LSU INFORMATION TECHNOLOGY SERVICES

Introduction to Linux

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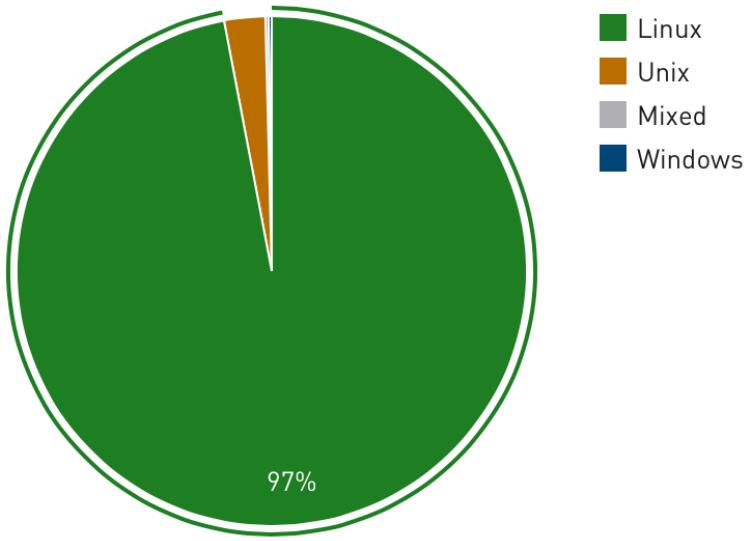
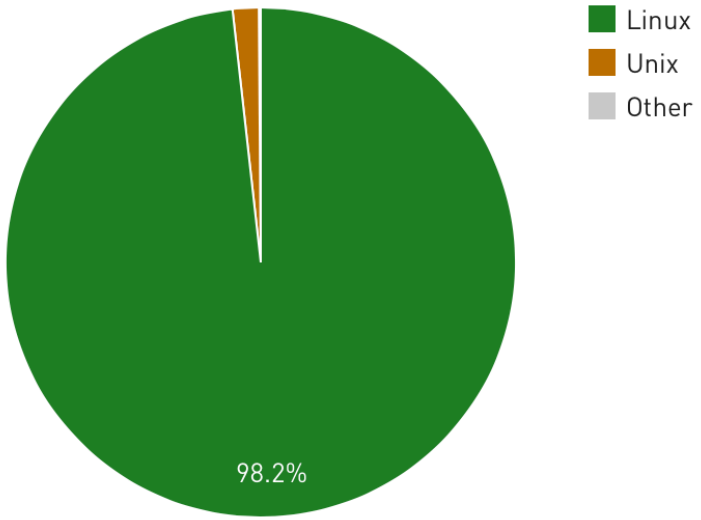
Why Linux for HPC - 2014

OS family system share



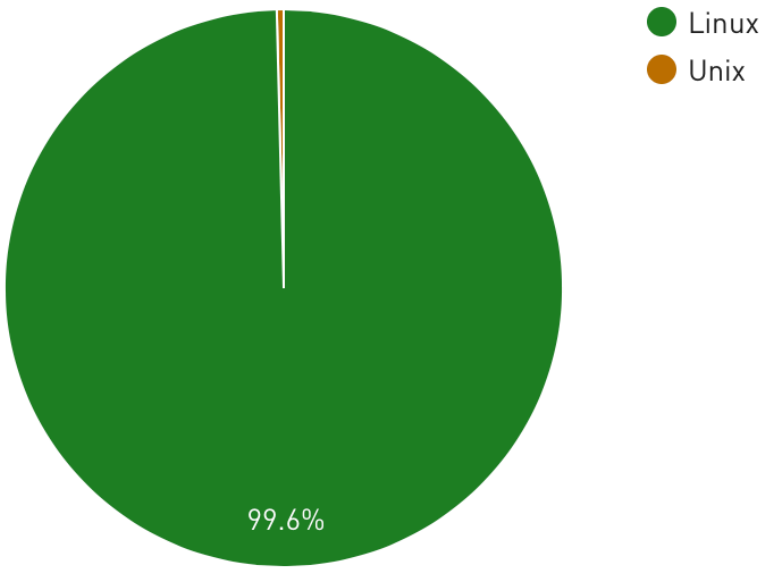
OS family performance share



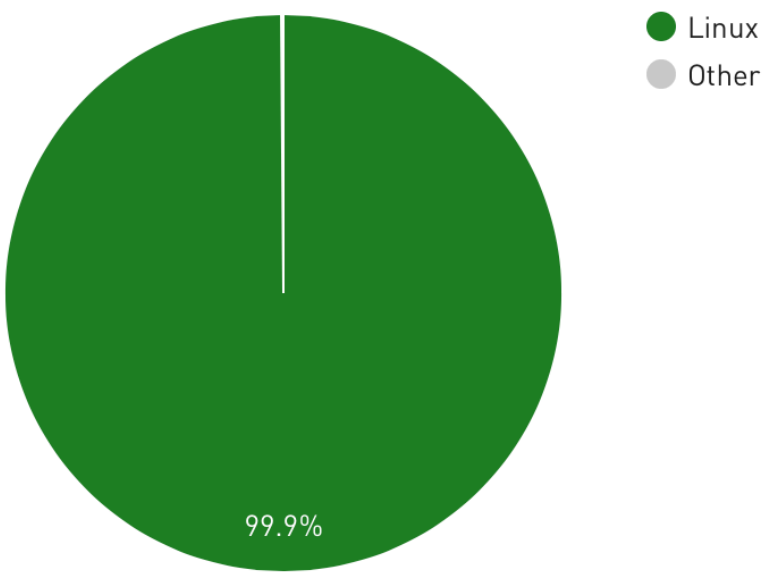
http://www.top500.org/statistics/list/ November 2014

Why Linux for HPC – 2016

OS family system share



OS family performance share



Linux is the most popular OS used in supercomputers

http://www.top500.org/statistics/list/ Nov 2016

Roadmap

- What is Linux
- Linux file system
- Basic commands
- File permissions
- Variables
- Use HPC clusters
- Processes and jobs
- File editing

History of Linux (1)

- Unix was initially designed and implemented at AT&T Bell Labs 1969 by Ken Thompson, Dennis Ritchie, Douglas McIlroy, and Joe Ossanna
- First released in 1971 and was written in assembly language
- Re-written in C by Dennis Ritchie in 1973 (with exceptions to the kernel and I/O) for better portability
- The GNU Project by Richard Stallman started in 1983
  - Goal: create a “complete Unix-compatible software system” with entirely free software

History of Linux (2)

- Linus Torvalds, a student at University of Helsinki began working on his own operating system, which became the "Linux Kernel", 1991
- Linus released his kernel for free download and helped further development

History of Linux (3)

- Linux is only the kernel, the component of applications was missing for Linux OS
- The GNU Project by Richard Stallman started in 1983
  -Creating a “complete Unix-compatible software system” with entirely free software
- "GNU/Linux”(Linux): Linux kernel + free software from the GNU project
- GNU/Linux (Linux) released under the GNU Public License (GPL): Free to use, modify and re-distribute **iff** later distributions are also under GPL

What is Linux

- Essential components: Linux kernel + GNU system utilities + installation scripts + management utilities etc.

