CSCI 315: Data Structures
Basic Unix Commands

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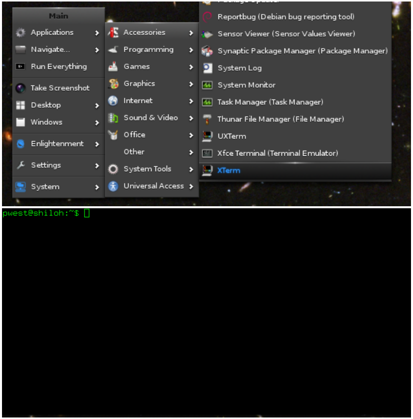
- Although modern Linux is equipped with a *fancy schmancy* Graphical User Interface (GUI), for system administrators (and **real** programmers), shell is the best tool to handle everything.
- In GUI mode, you can activate our shell by opening a terminal window.
- The terminal window is your control panel for the system.

Opening a terminal

- Terminal window shows a standard prompt
- Prompts displays all kinds of information, but they are not part of the commands you are giving to your system.



```
pwest@shiloh:~$ 
```

Choosing a Text Editor

- Do take some time to choose a good text editor.
    - You will be using it a lot.
- Most Windows/OSX editors have a clone in Linux.
- Linux has numerous choices.
- Be aware that text editors can become a religous affair...

vi

- Light weight with a high learning curve
- A *fast* editor once you learn it
- :q to quit from vi
- :wq to write the change to the file
- :q! quit without saving changes
- To exit from editing mode, click esc key
- i to insert
- x to delete a char

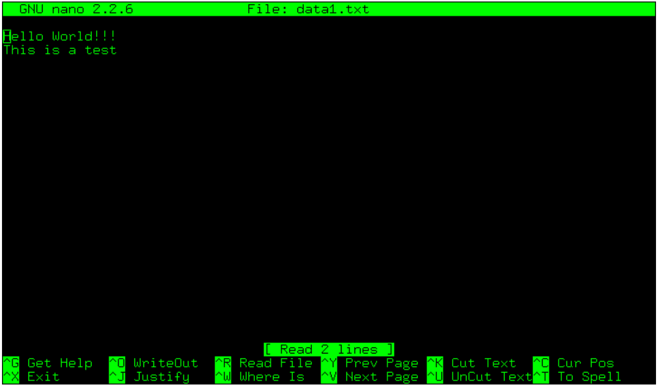
- dd to delete a line
- / text search
- same on every machine

emacs

- Lots of features – tons of capabilities
- LISP
- Your hand may be warpped from all the hotkeys
- Not always the same on every machine

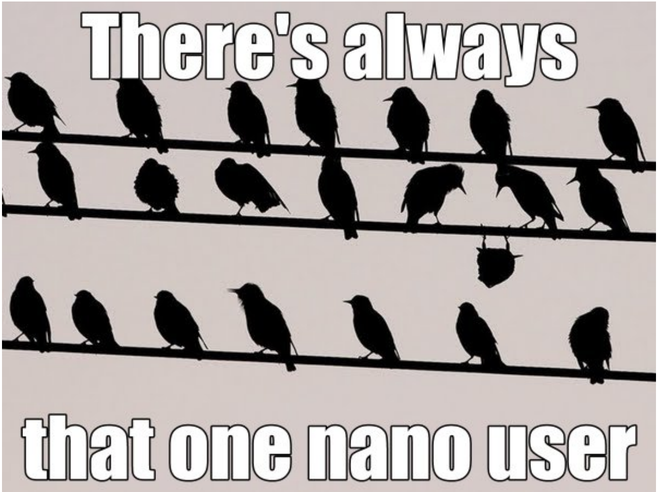
nano

- simple!
- commands are at the bottom of your screen
- same on every machine



```
  GNU nano 2.2.6                File: data1.txt

Hello World!!!
This is a test













                                    [ Read 2 lines ]
^G Get Help   ^O WriteOut   ^R Read File  ^Y Prev Page  ^K Cut Text   ^C Cur Pos
^X Exit       ^J Justify    ^W Where Is   ^V Next Page  ^U UnCut Text^T To Spell
```

