



Linux Lecture – 01

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Today's Lecture



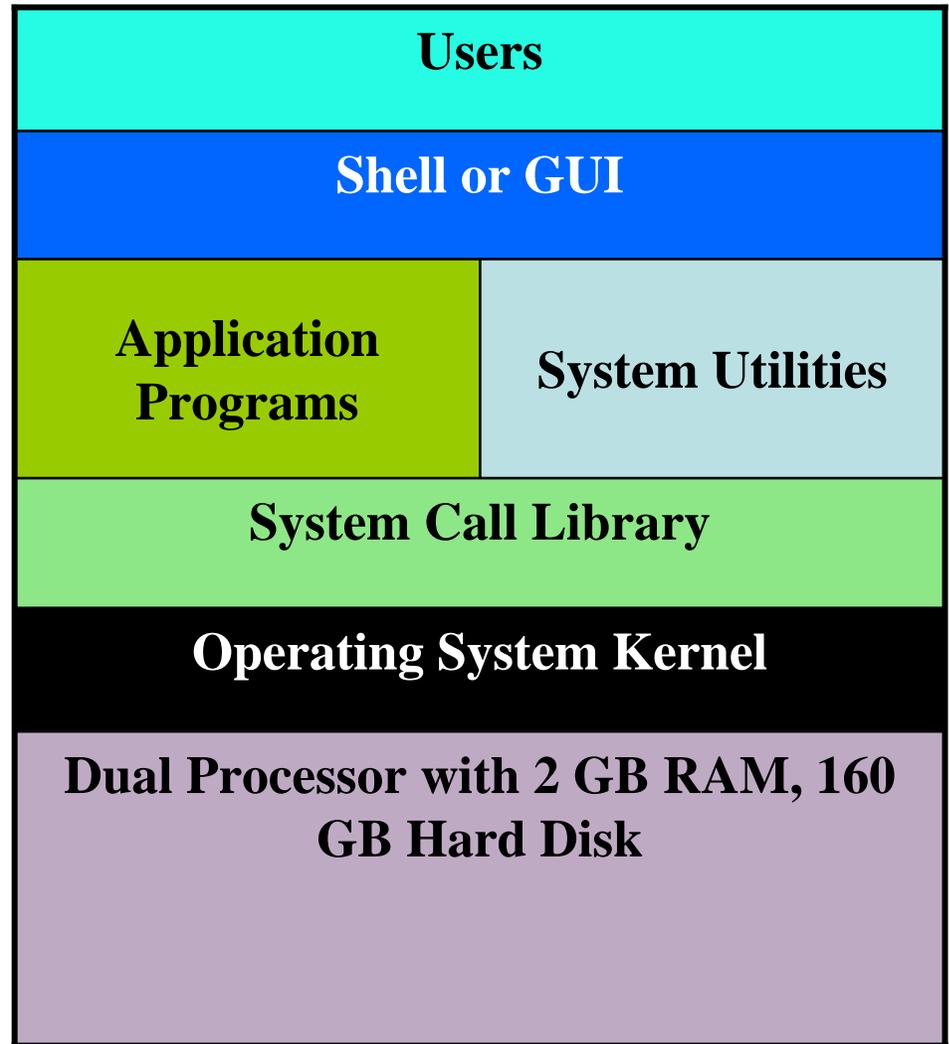
- Operating System Concept
- Brief History of UNIX & Linux
- A Linux Distribution
- Architecture of Linux
- Basic Principals of Linux
- Linux File System
- Typical Linux Directory Structure
- How to login
- Basic Linux Commands



Operating System Concept



- An operating system (OS) is a resource manager
- It is a set of software routines:
 - that allow users and application programs to access system resources
 - in a safe, efficient and abstract way
 - CPU, memory, disks, modems, printers network cards etc.
- A general operating system architecture can be understood by the figure





Operating System Concept



- The **kernel** controls the hardware
- It provides functions like
 - Handling of interrupts from the devices
 - Allocation of memory to programs
 - Sharing of CPU among the programs
- Basic kernel services are exposed to higher-level programs through a library of **system calls**
- **Application Programs** and **System Utility Programs** make use of system calls
 - Launched using a **shell/GUI**
- The OS may differ from one another on the basis of:
 - System calls
 - System utilities
 - User interface they provide
 - Resource scheduling policies implemented by the kernel