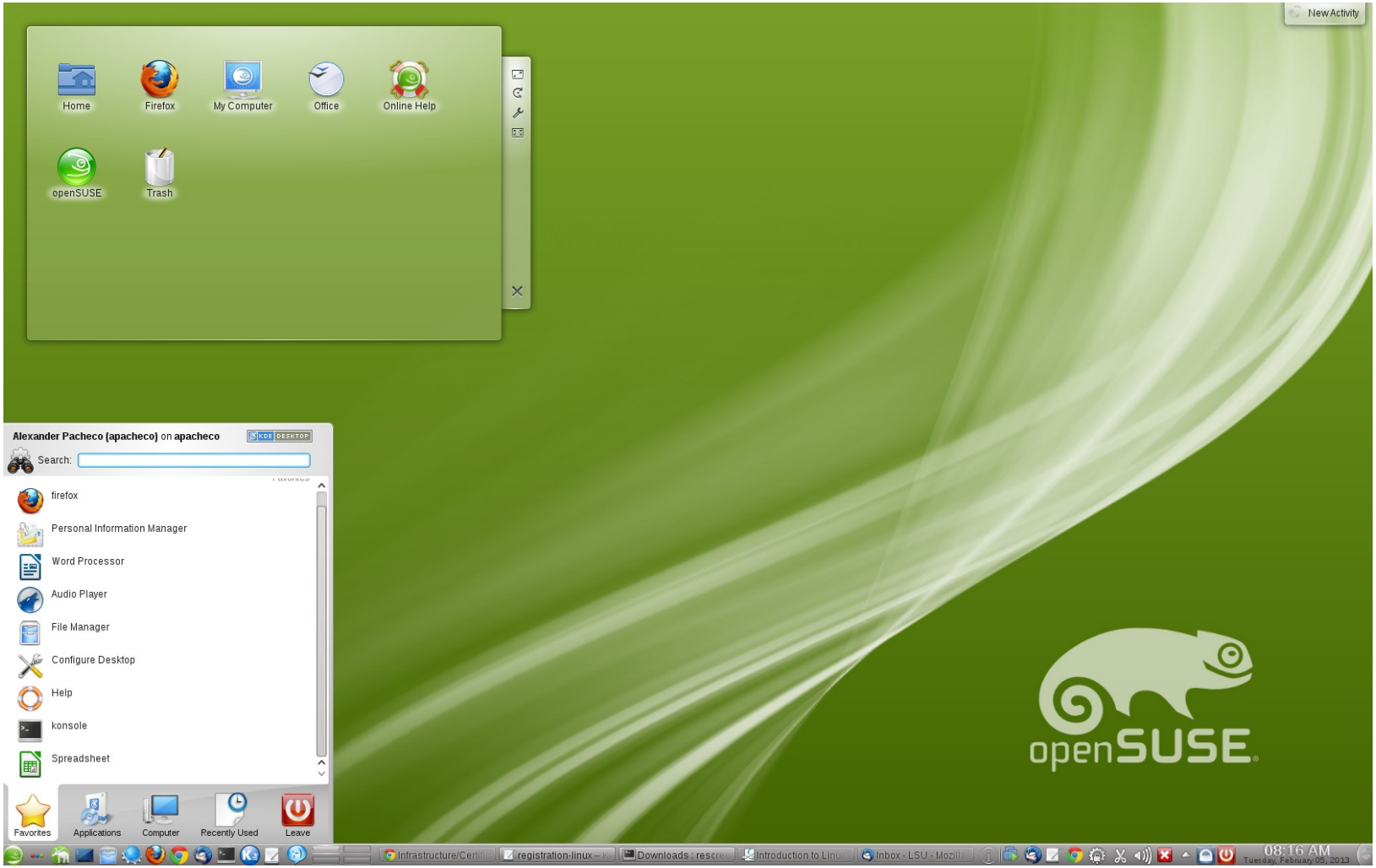
- Many software vendors release their own packages, known as distributions
  - Debian, Ubuntu, Mint
  - Red Hat, Fedora, CentOS, Scientific Linux
  - Slackware, OpenSUSE, SLES, SLED
  - Gentoo

- Linux distributions offer a variety of desktop environment

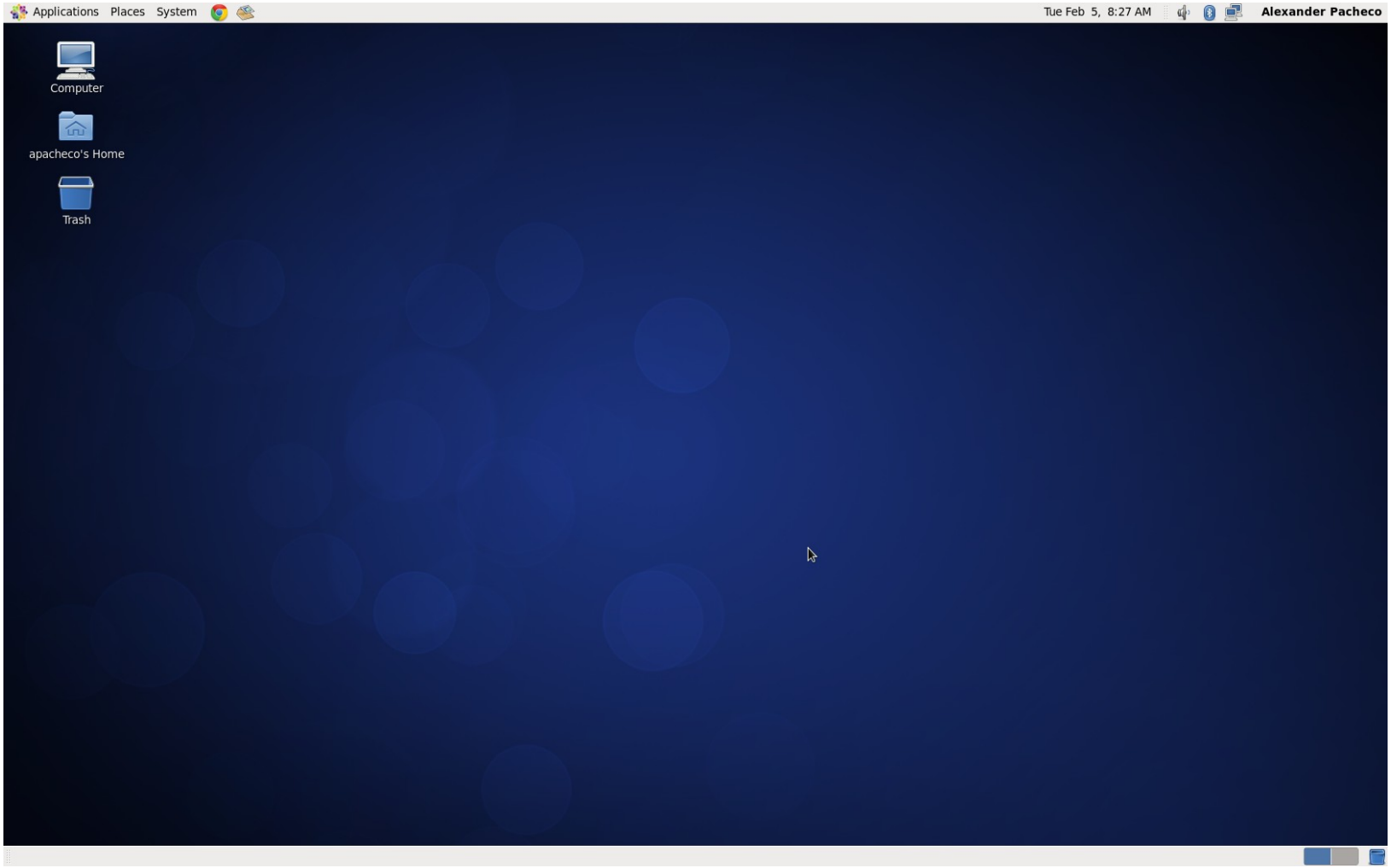
  Redhat, KDE, GNOME, XFCE, LXDE, Cinnamon, MATE