Don’t Be That Guy



Graphical Text Editors

- gvim: graphical vim
- xemacs: graphical emacs
- gedit: like MS wordpad/notepad
- atom: more advance text editor
- sublime: newer, very powerful
- kate: KDE text editor
- tea: Minimal QT text editor
- jed: Very basic. Essentiall nano++

ls

- ls (list)
  - displays a list of files in the current working directory, like dir in DOS
- -a
  - display hidden (start with a '.') files
- -A
  - Do not display '.' and '..'
  - '.' means current directory
  - '..' means upper layer directory
- -l
  - display file lists with long format
- -s
  - display file size
- -h
  - display sizes in a more human readable format

cd

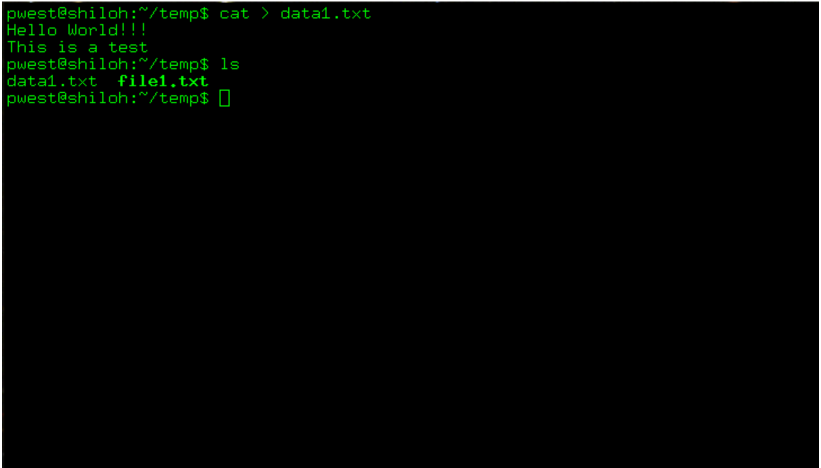
- change directory
- cd /usr/bin
  - Change directory to /usr/bin directory
- cd ..
  - Change to upper layer directory
- cd /
  - Change to root directory
- cd
  - Change to user home directory

Directory Operations

- mkdir
  - Make directory
  - mkdir temp
  - mkdir temp2
  - mkdir temp/insideTemp
- rmdir
  - remove directory
  - rmdir temp2

Creating a file with cat

cat is a command we will discuss later
gedit, vi, and nano are text editors available in our Linux and either can be used to create a file as well.



```
pwest@shiloh:~/temp$ cat > data1.txt
Hello World!!!
This is a test
pwest@shiloh:~/temp$ ls
data1.txt  file1.txt
pwest@shiloh:~/temp$ 
```

File Operations: cp

- copy
- cp data1.txt data2.txt
- cp data3.txt temp
    - -i
- ask before overwrite
    - -v
- display copying process
    - -R
- recursive copy, including sub-directories
- cp -R * backup

File Operations: rm

- rm
  - remove file or directory
  - rm data1.txt
  - rm *
  - -f
    - force remove files
    - rm -f *.txt
  - -r
    - recursive remove files, including sub-directories
    - rm -r *
  - -v
    - display removing process

Directory Usage

- Any command that accepts a file as a parameter assumes that file is in the present (current) working directory (pwd) unless told otherwise.
- Use relative or absolute paths to indicate where a file is.
- Absolute paths start with a / and the path begins from the highest level
- Relative paths NEVER start with a / and are how to get to the file from the pwd
- .. Is your parent directory, useful in relative paths

More File Operations

- mv
  - move files or rename a file
  - mv data1.txt ..
  - mv data1.txt data4.txt
- pwd
  - print (present) working directory
- file
  - display file type
  - file filename
  - file *

Even More File Operations

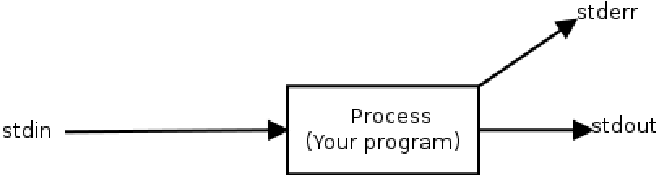
- head
  - head shows the first few lines of a file
  - head data1.txt shows first 10 lines of data1.txt
  - head -20 data1.txt shows first 20 lines
- tail
  - tail shows the last few lines of a file
  - tail data1.txt shows last 10 lines of data1.txt
  - -r : show content in reverse order
- wc
  - word count
  - 1st column -> number of lines
  - 2nd column -> number of unique words
  - 3rd column -> total word counts

