Linux

Introduction

It All Started With UNIX

- Remember Linux was a Unix-based OS
- Unix was developed in 1970 by AT&T Lab (Later known as Bell Lab)
- Originated from MULT-ICS → UNI-XS
  - Versions III, Version V (SVR1, ...)
- Later the source code of Unix was given to universities including UC Berkeley
- UC Berkeley enhanced the existing version called it Berkeley Software Distribution Unix
- SVR4 combines all Berkeley enhancements and original features
- Unix was essentially for workstations

Then Came Linux

- Created in 1991 by Linus Torvalds
- PC-based operating system
- Based on the existing UNIX operating system
- Released in 1994 as Version 1
- Initially was developed for 80x86 processors (IA32 or i386 architecture processors)
- Today it support various processor
  - AMD, Motorola 6800, Power PC, etc.

Linux Distros

- Each distro is a package including the OS and different applications
- Different distros provide different applications and require different installations steps
- The package includes
  - Core Linux OS (also called Kernel)
  - X Window System and GUI interfaces
  - Graphical desktop (e.g., GNOME orKDE)
  - Different applications
    - Corel, KOffice, Tex, Word Processor, Spreadsheet, etc.
  - Documentations
- Each Distro is under General Public License (GNU)
  - http://en.wikipedia.org/wiki/GNU
  - Anyone can copy and distribute the software in open source form to others
- Obtaining a distro can be through ready made packages over the net or buying the CD or just compiling a version

Distribution
Ubuntu 6.06.1
SUSE 10.1
Fedora Core 5
SimplyMEPIS 6.0
PCLinuxOS 0.93a
Mandriva 2006
Slackware 10.2
Debian 3.1r3
Damn Small 3.0.1
Gentoo 2006.1
Puppy 2.10
Freespire 1.0

Linux Distros - GNU

- **GNU** is a free operating system consisting of a kernel, libraries, system utilities, compilers, and end-user applications.
  - "**G**NU's **N**ot **U**nix", which was chosen because its design is Unix-like, but differs from Unix by being free software and by not containing any UNIX code.
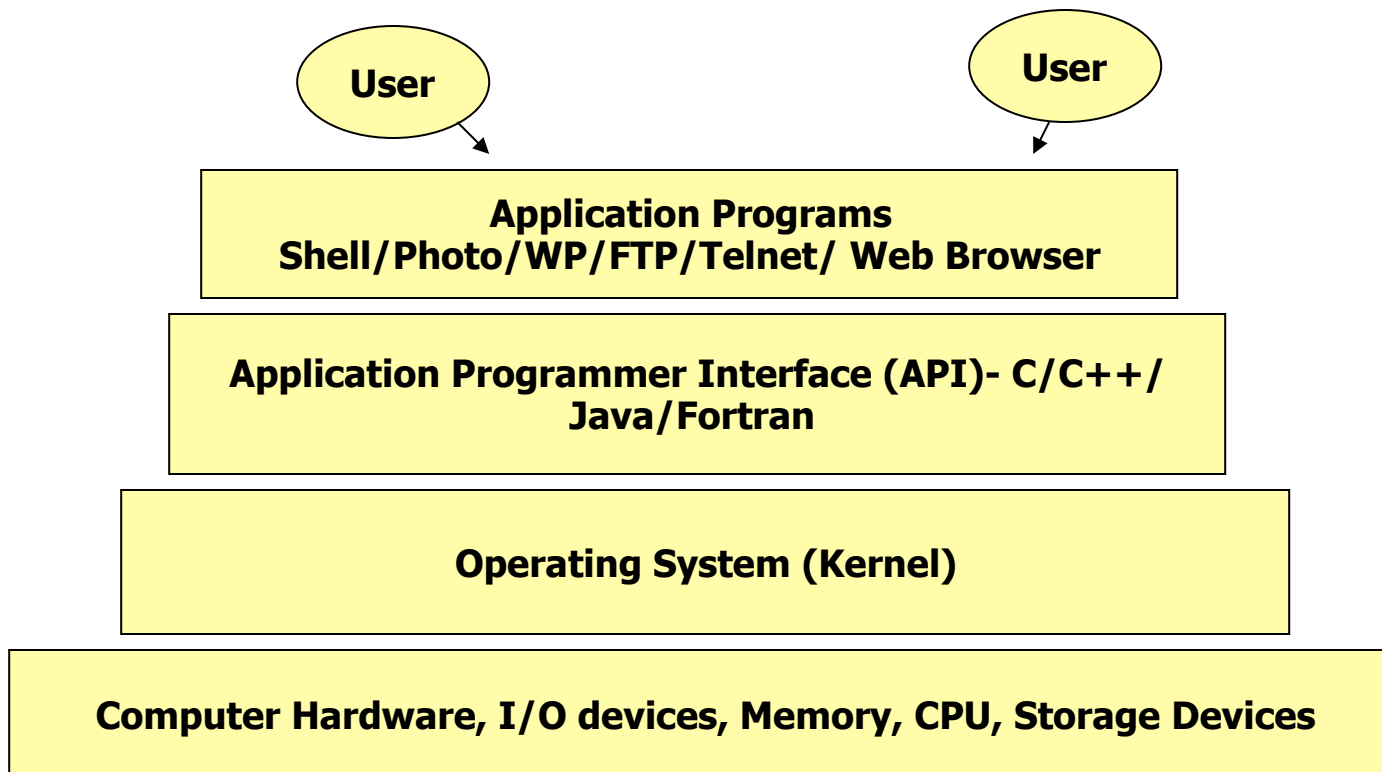
Red Hat and Fedora Core