Redhat Desktop

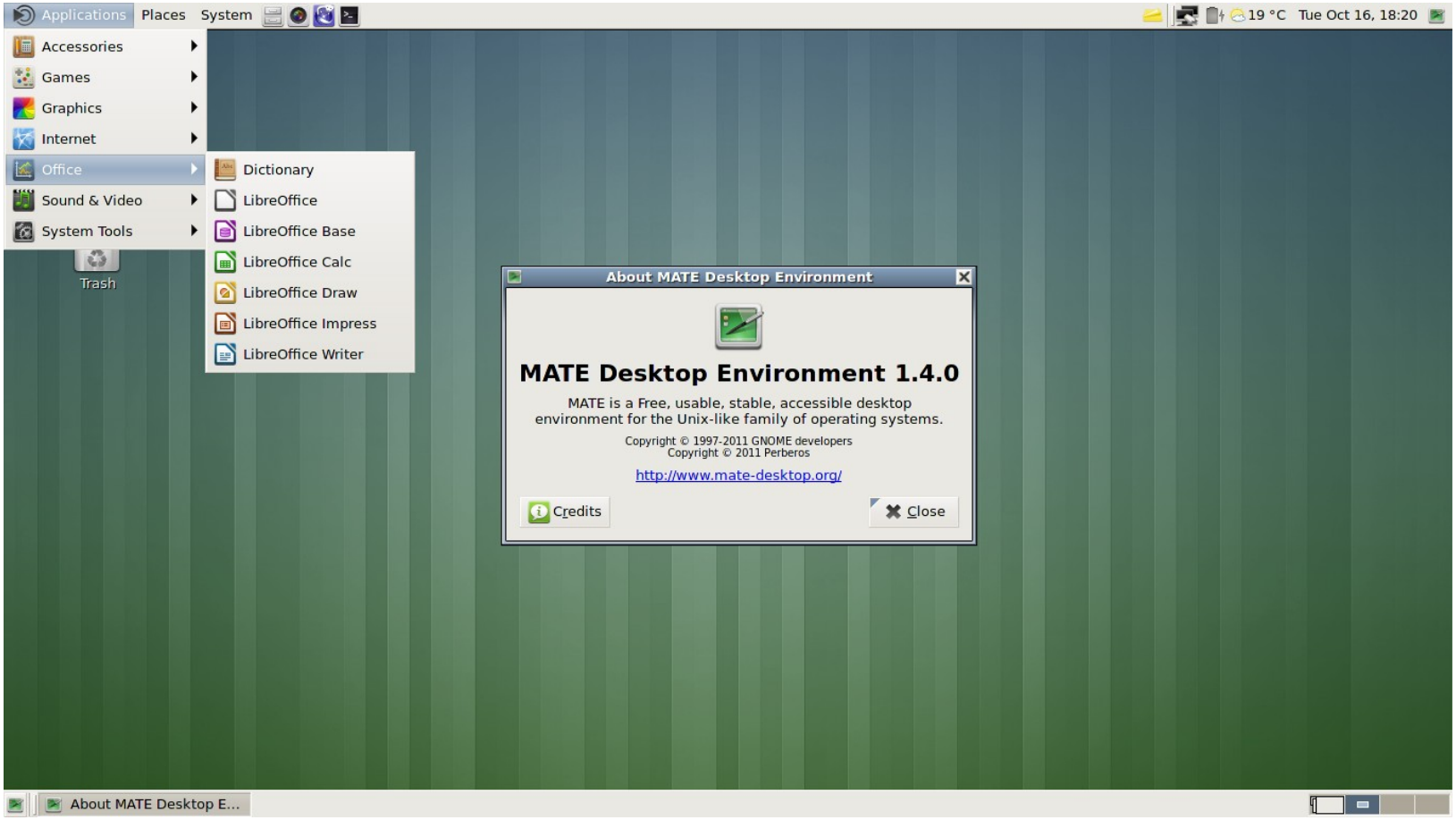
openSUSE KDE Desktop



CentOS GNOME Desktop



Debian MATE Desktop



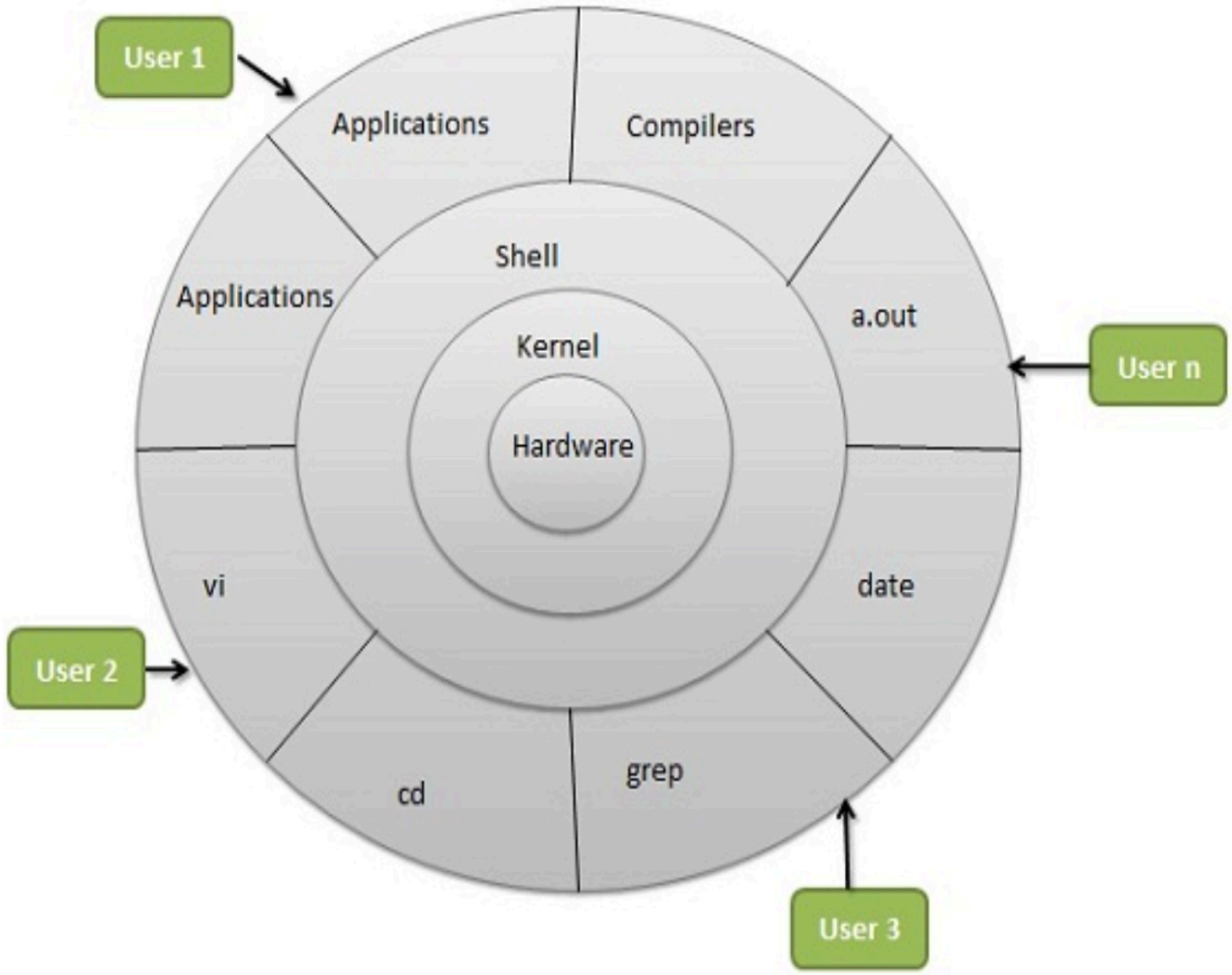
Linux Mint Cinnamon Desktop

Linux Distribution

- Linux distributions tailored to different requirements
  - Server
  - Desktop
  - Workstation
  - Router
  - Embedded devices
  - Mobile devices (Android is a Linux-based OS)

- Most software on Windows have equivalent software on Linux
  - Multiple versions and open source
  - http://wiki.linuxquestions.org/wiki/Linux-Windows_Software_Equivalents

Linux System Architecture



Linux Components

What is a Kernel

- The core component of an OS
- Manage the system's resources, memory, file systems…
- Provide the lowest level abstraction layer to upper layer components
- Inter-process communications and system calls are used to make services available

Linux Components

What is a Shell

- An application running on top of the kernel and provides a powerful interface to the system