Yes, Even More File Operations

- find
  - -name filename you are looking for
  - -print output results
  - find /usr -name compress -print
- grep
  - To search specified texts and display them
  - grep text files
  - more later
- ln
  - To link a file
  - ln -s data4.txt test
  - More later on linking

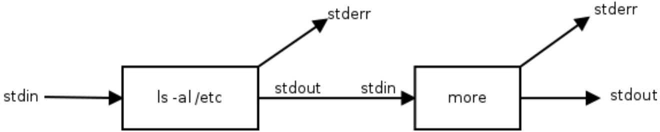
Input/Output (I/O)

- Three standard input/output devices
  - *stdin* <- keyboard input
  - *stdout* <- Monitor output
  - *stderr* <- Error output device



PIPE

- Redirect output of one program to another
- EX:
  ls -al /etc | more



- This can continue on...
- What Data Structure does this look like?

I/O Redirect to Files

- Use < and > to redirect I/Os
- cat > output.dat
- Use Ctrl-d to quit
- cat » output.dat
  - This will attach new texts to the end of output.dat (append)
- cat !> output.dat
  - will force overwrite output.dat

Hey Look, Even *More* File Operations!

- more
  - pausing output
  - ls -al | more
- less
  - hmmm, what does less do?
- cat (concatenate)
  - display file contents or concatenate a file to another
  - cat data1.txt | more
  - cat data1.txt » data2.txt
  - cat data1.txt data2.txt » data3.txt
- tac
  - hmmm, what does tac do?

Printing

- lp
  - prints the named files to the printer
  - -d : specify the printer
  - -n how many copies
- lpstat
  - displays the status of print jobs sent to any printer with the lp command
- cancel
  - removes all of the specified jobs from printer queue

Printing Continued

- Some systems use different commands
- lpr
  - for printing
  - -P specify the printer
  - -# number of copies
  - -m mail you when printing is done
- lprm
  - remove printing jobs
  - -P specify the printer

Misc Commands

- passwd (password)
  - Change the password for the current user
- man (manual pages)
  - man ls
- info (information of a command)
  - info ls
- –help (how to use a command)
  - ls –help

Universal Characters

- * - all possible combination(s)
  - des* - desk, desktop, description, ...
- ? - match exact position
  - des? - desk, des9, ...
- ls -al *.ps
- cat ??go
- more *a*b?
- [] - symbols in the quote
  - ls -al [ms]oon means to list files of moon and soon
  - more [a-p]ount means to list files of aount, bount, count, ..., pount

Advanced grep Operations

- Global or Get Regular Expression and Print
- LEARN IT, it can save time
- grep -hilnvw pattern filename
- fgrep -hilnvwx string filename
  - Fixed grep, fast, only works with string
- egrep -hilnvw pattern filename
  - Extended grep, supports extended regular expression
- Parameters:
  - -n Print line number
  - -w Restricts matching to whole words only
  - -v displays all lines NOT matching
  - -l displays a list of the files that contain the specified pattern, useful when filename has wildcards
  - -x displays lines that are exactly equal to string

Advanced grep Operations

- cat > grepfile
  Well, you know it’s your bedtime,
  So turn off the light,
  Say all your prayers and then,
  Oh you sleepy young heads dream of wonderful things,
  And you will be swimming through the sea
- grep the grepfile
- grep -wn the grepfile
- grep -v the grepfile

Advanced grep Operations

- grep .nd grepfile
- grep ^.nd grepfile
- grep sw*.ng grepfile
- grep [A-D] grepfile
- grep a. grepfile

Expressions

- . Matches any single character
- [] Matches any single characters enclosed in brackets.
- If the first character after the [is^, then any character not enclosed in brackets is matched
- * May follow any character and denotes zero or more occurrences of the character that precedes it.
- ^Matches the beginning of a line only
- $ Matches the end of a line only

Login and Logout

- In GUI mode you can easily login and logout using mouse click
- In text mode, you have to use command to logout a system.
- After logout, do not power off the system!