- Fedora Project was introduced in 1993 to take over Red Hat Linux
- Red Hat 9 was the last version
- The new Linux distro called Fedora Core
  - A new version every six months!
  - 2004 → Fedora Core 3
  - 2005 → Fedora Core 4
    - New applications include OpenOffice, FireFox, GIMP Photo Manipulation program
  - 2007 → Fedora Core 6

A Layered View

User

User

Application Programs
Shell/Photo/WP/FTP/Telnet/ Web Browser

Application Programmer Interface (API)- C/C++/
Java/Fortran

Operating System (Kernel)

Computer Hardware, I/O devices, Memory, CPU, Storage Devices

Kernel Basics

- Linux provides a Top-Bottom View
  - Virtual Machine
  - Isolates the user from the machine
  - Actions such as saving, copying, deleting, memory allocation, etc. are done without having to install external software
- Basic blocks
  - Process Management
  - File Management
  - Memory Management
  - CPU Scheduler
  - Inter-process Communication

Kernel Basic Blocks

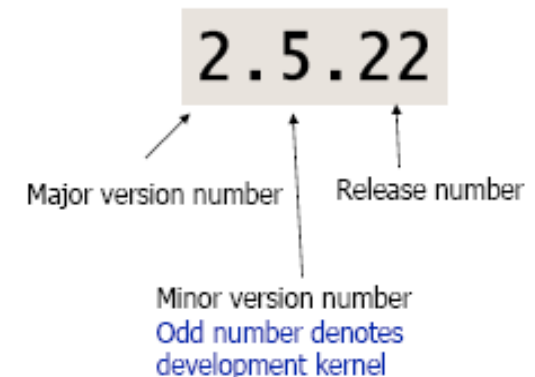|	
File Management	Inter-process Communication (IPC)
CPU Scheduler	Process Management
Primary and Secondary Storage Management	

Kernel

- The Kernel contains the actual Operating System (OS)
- Manages processes in terms of creating, suspending, terminating, and maintenance
- Schedules CPU
- Provides inter-process communications and communicates with devices
- Has many different versions
  - 1.x.y → Major.minor.patch
  - 2.6 is one of the most improved
- Linux 2.6 Version improvements
  - Supports more hardware
  - Higher Stability
    - Supports 4 billion users and 16 TB File System!
  - Handles external devices better (supporting Hot Plug Devices –
  - Supports many new devices (Wireless, USB-based, different stor SCSI, etc.)
  - Better sound system
  - Higher security → Using SELinux (Security Enhanced Linux)

2.5.22

Major version number | Release number

Minor version number
Odd number denotes
development kernel

Linux Platform

- Operating Systems divided according to
    - How many **users** can use the system (logon) at the same time
    - The number of **processors** the system can run simultaneously
- Basic categories
    - Single User / Single Processor (Windows 3.1, DOS)
    - Single User / Multi Processor (Win NT Workstations, OS/2)
    - Multi User / Single Processor (Does it exist?)
    - Multi User / Multi Processor (Linux, Windows NT Server)
        - High resource utilization using multiplexing
        - Uses Time Sharing
        - High Throughput (Number of processes finished in a unit of time)
        - Uses multi-programming – If the current processes is accessing I/O, the CPU can be assigned to another task

Process ←→ Executing the Program

Linux Platform

- A Linux **shell**, also called "the command line"
  - Provides the traditional user interface for the Linux operating system
  - Contains standard commands for Unix
  - Good learning tool to learn Unix!
- Basic Shells applications are
  - BASH, Bourne Shell
    - BASH is similar to Bourne Shell in Unix
  - C Shell, tcsh (TENEX C Shell), scsh (Scheme Shell)
  - http://www.freebsdsoftware.org/shells/ Has list of various shells and their differences

Basic Security In Linux

- ## Without SELinux
  - Domains are divided into Users and Group IDs
  - The ROOT has absolute control
- ## With SELinux
  - Domains are divided into Subjects and Objects
   - Even with Superuser privilege access to some files and devices maybe denied

