# An Introduction to Linux

&

Linux for S/390

# Credits

- Cleveland Linux Users' Group
  - Introduction to Linux (Jeff Gilton & Jim Weirich)
- IBM
  - An Introduction to Linux (Al Henderson)
  - Why Linux is storming the market (Jonathan Prial)
- Ivan Bowman
  - Conceptual software architecture of the Linux kernel

# Contents

- A quick guide to Linux
  - Background
  - Using Linux
  - S/390 Specifics
- Linux in the Marketplace
- Commercial Linux Applications
- Additional Resources

# What is Linux

- A fully-networked 32/64-Bit Unix-like Operating System
  - Unix Tools Like sed, awk, and grep (explained later)
  - Compilers Like C, C++, Fortran, Smalltalk, Ada
  - Network Tools Like telnet, ftp, ping, traceroute
- Multi-user, Multitasking, Multiprocessor
- Has the X Windows GUI
- Coexists with other Operating Systems
- Runs on multiple platforms
- Includes the Source Code

# Where did it come from?

- Linus Torvalds created it
  - with assistance from programmers around the world
  - first posted on Internet in 1991
- Linux 1.0 in 1994; 2.2 in 1999
- Today used on 7-10 million computers
  - with 1000's of programmers working to enhance it

# Open Source Software

- When programmers on the Internet can read, redistribute, and modify the source for a piece of software, **it evolves**
- People improve it, people adapt it, people fix bugs. And this can happen at a speed that, compared to conventional software development, seems **astonishing**

# How do you get it?

- Download it from the Internet
- From a “Distribution” (e.g. RedHat)
  - Linux kernel
  - X Windows system and GUI
  - Web, e-mail, FTP servers
  - Installation & configuration support
  - 3rd party apps
  - Hardware support

# Why is it significant?

- Growing popularity
- Powerful
  - Runs on multiple hardware platforms
  - Users like its speed and stability
  - No requirement for latest hardware
- It's "free"
  - Licensed under GPL
  - Vendors are distributors who package Linux

# Linux/390

Using it

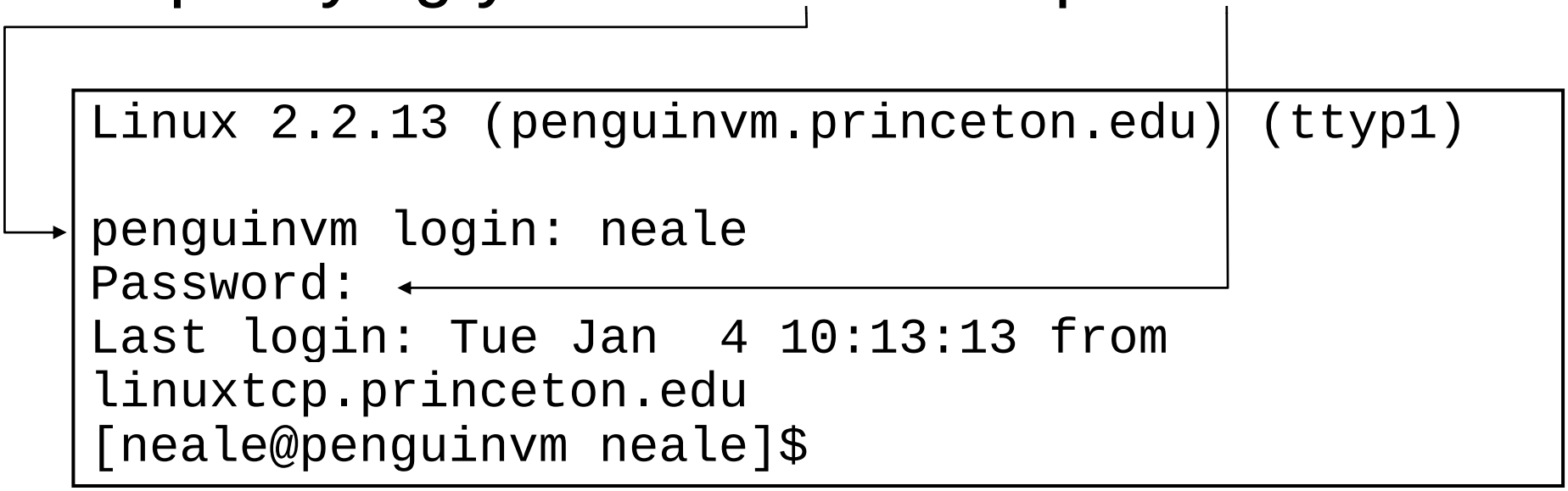

Powered by S/390

# Logging In

- Connect to the Linux system using telnet:
  - vt100, vt220, vt320
  - ansi
  - tty
  - X-windows
- Able to login more than once with same user
- No ‘MW’ problems!

# Logging In

- Before you can use it you must login by specifying your account and password:



# Rule Number 1

- Do not login as root unless you have to
- root is the system superuser (the “maint” of Linux but more “dangerous”)
  - Normal protection mechanisms can be overridden
  - Careless use can cause damage
  - Has access to everything by default
- root is the only user defined when you install
  - First thing is to change root’s password
  - The second job is to define “normal” users for everyday use

# Creating a new user

- Use the `useradd` command
- Use the `passwd` command to set password
- Try it... logon as `root`

```
[root@penguinvm]# useradd scully
[root@penguinvm]# passwd scully
Changing password for user scully
New UNIX password:
Retype new UNIX password:
passwd: all authentication tokens updated
successfully
[root@penguinvm]#
```

# Adding a new user

- Limits on users can be controlled by
  - Quotas
  - `ulimit` command
- Authority levels for a user controlled by group membership

# Users and Groups

- Users are identified by user identifications (UIDs), each of which is associated with an integer in the range of 0 to 4 294 967 295 (X'FFFFFFFF'). Users with UID=0 are given superuser privileges.
- Users are placed in groups, identified by group identifications (GIDs). Each GID is associated with an integer in the range from 0 to 4 294 967 295
- Let the system assign UID to avoid duplicates
- Use `id` to display your user and group information

```
uid=500(neale) gid=500(neale) groups=500(neale),3(sys),4(adm)
```

# Users and Groups

- Groups define functional areas/responsibilities
- They allow a collection of users to share files
- A user can belong to multiple groups
- You can see what groups you belong to using the `groups` command:

```
neale sys adm
```

# Typical Group Setup

sys

bin

adm

staff

# Using the new user

- Now logoff using the `exit` command
- login as the new user

```
Linux 2.2.13 (penguinvm.princeton.edu) (ttyp2)

penguinvm login: scully
Password:
[scully@penguinvm scully]$
```

# You need help?

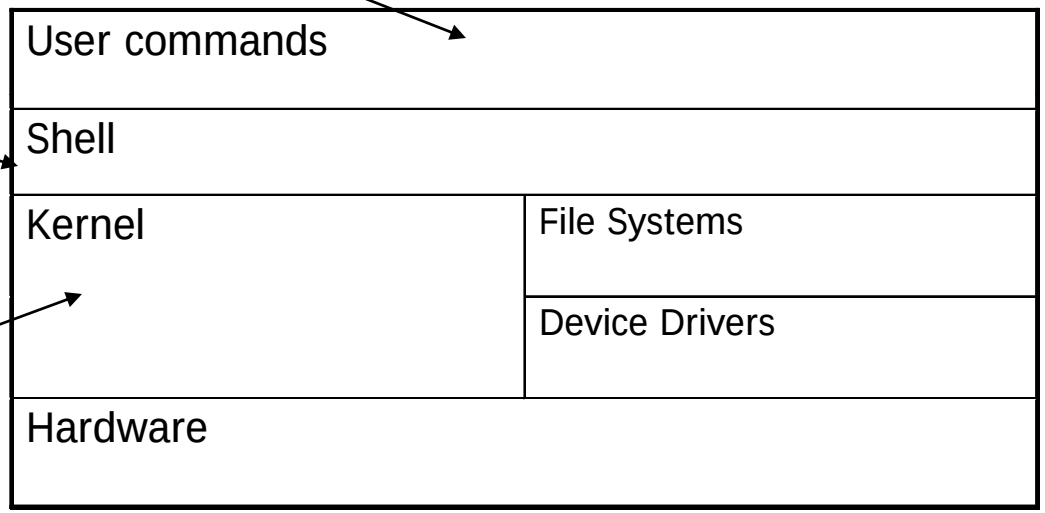
- The Linux equivalent of HELP is `man` (manual)
  - Use `man -k <keyword>` to find all commands with that keyword
  - Use `man <command>` to display help for that command
    - Output is presented a page at a time. Use `b` for to scroll backward, `f` or a space to scroll forward and `q` to quit