Shutdown

- time
  - hh:mm - shutdown 10:45
  - +m - shutdown +5
  - now - shutdown now
- warning message
  - shutdown +5 "system will shutdown in 5 minutes"
- r - reboot after shutdown
  - shutdown -r now
  - shutdown -r 23:50 &
- h - halt the system
  - shutdown -h now
  - After seeing "system halted", you can power off the system.
- c - cancel shutdown command
  - shutdown -c

Reboot

- -n - no sync before reboot
  - sync - to flush buffer and write them back to disks
- -f - force reboot

Man Page

- The man command allows you to access the MANual pages for a UNIX command.
- To get additional help on any of the commands listed below, you can always type man name_of_command at the command prompt.
- Examples:
  man ls
  man cd

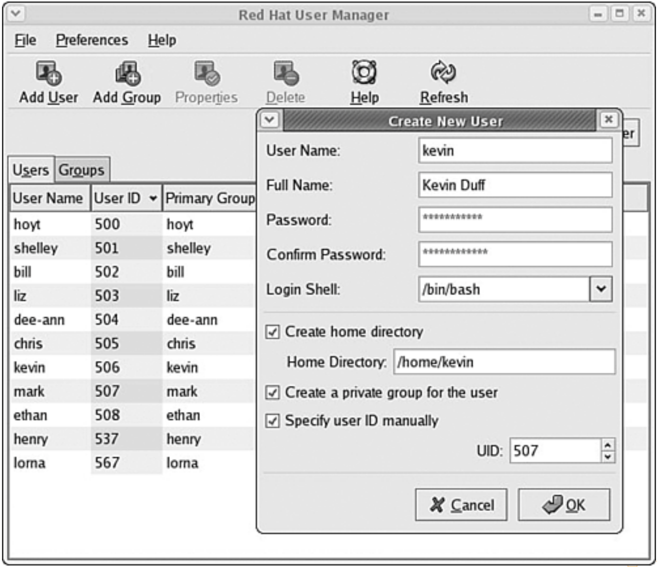
Management Tools

- User Management Tools
- useradd- This command is used to add a new user account to the system. Its options permit the sysadmin to specify the user's home directory and initial group or to create the user with the default home directory and group assignments.
- useradd -D- This command displays default settings for new users
- useradd -G- This command sets the system defaults for creating the users' home directory, account expiration date, default group, and command shell. See the specific options in man useradd. Used without any arguments, it displays the defaults for the system. The default set of files for a user are found in /etc/skel.
- # ls -al /etc/skel

User Management Tools

- userdel- This command will completely remove a user’s account (thereby eliminating that user’s home directory and all files it contains).
- passwd- This command updates the “authentication tokens” used by the password management system.
- usermod- This command changes several user attributes. The most commonly used arguments are -s to change the shell and -u to change the UID. No changes can be made while the user is logged in or running a process.
- chsh- This command changes the user’s default shell. For Fedora Core Linux, the default shell is /bin/bash, known as the Bash, or Bourne Again Shell.

- # useradd kevin -p gu1tarplayeR -s /bin/zsh -u 507



User Name	User ID	Primary Group
hoyt	500	hoyt
shelley	501	shelley
bill	502	bill
liz	503	liz
dee-ann	504	dee-ann
chris	505	chris
kevin	506	kevin
mark	507	mark
ethan	508	ethan
henry	537	henry
lorna	567	lorna

User Name: kevin

Full Name: Kevin Duff

Password: ***********

Confirm Password: ************

Login Shell: /bin/bash

☑ Create home directory

Home Directory: /home/kevin

☑ Create a private group for the user

☑ Specify user ID manually

UID: 507

Group Hug

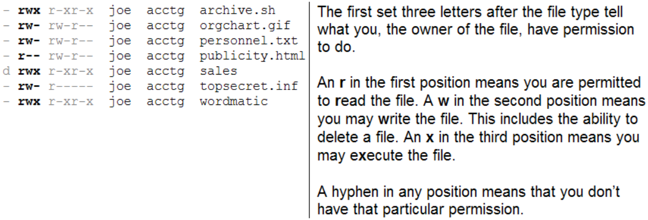
- Why group?
  - Groups establish relationships among users in which they share a common set of permissions
- All the groups are listed in /etc/group file.
- Group Management Tools:
  - Add a new group with the groupadd command.
  - # groupadd cdrw
  - Change the group ownership of the device to the new group with the chgrp command.
  - # chgrp cdrw /dev/scd0
  - Add the approved user to the group with the usermod command.
  - # usermod -G cdrw shelley
  - Make user shelley the group administrator with the gpasswd command so that she can add new users to the group.
  - # gpasswd -A shelley
- There is a GUI for group management as well.

