

Workshop 1: Introduction to UNIX command-line

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“Swiss Army knife” set of tools

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Collaboratory Website

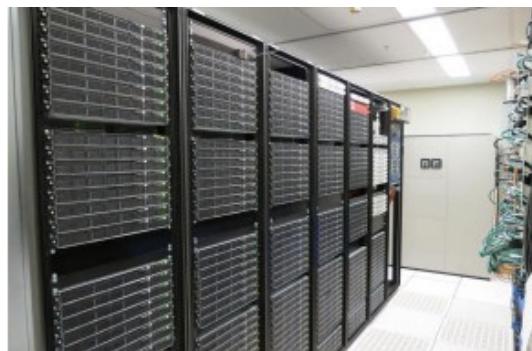
<http://qcb.ucla.edu/collaboratory/>

Workshop 1: Introduction to UNIX command-line

- **Day 1**
 - Unix - Learning the essentials
 - Unix fundamentals , syntax and usage
- **Day 2**
 - Unix commands
 - Useful tools for processing text files
- **Day 3**
 - Useful shell commands
 - UNIX Shell Scripting
 - Running jobs on hoffman2 cluster

Why Unix?

- As biological data sets have grown **larger** and biological problems have become more complex, the requirements for computing power have also grown.
- Computers that can provide this power generally use the Unix operating system (e.g. Hoffman2)



Why Unix?

- It is **very popular**, so it is easy to find information and get help
- Unix is **very stable** - computers running Unix almost never crash
- Unix is **very efficient**
 - manage extremely **huge amounts of data**
- Most new bioinformatics software is created for Unix

Command line interface

Topic	CLI	GUI
Ease	Due to a higher degree of memorization and familiarity needed for operation and navigation, new users find operating a command line interface more difficult than a GUI.	Because a GUI is much more visually intuitive, new users almost always pick up this interface faster than a CLI.
		

Command line interface

Topic	CLI	GUI
Control	<p>Users have more control over both the file and operating systems in a command line interface. For example, users can copy a specific file from one location to another with a one-line command.</p>	<p>Although a GUI offers ample access to the file and operating systems, advanced tasks may still need to utilize the command line.</p>



Command line interface

Topic	CLI	GUI
Multitasking	Although many command line environments are capable of multitasking, they do not offer the same ease and ability to view multiple things at once on one screen.	GUI users have windows that enable a user to view, control, manipulate, and toggle through multiple programs and folders at same time.



Command line interface

Topic	CLI	GUI
Speed	Command line users only need to utilize their keyboards to navigate a the interface. Additionally, they often only need to execute a few lines to perform a task.	Using both a mouse and keyboard to navigate and control your operating or file system is going to be much slower than someone who is working in a command line.



Command line interface

Topic	CLI	GUI
Scripting	A command line interface enables a user to script a sequence of commands to perform a task or execute a program.	Although A GUI enables a user to create shortcuts, tasks, or other similar actions, it doesn't even come close in comparison to what is available through a command line.



Command line interface

Topic	CLI	GUI
Diversity	After you've learned how to navigate and use a command line, it's not going to change as much as a new GUI. Although new commands may be introduced, the original commands always remain the same.	Each GUI has a different design and structure when it comes to performing different tasks. Even different iterations of the same GUI, such as Windows, can have hundreds of different changes between each version.
		

Command line interface

Topic	CLI	GUI
Strain	<p>The command line allows the user to keep their hands on the keyboard, almost never touching the mouse. Moving back and forth between a keyboard and mouse can cause additional strain and may help contribute to Carpal Tunnel Syndrome.</p>	<p>Although shortcut keys can help reduce the amount of times you have move from the keyboard to the mouse, you will still be moving much more between devices in a GUI.</p>
		

Do Biologists have to become Programmers?



Google

stackoverflow

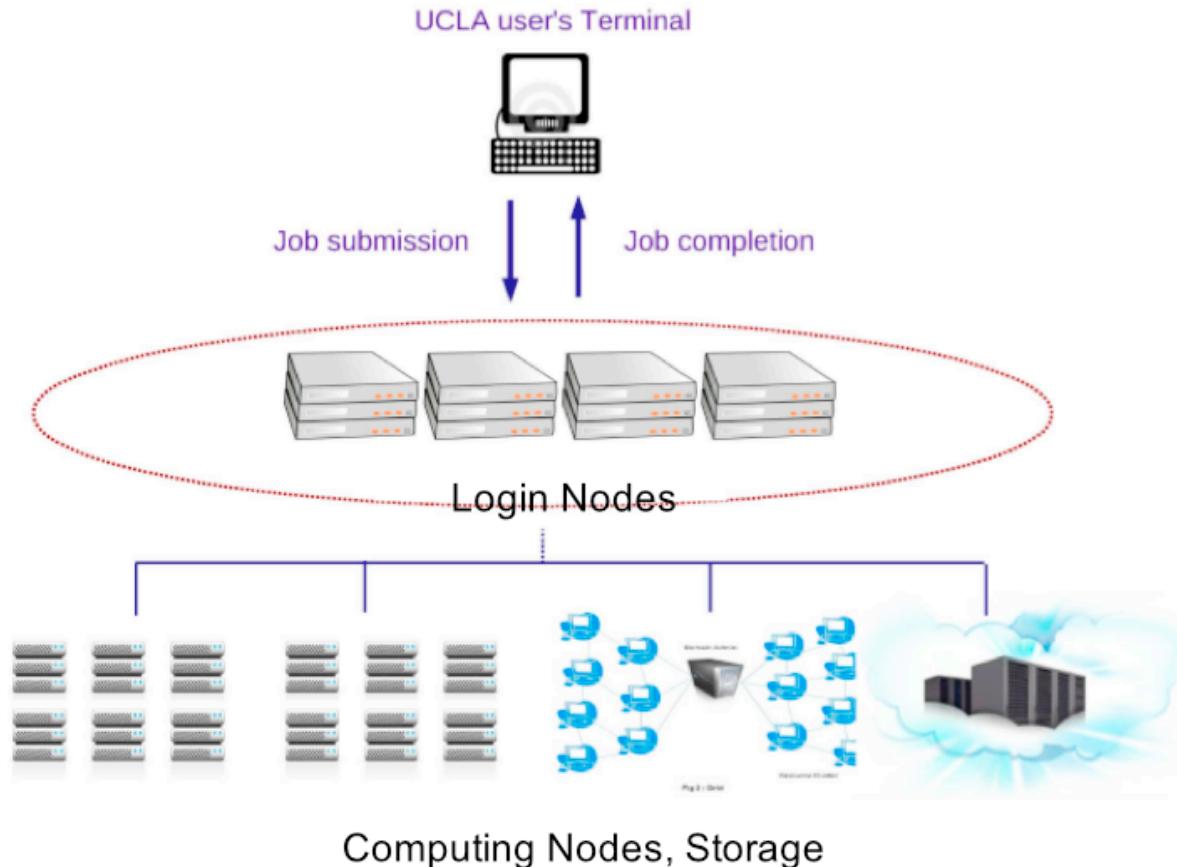
SEQanswers
the next generation sequencing community