Logon as ROOT

Linux Desktop
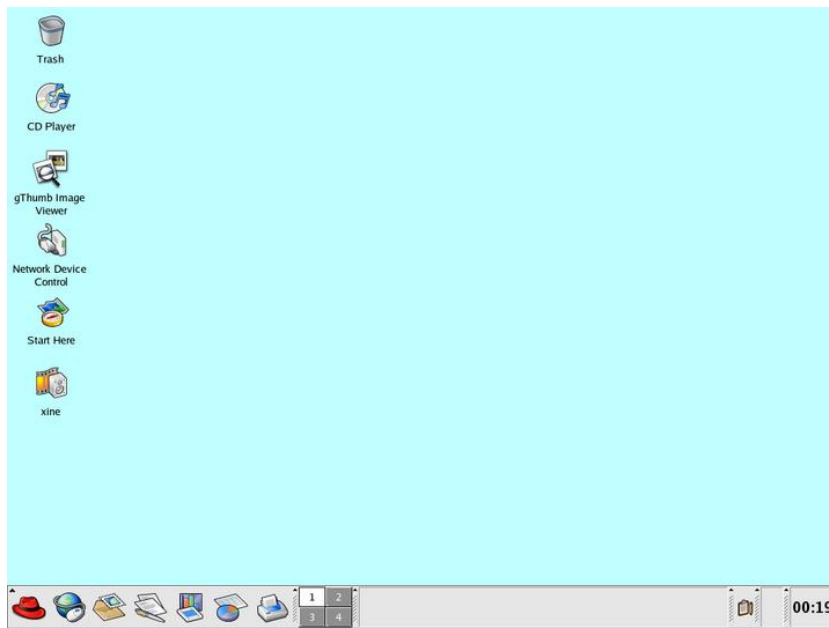
- Using the terminal commands is boring!
- X Window System or X provides standard mechanisms for displaying device-independent, bit-mapped graphics
- How the actual interface looks or feels depends on the GUI interface
  - KDL (K-desktop Environment), GNOME (GNU Network Object Model Environment), etc.
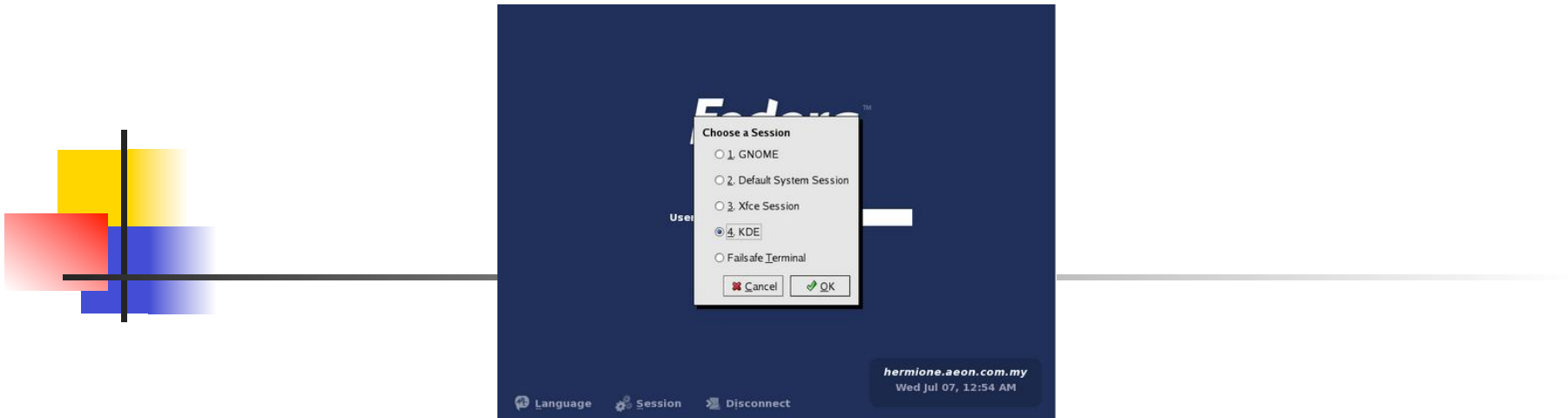
Choosing KDE at the Login Screen