# The Linux System

User commands includes executable programs and scripts

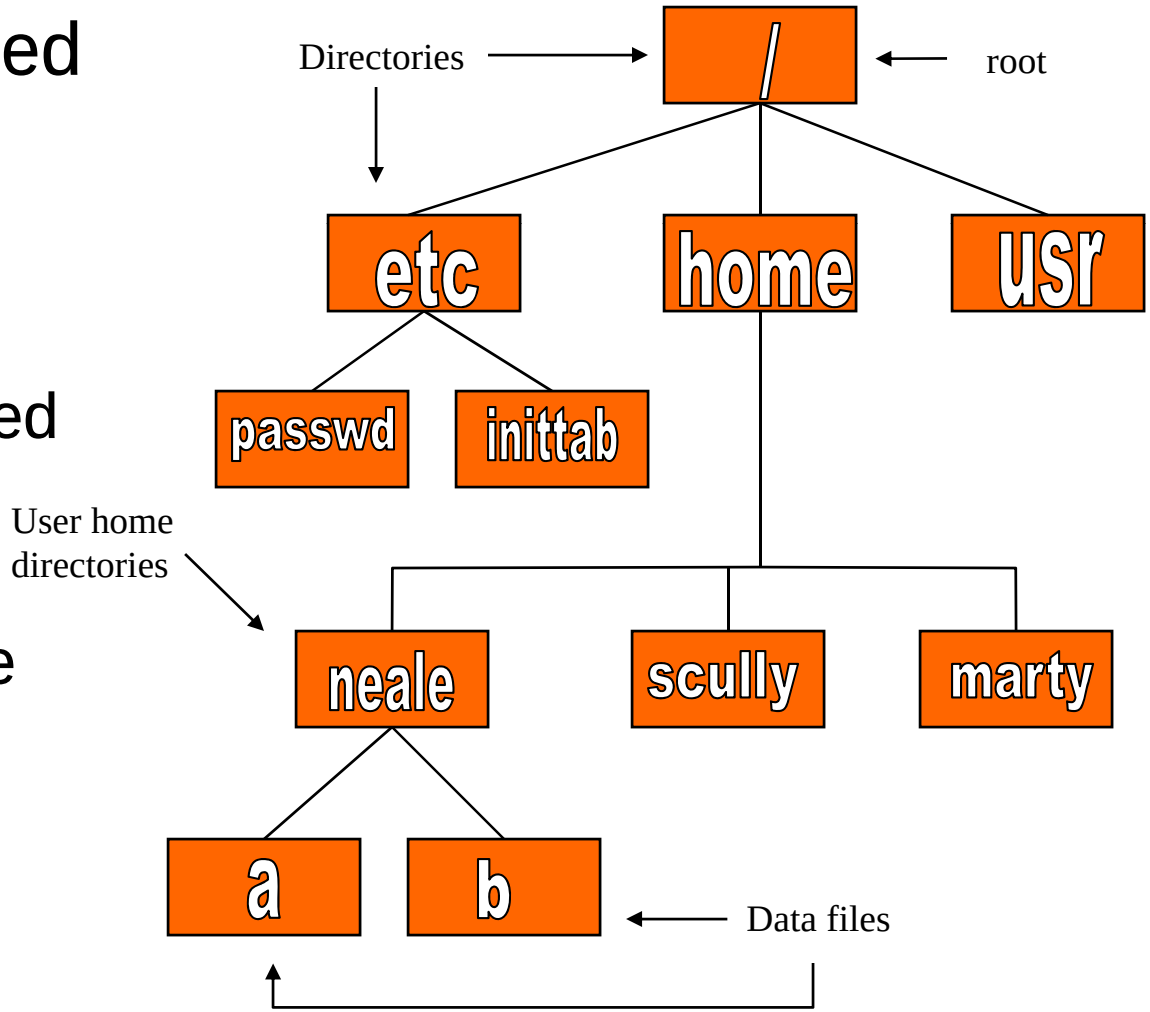
The shell interprets user commands. It is responsible for finding the commands and starting their execution. Several different shells are available. Bash is popular,

The kernel manages the hardware resources for the rest of the system.



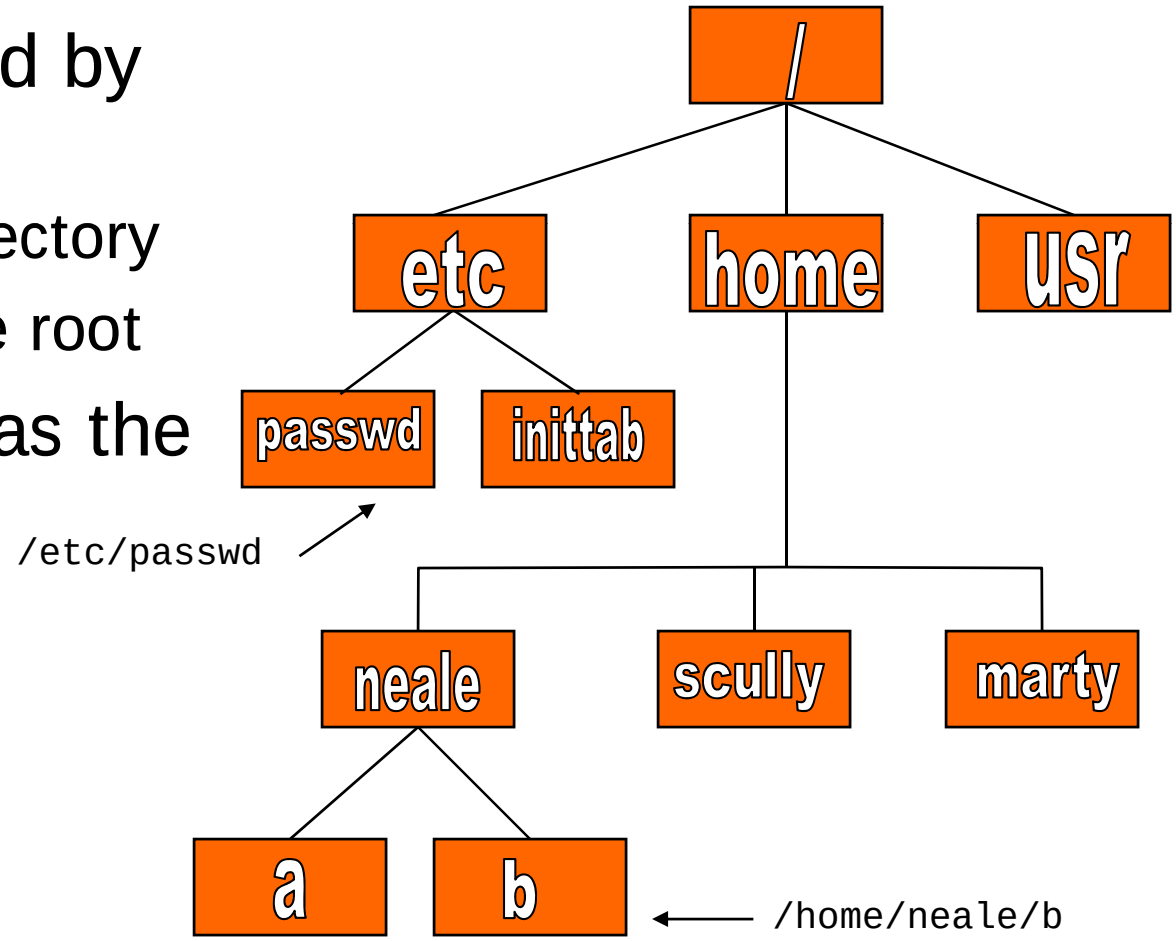
# Linux File System Basics

- Linux files are stored in a single rooted, hierarchical file system
  - Data files are stored in directories (folders)
  - Directories may be nested as deep as needed