History of UNIX & Linux



- In late 1960s, **MULTICS** was introduced for mainframe computers
- Joint venture of GE, MIT and Bell Labs
- Inspired Ken Thompson – who wrote simpler version called **UNICS**, which evolved into UNIX
- Ken Thompson with Dennis Ritchie in 1973 wrote the **UNIX** kernel in C
- The Fifth edition of UNIX was released to universities in 1974
- In 1978, **UNIX** development was split into two main branches:
 - **SYSV**
 - **BSD**



History of UNIX & Linux



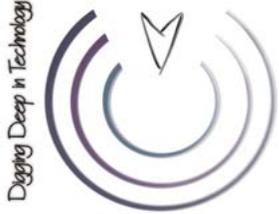
- Linux – open source OS for PCs
- Developed by Linus Torvalds (a Finnish graduate student), in 1991
- Neither pure SYSV nor BSD, mix of both
- Conforms to a set of standards called POSIX
- Code freely available, anyone can:
 - Modify, add features, correct deficiencies
- Different Distributions:

– Caldera Systems	Corel	Debian	Mandrake
– Red Hat	Slackware	Strom	SUSE
– Turbo	Gentoo	Stampede	Knoppix
– Fedora	Ubuntu	College Linux	White Box Linux



A Linux Distribution

- A distribution comprises of:
 - Kernel
 - 2.6.9-89.0.11.EL.cernsmp
 - System Utilities
 - File copy, hard disk repair/defragment etc.
 - GUI
 - GNOME, KDE
 - Application Programs
 - Open office, evolution, firefox, gedit, gftp. konqueror, evince, kdevelop, kview, emace, vim etc.



Architecture of Linux



- Kernel
 - Initializes the device drivers
 - Processor & memory management functions
 - Support for many different type of file systems
 - A wide range of system calls (mix of SYS V, BSD and POSIX.1)
 - Loaded into the memory at system startup
 - Location `/boot/vmlinuz`
 - Source files `/usr/src/linux`
- Shells & GUIs
 - Textual command line shells
 - bourne shell (sh), bourne again shell (bash)
 - csh and tcsh
 - GUI Environment
 - GNOME and KDE



Architecture of Linux



- System Utilities
 - ls, grep, sed, awk, less, bc, wc, more etc.
 - Powerful tools that perform a single task extremely well
 - Can also chain programs together using pipes
 - Server programs called **daemons**
- Application Programs
 - emacs, vi, kdevelop, gcc, g++, open/star office etc.



Basic Principals of Linux



- Everything is a file
- Small, single purpose programs
- Ability to chain programs to perform complex tasks
- Avoid captive user interface
- Configuration data is stored in text
- Linux is case-sensitive



Linux File System

- Every file in Linux can be one of the following four types:
 - Ordinary File (contain data, info)
 - Directories (hold files & other directories)
 - Devices (for accessing the hardware)
 - Links (Pointer to another file)
 - Hard Link
 - Soft Link

Typical Directory Structure

- Linux Filesystem is laid out in a hierarchical tree structure.
- Top level directory is called root “/”

```
/  _____ the root directory
├── bin    Essential command binaries
├── boot  Static files of the boot loader
├── dev   Device files
├── etc   Host-specific system configuration
├── lib   Essential shared libraries and kernel modules
├── mnt   Mount point for mounting a filesystem temporarily
├── opt   Add-on application software packages
├── sbin  Essential system binaries
├── tmp   Temporary files
├── usr   Secondary hierarchy
└── var   Variable data
```



`/bin`: Binary files

- `/bin` contains commands that may be used by both the system administrator and by users

<code>cs</code>	The C shell (optional)
<code>ed</code>	The 'ed' editor (optional)
<code>tar</code>	The tar archiving utility (optional)
<code>cpio</code>	The cpio archiving utility (optional)
<code>gzip</code>	The GNU compression utility (optional)
<code>gunzip</code>	The GNU uncompression utility (optional)
<code>zcat</code>	The GNU uncompression utility (optional)
<code>netstat</code>	The network statistics utility (optional)
<code>ping</code>	The ICMP network test utility (optional)