The KDE Desktop (Fedora Core
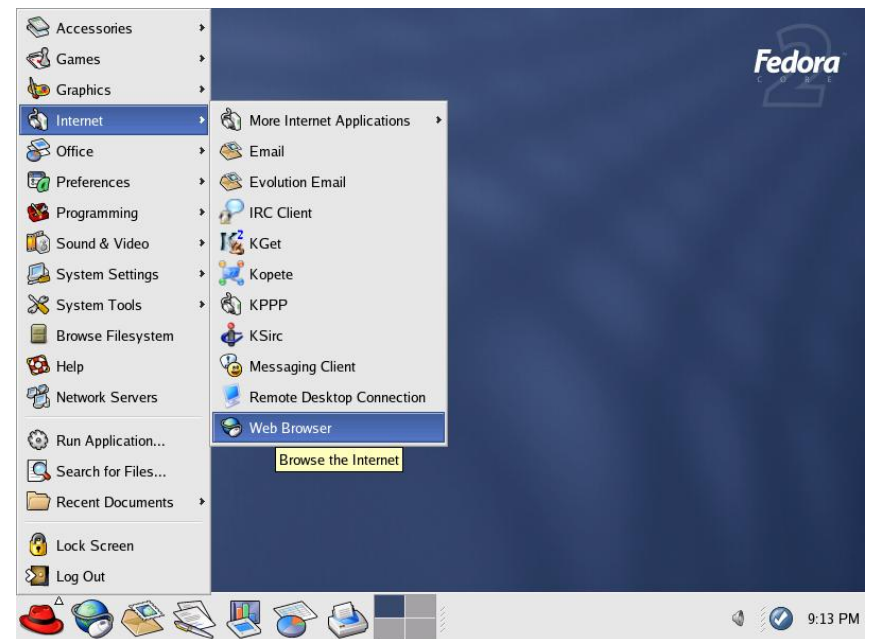
default GNOME Desktop

Kedit Text Editor

- The Kedit text editor is similar to Windows Notepad

- Note that the positioning of the icons is basically the same as Notepad
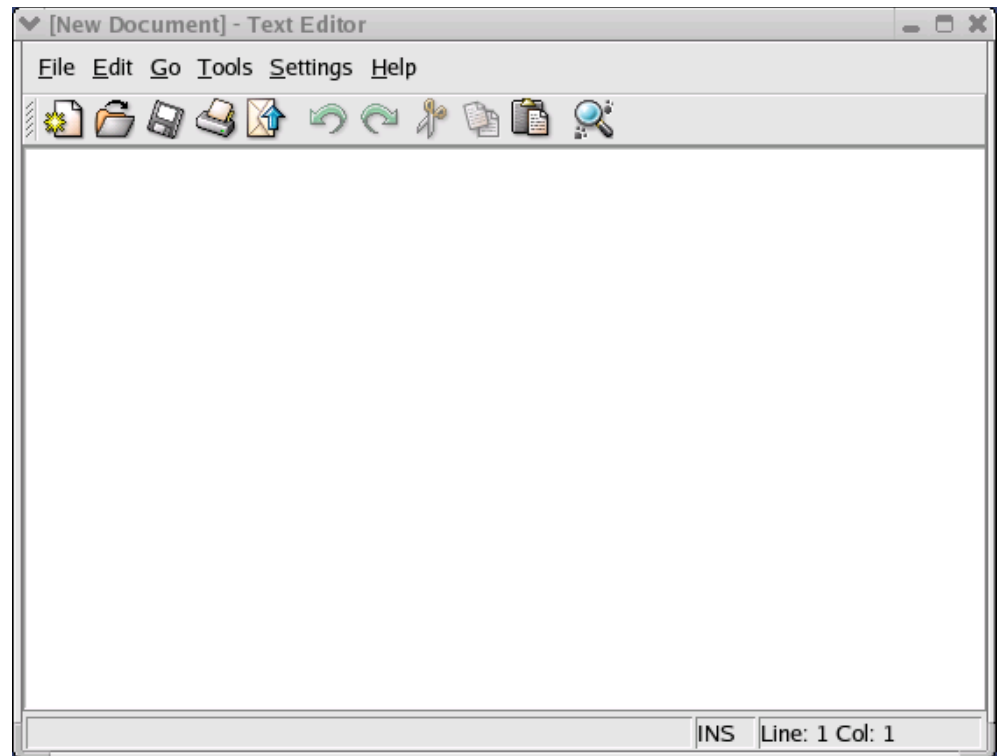
Ways to Get Linux

- Install Linux OS
- Terminal Emulator
  - puTTY, Remote Linux
- Off-campus rlogin using VPN
  - Serer and Viewer: http://www.tightvnc.com/download.php
- Live CD
  - e.g., http://www.knoppix.net/

Shell Prompt

- Most work is done at the shell prompt which is the command-line interface
- Remember root is /
- ls – list files
  - `ls /mnt/floppy` to see contents of floppy
- cd – change directory
  - `cd /mnt/floppy`
- mkdir – create a directory
  - `mkdir /mnt/floppy/test`

Shell Prompt

- ## rmdir – remove a directory
  - `rmdir /mnt/floppy/test`
- ## mv – move or rename a file
  - `mv /etc/ftpaccess /var/ftp/ftpaccess`
- ## cp – copy a file
  - `cp var/ftp/ftpaccess /mnt/floppy`
- ## locate – find a file
  - `locate ftpaccess`
- ## kedit <filename> - start editing a file
  - `kedit /var/ftp/ftpaccess`