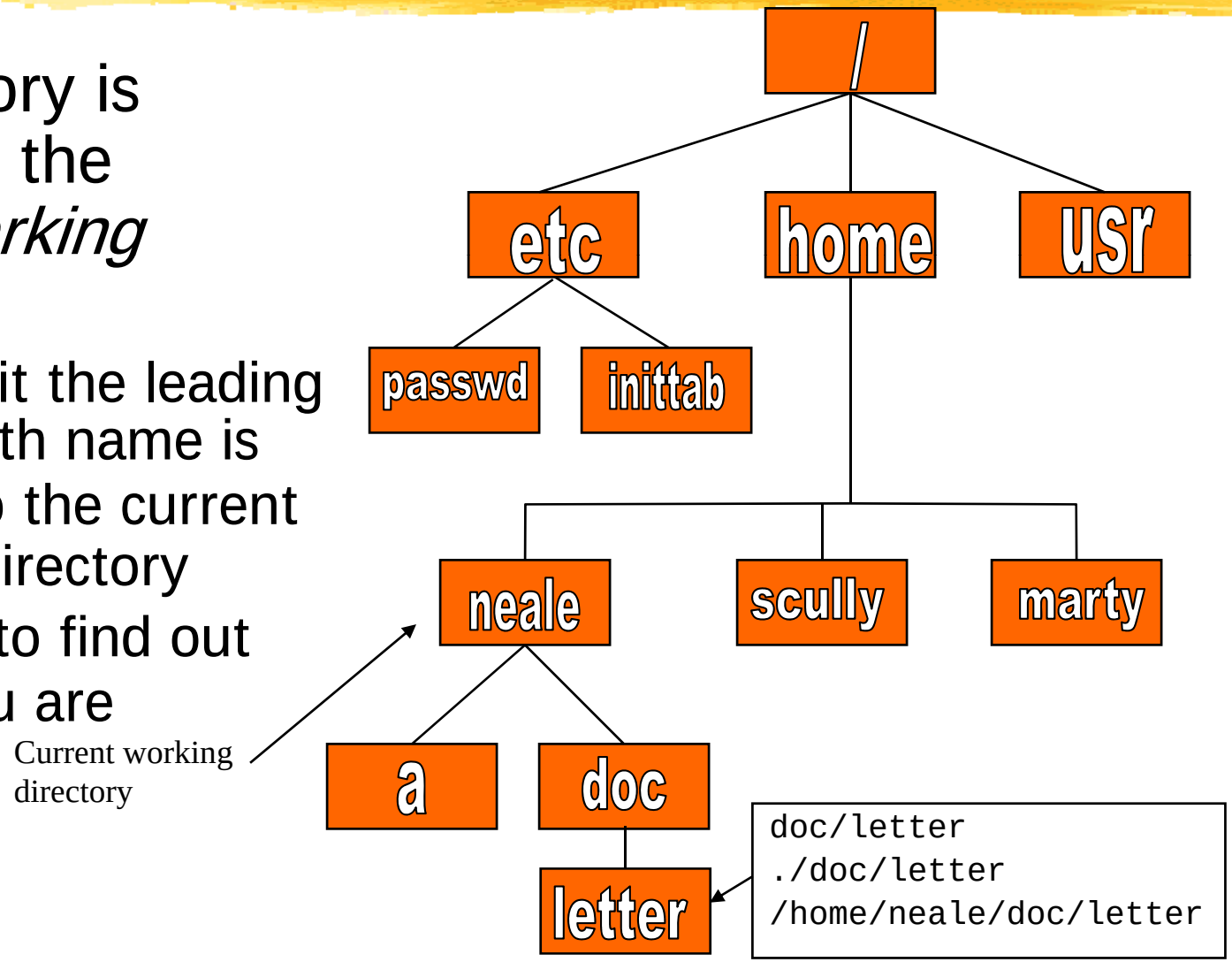
# Naming Files

- Files are named by
  - naming each containing directory
  - starting at the root
- This is known as the *pathname*



# The Current Directory

- One directory is designated the *current working directory*
  - if you omit the leading / then path name is relative to the current working directory
  - Use pwd to find out where you are



# Some Special File Names

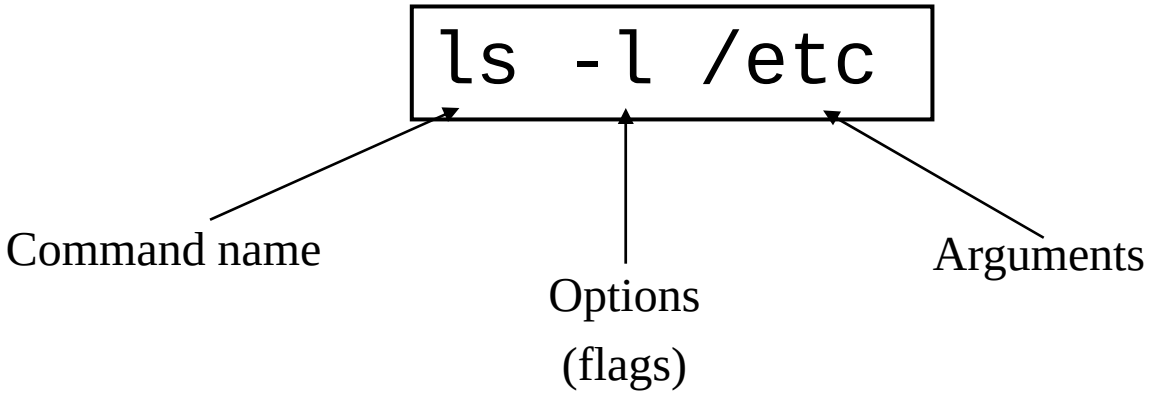
- Some file names are special:
  - `/` The root directory (not to be confused with the root user)
  - `.` The current directory
  - `..` The parent (previous) directory
  - `~` My home directory
- Examples:
  - `./a` same as a
  - `../jane/x` go up one level then look in directory `jane` for `x`

# Special Files

- `/home` - all users' home directories are stored here
- `/bin`, `/usr/bin` - system commands
- `/sbin`, `/usr/sbin` - commands used by sysadmins
- `/etc` - all sorts of configuration files
- `/var` - logs, spool directories etc.
- `/dev` - device files
- `/proc` - special system files

# Linux Command Basics

- To execute a command, type its name and arguments at the command line



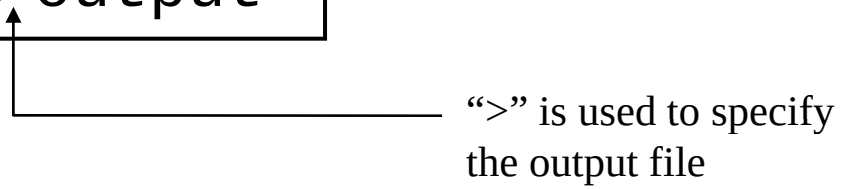
# Standard Files

- UNIX concept of “standard files”
  - standard input (where a command gets its input) - default is the terminal
  - standard output (where a command writes it output) - default is the terminal
  - standard error (where a command writes error messages) - default is the terminal

# Redirecting Output

- The output of a command may be sent (piped) to a file:

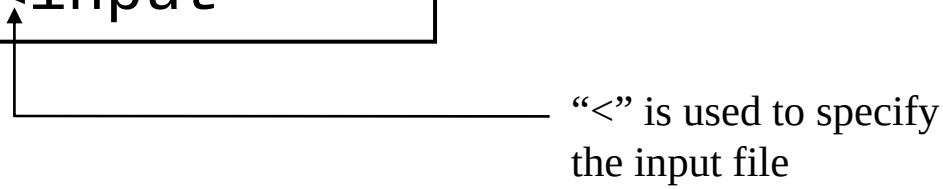
```
ls -l >output
```



# Redirecting Input

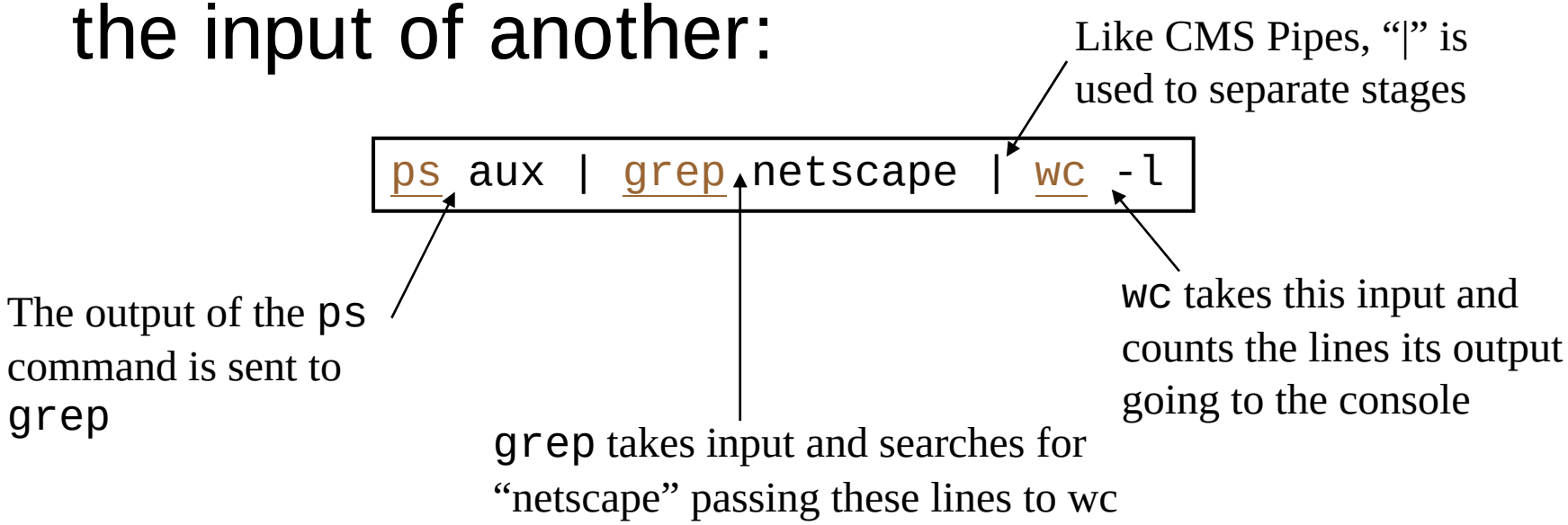
- The input of a command may come (be piped) from a file:

```
wc <input
```



# Connecting commands with Pipes

- Not as powerful as CMS Pipes but the same principle
- The output of one command can become the input of another:



# Command Options

- Command options allow you to control a command to a certain degree
- Conventions:
  - Usually being with a single dash and are a single letter (“`-l`”)
  - Sometimes have double dashes followed by a keyword (“`--help`”)
  - Sometimes follow no pattern at all

# Common Commands

- `pwd` - print (display) the working directory
- `cd` *<dir>* - change the current working directory to *dir*
- `ls` - list the files in the current working directory
- `ls -l` - list the files in the current working directory in long format

# File Commands

- `cp <fromfile> <tofile>`
  - Copy from the <fromfile> to the <tofile>
- `mv <fromfile> <tofile>`
  - Move/rename the <fromfile> to the <tofile>
- `rm <file>`
  - Remove the file named <file>
- `mkdir <newdir>`
  - Make a new directory called <newdir>
- `rmdir <dir>`
  - Remove an (empty) directory

# More Commands

- `who`
  - List who is currently logged on to the system
- `whoami`
  - Report what user you are logged on as
- `ps`
  - List your processes on the system
- `ps aux`
  - List all the processes on the system
- `echo “A string to be echoed”`
  - Echo a string (or list of arguments) to the terminal

# More Commands

- `alias` - used to tailor commands:
  - `alias erase=rm`
  - `alias grep=”grep -i”`
- `ar` - Maintain archive libraries: a collection of files (usually object files which may be linked to a program, like a CMS TXTLIB)

```
ar -t libgdbm.a
__.SYMDEF
dbmopen.o
```

# More Commands

- awk - a file processing language that is well suited to data manipulation and retrieval of information from text files
- chown - sets the user ID (UID) to owner for the files and directories named by pathname arguments. This command is useful when from test to production

```
chown -R apache:httpd /usr/local/apache
```

# More Commands

- `diff` - attempts to determine the minimal set of changes needed to convert a file specified by the first argument into the file specified by the second argument
- `find` - Searches a given file hierarchy specified by path, finding files that match the criteria given by expression

# More Commands

- grep - Searches files for one or more pattern arguments. It does plain string, basic regular expression, and extended regular expression searching

```
find ./ -name "*.c" | xargs grep -i "fork"
```

In this example, we look for files with an extension “c” (that is, C source files). The filenames we find are passed to the xargs command which takes these names and constructs a command line of the form: `grep -i fork <file.1>…<file.n>`. This command will search the files for the occurrence of the string “fork”. The “`-i`” flag makes the search case insensitve.

# More Commands

- kill - sends a signal to a process or process group
- You can only kill your own processes unless you are root

```
UID         PID  PPID  C STIME TTY          TIME CMD
root       6715  6692  2 14:34 ttyp0    00:00:00 sleep 10h
root       6716  6692  0 14:34 ttyp0    00:00:00 ps -ef
[root@penguinvm log]# kill 6715
[1]+  Terminated              sleep 10h
```

# More Commands

- `make` - helps you manage projects containing a set of interdependent files (e.g. a program with many source and object files; a document built from source files; macro files)
- `make` keeps all such files up to date with one another: If one file changes, `make` updates all the other files that depend on the changed file
- Roughly the equivalent of VMFBLD

# More Commands

- `sed` - applies a set of editing subcommands contained in a script to each argument input file

```
find ./ -name "*.c,v" | sed 's/,v//g' | xargs grep "PATH"
```

This `finds` all files in the current and subsequent directories with an extension of c,v. `sed` then strips the ,v off the results of the find command. `xargs` then uses the results of `sed` and builds a `grep` command which searches for occurrences of the word PATH in the C source files.

# More Commands

- `tar` - manipulates archives
  - An archive is a single file that contains the complete contents of a set of other files; an archive preserves the directory hierarchy that contained the original files. Similary to a VMARC file

```
tar -tzf imap-4.7.tar.gz
imap-4.7/
imap-4.7/src/
imap-4.7/src/c-client/
imap-4.7/src/c-client/env.h
imap-4.7/src/c-client/fs.h
```

# Shells

- An interface between the Linux system and the user
- Used to call commands and programs
- An interpreter
- Powerful programming language
  - “Shell scripts” = .bat .cmd EXEC REXX
- Many available (bsh; ksh; csh; bash; tcsh)

# Another definition of a Shell

- A shell is any program that takes input from the user, translates it into instructions that the operating system can understand, and conveys the operating system's output back to the user.
  - i.e. Any User Interface
  - Character Based v Graphics Based

# Why Do I Care About The Shell?

- Shell is Not Integral Part of OS
  - UNIX Among First to Separate
  - Compare to MS-DOS, Mac, Win95, VM/CMS
  - GUI is NOT Required
  - Default Shell Can Be Configured
    - `chsh -s /bin/bash`
    - `/etc/passwd`
  - Helps To Customize Environment

# Shell Scripts

```
#!/bin/bash
while
true
do
    cat somefile > /dev/null
    echo .
done
```

```
/* */
do forever
   'PIPE < SOME FILE | hole'
   say '.'
end
```

# Switching Users

- `su` *<accountname>*
  - switch user accounts. You will be prompted for a password. When this command completes, you will be logged into the new account. Type `exit` to return to the previous account
- `su`
  - Switch to the root user account. Do not do this lightly

**Note:** The root user does not need to enter a password when switching users. It may become any user desired. This is part of the power of the root account.