*provided in the class

*free and easy to use

Hoffman2



How to connect to hoffman2

- Open a **SSH** program on your computer
- Connect to: **hoffman2.idre.ucla.edu**
- Type your **username** and **password**
 - You can't backspace/delete while typing username and password
 - Notice that when you type a password, nothing shows up on the screen, this is for your security

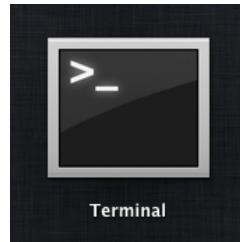
Open SSH program



Terminal



Utilities



Terminal



Microsoft®
Windows®

Putty



<http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html>



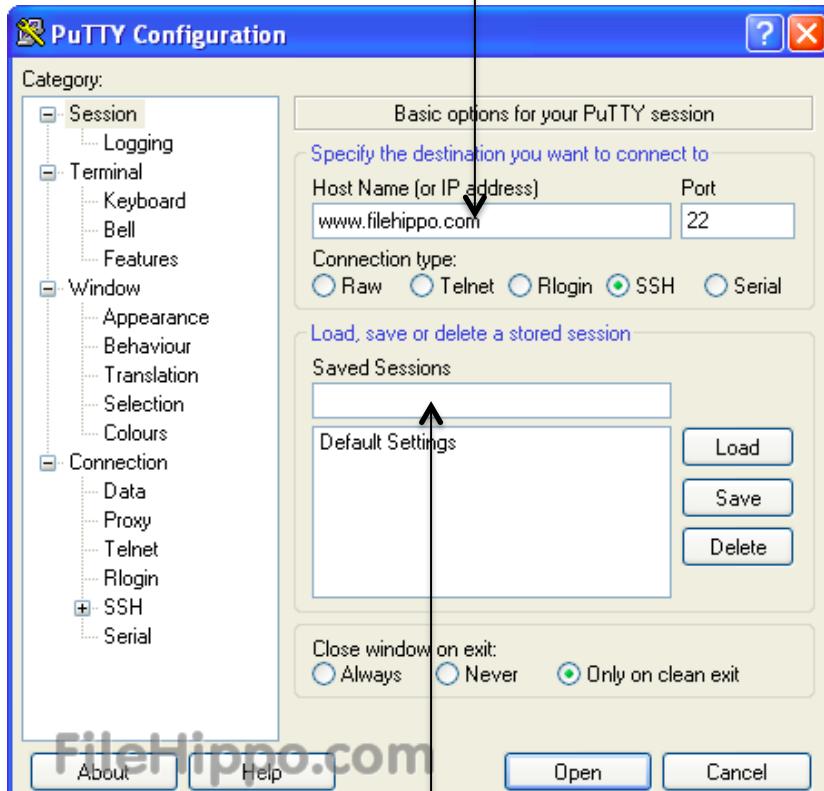
For Windows on Intel x86

PuTTY: [putty.exe](#)



Connect to hoffman2

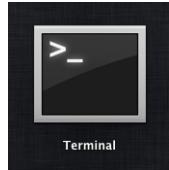
hoffman2.idre.ucla.edu



Session name (e.g. hoffman2)