- Process user's commands, gather input from user and execute programs
- Types of shell with varied features
  - sh
  - csh
  - ksh
  - bash
  - tcsh

Shell Comparison

Software	sh	csh	ksh	bash	tcsh
Programming language	y	y	y	y	y
Shell variables	y	y	y	y	y
Command alias	n	y	y	y	y
Command history	n	y	y	y	y
Filename autocompletion	n	y*	y*	y	y
Command line editing	n	n	y*	y	y
Job control	n	y	y	y	y

*: not by default

http://www.cis.rit.edu/class/simg211/unixintro/Shell.html

Shell Comparison

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What can you do with a shell?

- Check the current shell
  - `echo $0`
- List available shells on the system
  - `cat /etc/shells`
- Change to another shell
  - `exec sh`
- Date and time
  - `date`
- Calendar:
  - `Cal2015`
- Compile and run applications
  - `gcc hello.c –o hello`
  - `./hello`

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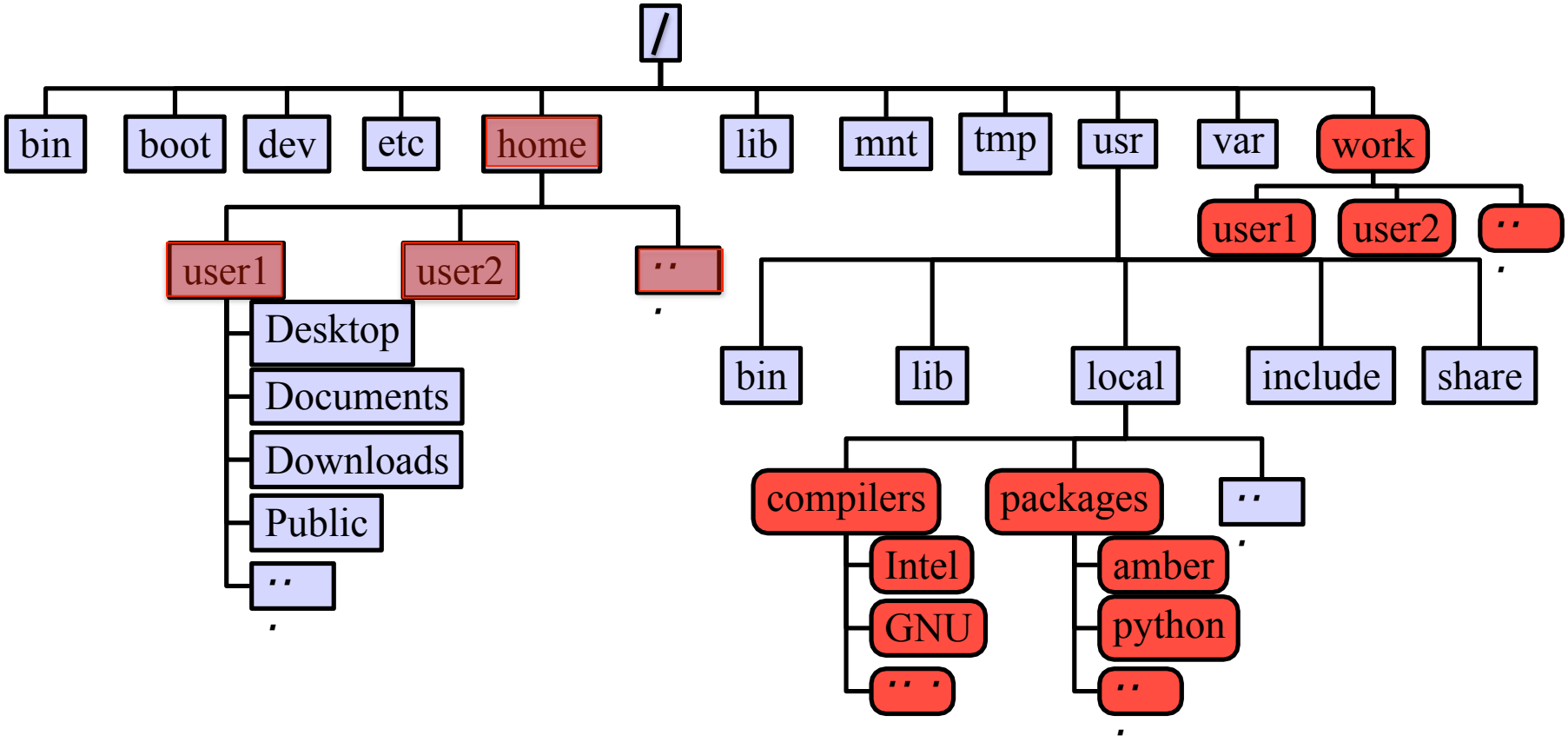
Files