# Environment Variables

- Environment variables are global settings that control the function of the shell and other Linux programs. They are sometimes referred to global shell variables.
- Setting:
  - `VAR=/home/fred/doc`
  - `export TERM=ansi`
  - `SYSTEMNAME=`uname -n``
- Similar to GLOBALV SET ... in CMS

# Environment Variables

- Using Environment Variables:
  - `echo $VAR`
  - `cd $VAR`
  - `cd $HOME`
  - `echo “You are running on $SYSTEMNAME”`
- Displaying - use the following commands:
  - `set` (displays local & env. Vars)
  - `export`
- Vars can be retrieved by a script or a program

# Some Important Environment Variables

- HOME
  - Your home directory (often be abbreviated as “~”)
- TERM
  - The type of terminal you are running (for example vt100, xterm, and ansi)
- PWD
  - Current working directory
- PATH
  - List of directories to search for commands

# PATH Environment Variable

- Controls where commands are found
  - PATH is a list of directory pathnames separated by colons. For example:

    ```
    PATH=/bin:/usr/bin:/usr/X11R6/bin:/usr/local/bin:/home/scully/bin
    ```

  - If a command does not contain a slash, the shell tries finding the command in each directory in PATH. The first match is the command that will run

# PATH Environment Variable

- Similar to setting the CMS search order
- Usually set in `/etc/profile` (like the SYSPROF EXEC)
- Often modified in `~/.profile` (like the PROFILE EXEC)

# File Permissions

- Every file
  - Is owned by someone
  - Belongs to a group
  - Has certain access permissions for owner, group, and others
  - Default permissions determined by `umask`

# File Permissions

- Every user:
  - Has a uid (login name), gid (login group) and membership of a "groups" list:
    - The *uid* is who you are (name and number)
    - The *gid* is your initial “login group” you normally belong to
    - The *groups list* is the file groups you can access via group permissions

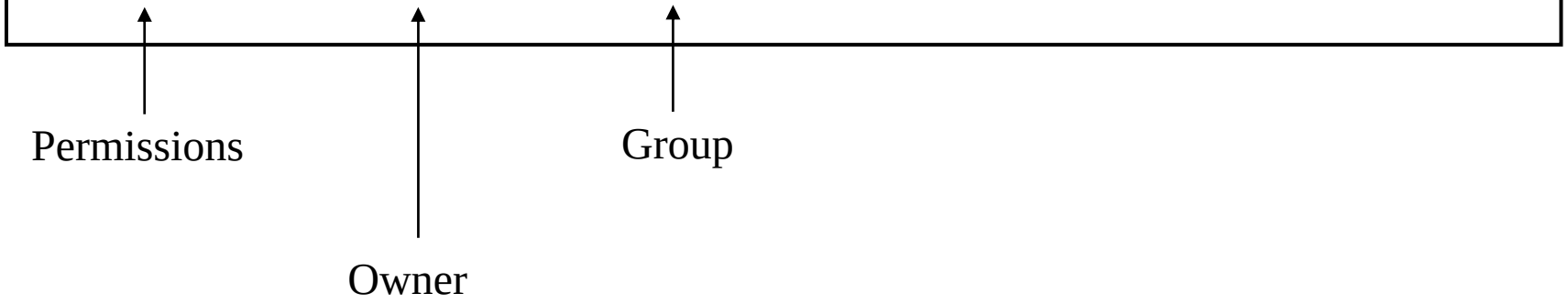
# File Permissions

- Linux provides three kinds of permissions:
  - Read - users with read permission may read the file or list the directory
  - Write - users with write permission may write to the file or new files to the directory
  - Execute - users with execute permission may execute the file or lookup a specific file within a directory

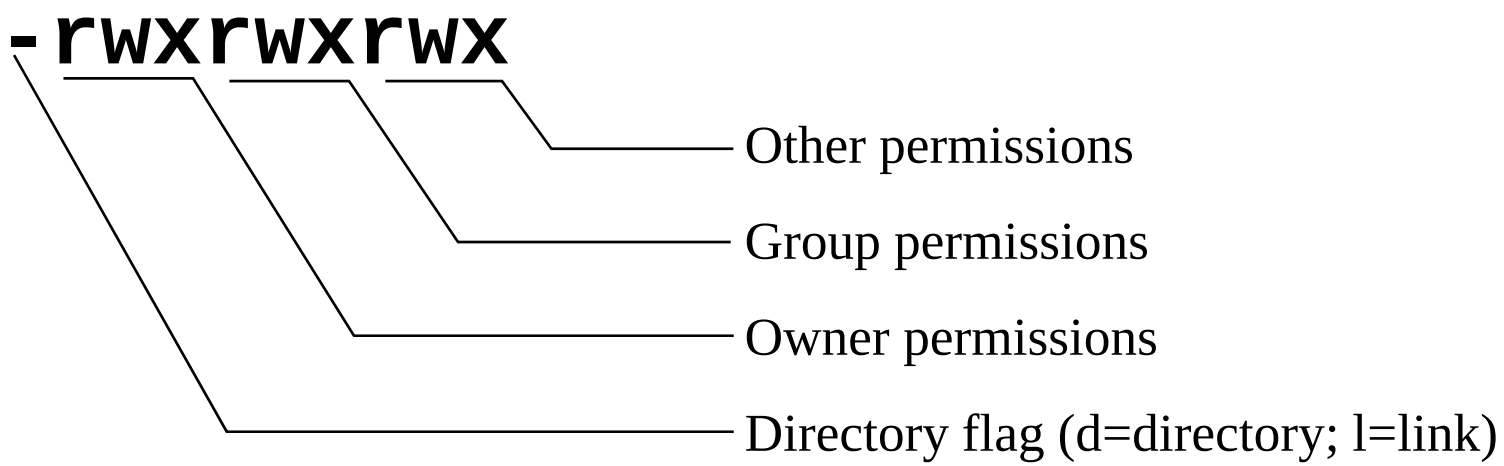
# File Permissions

- The long version of a file listing (`ls -l`) will display the file permissions:

```
-rwxrwxr-x   1 rvdheij  rvdheij      5224 Dec 30 03:22 hello
-rw-rw-r--   1 rvdheij  rvdheij       221 Dec 30 03:59 hello.c
-rw-rw-r--   1 rvdheij  rvdheij      1514 Dec 30 03:59 hello.s
drwxrwxr-x   7 rvdheij  rvdheij      1024 Dec 31 14:52 posixuft
```



# Interpreting File Permissions



# Changing File Permissions

- Use the `chmod` command to change file permissions
  - The permissions are encoded as an octal number

```
chmod 755 file  # Owner=rwx Group=r-x Other=r-x
chmod 500 file2 # Owner=r-x Group=--- Other=---
chmod 644 file3 # Owner=rw- Group=r-- Other=r--

chmod +x  file  # Add execute permission to file for all
chmod o-r file  # Remove read permission for others
chmod a+w file  # Add write permission for everyone
```

# Links?

- Links are references to files (aliases)
- Two forms:
  - Hard
  - Symbolic
    - Can point to files on different physical devices
    - Delete of original leaves link
    - Delete of link leaves original
    - Can be created for directories
- Create using `ln` command