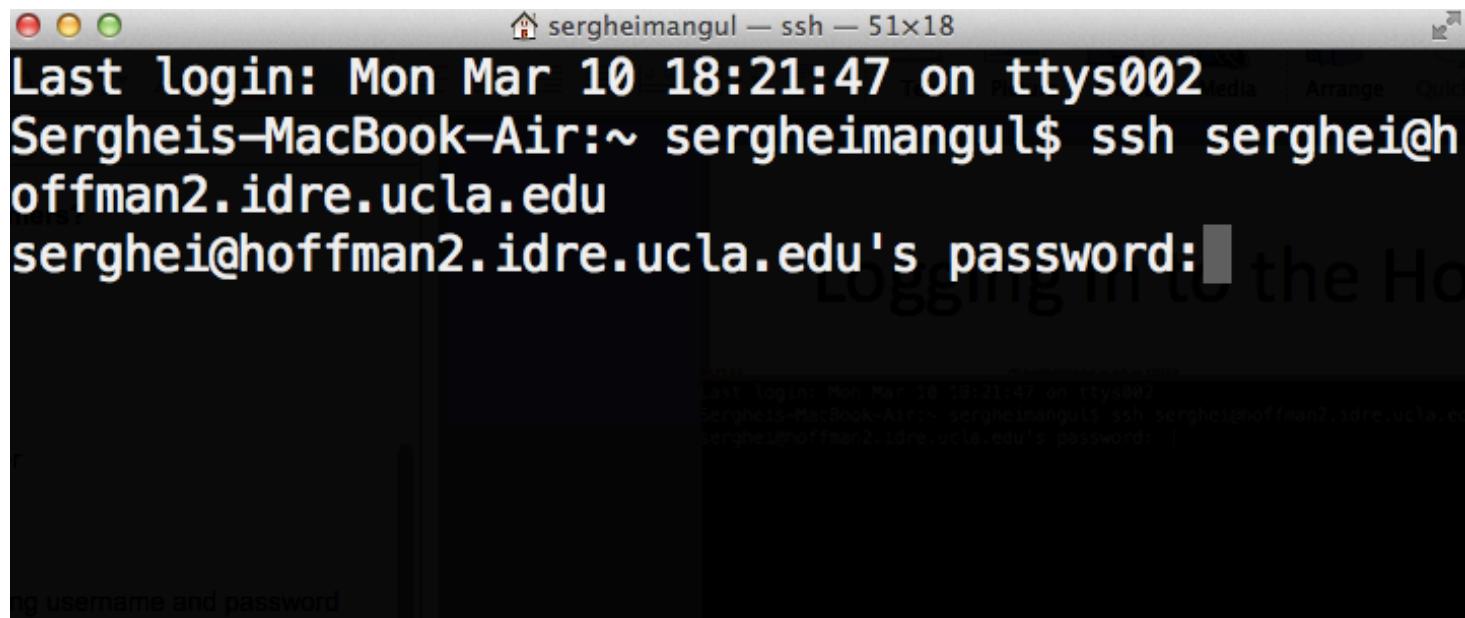


"Yes" for fingerprint for the first time!



Connect to hoffman2

ssh serghei@hoffman2.idre.ucla.edu



A screenshot of a Mac OS X Terminal window titled "sergheimangul — ssh — 51x18". The window shows the following text:

```
Last login: Mon Mar 10 18:21:47 on ttys002
Sergheis-MacBook-Air:~ sergheimangul$ ssh serghei@hoffman2.idre.ucla.edu
serghei@hoffman2.idre.ucla.edu's password: [REDACTED]
```

The password field is redacted with a gray box. In the background, a faint watermark-like text "Logging in to the Ho" is visible.