- All data in Linux/UNIX is organized in files
- A file is a collection of data created by users, system admins...
- Example of files
  - Documents composed of ascii text
  - Program written in high level programming languages
  - Executables that you can run
  - Directory containing information about its content

File Directory Structure

- All files are arranged in directories.
- These directores are organized into the file system



Important Directories

/bin	contains files that are essential for system operation, available for use by all users.
/lib,/lib64	contains libraries that are essential for system operation, available for use by all users.
/var	used to store files which change frequently (system level not user level)
/etc	contains various system configurations
/dev	contains various devices such as hard disk, CD-ROM drive etc
/sbin	same as bin but only accessible by **root**
/tmp	temporary file storage
/boot	contains bootable kernel and bootloader
/usr	contains user documentations, binaries, libraries etc
/home	contains home directories of all users. This is the directory where you are at when you login to a Linux/UNIX system.

File Path

Definition: position in the directory tree

- Absolute path
  - Uniquely defined and does NOT depend on the current path
  - `/tmp` is unique
- Relative path
  - Depend on the current location in the directory tree
  - `.` is the current working directory
  - `..` is one directory up
  - `: ../tmp` is not unique

Linux is Case Sensitive

- All names are case sensitive
  - Commands, variables, files etc.

- Example: MyFile.txt, myfile.txt, MYFILE.TXT are three different files in Linux

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Basic Commands

- Command format: `command_name [options] arguments`

  ```
  ls –l /home/user
  ```

- Command prompt: a sequence of characters used in a command line interface to indicate the readiness to accept commands
  - Prompt user to take action
  - A prompt usually ends with one of the characters $,%#,:,> and often includes information such as user name and the current working directory
  - The format can be changed via $PS1

Get More Information

- **`Man:`** show the manual for a command or program
  - The manual shows how to use the command and list the different options and arguments
  - Usage: `man <command name>`
  - Example: `man ls`
- **`Apropos:`** show all of the man pages that may be relevant to a certain command or topic
  - Usage: `apropos <string>`
  - Example: `apropos editor`
- **`Info:`** Information of documents
  - `info ls`

Commands: ls

- **`ls`** command list the contents of a directory
  - Usage: `ls <options> <path>`
  - Example: `ls`
  - The default path will be current working directory if `path` is omitted.
- Options
  - `-l`: show long listing format
  - `-a`: (--all) show hidden files(name starts with an "." is hidden)
  - `-r`: reverse order when sorting
  - `-t`: show modification times
  - `-h`: (--human-readable) use file sized in SI units (bytes, kbytes, megabytes etc.)
  - `-d`: (--directory) list directory entries instead of contents, and do not dereference symbolic links

Commands: cat, more/less, head/tail

- Display the content of a file to screen
  - **`cat`**: show content of a file
  - **`more`**: display contents one page at a time
  - **`less`**: display contents one page at a time, and allow forward/backward scrolling
- Usage: `cat/more/less <options> <filename>`

- **`head`**: output the first part of files
- **`tail`**: output the last part of files
- Usage: `head/tail <options> <filename>`

- Be careful when using those commands on binary files
  - The **`file`** command reveal what type of file the target is

Auto-completion

- Allows automatic completion of typing file, directory or command name via the TAB key
  - Convenient, also error-proof
  - If there is no unique name, all matching names will show
- The default feature in `bash` and `tcsh`
- Example: your home directory contains directories `Desktop`, `Documents` and `Downloads`
  - Enter command `ls D`, then press tab
  - Enter command `ls Do`, then press tab
  - Enter command `ls Dow`, then press tab

Wildcards

Linux allows the use of wildcards for strings

- *: any number of characters
  - Example: `ls *.gz` will list all the file ending with .gz
- ?: any *single* character
- [ ]: specify a range

  e.g.: `ls test[1-9]` list the file test1,test2 …

Commands: pwd and cd

- **`pwd`** command prints the current working directory
  - Usage: `pwd`
  - Example: `pwd`
- **`cd`** command allows one to change the current working directory
  - Usage: `cd [destination]`
  - Example: `cd /tmp`
  - The default destination is the home directory if `[destination]` is omitted
  - `~` stands for home directory (bash)

Commands: mkdir

- **`mkdir`** is a command to create a directory
- Usage: `mkdir <options> <path>`
- Example: `mkdir ~/testdir`
- By default, the directory is created in the current directory
- Options
  - `-p`: create the target directory as well as any directories that appear in the path but does not exist

Commands: cp

- **cp**: copy a file or directory
- Usage: `cp <options> <sources> <destination>`
- Example: `cp $HOME/.bashrc ~/testdir`
- Options
  - `-r`: copy recursively, required when copying directories.
  - `-i`: prompt if file exists on destination and can be copied over.
  - `-p`: preserve file access times, ownership etc.

- By default **cp** will overwrite files with identical names (!!)
- If there are more than one source files, then the destination must be a directory

Commands: rm

- **`rm:`** removes files and directories
- Usage: `rm <options> <list of files/directories>`
- Examples: `rm testdir/.bashrc ~/testfile`
- Options
  - `-r`: remove recursively, required when deleting directories
  - `-i`: prompt if the file really needs to be deleted
  - `-f`: force remove (override the `-i` option)

- BE CAREFUL: DELETED FILES *CANNOT* BE RECOVERED!!!

Commands: mv

- **`mv`** command moves or renames a file or directory
- Usage: `mv <options> <sources> <dest>`
- Example: `mv test test1`
- Use the `-i` option to prompt if a file or directory will be overwritten.
- If there are more than one source files, the destination must be a directory

Commands: alias

- **`alias:`** create a shortcut to another command or name to execute a long string
- Usage
  - `bash/sh/ksh: alias <name>="<actual command>"`
  - `csh/tcsh: alias <name> "<actual command>"`
- Example
  - `bash/sh/ksh: alias lla="ls -altr"`
  - `csh/tcsh: alias lls "ls -altr"`

- `alias` can be used to prevent files from being deleted accidentally
  - Example: `alias rm "rm -i"`

- **`alias:`** list all aliases currently defined (without arguments)