Shell Types

- sh – Bourne shell
- csh – C shell
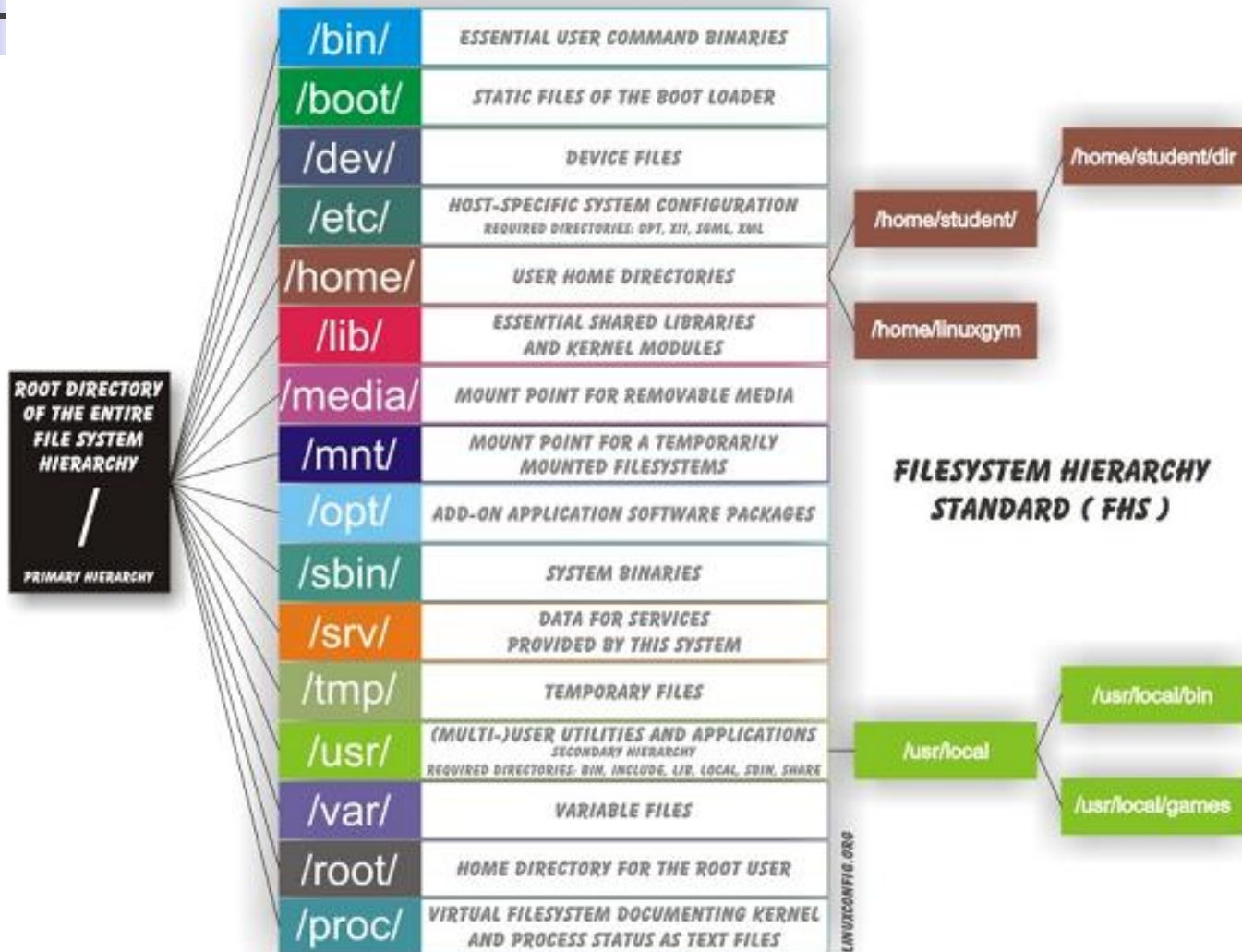- ksh – Korn shell
- bash – Bourne Again (Bash) shell
- tcsh – TENEX C shell
- zsh – Z shell
- rc – rc shell
- es – es shell
- → csh and bash are the most common
- Shells can be changed by simply typing the name of the shell at the command prompt
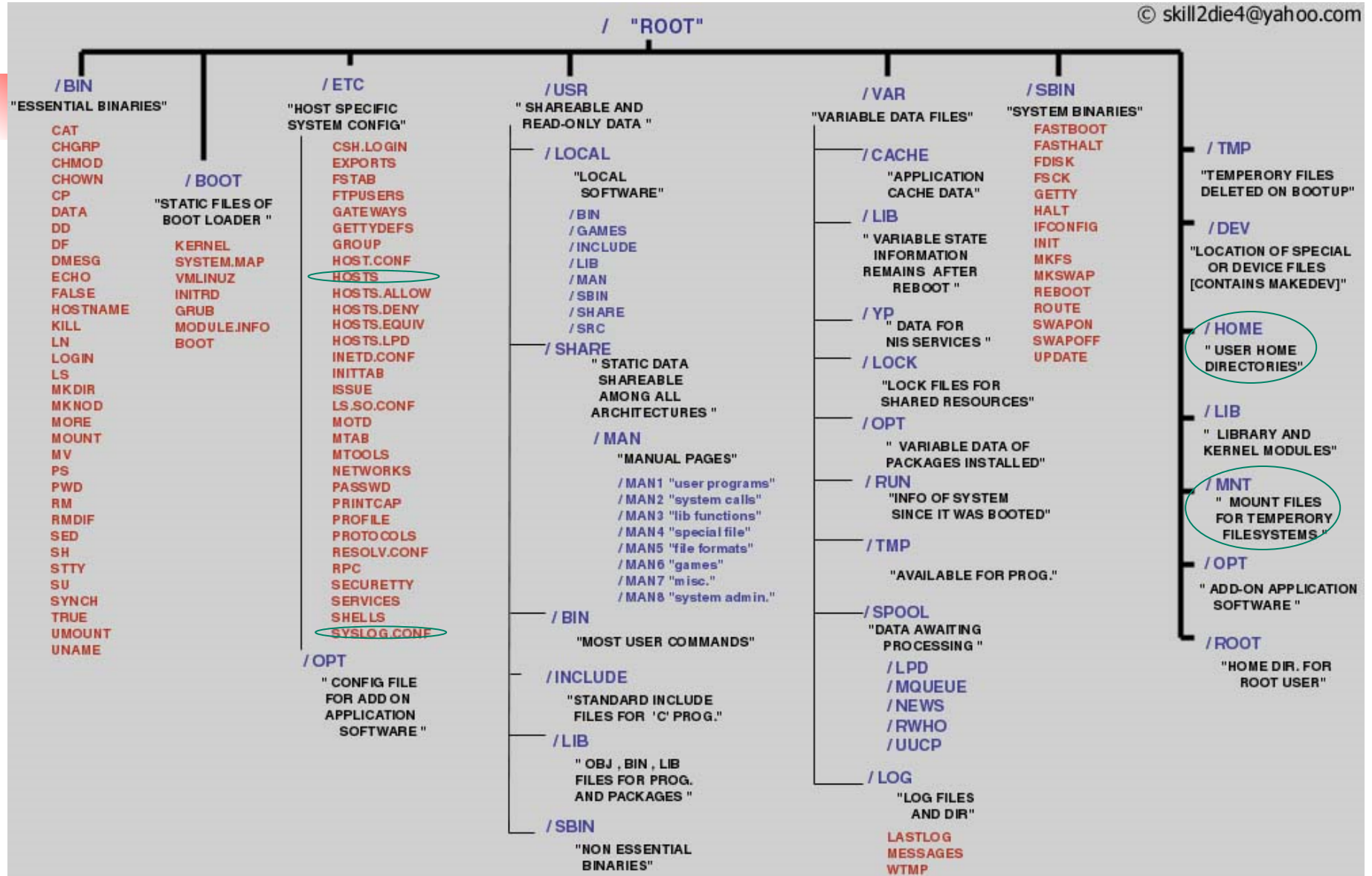 - *chsh* (*change shell*)