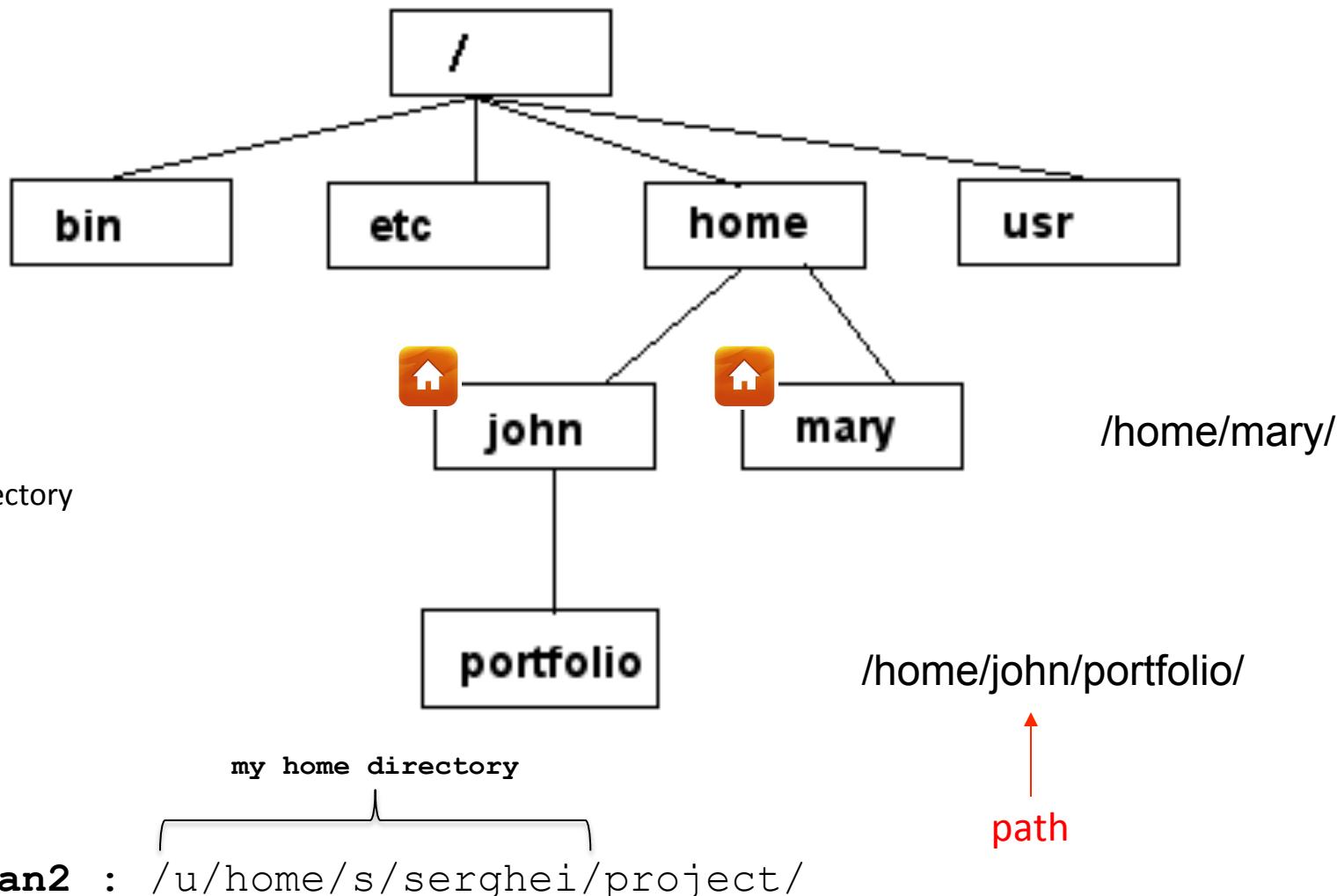
The Unix Shell



- A shell is a program that waits for you to type a command and then executes it.
 - type the command, then “return”

Unix File System

Unix is cAsE sEnsItiVe !



Home directory

- When you login to the hoffman2 server, you always start in your Home directory.
- Create sub-directories to store specific projects or groups of information

Tips

Do not accumulate thousands of files with cryptic names in your Home directory

Command: pwd

- To display current directory

```
[serghei@login3 ~] $ pwd  
/u/home/s/serghei
```

Command: mkdir

- To create a new directory use “mkdir”

```
[serghei@login3 ~] $ mkdir test
```



If no error message is displayed
means the command was run
successfully

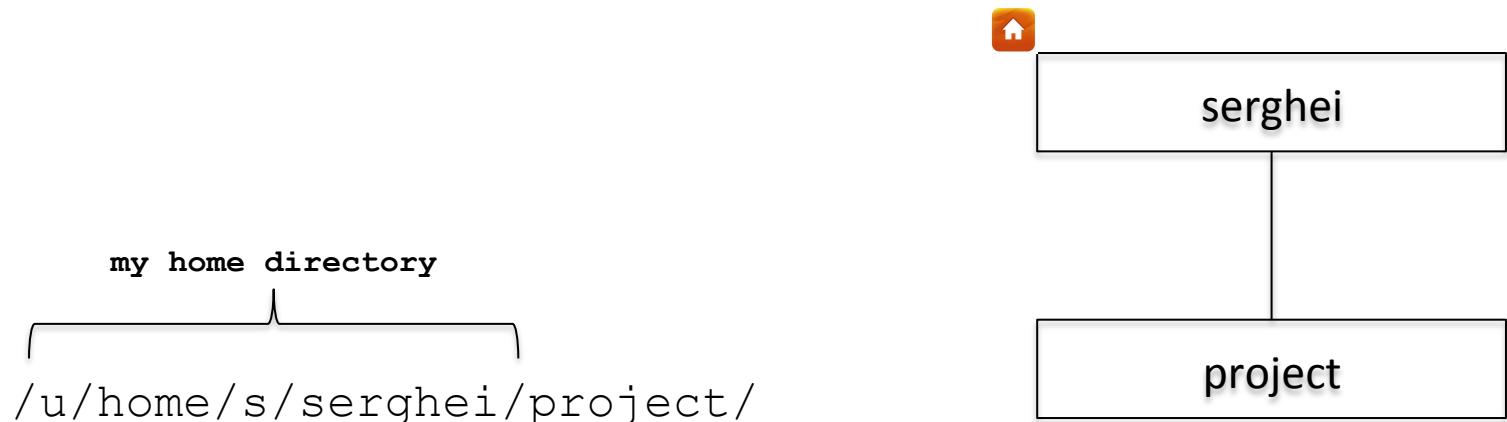
Command: cd

- cd changes your current working directory

```
[serghei@login3 ~]$ cd test
[serghei@login3 test]$ pwd
/u/home/s/serghei/test
```

Command: cd

- “~” is the location of your home directory
- “..” is the location of the directory above the current one





Let's practice

```
[serghei@login3 test]$ cd ~  
[serghei@login3 ~]$ pwd  
/u/home/s/serghei  
[serghei@login3 ~]$ cd ..  
[serghei@login3 s]$ pwd  
/u/home/s  
[serghei@login3 s]$ cd  
/u/home/s/serghei
```

TIPS

- to go back to previously entered commands, use the **up** and **down** arrows
- to auto-complete file names, use the **tab** key
- if you are **stuck** within a command/process/program, try **ctrl-z** to terminate it





Let's practice

```
[serghei@login3 test]$ mkdir jdkhfkjdsfhkjsdhfkjsdhfkjhs  
[serghei@login3 test]$ cd jdkhfkjdsfhkjsdhfkjsdhfkjhs
```

Create a text file

1. [serghei@login3 ~] \$ vi test.txt

On-screen, you will see blank lines, each with a tilde (~) at the left, and a line at the bottom giving the name and status of the new file:

```
~  
"test.txt" [New File]
```

2. Press “i” to edit the file

```
~  
-- INSERT --
```

3. Press

- “ESC” (insert mode is gone)
- “SHIFT” + ";" (you should see on the screen :wq)
- “wq” (w – save file, q- quit) OR “q!” (discard changes and quit file)
- “ENTER”

```
~  
:wq
```

```
~  
:q!
```

Command: passwd

- changes your hoffman2 password
- A very good idea after you got a default one.

```
[serghei@login3 ~] $ passwd
```

Changing password for user serghei.