- **`unalias:`** remove an alias

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File Permission

```
weis-MacBook-Pro:Laplace2D wei$ ll -al
total 56
drwxr--r--   9 wei  staff   306 Jun 13 16:13 .
drwxr-xr-x  12 wei  staff   408 May  4 17:09 ..
-rwxr--r--   1 wei  staff  1614 May  4 17:09 README
-rwxr--r--   1 wei  staff  2083 May  4 17:09 answer.c
-rwxr--r--   1 wei  staff  1945 May  4 17:09 answer.f90
-rwxr--r--   1 wei  staff  2004 May  4 17:09 exercise.c
-rwxr--r--   1 wei  staff  1833 May  4 17:09 exercise.f90
lrwxr-xr-x   1 wei  staff    10 Jun 13 16:13 linkMe -> exercise.c
-rwxr--r--   1 wei  staff  1572 May  4 17:09 timer.h
```

Linux File Permission

- Designed as the multi user environment, the access restriction of files to other users on the system is embedded.
- Three types of file permission
  - Read (r)
  - Write (w)
  - Execute (x)
- Three types of user
  - User (u) (owner)
  - Group (g) (group members)
  - World (o) (everyone elseon the system)

Linux File Permission

Each file in Linux has the following attributes:

- **Owner permissions:** determine what actions the owner of the file can perform on a file

- **Group permissions:** determine what actions a user, who is a member of the group that a file belongs to, can perform on a file

- **Other (world) permissions:** indicate what action all other users can perform on a file

File Permission

```
weis-MacBook-Pro:Laplace2D wei$ ll -al
total 56
drwxr--r--   9 wei  staff   306 Jun 13 16:13 .
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-rwxr--r--   1 wei  staff  1945 May  4 17:09 answer.f90
-rwxr--r--   1 wei  staff  2004 May  4 17:09 exercise.c
-rwxr--r--   1 wei  staff  1833 May  4 17:09 exercise.f90
lrwxr-xr-x   1 wei  staff    10 Jun 13 16:13 linkMe -> exercise.c
-rwxr--r--   1 wei  staff  1572 May  4 17:09 timer.h
```

The first column indicates the type of the file and

- d:for directory
- l: for symbolic link
- - for normal file

File Permission

```
weis-MacBook-Pro:Laplace2D wei$ ll -a
total 56
drwxr--r--   9 wei  staff   306 Jun 1
drwxr-xr-x  12 wei  staff   408 May
-rwxr--r--   1 wei  staff  1614 May
-rwxr--r--   1 wei  staff  2083 May
-rwxr--r--   1 wei  staff  1945 May
-rwxr--r--   1 wei  staff  2004 May
-rwxr--r--   1 wei  staff  1833 May
lrwxr-xr-x   1 wei  staff    10 Jun 1
-rwxr--r--   1 wei  staff  1572 May
```

Owner (u)

Group (g)

Others (o)

Changing File Permission

- **`chmod`** is a *NIX command to change permissions on a file
- Usage: chmod <option> <permissions> <file or directory name>
- `–R:` change permission recursively in a directory
- **`chmod` in Symbolic Mode:**

Chmod operator	Description
+	Adds the designated permission(s) to a file or directory.
-	Removes the designated permission(s) from a file or directory.
=	Sets the designated permission(s).

e.g. `chmod u+rwx filename`

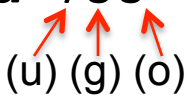
`chmod o-w filename`

Changing File Permission

- **`Chmod` in Absolute Mode**:

Number	Octal Permission Representation	Ref
0	No permission	---
1	Execute permission	--x
2	Write permission	-w-
3	Execute and write permission: 1 (execute) + 2 (write) = 3	-wx
4	Read permission	r--
5	Read and execute permission: 4 (read) + 1 (execute) = 5	r-x
6	Read and write permission: 4 (read) + 2 (write) = 6	rw-
7	All permissions: 4 (read) + 2 (write) + 1 (execute) = 7	rwx

e.g. `chmod 755 test.txt`



Permission Effect on File vs Directory

Permission	File	Directory
r	read the file content	ls the files under the directory
w	write to the file	create new files and directories,delete existing files and directories, rename and move the existing files and directories
x	execute the file (if executable)	cd into the directory

User Groups at HPC/LONI

- Users are organized into groups
  - **`groups`** command to find your group membership
- Group membership makes sharing files with members of a group easy
- Each user is in at least one group and can be in multiple groups
  - Groups in LONI systems:

    ```
    lsuusers, latechusers, unousers,
    ullusers, sususers, tulaneusers,
    loniusers, xavierusers
    ```

  - Groups in LSU HPC system

    ```
    Users, Admins, xsede…
    ```

  - You are only in one of the above groups due to software licensing

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Variables

- Linux allows the use of variables
  - Similar to programming languages
  - Number, character or string
- Rules for variable names
  - Must start with a letter or underscore
  - Number can be used anywhere else
  - Do not use special characters such as @,#,%,$
  - Case sensitive
  - Allowed: VARIABLE, VAR1234able, var_name, _VAR
  - Not allowed: 1var, %name, $myvar, var@NAME
- Two types of variables:
  - Global variables (ENVIRONMENT variables)
  - Local variables (user defined variables)

Global Variables

- Environment variables provide a simple way to share configuration settings between multiple applications and processes in Linux
  - Using all uppercase letters
  - Example: PATH, LD_LIBRARY_PATH, DISPLAY etc.
- To reference a variable, prepend $ to the name of the variable
- Example: $PATH, $LD_LIBRARY_PATH, $DISPLAY etc.
- **`printenv/env`** list the current environmental variables in your system.

List of Some Environment Variables

PATH	A list of directory paths which will be searched when a command is issued
LD_LIBRARY_PATH	colon-separated set of directories where libraries should be searched for first
HOME	indicate where a user's home directory is located in the file system.
PWD	contains path to current working directory.
OLDPWD	contains path to previous working directory.
TERM	specifies the type of computer terminal or terminal emulator being used
SHELL	contains name of the running, interactive shell.
PS1	default command prompt
PS2	Secondary command prompt
HOSTNAME	The systems host name
USER	Current logged in user's name
DISPLAY	Network name of the X11 display to connect to, if available.

Editing Variables

- Assign values to variables

Type	sh/ksh/bash	csh/tcsh
Shell (local)	`name=value`	`set name=value`
Environment (global)	`export name=value`	`setenv name=value`

- Shell variables is only valid within the current shell, while environment variables are valid for all subsequently opened shells.
- Example: useful when running a script, where exported variables (global) at the terminal can be inherited within the script.
  - $ `export v1=one`
    - $ `bash`
      - $ `echo $v1` → `one`

Editing Variables at the curent login

Example: to add a directory to the PATH variable

```
sh/ksh/bash: export PATH=/path/to/executable:${PATH}
csh/tcsh: setenv PATH /path/to/executable:${PATH}
```

- The path order matters, first in line takes higher priority

Editing Variables for each login

- Not to change at each login
- Make setting changes available in both login and non-login shells
- Define these variables in the ~/.bashrc file.
  - edit ~/.bashrc
  - source ~/.bashrc

Input & Output Commands

The basis I/O statements:

- **`echo:`** display info to screen
  - The `echo arguments` command will print arguments to screen or standard output, where `arguments` can be a single or multiple variables, string or numbers
- **`read:`** reading input from screen/keyboard/prompt
  - The `read` statement takes all characters typed until the Enter key is pressed
  - Usage: `read <variable name>`
  - Example: `read name`

Input & Output Commands

- Examples
  - `echo "hello !"`
  - `hello`
- By default, `echo` eliminates redundant whitespaces (multiple spaces and tabs) and replaces it with a single whitespace between arguments.
- To include redundant whitespace, enclose the arguments within double quotes

Other Useful Commands

passwd	Change password (does not work on LSU HPC and LONI systems)
chsh	Change default shell (does not work on LSU HPC and LONI systems)
df	Report disk space usage by filesystem
du	Estimate file space usage - space used under a particular directory or files on a file system.
sudo	Run command as root (only if you have access)
mount	Mount file system (root only)
umount	Unmount file system (root only)
shutdown	Reboot or turn off machine (root only)
top	Produces an ordered list of running processes
free	Display amount of free and used memory in the system
find	Find a file
alias	enables replacement of a word by another string

Other Useful Commands

vi	Edit a file using VI/VIM
emacs	Edit a file using Emacs
file	Determine file type
wc	Count words, lines and characters in a file `wc -l file`
grep	Find patterns in a file `grep alias file`
awk	File processing and report generating `awk '{print $1}' file`
sed	Stream Editor `sed 's/home/HOME/g' file`
set	manipulate environment variables `set -o emacs`
touch	change file timestamps or create file if not present
date	display or set date and time

Other Useful Commands

ln	Link a file to another file `ln -s file1 file2`
wait	Wait for each specified process and return its termination status.
which	Shows the full path of (shell) commands
who	Show who is logged on
whoami	Print effective userid
finger	User information lookup program
whatis	Display manual page descriptions
history	Display the command history list with line numbers. An argument of n lists only the last n lines.

- `man` *`command:`* learn more about these commands

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Login Remote Systems

- Most Linux systems allocate secure shell connections from other systems
- Log in using the **`ssh`** command to the LSU HPC and LONI clusters
- Usage: `ssh <username>@<remote host name>`
  - Example: `ssh user@smic.hpc.lsu.edu`
- **`–X`** option: forward the display of an application
- The default port is 22 for `ssh`
  - `ssh –p <port number> <username>@<hostname>`

File Transfer between Two Systems

- **`scp`** : copy files between two hosts over the ssh protocol
- Usage:
  - `scp <options> <user>@<host>:/path/to/`**`source`** `<user>@<host>:/path/to/`**`destination`**
- If the user name is the same on both systems, omit `<user@>`
- If transferring files from or to localhost, `<user>@<host>:` option can be omitted
- Options are `-r` and `-p`, same meaning with `cp`
- Examples
  - `scp user@mike.hpc.lsu.edu:/work/user/somefile .`
  - `scp -r code user@eric.loni.org:/home/user`

File Transfer between Two Systems

- **`rsync`** is another utility for file transferring
- Usage: `rsync <options> <source> <destination>`
- Delta-transfer algorithm
  - Only transfer the bits that are different between source and destination
- Widely used for backups and mirroring as an improved copy command for everyday use
- Command options
  - -a: archive mode
  - -r: recursive mode
  - -v: increase verbosity
  - -z: compress files during transfer
  - -u: skip files that are newer on the receiver
  - -t: preserve modification times

Compressing and Archiving Files

- Reduce storage usage or bandwidth while transferring files.
- By convention
  - gzipped files have extension .gz, .z or .Z
  - zipped files have extension .Zip or .zip
  - bzipped files have extension .bz2 or .bz

- **Compress**: `gzip, zip, bzip2`
- **Decompress**: `gunzip, unzip, bunzip2`
- Options
  - Recursively, use the `-r` option
  - Overwrite files while compressing/uncompressing, use the `-f` option

Compressing and Archiving Files

- **`tar:`** create and manipulate streaming archive of files.
- Usage: **`tar <options> <file> <path>`**
  - `<file>` is name of the tar archive file, usually with extension .tar
  - `<path>` are pathnames for files/directories being archived
- Common options
  - -c: create/compress an archive file
  - -x: extract/decompress an archive file
  - -t: list contents of archive (for testing)
  - -z: filter the archive through gzip
  - -j: filter the archive through bzip2
  - -f: archive
  - -v: verbosely list files processed

Compressing and Archiving Files

- **`tar:`** create and manipulate streaming archive of files.
- Usage: **`tar <options> <file> <path>`**
  - `<file>` is name of the tar archive file, usually with extension .tar
  - `<path>` are pathnames for files/directories being archived

Examples:

- File compressing
  - `tar -czvf file.tgz ${HOME}/*`
  - `tar -cjvf file.tgz2 ${HOME}/*`
- File decompressing
  - `tar -xzvf file.tgz -C [dest]`
  - `tar -xjvf file.tgz2 -C [dest]`

Pipes: grep

- Connect two or more commands together using "|"
- **`grep:`** searches certain patterns from a file(s)

```
cat file | grep [option] pattern
```

Option	Description
-v	Print all lines not match pattern
-n	Print the matched line and line number
-l	Print only the names of files with matching pattern
-i	Match either upper- or lowercase.
-c	Print the count of matching lines

Pipes: sort, wc, more, less

- `sort`: arranges lines of text alphabetically or numerically
- `ls |sort –k2`

Option	Description
-n	Sort numerically
-r	Reverse the order of sort
-k	Sort by a certain column
-t	Field separator

- `ls |wc`
- `cat file | more`
- `Cat file | less`

I/O Redirection

- Linux take input from the keyboard and send output to the terminal
- Three file descriptors for I/O streams (everything is a file in Linux)
  - STDIN (0): Standard input
  - STDOUT (1): standard output
  - STDERR (2): standard error
- I/O redirection allows users to connect applications
  - <: connects a file to STDIN of an application
  - >: connects STDOUT of an application to a file
  - >>: connects STDOUT of an application by appending to a file
  - |: connects the STDOUT of an application to STDIN of another application.

I/O Redirection Examples

- Write STDOUT to file: `ls -l > ls.out`
- Write STDERR and STDOUT to file: `ls -l >output 2>&1`
- Write STDERR to file: `ls -l &2 > ls-l.err`
- Write STDERR to STDOUT: `ls -l 2>&1`
- Send STDOUT as STDIN for another application (pipe):

  `ls -l | less`
- Discard STDOUT: `command > /dev/null`
- Discard STDOUT and STDERR:

  `command > /dev/null 2>&1`

Roadmap

- What is Linux
- Linux file system
- Basic commands
- File permissions
- Variables
- Use HPC clusters
- Processes and jobs
- File editing

Processes

- Process: an instance of running program
- Linux create and start a new process (PID) for each command
  - **`ps`** or **`top`**
- A process cab be run in :
  - **Foreground**: the command prompt is not returned until the current process has finished executing.
  - **Background**: the command prompt back to do some other useful work `e.g. ls -l &`

Processes and Jobs

- Two ways to send a job into the background:
  1. **`command &`**
  2. suspend the running job using **`Ctrl-z`** and **`bg`**.