# Editors

- People are fanatical about their editor
- Several choices available:
  - `vi` Standard UNIX editor
  - `the` XEDIT-like editor
  - `xedit` X windows text editor
  - `emacs` Extensible, Customizable Self-Documenting Display Editor
  - `pico` Simple display-oriented text editor
  - `nedit` X windows Motif text editor

# Linux Device Handling

- Devices are the way linux talks to the world
- Devices are special files in the `/dev` directory (try `ls /dev`)

| | |
|---|---|
| /dev/ttyx | TTY devices |
| /dev/hdb | IDE hard drive |
| /dev/hdb1 | Partition 1 on the IDE hard drive |
| /dev/mnda | VM Minidisk |
| /dev/dda | Channel Attached DASD |
| /dev/dda1 | Partition 1 on DASD |
| /dev/null | The null device (“hole”) |
| /dev/zero | An endless stream of zeroes |
| /dev/mouse | Link to mouse (not /390) |

# Devices and Drivers

- Each /dev file has a major and minor number
  - Major defines the device type
  - Minor defines device within that type
  - Drivers register a device type

```
brw-r--r--   1 root     root       64,   0 Jun  1  1999 /dev/mnda
crw-r--r--   1 root     root        5,   0 Jan  5 09:18 /dev/tty
```

Device Type:
b - block
c - character

Major no.

Minor no.

# Special Files - /proc

- Information about internal Linux processes are accessible to users via the /proc file system (in memory)

| | |
|---|---|
| /proc/cpuinfo | CPU Information |
| /proc/interrupts | Interrupt usage |
| /proc/version | Kernel version |
| /proc/modules | Active modules |

```
cat /proc/cpuinfo
vendor_id       : IBM/S390
# processors    : 1
bogomips per cpu: 86.83
processor 0: version = FF, identification = 045226, machine = 9672
```

# File Systems

- Linux supports many different types
- Most commonly, ext2fs
  - Filenames of 255 characters
  - File sizes up to 2GB
  - Theoretical limit 4TB
- Derived from extfs
- Highly reliable and high performer

# File Systems

- Other file systems:
  - sysv - SCO/Xenix
  - ufs - SunOS/BSD
  - vfat - Win9x
  - msdos - MS-DOS/Win
  - umsdos - Linux/DOS
  - ntfs - WinNT (r/o)
  - hpfs - OS/2 (r/o)
- Other File systems:
  - iso9660 (CD-ROM)
  - nfs - NFS
  - coda - NFS-like
  - ncp - Novell
  - smb - LANManager

    etc

# File Systems

- `mount`
  - Mounts a file system that lives on a device to the main file tree
  - Start at Root file system
    - Mount to root
    - Mount to points currently mounted to root
  - `/etc/fstab` used to establish boot time mounting

# Virtual File System

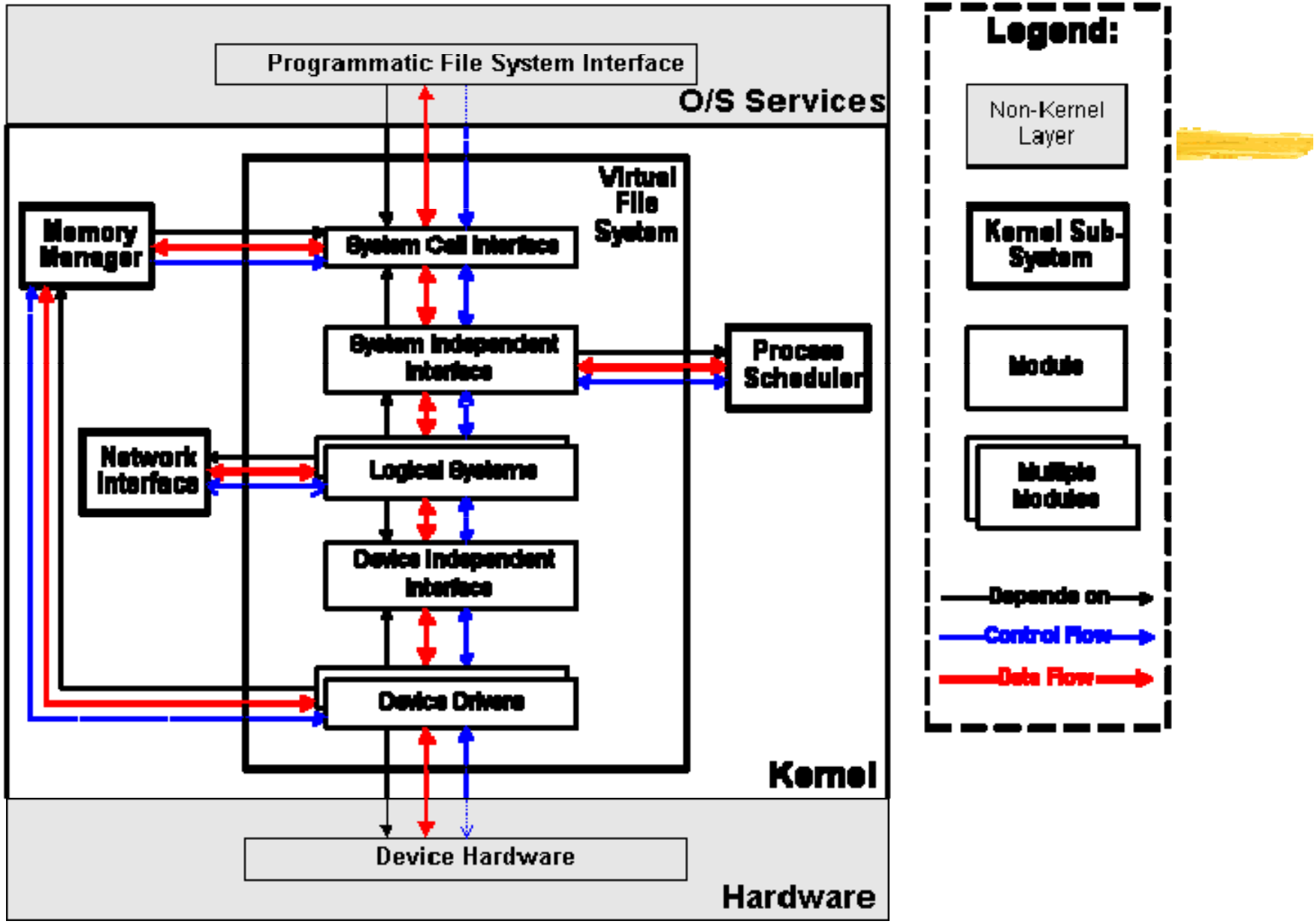
- VFS is designed to present a consistent view of data as stored on hardware
- Almost all hardware devices are represented using a generic interface
- VFS goes further, allowing the sysadmin to mount any of a set of logical file systems on any physical device

# Virtual File System

- Logical file systems promote compatibility with other operating system standards permitting developers to implement file systems with different policies
- VFS abstracts details of physical device and logical file system allowing processes to access files using a common interface, without knowing what physical or logical system the file resides on

# Virtual File System

- Analogous to CMS:
  - SFS
  - Minidisks
- Two different designs
- Common/transparent access


Programmatic File System Interface
O/S Services
Virtual File System
Memory Manager
System Call Interface
System Independent Interface
Process Scheduler
Network Interface
Logical Systems
Device Independent Interface
Device Drivers
Kernel
Device Hardware
Hardware
Legend:
Non-Kernel Layer
Kernel Sub-System
Module
Multiple Modules
Depends on
Control Flow
Data Flow

# Processes

- Processes are created in a hierarchical structure whose depth is limited only by the virtual memory available to the virtual machine
- A process may control the execution of any of its descendants by suspending or resuming it, altering its relative priority, or even terminating it
- Termination of a process by default causes termination of all its descendants; termination of the root process causes termination of the session
- Linux assigns a *process ID* (PID) to the process