Please enter your current password:

Command : ls

- to list the files in the current directory

```
[serghei@login3 project] $ ls
allgtex.samples
Alu
Bacteria
```

Command : ls

- ls has many options
 - -l long list (displays lots of info)
 - -t sort by modification time
 - -S sort by size
 - -h list file sizes in human readable format
 - -r reverse the order
- Options can be combined: “ls -lh”



Let's practice!

```
[serghei@login3 test]$ ls  
jdkhfkjdsfhkjsdhfkjsdhfkjhsdjfk  test.txt
```

```
[serghei@login3 test]$ ls -l  
total 8  
drwxr-xr-x 2 serghei eeskin 4096 Sep  8 09:35  
jdkhfkjdsfhkjsdhfkjsdhfkjhsdjfk  
-rw-r--r-- 1 serghei eeskin    80 Sep  8 09:50 test.txt
```

```
[serghei@login3 test]$ ls -lh  
total 8.0K  
drwxr-xr-x 2 serghei eeskin 4.0K Sep  8 09:35  
jdkhfkjdsfhkjsdhfkjsdhfkjhsdjfk  
-rw-r--r-- 1 serghei eeskin    80 Sep  8 09:50 test.txt
```

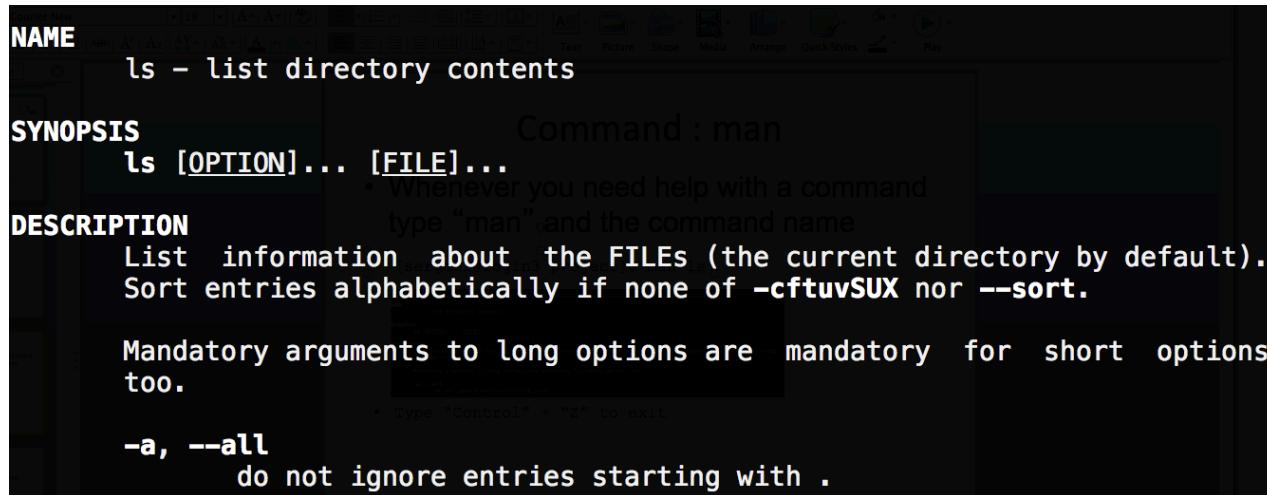
How to know more?

- Manual
- Google

Command : man

- displays manual pages

```
[serghei@login3 project]$ man ls
```



The screenshot shows a terminal window with the man page for the 'ls' command. The title bar says 'NAME'. The page content is as follows:

NAME ls - list directory contents

SYNOPSIS Command : man
ls [OPTION]... [FILE]...
• Whenever you need help with a command type "man" and the command name

DESCRIPTION List information about the FILEs (the current directory by default). Sort entries alphabetically if none of **-cftuvSUX** nor **--sort**.
Mandatory arguments to long options are mandatory for short options too.
* Type "Control" + "Z" to exit

-a, --all
do not ignore entries starting with .



ctrl-z to exit



Google

Is sort by data



Web Images Shopping Videos News More Search tools

About 33,700,000 results (0.77 seconds)

[linux - How can I sort the output of 'ls' by last modified date ...](#)

superuser.com/.../how-can-i-sort-the-output-of-ls-by-last-modified-date ...
Apr 9, 2009 - The ls man page describes this in more details, and lists other options ... ls -halt is for human readable , show hidden , print details , sort by date ...



[Linux / Unix: Sort ls Command Output By Last Modified Date ...](#)

www.cyberciti.biz/.../ls-command-sort-the-output-by-last-modified-time-...
Aug 25, 2013 - Explains how to sort the output of ls command by last modified date in ...
1 vivek staff 301746331 Aug 25 01:25 data-db2-sample.rar -rw-r--r@ ...

[linux - How to sort results from ls command by modification ...](#)

unix.stackexchange.com/.../how-to-sort-results-from-ls-c... Stack Exchange
Aug 11, 2013 - ls -lrt. to get files and folders sorted by modification date, but this does not Sort data in descending order of first column, for equal values, use ...