/bin: Binary files

cat	Utility to concatenate files to standard output
chgrp	Utility to change file group ownership
chmod	Utility to change file access permissions
chown	Utility to change file owner and group
cp	Utility to copy files and directories
date	Utility to print or set the system data and time
dd	Utility to convert and copy a file
df	Utility to report filesystem disk space usage
dmesg	Utility to print or control the kernel message buffer
echo	Utility to display a line of text
false	Utility to do nothing, unsuccessfully
hostname	Utility to show or set the system's host name
kill	Utility to send signals to processes
ln	Utility to make links between files
login	Utility to begin a session on the system
ls	Utility to list directory contents
mkdir	Utility to make directories
mknod	Utility to make block or character special files
more	Utility to page through text
mount	Utility to mount a filesystem
mv	Utility to move/rename files
ps	Utility to report process status
pwd	Utility to print name of current working directory
rm	Utility to remove files or directories
rmdir	Utility to remove empty directories
sed	The 'sed' stream editor
sh	The Bourne command shell
stty	Utility to change and print terminal line settings
su	Utility to change user ID
sync	Utility to flush filesystem buffers
true	Utility to do nothing, successfully
umount	Utility to unmount file systems
uname	Utility to print system information



/sbin: Super-user Binaries

- This directory contains the binaries used by the root user

/boot: Boot files

- This directory contains everything required for the boot process except configuration files



/dev : Device files

- The /dev directory is the location of special or device files

/proc : Virtual File System

- The /proc directory contains directories and files that report system information and status



/etc: Configuration files

- /etc contains configuration files and directories.

<code>csh.login</code>	Systemwide initialization file for C shell logins (optional)
<code>exports</code>	NFS filesystem access control list (optional)
<code>fstab</code>	Static information about filesystems (optional)
<code>ftplib</code>	FTP daemon user access control list (optional)
<code>gateways</code>	File which lists gateways for routed (optional)
<code>gettydefs</code>	Speed and terminal settings used by getty (optional)
<code>group</code>	User group file (optional)
<code>host.conf</code>	Resolver configuration file (optional)
<code>hosts</code>	Static information about host names (optional)
<code>hosts.allow</code>	Host access file for TCP wrappers (optional)
<code>hosts.deny</code>	Host access file for TCP wrappers (optional)
<code>hosts.equiv</code>	List of trusted hosts for rlogin, rsh, rcp (optional)
<code>hosts.lpd</code>	List of trusted hosts for lpd (optional)
<code>inetd.conf</code>	Configuration file for inetd (optional)
<code>inittab</code>	Configuration file for init (optional)
<code>issue</code>	Pre-login message and identification file (optional)
<code>ld.so.conf</code>	List of extra directories to search for shared libraries (optional)
<code>motd</code>	Post-login message of the day file (optional)
<code>mtab</code>	Dynamic information about filesystems (optional)
<code>mttools.conf</code>	Configuration file for mtools (optional)
<code>networks</code>	Static information about network names (optional)
<code>passwd</code>	The password file (optional)
<code>printcap</code>	The lpd printer capability database (optional)
<code>profile</code>	Systemwide initialization file for sh shell logins (optional)
<code>protocols</code>	IP protocol listing (optional)
<code>resolv.conf</code>	Resolver configuration file (optional)
<code>rpc</code>	RPC protocol listing (optional)
<code>securetty</code>	TTY access control for root login (optional)
<code>services</code>	Port names for network services (optional)
<code>shells</code>	Pathnames of valid login shells (optional)
<code>syslog.conf</code>	Configuration file for syslogd (optional)



/home: User area

- /home contains user home directories
- Area writable by individual users
- Others users may be able to read depending upon permissions



/lib: Library files

- `/lib` contains essential shared libraries and kernel modules.
- The `/lib` directory contains those shared library images needed to boot the system and run the commands in the root filesystem, i.e., by binaries in `/bin` and `/sbin`.



/mnt: Mount area

- Mount point for a temporarily mounted filesystem.
- This directory is provided so that the system administrator may temporarily mount a filesystem as needed.
- The content of this directory is a local issue and should not affect the manner in which any program is run.



