


Linux is free

- Excellent tools
- Lots of documentation
- Works on less than state-of-the-art hardware
(But newer versions with GUIs suck up CPU cycles just like MS Windows)
- Not many magic configurations
Mostly readable text files

Linux Benefits

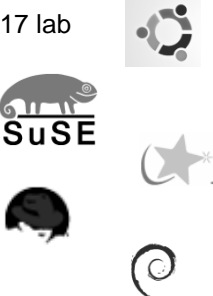
- Not just for techies anymore
- Installation can be burned on CD or run from a USB drive
- Good security

But running a "production" system requires lots of tinkering & tuning



Common Linux Distributions

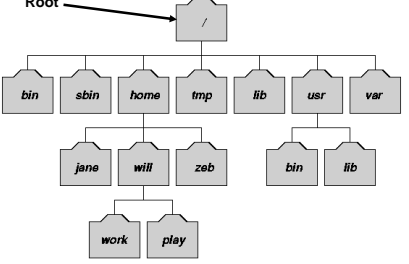
- Ubuntu / Debian – in D017 lab
- SuSE (Novell)
- Mandriva
- RedHat
- Slackware
- Linspire / Freespire



Linux is a multiprocess, multiuser, interactive computing environment

- *Multiprocess* – several programs can run at the same time
- *Multiuser* – Multiple users can be using the same system at the same time
- Can operate in either a *text-based interface* or *GUI*
- Designed for a networking environment

The Linux file system is organized into a tree structure of directories



File
data stored as a unit

Directory
a collection of files

Directory references

/ → root (no drive letters like Windows)
 ~ → your home directory
 . → current directory
 .. → parent of current directory

Reference files with a *pathname*

absolute: starts from the root
relative: starts from current working directory

Wildcards

* → matches any number of characters
 ? → matches any single characters

The Linux Shell - a command interpreter

- Similar to DOS
- Several available but most common is BASH (Bourne Again SHell)

Note: Linux commands are case sensitive

Location of Commands

Most user commands are in

- /bin
- /usr/bin
- /usr/local/bin

Most system administration commands are in

- /sbin
- /usr/sbin

Linux Command Structure

command options arguments

Command to be executed

Modify the command
Usually a dash followed by letter(s)

Filenames or other targets affected by command

```
ls                List contents of current directory
ls -a             List current directory (w/hidden files)
ls -l /etc       "Long" listing of /etc directory
```

Common Commands

- ls - list directory contents
- cp - copy files
- mv - move/rename files
- rm - remove/delete files
- mkdir - make a new directory
- cd - change directory
- more/less - display contents of a text file
- man - get help about a command

Command Editing

- Left and Right Arrow keys (not the mouse) can be used to move through a command line
 - Can edit at the cursor position
- Command history
 - Previous commands are stored in a list
 - Up and Down Arrow keys cycle through previously entered commands
- File name completion
 - Type the start of a file name and press Tab, and name will automatically be completed

Shell Power

Redirection

Output to a file or input from a file

```
ls -al > myfiles
wc -l < myfiles
```

Piping

Output from one command is input for another

```
ls -l | wc -l
```

Shell Script Power

- Shell scripts - store commands in a text file that can be executed like a program
- Shells have a simplified but complete programming language for shell scripts

Example Script

Scan some text to find and print the 20 most frequently used words, together with counts of how often they occur.

```
tr -c -s '[:alpha:]' '[\n*]' < FILE | \
sort | \
uniq -c | \
sort -n -r -k 1,1 | \
sed 20q
```

Access Control with Permissions

- Important for security in multiuser and networked environments
- Each directory and file has an *owner* who created it
- Users belong to *groups*
- Access permissions determine what operations a user can perform on a directory or file

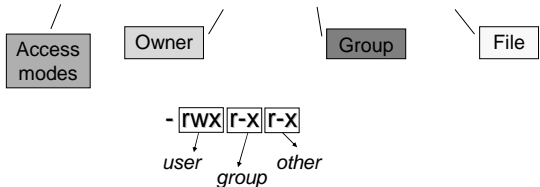
Access permissions

Permission	Directory	File
r	List the directory	Read contents
w	Create or delete files	Write contents
x	Access files and subdirectories	Execute

Access modes consist of three permissions, for each of
user – applies to owner of file
group – applies to users belonging to the group assigned to file
other – applies to other users

File Permissions

```
drwxr-xr-x 4 o lanm users tools/
drwx----- 8 o lanm users private/
-rw-r--r-- 1 o lanm users prog2.zip
-rwxr-xr-x 1 o lanm users myscript
```