A good summary is offered here:
http://telecomm.boisestate.edu/linux/shelldetails.htm

Linux Directory Hierarchy

Linux Directory Hierarchy

© skill2die4@yahoo.com

/ "ROOT"

/ BIN
"ESSENTIAL BINARIES"

CAT
CHGRP
CHMOD
CHOWN
CP
DATA
DD
DF
DMESG
ECHO
FALSE
HOSTNAME
KILL
LN
LOGIN
LS
MKDIR
MKNOD
MORE
MOUNT
MV
PS
PWD
RM
RMDIF
SED
SH
STTY
SU
SYNCH
TRUE
UMOUNT
UNAME

/ BOOT
"STATIC FILES OF
BOOT LOADER "

KERNEL
SYSTEM.MAP
VMLINUZ
INITRD
GRUB
MODULE.INFO
BOOT

/ ETC
"HOST SPECIFIC
SYSTEM CONFIG"

CSH.LOGIN
EXPORTS
FSTAB
FTPUSERS
GATEWAYS
GETTYDEFS
GROUP
HOST.CONF
HOSTS
HOSTS.ALLOW
HOSTS.DENY
HOSTS.EQUIV
HOSTS.LPD
INETD.CONF
INITTAB
ISSUE
LS.SO.CONF
MOTD
MTAB
MTOOLS
NETWORKS
PASSWD
PRINTCAP
PROFILE
PROTOCOLS
RESOLV.CONF
RPC
SECURETTY
SERVICES
SHELLS
SYSLOG.CONF

/ OPT
" CONFIG FILE
FOR ADD ON
APPLICATION
SOFTWARE "

/ USR
" SHAREABLE AND
READ-ONLY DATA "

/ LOCAL
"LOCAL
SOFTWARE"
/ BIN
/ GAMES
/ INCLUDE
/ LIB
/ MAN
/ SBIN
/ SHARE
/ SRC

/ SHARE
" STATIC DATA
SHAREABLE
AMONG ALL
ARCHITECTURES "

/ MAN
"MANUAL PAGES"
/ MAN1 "user programs"
/ MAN2 "system calls"
/ MAN3 "lib functions"
/ MAN4 "special file"
/ MAN5 "file formats"
/ MAN6 "games"
/ MAN7 "misc."
/ MAN8 "system admin."