- When a process is running in background or suspended, it will be entered on to a list along with a job number (not PID)

  `jobs -l`

- **`nohup`**: prevent background jobs to be terminated when users exit the shell

  `nohup program &`

Managing Processes and Jobs

- Restart a suspended job in foreground or background
  - `fg %<job number>`
  - `bg %<job number>`

- To kill or terminate a process:
  - Job running in foreground: `Ctrl-c`
  - Job whose job ID you know: `kill %<job number>`
  - Job whose PID you know: `kill <PID>`

Roadmap

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File Editing

- Most commonly used editors on Linux/Unix systems
  - vim or vim (vi improved)
  - Emacs
- vi/vim is installed by default on Linux/Unix systems and has only a command line interface (CLI).
- Emacs has both a command line interface (CLI) and a graphical user interface (GUI).
  - use `emacs -nw` to open file in console
- Other editors: nano, pico, kate, gedit, gvim, kwrite, nedit

File Editing (vi)

vi works in two modes:

- Command mode
  - This is the mode when entering vi
  - Commands can be issued at the bottom of the screen, e.g. copy, paste, search, replace etc.
  - Press “i” to enter editing mode
- Editing mode
  - Text can be entered in this mode
  - Press “esc” key to go back to the command mode

Most used commands (vi)

Description	Command
Insert at cursor	i
Insert at the beginning of line	I
Delete a line	dd
Copy a line	yy
Paste	p
Search forward	/pattern
Search backward	?pattern
Search again	n
Go to line #n	n
Replace text	%s/new/old/g
Save and exit	wq

Editor cheatsheet (1)

Cursor Movement	vi	emacs
move left	h	C-b
move down	j	C-n
move up	k	C-p
move right	l	C-f
jump to beginning of line	0	C-a
jump to end of line	$	C-e
goto line n	nG	M-x goto-line ⟵ n
goto top of file	1G	M-<
goto end of file	G	M->
move one page up	C-u	M-v
move one page down	C-d	C-v

Editor cheatsheet (2)

File Manipulation	vi	emacs
save file	`:w`	`C-x C-s`
save file and exit	`:wq, ZZ`	
quit	`:q`	`C-x C-c`
quit without saving	`:q!`	
delete a line	`dd`	`C-a C-k`
delete *n* lines	*n*`dd`	`C-a M-`*n*` C-k`
paste deleted line after cursor	`p`	`C-y`
paste before cursor	`P`	
undo edit	`u`	`C-_`
delete from cursor to end of line	`D`	`C-k`
search forward for *patt*	`\`*patt*	`C-s` *patt*
search backward for *patt*	`?`*patt*	`C-r` *patt*
search again forward (backward)	`n`	`C-s(r)`

Editor cheatsheet (3)

File Manipulation (contd)	vi	emacs
replace a character	`r`	
join next line to current	`J`	
change a line	`cc`	
change a word	`cw`	
change to end of line	`c$`	
delete a character	`x`	`C-d`
delete a word	`dw`	`M-d`
edit/open file *file*	`:e file`	`C-x C-f` *file*
insert file *file*	`:r file`	`C-x i` *file*
split window horizontally	`:split` or `C-ws`	`C-x 2`
split window vertically	`:vsplit` or `C-wv`	`C-x 3`
switch windows	`C-ww`	`C-x o`

Shell Scripts

- Script: a program written for a software environment to automate the execution of tasks
  - A series of shell commands put together in a file
  - When the script is executed, it is as if someone type those commands on the command line

- The majority of script programs are “quick and dirty”, where the main goal is to get the program written quickly
  - May not be as efficient as programs written in C and Fortran

Startup Scripts

- When you login to a Linux computer, shell scripts are automatically loaded depending on your default shell

- `bash` (in the specified order)
  - `/etc/profile` (for login shell)
  - `/etc/bashrc`
  - `$HOME/.bash_profile` (for login shell)
  - `$HOME/.bashrc`
- `sh/ksh`
  - `/etc/profile`
  - `$HOME/.profile`
- `csh/tcsh`
  - `/etc/csh.cshrc`
  - `$HOME/.tcshrc or .cshrc` (if `.tcshrc` is not present)
- .bashrc, .tcshrc, .cshrc, .bash_profile at located at ~/
  users can define their own aliases, environment variables, modify paths etc.

Script Example (~/.bashrc)

```
# .bashrc

# Source global definitions
if [ -f /etc/bashrc ]; then
        . /etc/bashrc
fi

# User specific aliases and functions
export PATH=$HOME/packages/eFindsite/bin:$PATH
export LD_LIBRARY_PATH=$HOME/packages/eFindsite/lib:$LD_LIBRARY_PATH
alias qsubI="qsub -I -X -l nodes=1:ppn=20 -l walltime=01:00:00 –A
my_allocation“
alias lh="ls -altrh"
```

Getting Help

- User Guides
  - LSU HPC: http://www.hpc.lsu.edu/docs/guides.php#hpc
  - LONI: http://www.hpc.lsu.edu/docs/guides.php#loni
- Documentation: http://www.hpc.lsu.edu/docs
- Online courses: http://moodle.hpc.lsu.edu
- Contact us
  - Email ticket system: sys-help@loni.org
  - Telephone Help Desk: 225-578-0900
  - Instant Messenger (AIM, Yahoo Messenger, Google Talk)
    - Add “lsuhpchelp”

Exercise (1)

- Login to a Linux machine and open a terminal
- Enter the following commands or carry out operations asked for.
- Understand what you are doing and ask for help if unsure. Some commands are incorrect or will fail; if this is the case, enter the correct ones

Exercise (2)

```
$ echo hello world
$ pwd
$ whoami
$ cd /tmp
$ cd -
$ mkdir test/testagain
$ cd test/testagain
$ touch file
```

- Go back to your home directory
- Figure out which shell you are using

Exercise (3)

- Create an alias for removing files which prompt for confirmation and delete
  - the file that you created.
- From your home directory get a list of files and directory in long format in reverse order with file sizes listed in human readable format.
- (On HPC or LONI clusters) Find out the location of `vi`, `emacs`, `perl` and `ifort`.
- Change the permission of the testagain directory to be world writable.
- Open a few applications of choice in foreground one by one and then suspend them,
- Get a list of suspended jobs,
- Foreground job 1 and close it,
- Background job 2,
- Kill job 3,
- Put job 2 in foreground and close it,
- Check if you still have any jobs running.

Exercise (4)

If you have never used vim or emacs, go through the vim tutorial: vimtutor

```
===============================================================================
=    W e l c o m e   t o   t h e   V I M   T u t o r   -   Version 1.7      =
===============================================================================

     Vim is a very powerful editor that has many commands, too many to
     explain in a tutor such as this.  This tutor is designed to describe
     enough of the commands that you will be able to easily use Vim as
     an all-purpose editor.
```