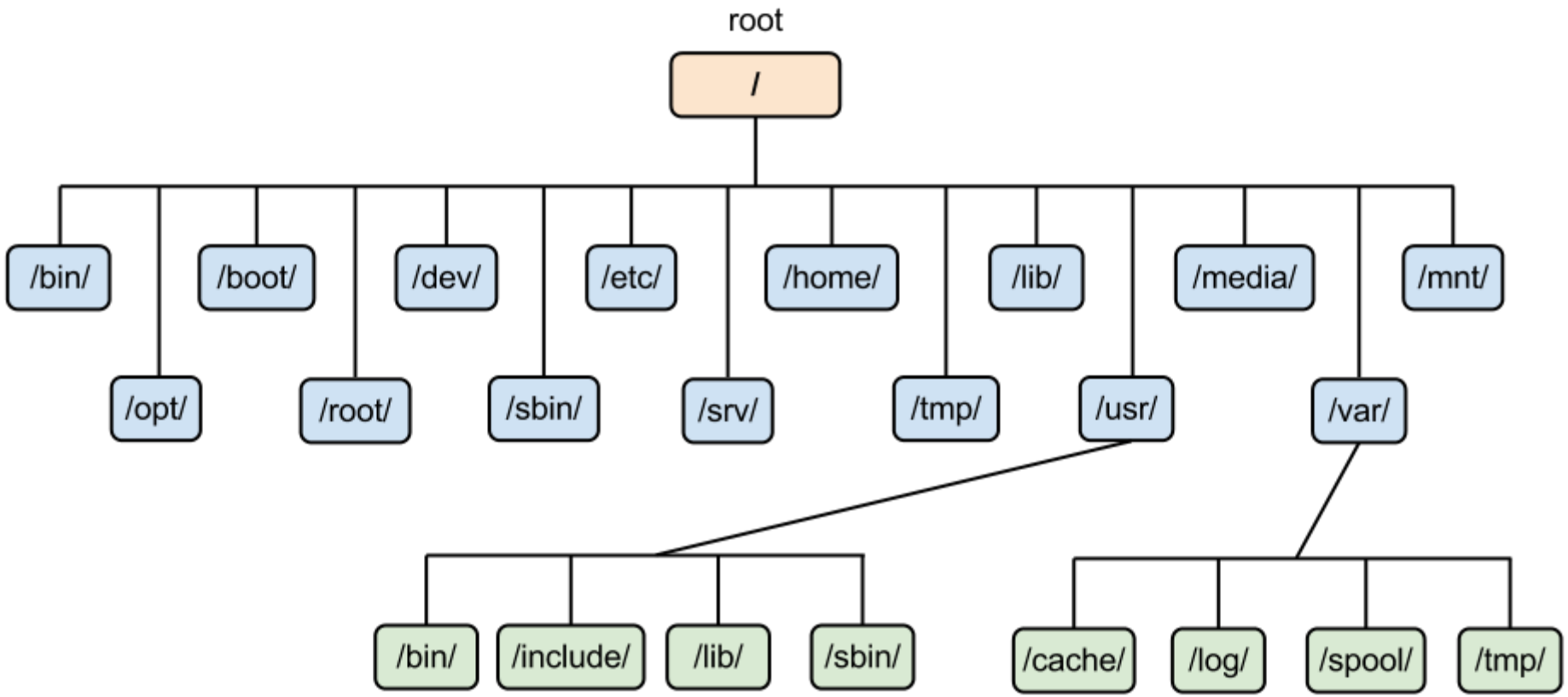
Types of Files in Linux

- Ordinary file – files created by user. User can modify
- Directories
  - directory file is automatically created by Linux when you create a directory in Linux.
  - User can’t modify it. However Linux will modify it automatically when a file or sub directory is added
- Special files
  - Most of the system files in Linux are special files.
  - Usually associated with I/O devices.
  - Stored in standard Linux directories such as /dev or /etc.
  - User can’t modify
- Pipe file
  - Pipe act as temporary file which only exist to hold data from one command until it’s read by another.
- Socket File
  - Used to pass information between applications for communication purpose
- Symbolic link file
  - Used for referencing some other file of the file system
  - Two types of link file available in Linux: Soft link & Hard Link
  - Soft Link : Actual link to the original file ; Hard Link: acts as a mirror copy of the original file

Linux standard directories

- Linux filesystem resembles an upside down tree.
- Hierarchy starts from root (Represented by “/”)
- Properties of a file system in Linux:
  - Has a root directory that contains other files and directories
  - Each file & directory is identified by unique identifier called inode
  - By default, root directory has an inode number of 2
  - 0 & 1 inode numbers are not used.
  - No dependencies between filesystems

Linux standard directories



Linux standard directories

- / (root)
  - Top level directory in the filesystem
  - Contains all other directories & their directories
  - Contains all files required to boot the Linux system
  - Also contains a file called as Linux which is Linux Kernel itself.
- /bin
  - Contains binary files, such as commands that are required by system Admin & normal user.
  - Usually contains shells.
- /boot
  - Contains boot loader, kernel executable & configuration files required to Boot Linux system
- /dev
  - Contains device files for each hardware devices attached to the system.
  - Files are those which represents each device in the computer & helps in access to those devices
  - Users can access these devices directly though these device files; But some applications hide the actual device names to end users.
- /etc
  - Contains admin configuration files and directories.