# Processes

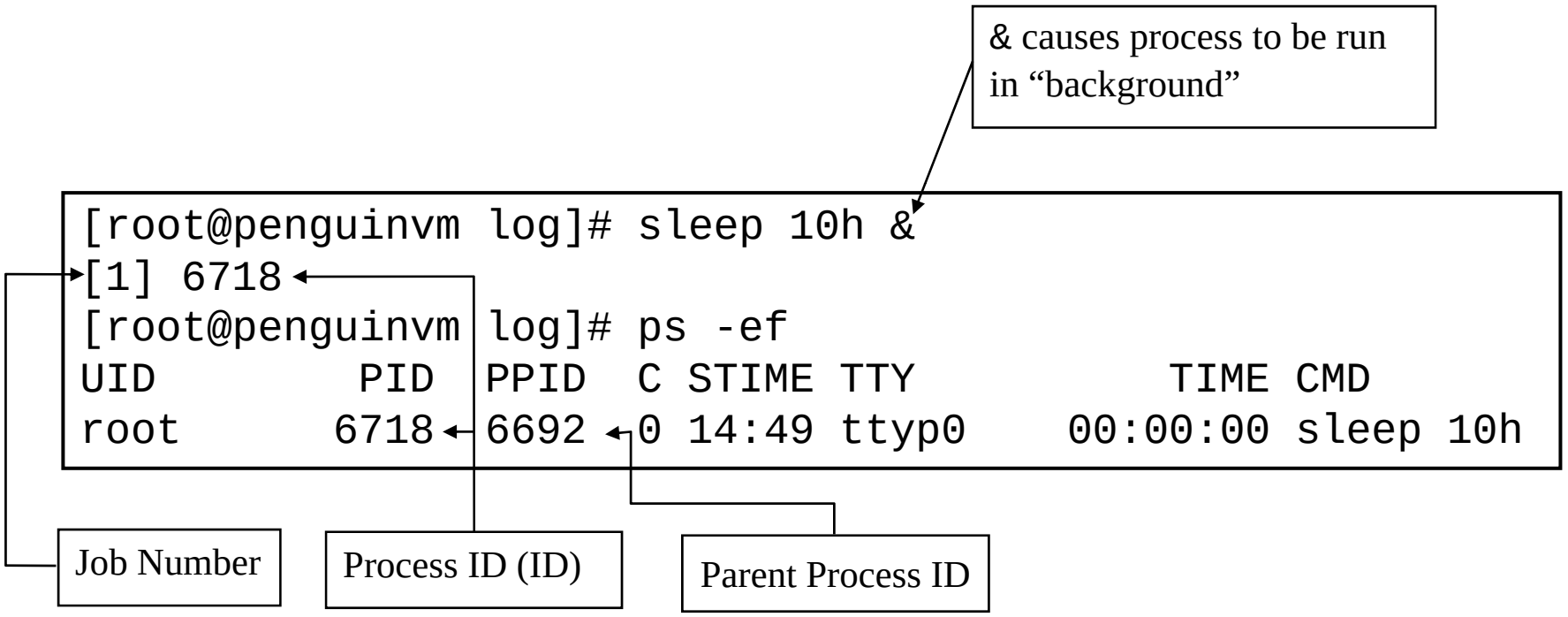
- Foreground
  - When a command is executed from the prompt and runs to completion at which time the prompt returns is said to run in the foreground
- Background
  - When a command is executed from the prompt with the token “&” at the end of the command line, the prompt immediately returns while the command continues is said to run in the background

# Processes

- Daemons
  - Background processes for system administration are referred to as “daemons”
  - These processes are usually started during the boot process
  - The processes are not assigned any terminals

```
UID        PID  PPID  C STIME TTY          TIME CMD
root         5     1  0  1999 ?        00:00:14 [kswapd]
bin        254     1  0  1999 ?        00:00:00 [portmap]
root       307     1  0  1999 ?        00:00:23 syslogd -m 0
root       350     1  0  1999 ?        00:00:34 httpd
```

# Processes


& causes process to be run in “background”
[root@penguinvm log]# sleep 10h &
[1] 6718
[root@penguinvm log]# ps -ef
UID PID PPID C STIME TTY TIME CMD
root 6718 6692 0 14:49 ttyp0 00:00:00 sleep 10h
Job Number
Process ID (ID)
Parent Process ID

# Processes - UID & GID

- Real UID
  - At process creation, the real UID identifies the user who has created the process
- Real GID
  - At process creation, the real GID identifies the current connect group of the user for which the process was created

# Processes - UID & GID

- Effective UID
  - The effective UID is used to determine owner access privileges of a process.
  - Normally the same as the real UID. It is possible for a program to have a special flag set that, when this program is executed, changes the effective UID of the process to the UID of the owner of the program.
  - A program with this special flag set is said to be a set-user-ID program (SUID). This feature provides additional permissions to users while the SUID program is being executed.

# Processes - UID & GID

- Effective GID
  - Each process also has an effective group
  - The effective GID is used to determine group access privileges of a process
  - Normally the same as the real GID. A program can have a special flag set that, when this program is executed, changes the effective GID of the process to the GID of the owner of this program
  - A program with this special flag set is said to be a set-group-ID program (SGID). Like the SUID feature, this provides additional permission to users while the set-group-ID program is being executed

# Processes - Process Groups

- Each process belongs to a process group
- A *process group* is a collection of one or more processes
- Each process group has a unique process group ID
- It is possible to send a signal to every process in the group just by sending the signal to the process group leader
- Each time the shell creates a process to run an application, the process is placed into a new process group
- When an application spawns new processes, these are members of the same process group as the parent

# Processes - PID

- PID
  - A process ID is a unique identifier assigned to a process while it runs
  - Each time you run a process, it has a different PID (it takes a long time for a PID to be reused by the system)
  - You can use the PID to track the status of a process with the `ps` command or the `jobs` command, or to end a process with the `kill` command

# Processes - PGID

- PGID
  - Each process in a process group shares a process group ID (PGID), which is the same as the PID of the first process in the process group
  - This ID is used for signaling-related processes
  - If a command starts just one process, its PID and PGID are the same

# Processes - PPID

- PPID
  - A process that creates a new process is called a *parent process*; the new process is called a *child process*
  - The parent process (PPID) becomes associated with the new child process when it is created
  - The PPID is not used for job control

# Security Guidelines

- Take Care With Passwords
  - Use good ones (motherhood statement)
    - Don't Use Real Words
    - Make Sure They Are Not Easily Guessed
    - Use Combinations Of Upper and Lower Case, Numbers, Punctuation
    - One Method: Take first letter of a sentence or book title, insert numbers and punctuation.

# Security Guidelines

- Take care of passwords (continued)
  - Use Shadow Passwords
    - Allows encrypted passwords to be in a file that is not world readable
  - Use Password Aging
    - Requires shadow passwords

# Security Guidelines

- Restrict Superuser Access
  - Restrict where root can log in from
    - `/etc/securetty` restricts root access to devices listed
  - Use wheel group to restrict who can `su` to root
    - Put users who can `su` to root in wheel group in `/etc/group` file.