7 Answers

active oldest

votes



ls -t

477

or (for reverse, most recent at bottom):



ls -tr

The ls man page describes this in more details, and lists other options.



General Syntax: *

- “*” can be used as a wildcard in Unix

```
[serghei@login3 test]$ ls *txt  
test.txt
```

```
[serghei@login3 test]$ ls t*g  
test.log
```

```
[serghei@login3 test]$ ls t*  
test.log  
test.txt
```

Displaying a file

- Various ways to display a file in Unix
 - cat
 - less
 - head
 - tail

Command: cat

- dumps an entire file to standard output
- good for displaying short, simple files

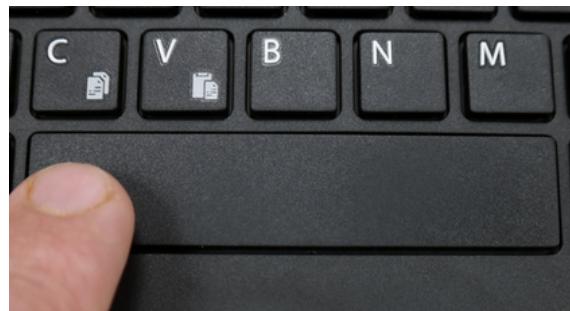
```
[serghei@login3 test]$ cat test.txt
My first txt file!
```

Command: less

- Scrolling through a file without a mouse



Up and down keys
Scroll one line



space-b
Scroll one page



To exit press ctrl-z



Let's practice!

```
[serghei@login3 test]$ less large.txt
```

```
1  
2  
3  
4  
5  
6  
7  
...  
30
```



Try to scroll forward/back one line/page!

Command: head

- displays the top part of a file

by default it shows the first 10 lines

- **-n** option allows you to change that

Command: tail

- Same as head, but shows the last lines



Let's practice!

```
[serghei@login3 test]$ head large.txt
```

1

2

...

9

10

```
[serghei@login3 test]$ tail large.txt
```

21

22

...

30

```
[serghei@login3 test]$ tail -n 3 large.txt
```

28

29

30

File Commands

- Copying a file: **cp**
- Move or rename a file: **mv**
- Remove a file: **rm**



Copy

`cp <source> <destination>`

- to remove a file use **cp**
- to remove a directory use **cp-r**

- **-i (interactive)**
Prompts you to confirm if the file is going to overwrite a file in your destination.
- **-r (recursive)**
 - Rather than just copying all the files and directories, copies the whole directory tree, subdirectories and all, to another location.
- **-f (force)**
 - Copies without prompting you for confirmation that the file should be overwritten.
- **-v (verbose)**
 - Will show the progress of the files being copied.



Let's practice

```
[serghei@login3 test]$ cp test.txt test1.txt
[serghei@login3 test]$ ls
large.txt test1.txt test.log test.txt
[serghei@login3 test]$ mkdir new
[serghei@login3 test]$ cp -r new new2
[serghei@login3 test]$ ls
large.txt new new2 test1.txt test.log test.txt
[serghei@login3 test]$ cp test.txt new/
[serghei@login3 test]$ cp test.txt new/test_new.txt
[serghei@login3 test]$ cd new
[serghei@login3 new]$ ls
test_new.txt test.txt
```

Command: mv

`mv <source> <destination>`

- moves a file/directory to a different location
- renames a file/directory

```
[serghei@login3 new]$ cd ..
[serghei@login3 test]$ pwd
/u/home/s/serghei/test
[serghei@login3 test]$ mv test1.txt new
[serghei@login3 test]$ mv test.txt test_rename.txt
[serghei@login3 test]$ ls
large.txt  new  new2  test.log  test_rename.txt
[serghei@login3 test]$ mv test.txt new/test2.txt
```