Linux standard directories

- /home
  - Home directory storage for user files
  - Each user has subdirectory in /home
- /lib
  - Contains shared library files & sometimes other kernel-related files that are required to boot the system.
- /media
  - Mount points for removable media
- /mnt
  - Temporary mount point for regular file systems that can be used while administrator is repairing or working on a file system
- /opt
  - Optional files such as vendor supplied application programs are stored here
- /root
  - Home directory for the root user. Home directory for root does not stored in /home due to security issues.
- /sbin
  - Contains system binary files.
  - Similar to /bin but /sbin contains applications required by super user.

Linux standard directories

- /tmp
  - Used by OS and programs to store temporary files.
- /usr
  - Contains user documentation, games and other commands, files that are not required during boot time.
- /var
  - Stores variable data files
  - Includes files like, log files, MySQL & other database files, server files etc.
- /proc
  - Contains information about system resources.
  - Contains info about your computer
- /srv
  - Contains data for servers. Eg: HTML files etc.
- /sys
  - It’s a virtual directory like /proc & /dev. Also contains information from devices connected to the system

Linux Commands

- man
  - Provides detailed description and usage of the commands.
  - Syntax: man <commandname>
- cd
  - To change directory
  - Syntax cd options directory
  - cd ~ - Change to home directory
  - cd / - Change to root directory
  - cd .. - Change to previous directory
- ls
  - Used to list the content of specified directory
  - Syntax: ls option directory
  - ls –a : List all files including hidden files
  - ls –d : Lists directory
  - ls –r : List in reverse order

Linux Commands

- cp
  - Used to copy content of one file to another
  - Syntax: cp options source_file destination_file
  - Eg: cp animal.txt birds.txt
  - If destination file is an existing one. Then it's overwritten. If destination is an directory then the file is copied to that directory.
  - cp –r : Recursive copy (includes hidden file)
  - cp –v : Print information message
  - cp –i : Prevents from overwriting existing files. Prompt before overwriting destination file.
- rm
  - To remove files or directory.
  - Syntax rm options filename
  - Options same as cp mentioned above, rm –d : removes empty directories.
- mkdir
  - Creates a new directory
  - Syntax: mkdir option directory_name
  - Can also create multiple directories at once & also able set permissions while creating directory.
  - Options
    - -m – Set permission mode
    - -p – Create parent directories as necessary

Linux Commands

- rmdir
  - Used to remove directory
  - Directory should be empty before removing it
  - Options,syntax same as mkdir
- pwd
  - Displays the current working directory
  - Syntax: pwd option
  - Options
    - -L – Display the content as absolute name
    - -P – Displays actual path
- File
  - Used to determine the type of a file
  - Reports file type in human readable form or MIME type
  - Useful to determine how to work or view the file.
  - Syntax: file options filename
  - -b – brief mode – displays the file type
  - -s – used for special files
  - -i – to view mime type of a file
  - -z – to view compressed files without decompressing

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Linux Commands

- more
  - Used to display output page by page
  - Syntax: more filename
  - Option: -s – Squeeze multiple blanks lines into one. –num limits line displayed per page
  - Controls used while viewing file:
    - Enter Key: To scroll down line by line
    - Space bar or f key: To go to next page
    - B key: to go back one page
    - Q key: to quit
- Less
  - Used to read contents of text file one page per time
  - Faster Access because if the file is large it don’t access complete file but access page by page.
  - Option: -s – Squeeze multiple blank lines into one. –u – omits the underlines
  - Syntax: less filename

Creating & viewing files using cat

- Used to create, display the content of text file and combine several files to one.
- Cat command can read & write data from standard input & output devices.
- Used to copy text files into a new document.
- Syntax: cat option filename
- To view content of file: cat filename
- To create a new file: cat > filename
- Once you're done, just press ctrl + d to save file.
- To copy contents of one file to another: cat filename_source > filename_destination
- To copy contents of multiple files: cat filename1 filename2 file3
- To append the contents of one file to another: cat file1 >> file2

File Comparisons Commands

1. cmp
    - Used to compare two files byte by byte.
    - Syntax: cmp options filename1 filename2
    - Reports the location of the first mismatch to the screen if difference found & displays no message if files are identical.
    - Options:
        - -b – Displays the differing bytes in the output
        - -i [bytes to skip] – Skip particular number of intial bytes from both the files and then after skipping it compares files
        - -i skip1:skip2 – Skip the skip1 bytes of file1 & skip2 bytes of file2
2. Diff
    - Used to display the differences in the files by comparing the files line by line.
    - Outputs a set of instruction on how to make changes in one file to make it identical to other file.
    - Syntax: diff options file1 file2
    - Offers two different ways to view the diff command ouput: 1. Context mode (-c) 2. unified mode (-u)
    - Diff uses some special symbols and instructions on how to make changes to a file.
        - a: Add
        - c: Change
        - d: Delete
    - Options:
        - -i – Ignore case differences in file content.
        - -b – Ignore changes in amount of white spaces
        - -w – Ignore all white space.

File Comparisons Commands

3. Comm
    - Used to compare two sorted files line by line.
    - Syntax: comm option file1 file2
    - Options:
        - -1 – Hide column 1
        - -2 – Hide column 2
        - -3 – Hide column 3
    - Produces three-column output.
        - Col1: lines unique to file1
        - Col2: lines unique to file2
        - Col3: lines common to both files
4. Uniq
    - Filter out the repeated lines in a file.
    - Syntax: uniq option filename
    - Option:
        - -d – Displays only duplicate lines
        - -u – Displays unique lines