/ BIN
"MOST USER COMMANDS"

/ INCLUDE
"STANDARD INCLUDE
FILES FOR 'C' PROG."

/ LIB
" OBJ , BIN , LIB
FILES FOR PROG.
AND PACKAGES "

/ SBIN
"NON ESSENTIAL
BINARIES"

/ VAR
"VARIABLE DATA FILES"

/ CACHE
"APPLICATION
CACHE DATA"

/ LIB
" VARIABLE STATE
INFORMATION
REMAINS AFTER
REBOOT "

/ YP
" DATA FOR
NIS SERVICES "

/ LOCK
"LOCK FILES FOR
SHARED RESOURCES"

/ OPT
" VARIABLE DATA OF
PACKAGES INSTALLED"

/ RUN
"INFO OF SYSTEM
SINCE IT WAS BOOTED"

/ TMP
"AVAILABLE FOR PROG."

/ SPOOL
"DATA AWAITING
PROCESSING "
/ LPD
/ MQUEUE
/ NEWS
/ RWHO
/ UUCP

/ LOG
"LOG FILES
AND DIR"
LASTLOG
MESSAGES
WTMP

/ SBIN
"SYSTEM BINARIES"

FASTBOOT
FASTHALT
FDISK
FSCK
GETTY
HALT
IFCONFIG
INIT
MKFS
MKSWAP
REBOOT
ROUTE
SWAPON
SWAPOFF
UPDATE

/ TMP
"TEMPERORY FILES
DELETED ON BOOTUP"

/ DEV
"LOCATION OF SPECIAL
OR DEVICE FILES
[CONTAINS MAKEDEV]"

/ HOME
" USER HOME
DIRECTORIES"

/ LIB
" LIBRARY AND
KERNEL MODULES"

/ MNT
" MOUNT FILES
FOR TEMPERORY
FILESYSTEMS "

/ OPT
" ADD-ON APPLICATION
SOFTWARE "

/ ROOT
"HOME DIR. FOR
ROOT USER"

Let's Get to Work....

- Open a shell....
- Type in the following and observe:

- `w`
- `date`
- `man w (get more information on w command)`
- `whatis man`
- `whereis csh (lists the path)`
- `whoami`
- `hostname`
- `uname (linux)`
- `who (information about current user)`

Let's Get to Work….

- Redirecting:
  - Using **>** and **>>** e.g., *cmd > filename*
  - *Cmd* | tee filename
  - *ls* | tee filename
  - *Cmd > filename & tail –f filename*
- Using utility program grep
  - E.g., *grep ACK filename*
  - *man grep*

Processor Jobs

- Jobs
- fg %n   // %n is job number
- bg %n
- kill %n
- reboot
- halt

File System Permissions in Linux

Permission type	When used with files	When used with directories
Read	Read a file or copy a file	List the contents of a directory
Write	Write to the file, including deleting the file	Create files
Execute	Execute programs and shell scripts, which are text files containing Linux commands	Modify the file permissions

Linux Permissions

- Permissions are set for user, group, and others
- Each permission is set with a single digit from 0 to 7 based on the combination of permissions
  - read = 4
  - write = 2
  - execute = 1

Using chmod to Set Permissions

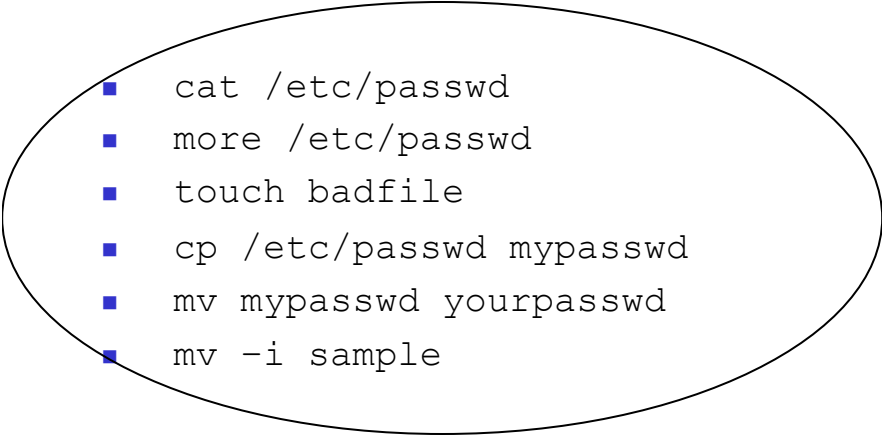| Command	Permissions		
	Owner	Group	Other
chmod 755 myfile	rwx	r-x	r-x
chmod 540 myfile	r-x	r--	---
chmod 744 myfile	rwx	r--	r--