Changing Permissions

chmod command

```

chmod +w somefile
chmod u+x somescript
chmod o-x somedirectory
chmod go+rw somefile
chmod 755 somescript
    
```

Basic Networking Tools

ping (Packet Internet Groper)

- Sends packet to remote computer
- Remote computer replies with echo packet
- Local computer reports
 - Receipt of reply
 - Round trip times for packets
 - Statistics of the transmission

ping examples

```

olann@zeus:~$ ping loki
PING loki.stockton.edu (134.210.1.200): 56 octets data
64 octets from 134.210.1.200: icmp_seq=0 ttl=63 time=0.4 ms
64 octets from 134.210.1.200: icmp_seq=1 ttl=63 time=0.2 ms
64 octets from 134.210.1.200: icmp_seq=2 ttl=63 time=0.3 ms
64 octets from 134.210.1.200: icmp_seq=3 ttl=63 time=0.3 ms
64 octets from 134.210.1.200: icmp_seq=4 ttl=63 time=0.3 ms
64 octets from 134.210.1.200: icmp_seq=5 ttl=63 time=0.2 ms
64 octets from 134.210.1.200: icmp_seq=6 ttl=63 time=0.3 ms

--- loki.stockton.edu ping statistics ---
7 packets transmitted, 7 packets received, 0% packet loss
round-trip min/avg/max = 0.2/0.2/0.4 ms
    
```

ping examples

```

olann@zeus:~$ ping -c 6 netbook.cs.purdue.edu
PING netbook.cs.purdue.edu (128.10.19.20): 56 octets data
64 octets from 128.10.19.20: icmp_seq=0 ttl=241 time=44.2 ms
64 octets from 128.10.19.20: icmp_seq=1 ttl=241 time=43.9 ms
64 octets from 128.10.19.20: icmp_seq=2 ttl=241 time=43.7 ms
64 octets from 128.10.19.20: icmp_seq=3 ttl=241 time=44.2 ms
64 octets from 128.10.19.20: icmp_seq=4 ttl=241 time=44.3 ms
64 octets from 128.10.19.20: icmp_seq=5 ttl=241 time=44.3 ms

--- netbook.cs.purdue.edu ping statistics ---
6 packets transmitted, 5 packets received, 16% packet loss
round-trip min/avg/max = 43.7/44.0/44.3 ms
    
```

Basic Tools

traceroute

- Sends a series of packets along the path to destination
- Each successive packet identifies the next router along path
- Uses an *expanding ring* search

traceroute example

```

olann@zeus:~$ traceroute netbook.cs.purdue.edu
traceroute to netbook.cs.purdue.edu (128.10.19.20), 30 hops max, 38 byte packets
 1 134.210.177.253 (134.210.177.253) 0.446 ms 0.346 ms 0.454 ms
 2 134.210.5.249 (134.210.5.249) 0.806 ms 0.658 ms 0.853 ms
 3 AL-0-0-181.EDGE-RTR1.ATC.verizon-gni.net (130.156.249.1) 1.994 ms 2.637 ms
 2.098 ms
 4 130.156.250.122 (130.156.250.122) 8.984 ms 8.994 ms 9.214 ms
 5 local.njedge.magpi.net (216.27.98.41) 11.445 ms 11.177 ms 11.558 ms
 6 * * *
 7 remote1.abilene.magpi.net (198.32.42.210) 14.497 ms 14.260 ms 14.245 ms
 8 nycmgw-washing.abilene.ucaid.edu (198.32.8.84) 18.542 ms 18.659 ms 18.480 ms
 9 chinnng-nycmgw.abilene.ucaid.edu (198.32.8.82) 49.094 ms 38.950 ms 38.745 ms
10 ip1sng-chinnng.abilene.ucaid.edu (198.32.8.77) 42.324 ms 42.700 ms 42.199 ms
11 192.12.206.250 (192.12.206.250) 43.004 ms 42.530 ms 42.558 ms
12 tel-210-m10-01-gp.tcom.purdue.edu (192.5.40.129) 43.700 ms 43.546 ms
43.737 ms
13 tel-210-c6509-01-campus.tcom.purdue.edu (192.5.40.53) 44.445 ms 43.432 ms
43.517 ms
14 * * *
15 Tucan.cs.purdue.edu (128.10.19.20) 43.803 ms 43.490 ms 43.916 ms
    
```