/root & /tmp

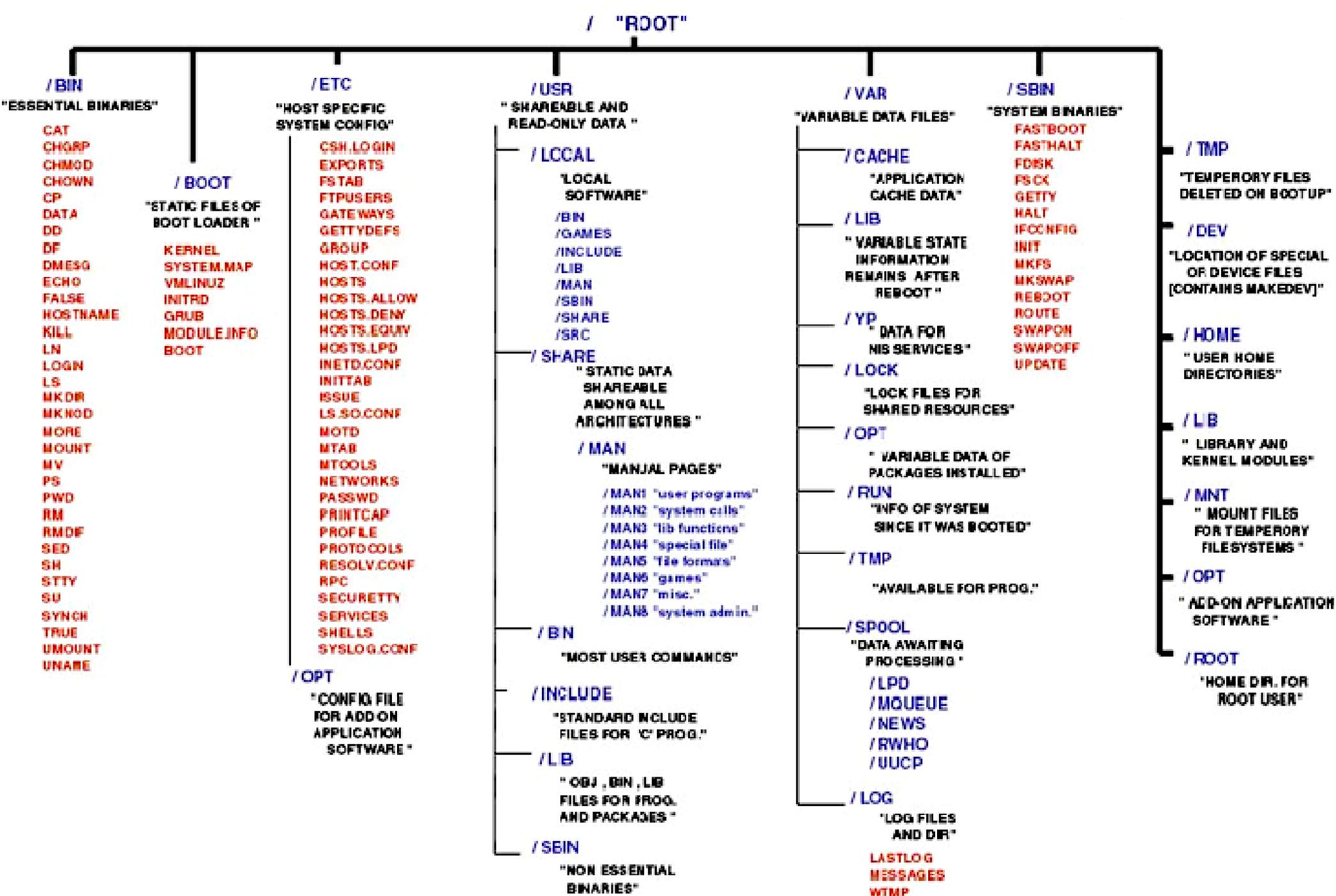
- The `/root` is a home directory for the root user
- The `/tmp` directory must be made available for programs that require temporary files
- `/tmp` is writable by everyone i.e. world writable



`/usr/lib`: Library files



- Libraries for programming and packages.
- `/usr/lib` includes object files, libraries, and internal binaries that are not intended to be executed directly by users or shell scripts.