Finding Your IP Address

- Use "uname"

- Using grep command (or anything else) you can display the IP address and machine name

Some Basic Commands

- pwd
- cd /bin
- ls
- ls -l
- ls -l/more
- .win ls -a (show hidden files)
- mkdir myoffice
- mkdir /root/mydocuments
- rmdir office

- w
- date
- man w (get more information on w command)
- whatis man
- whereis tcsh (lists the path)
- whoami
- hostname
- **uname** (linux)
- who (information about current user)

- cat /etc/passwd
- more /etc/passwd
- touch badfile
- cp /etc/passwd mypasswd
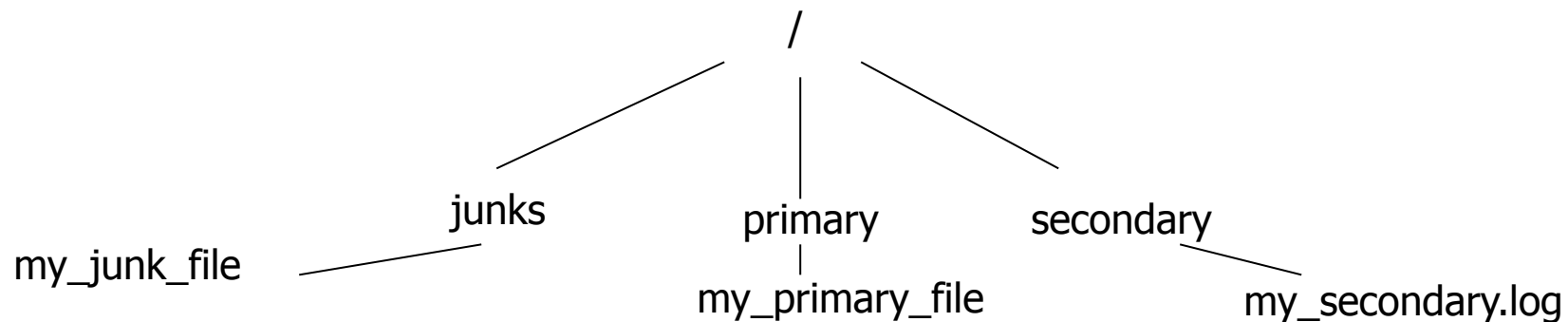- mv mypasswd yourpasswd
- mv -i sample

Make sure you can
do these!

Using mTools to read your floppy

- mTool comes with all distros
- Check the version:
  - `rpm -q mtools`
  - Typically will be `mtools – 3.9.9 -13`
- Common commands
  - `mdir a:`
  - `mmove`
  - `mformat`
  - `mcopy`
- Check the mtool.conf
  - `less /etc/mtools.conf`

Practice

- Read about chmod - Read about <u>LINUX permissions</u> (check the hyperlink)
- Find install.log file
- Write a shell script and using grep command (or anything else) display the IP address and machine name (use uname)
- Create the following directories and files (/ is the root directory):

```
                              /
               /              |              \
            junks          primary         secondary
           /                  |                  \
  my_junk_file         my_primary_file        my_secondary.log
```

Linux Resources

- ## Useful Linux Related
  - http://distrowatch.com/
- ## Fedora vs Mandrake vs Suse: Linux Distros Compared
  - http://www.flexbeta.net/main/printarticle.php?id=70

Multi-OS Environment

- ## Installing two different OS
  - Two different partitions
  - No access to each other
- ## Using an emulator
  - E.g., WMware runs copies of the guest OS on the HD

Host OS	VMWare VPC/ WINE	Guest OS

Windows   Linux
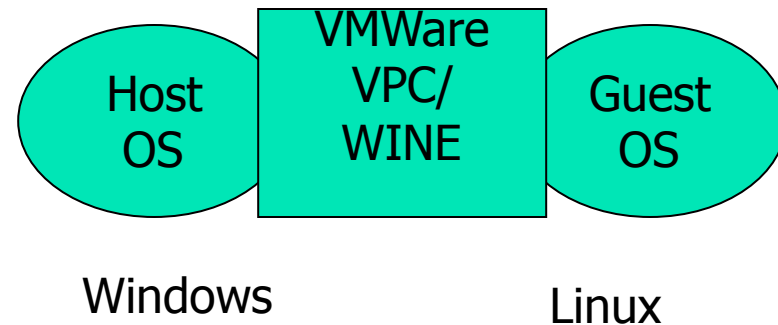
Wine - Windows apps running without Windows