# Security Guidelines

- Use groups to allow access to files that must be shared
  - Otherwise users will set world permission
- Be careful with SUID and SGID
  - Avoid setting executables to SUID root
  - Wrap SUID root wrapper around programs if they must be run SUID root
  - Create special accounts for programs that must run with higher permissions

# Security - Important Files

/etc/passwd - password file
/etc/shpasswd - shadow password file
/etc/group -lists groups and users contained in groups
/etc/services - lists network services and their ports
/etc/ftpusers - contains list of accounts that cannot use ftp
/etc/hosts.equiv - generic list of remote users
~/.rhosts - list of remote users for a specific account
/etc/hosts - host definition list
/etc/hosts.lpd - hosts who can use remote printing
/etc/hosts.allow - lists services that remote users are allowed to use
/etc/hosts.deny - lists services tthat remote users are not allowed to use
/etc/nologin - no login message that also disables logins
/etc/securetty - lists legal terminals for root to login from
/etc/exports - lists locations that can be remotely accessed via NFS
/etc/syslog.conf - configures the syslog facility
/etc/inetd.conf - configures inetd

# Linux/390 Specifics

- An ASCII implementation
- Adds a layer of abstraction to I/O
  - Channel based v IRQ based
- Support for ECKD using SSCH
- Support for VM minidisks (ECKD, CKD, FBA, VDISK)

# Linux/390 Specifics

- Runs natively, in LPAR, or under VM/ESA
- Uses relative instructions: G2, P/390, R/390 or better
- Will use hardware IEEE FP or will emulate
- Network drivers for CTCA/ESCON, OSA-2, and IUCV (VM only)
- 3215 emulation for virtual console
- Hardware console driver (HMC)

# Linux/390 Specifics

- GNU tools ported
  - C/C++ compiler (gcc-2.95.1)
  - Assembler and linker (binutils-2.9.1)
- Packages “ported”:
  - Regina; THE; UFT; X11; OpenLDAP; IMAP; Sendmail; Bind; RPM; Samba 2.0.6; Apache; Perl

# Linux in the Business World

Issues and observations

# Linux's place in the market

- The business world is interested in:
  - Efficiency and effectiveness
  - Networked economy
  - Network-based businesses

# Linux's place in the market

- The world is heterogeneous
  - 90% of Fortune 1000 companies use 3 or more Operating Systems
- The demands of e-business
  - Integrates with existing investments
  - Supports any client
  - Applications built/deployed independent of client
  - 24 x 7

# Linux's place in the market

- Importance of the application model
  - Server-centric and based on standards that span multiple platforms
  - Leverage core business systems and scale to meet unpredictable demands
  - Quick to deploy, easy to use and manage

# Linux's place in the market

- ISVs which have made Linux announcements:
  - BEA; Novell; SAP; Informix; Oracle, IBM; HP; CA; ApplixWare; Star; Corel; Cygnus; MetroWerks; ObjectShare; Inprise
- Media spotlight:
  - CNN; PCWorld; PCWeek; InternetWeek

# Linux's place in the market

- Early commercial users
  - Cendant Corporation - 4000 hotels
  - Burlington Coat Factory - back office functions
  - Northwest Airlines - 23 flight simulators
- Intel announcement January 5 2000
  - New web appliances to run Linux
  - At the insistence of customers (e.g. NEC)

# Linux's place in the market

- Impacts:
  - Applications:
    - Webservers (65%)
    - WebInfrastructure (mail, DNS) (15%)
    - File/Print (15%)
    - DB & DB Applications (2%)
  - Observations
    - Linux/Apache share of Web serving high
    - Autonomous departments
    - Many SMB and small ISP
    - CIOs discovering they have Linux running somewhere
    - Strong mindshare among developers

# Linux's place in the market

- Linux's appeal
  - Embraces new generation of web-based apps
  - Player in the heterogeneous e-business world
  - Provides flexibility and choice of environment
  - Open Source focuses on open standards

# Linux's place in the market

- Challenges for growth
  - Products/Technologies/Offerings
    - Support services
    - ISV applications
    - Service providers
  - Trends
    - Movement to mainstream
    - Standards
    - Ease of use

# IBM's focus on Linux

| | |
|---|---|
| Services | Support offering; Curriculum |
| Software | Porting all key products to Linux |
| Hardware | Intel; RS/6000; S/390 |
| Alliances | Partner with Caldera; Redhat; SuSe |
| Open Source | Support standards & contribute to bodies |

# IBM Software Announcements

- DB2 Universal Database
- Transarc AFS (distributed file system)
- On Demand Server
- Lotus Domino R5
- WebSphere
- Tivoli

# Linux's place in the market

- Summary
  - Linux is viable in many key application areas
  - Linux has moved from small technical projects to significant deployment
  - IBM claims to be fully supportive of Linux
    - Part of their heterogeneous strategy
    - Open source supporter
    - Hardware, software, and service offerings

# Linux

Available Commercial Software

# Website Development

- ASWedit, HTML editor
- Empress DataWEB
- EZ-EDIT
- LinkScan
- TalentSoft Web+ (WebPlus)
- VirtuFlex 1.1
- Visual prolog
- Web Crossing
- ThreadTrack WebTailor from Webthreads.

# Databases

- c-tree Plus
- Empress
- Essentia
- FairCom Server
- INFORMIX-SE
- Just Logic/SQL
- KE Texpress
- Qddb
- Raima Database Manager++
- Empress Embedded RDBMS
- SOLID Server
- Velocis Database Server
- Yard SQL

# Data Visualization and CAD

- IDL (Interactive Data Language)
- Megahedron
- Tecplot 7.0
- VariCAD
- VARKON
- XVScan

# Development Tools

- ACUCOBOL-GT
- Amzi! Prolog & Logic Server
- Basmark QuickBASIC
- Critical Mass CM3
- Dynace
- Absoft Fortran 77
- Finesse
- ISE Eiffel
- EiffelBench
- C-Forge IDE
- IdeaFix
- j-tree
- KAI C++
- Khoros Pro 2.1

# Development Tools

- MetaCard
- ObjectManual Rel 3.0
- Critical Mass Reactor
- Resource Standard Metrics
- r-tree
- sdoc (Source Documenter)
- SEDIT, S/REXX
- SNiFF+
- ST/X (Smalltalk/X)
- tdb (Tcl Debugger)
- tprof (Tcl Profiler)
- View Designer/X (VDX)
- XBasic
- XMove 4.0 for Linux

# Emulation Tools

- Emulus
- Executor 2
- Wabi 2.2 for OpenLinux

# Financial Software

- BB Stock Pro and BB Stock Tool
- TimeClock

# Libraries

- FontScope
- INTERACTER
- Matrix<LIB> - C++ Math Matrix Library
- PKWARE Data Compression Library for Linux
- readyBase
- SIMLIB IG

# Mathematics

- Maple V Release 4 - The Power Edition
- MATCOM and MATCOM MATH LIBRARY
- Mathematica 3.0
- MATLAB and Simulink

# Multimedia

- Peter Lipa and his Journeys
- Lucka Vondrackova and her Journeys
- MpegTV Player 1.0
- Peter Nagy and his Journeys
- Xaudio

# Network Servers

- Critical Angle X.500 Enabler
- DNEWS News Server
- Aventail Internet Policy Manager
- Aventail VPN
- WANPIPE
- Zeus Web Server

# Office Tools

- Corel WordPerfect 8
- The American Heritage Dictionary Deluxe
- Applixware Office Suite
- D.M.S. Document Management System
- HotWire EasyFAX
- NExS, the Network Extensible Spreadsheet
- Axene Office
- Projector and Projector/Net
- The Virtual Office System
- Axene XAllWrite
- Axene Xclamation
- Axene XQuad

# Text Processing

- Edith Pro for X11
- TeraSpell 97 for Emacs

# System Administration

- Host Factory
- PerfectBACKUP+
- Venus

# X Windows Related

- Accelerated-X Display Server
- BXwidgets
- BXwidgets/DB
- Laptop, Accelerated-X Display Server
- MaXimum cde Developer's Edition v1.0
- Multi-headed, Accelerated-X Display Server
- OpenGL, Accelerated-X Display Server
- OSF-Certified Motif

# Other Software

- ABACUS 4
- BBBS
- Clustor
- FootPrints
- Aladdin Ghostscript
- Magician
- journyx WebTime
- LanSafe
- LjetMgr
- Synchronize/CyberScheduler

# Additional Resources

- UNIX Systems Administrator Resources
  - http://www.ugu.com/
- Linux/390 Observations and Notes
  - http://penguinvm.princeton.edu
- Introduction to Linux
- Introduction to UNIX
- Linux/390 Installation
- Linux Administration Made Easy
  - http://www.linuxninja.com/linux-admin/book1.html
- Conceptual software architecture of the Linux kernel

# Additional Resources

- http://www.linux.org
- http://www.tux.org
- http://www.li.org