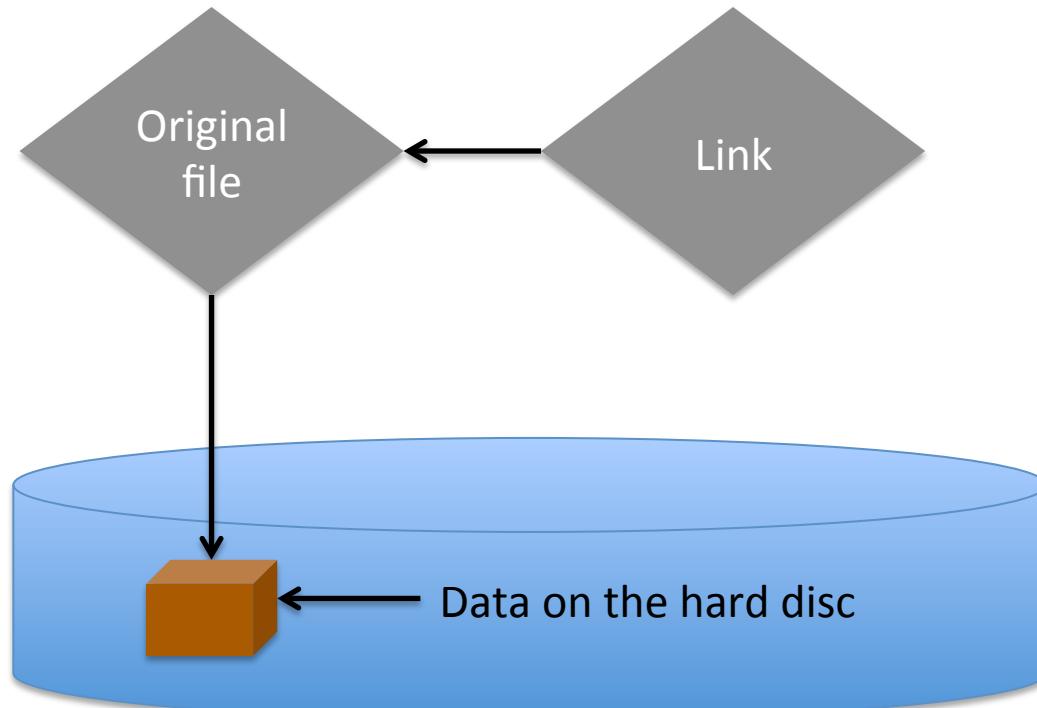
Symbolic Links

- is a special kind of file that points to another file

existing file for which you want to create the symbolic link

name of the symbolic link

```
ln <ORIGINAL_FILE> <LINK_NAME>
```



Good to know



- You can perform an operation on *LINK_NAME*, just as you could with the *ORIGINAL_FILE*
- You can use normal file management commands (e.g., cp, rm) on the symbolic link.

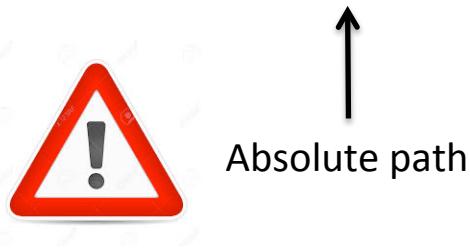


Don't modify the original file through the link



Let's practice!

```
[serghei@login4 new2]$ ln -s /u/home/s/serghei/test/test.txt .
```



```
[serghei@login3 new2]$ ls -l
total 0
lrwxrwxrwx 1 serghei eeskin 31 Sep  8 11:39 test.txt -> /
u/home/s/serghei/test/test.txt
```



How to get the absolute path?

- Copy/Paste
- \$PWD

```
ln -s $PWD/..../test.txt
```



How to Copy/Paste Text in Putty?

- **To copy** : Highlight the text
- **To paste** : Shift-insert, ctrl-v or right click of the mouse



Video explaining how to copy paste text in Putty is posted on the workshop webpage

Command: rm

- to remove a file use **rm**
- to remove a directory use **rm -r**

```
[serghei@login3 test]$ rm test.log  
[serghei@login3 test]$ rm -r new2  
[serghei@login3 test]$ ls  
large.txt  new  test_rename.txt
```



Files and directories deleted with **rm** are gone forever and cannot be recovered!!!



Good to know

- **cp/mv/rm** can work on many files at once:

```
cp file1 file2 new/  
rm file1 file2 file27
```

- **cp/mv/rm** can work with *:

```
mv f* new/  
rm f*  
rm l*s  
rm *txt
```

Accidental loss



- Backup your files on external hard drive
- Modify your personal Linux environment
- Remove your own write access to files you intend to not change or delete (Day 2)

Backup

- Make backup copies of files and directories in compressed tar format
- Copy to your laptop/hard drive

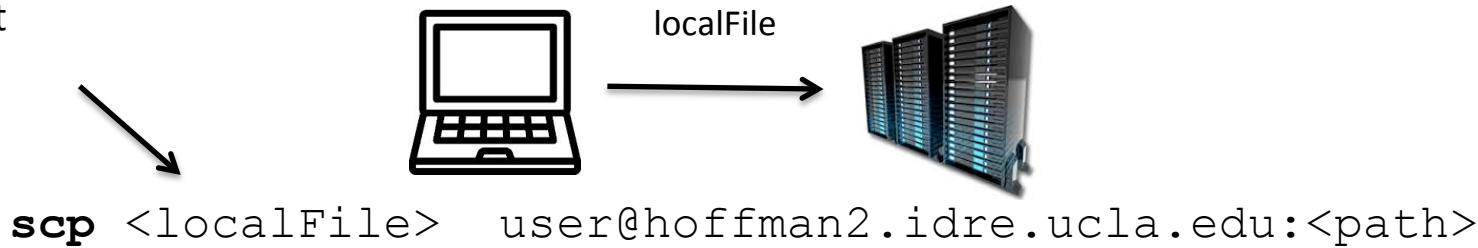


```
[serghei@login3 test]$ tar -czf new.tgz new/
[serghei@login3 test]$ ls -l
total 12
-rw-r--r-- 1 serghei eeskin 255 Mar 11 10:30 large.txt
drwxr-xr-x 2 serghei eeskin 4096 Mar 11 10:55 new
-rw-r--r-- 1 serghei eeskin 228 Mar 11 11:34 new.tar
-rw-r--r-- 1 serghei eeskin 19 Mar 11 10:20 test_rename.txt
```

Remote copying : scp



File located on
the laptop, in
the current
directory



scp user@hoffman2.idre.ucla.edu:<path>/<remoteFile> ./



Run scp from the local session of the terminal. To open a local session :

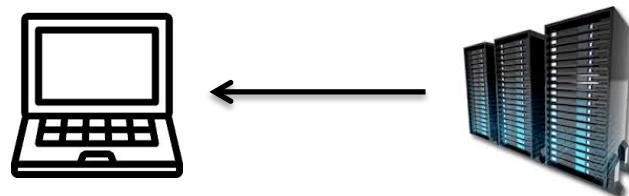
- Control-T to open a new tab
- New tab by default corresponds to a local session