Summary: Directory Structure



- Home Directories: `/root`, `/home/username`
- User Executables: `/bin`, `/usr/bin`, `/usr/local/bin`
- System Executables: `/sbin`, `/usr/sbin`, `/usr/local/sbin`
- Other Mountpoints: `/media`, `/mnt`
- Configuration: `/etc`
- Temporary Files: `/tmp`
- Kernels and Bootloader: `/boot`
- Server Data: `/var`, `/srv`
- System Information: `/proc`, `/sys`
- Shared Libraries: `/lib`, `/usr/lib`, `/usr/local/lib`



Logging into a Linux System



- Two types of login screens
 - virtual consoles (text-based)
 - graphical logins (display managers)
- Login using login name and password
- Each user has a home directory for personal file storage



Absolute & Relative Paths



- Absolute pathnames
 - Begin with a forward slash
 - Complete "road map" to file location
 - Can be used anytime you wish to specify a file name
- Relative pathnames
 - Do not begin with a slash
 - Specify location relative to your current working directory
 - Can be used as a shorter way to specify a file name



Basic Linux Commands



- **ls**, listing files and directories
 - `ls -a`
 - `ls -l`
 - `ls -C`
 - `ls -F`
 - `ls --color`
 - `ls -d`
 - `ls -g`
 - `ls -o`
 - `ls -h`
 - `ls -lh, ls -CaF`



Basic Linux Commands



- **cd**, change directory
 - cd ..
 - cd –
 - cd ~/mydir
 - cd /home/usman
 - cd
- **su**, switch user, su – (complete user environment)
- **id**, print user and group ids
- **passwd**, change password
 - **yppasswd**



Basic Linux Commands



- **man**, manual pages
 - `man <command>`
- **info**, information pages
 - `info <command>`
- **command --help**, basic help by author
 - `ls --help`, `man --help`
- **pwd**, present working directory



Basic Linux Commands



- **ps**, process information
 - ps aux
 - pstree
 - ps fax
 - top
- **free**, memory information
 - free -m
- **cal**, calendar information
 - cal, cal 2009
- **head**, output the first part of files
 - head [-n <lines>] <filename>
- **tail**, output the last part of files
 - tail [-n <lines>] <filename>



Basic Linux Commands



- **cat**, concatenate/display files
 - `cat /home/usman/myfile`
- **clear**, clears the screen
- **date**, see/modify system date & time
 - `date, date [MMDDhhmm[[CC]YY][.ss]]`
- **df**, disk space usage
 - `df -h`
- **du**, file space usage
 - `du -sh`
- **uname**, print system info
 - `uname [-a, -s, -n, -r, -v, -m]`



Basic Linux Commands



- **echo**, display a line or text
 - echo “any text”, echo \$HOSTNAME
- **exit**, exit the current session/shell
- **file**, determine file type
 - file <file name/path>
- **hostname**, show or set the system hostname
 - hostname [<new-name>]
- **more**, file perusal filter for CRT viewing
 - more <file name/path>
- **less**, file perusal filter
 - less <file name/path>



Basic Linux Commands



- **cp**, copy files and directories
 - `cp [options] file destination`
- More than one file may be copied at a time if the destination is a directory:
 - `cp [options] file1 file2 destination`
- If the destination is a directory, the copy is placed there
- If the destination is a file, the copy overwrites the destination
- If the destination does not exist, the copy is renamed



Basic Linux Commands



- **mv**, move and/or rename files and directories
 - `mv [options] file destination`
- More than one file may be moved at a time if the destination is a directory:
 - `mv [options] file1 file2 destination`
- In **mv** also, the destination works like **cp**
- **mkdir**, creates directories
 - `mkdir <directory name/path>`
- **rmdir**, removes empty directories
 - `rmdir < directory name/path>`



Basic Linux Commands



- **touch**, create empty files or update file timestamps
 - touch <file name/path>
- **rm**, remove files
 - rm [options] <file name/path>
 - **rm -i** *file* (interactive)
 - **rm -r** *directory* (recursive)
 - **rm -f** *file* (force)
- **rm -r**, recursively removes directory trees
 - rm -rf <directory name/path>