User Accounts

- Most Linuxes uses the /etc/passwd file to hold user account information. Each user, regardless of type, will have a one-line entry of account information stored in the /etc/passwd text file.
- The superuser is also known by the name root.
- User IDs and Group IDs
- File Permissions
  - chgrp- Changes the group ownership of a file or directory.
  - chown- Changes the owner of a file or directory.
  - chmod- Changes the access permissions of a file or directory.

chmod

- Try “ls -l”



```
- rwx r-xr-x  joe  acctg  archive.sh
- rw- rw-r--  joe  acctg  orgchart.gif
- rw- rw-r--  joe  acctg  personnel.txt
- r-- rw-r--  joe  acctg  publicity.html
d rwx r-xr-x  joe  acctg  sales
- rw- r-----  joe  acctg  topsecret.inf
- rwx r-xr-x  joe  acctg  wordmatic
```

The first set three letters after the file type tell what you, the owner of the file, have permission to do.

An **r** in the first position means you are permitted to **read** the file. A **w** in the second position means you may **write** the file. This includes the ability to delete a file. An **x** in the third position means you may **execute** the file.

A hyphen in any position means that you don’t have that particular permission.

- The best way to use chmod is with numbers. Each permission is assigned a value
  r = 4, w = 2, x = 1, Therefore:
  - 0: Means no permission
  - 4: Read only
  - 5: Read & Execute
  - 6: Read & Write
  - 7: Full permission

Using chmod

With chmod you have three numbers: first for the owner, second for group, third for everyone else.

Lets do some examples.

Before:	-rwxr-xr-x archive.sh
Command:	chmod 754 archive.sh
After:	-rwxr-xr– archive.sh

Before:	-rw-r–r– topsecret.txt
Command:	chmod 600 topsecret.txt
After:	-rw——- topsecret.txt

Before:	-rw——- publicity.html
Command:	chmod 665 publicity
After:	-rw-rw-r– publicity.html

- The password file is /etc/passwd, and it is the database file for all users on the system. The format of each line is as follows:
  username:password:uid:gid:gecos:homedir:shell
- Example:
  - sshd:x:74:74:Privilege-separated SSH:/var/empty/sshd:/sbin/nologin
  - rpc:x:32:32:Portmapper RPC user:/:/sbin/nologin
  - rpcuser:x:29:29:RPC Service User:/var/lib/nfs:/sbin/nologin
  - nfsnobody:x:65534:65534:Anonymous NFS User:/var/lib/nfs:/sbin/nologin
  - mailnull:x:47:47::/var/spool/mqueue:/sbin/nologin

Become Root!

- Temporarily Changing User Identity with the su Command
  $ su - root

Login Process

- Login prompts for a username.
- If the /etc/nologin file exists and the user isn't root, a warning message is issued and the login process is halted. The /etc/nologin file is typically used when the system will be shut down shortly and new logins should be restricted.
- The /etc/usertty file is examined to see if any restrictions are specified for the user. As a security measure, root logons can be restricted to specific terminals and regular users can have the same restrictions placed on them as necessary.
- The system prompts for a password; it is checked against the encrypted password kept in /etc/shadow. Unsuccessful attempts are logged via the syslog facility and can be reviewed with the lastd command.
- The user's command shell is started at this point, presenting the user with a command prompt. If no shell is specified for the user in /etc/passwd, /bin/sh is used by default. (Some UNIX operating systems will just log you back out.) If no home directory is specified in /etc/passwd, / is used.

Quota

- Why quota?
- Disk quotas are designed to control the amount of disk space a user has access to.
- Sysadmins use the family of quota commands, such as quotacheck to initialize the quota database files, edquota to set and edit user quotas, setquota to configure disk quotas, and quotaon or quotaoff to control the service. (Other utilities include warnquota for automatically sending mail to users over their disk space usage limit.)
- man quota

- Yes, this is graded.
- Follow the instructions for lab 01