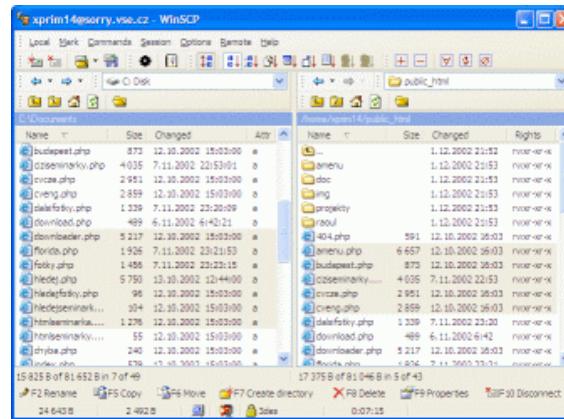
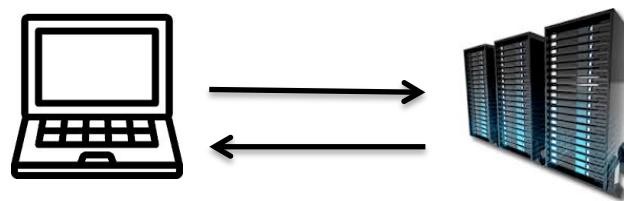
File located on
the cluster, in
the <path>
directory



Let's practice

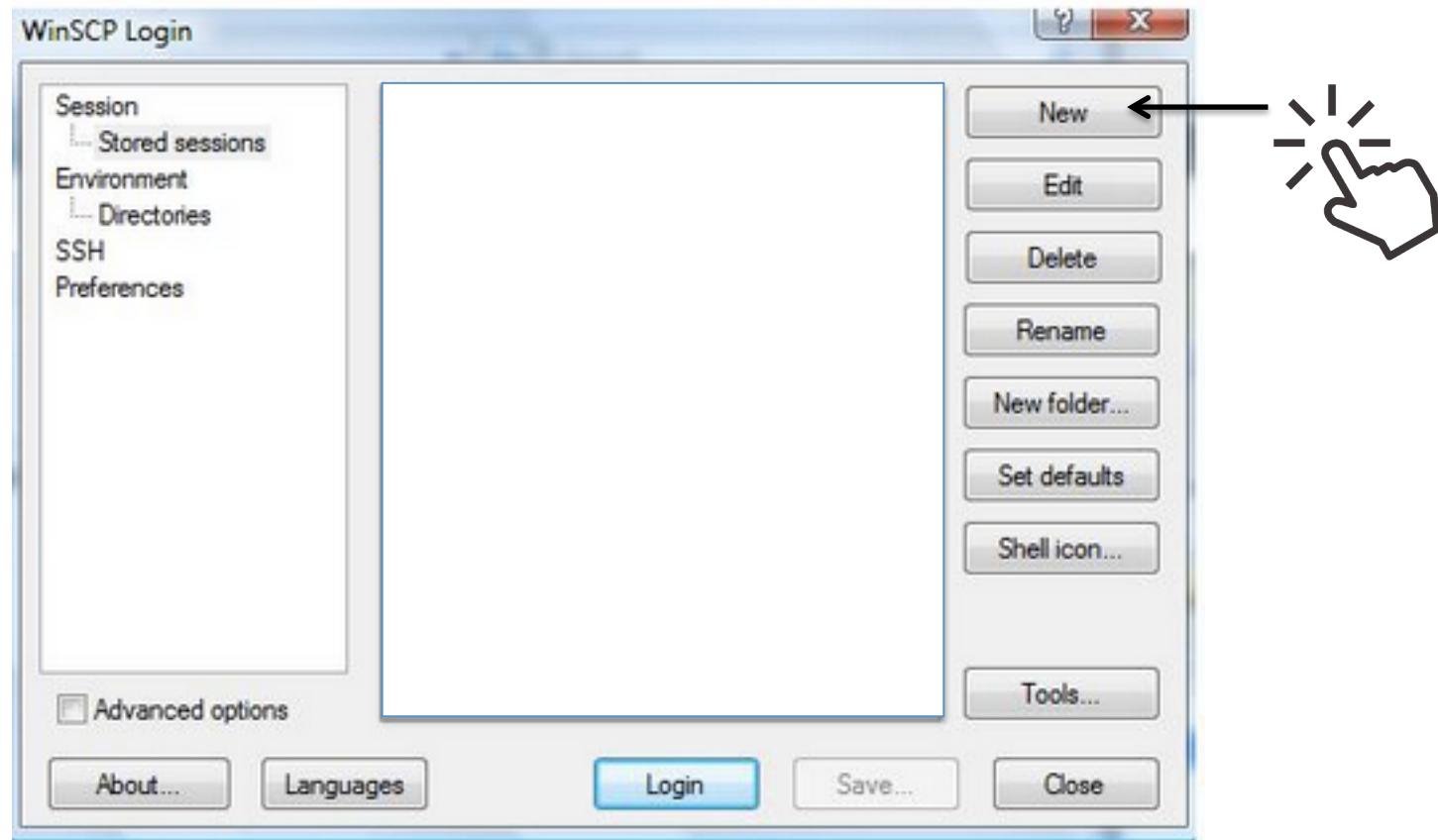
- [Serghei-MacBook-Air] \$ scp
serghei@hoffman2.idre.ucla.edu:~/test/
new.tar ./
- serghei@hoffman2.idre.ucla.edu's password:





Winscp

Winscp

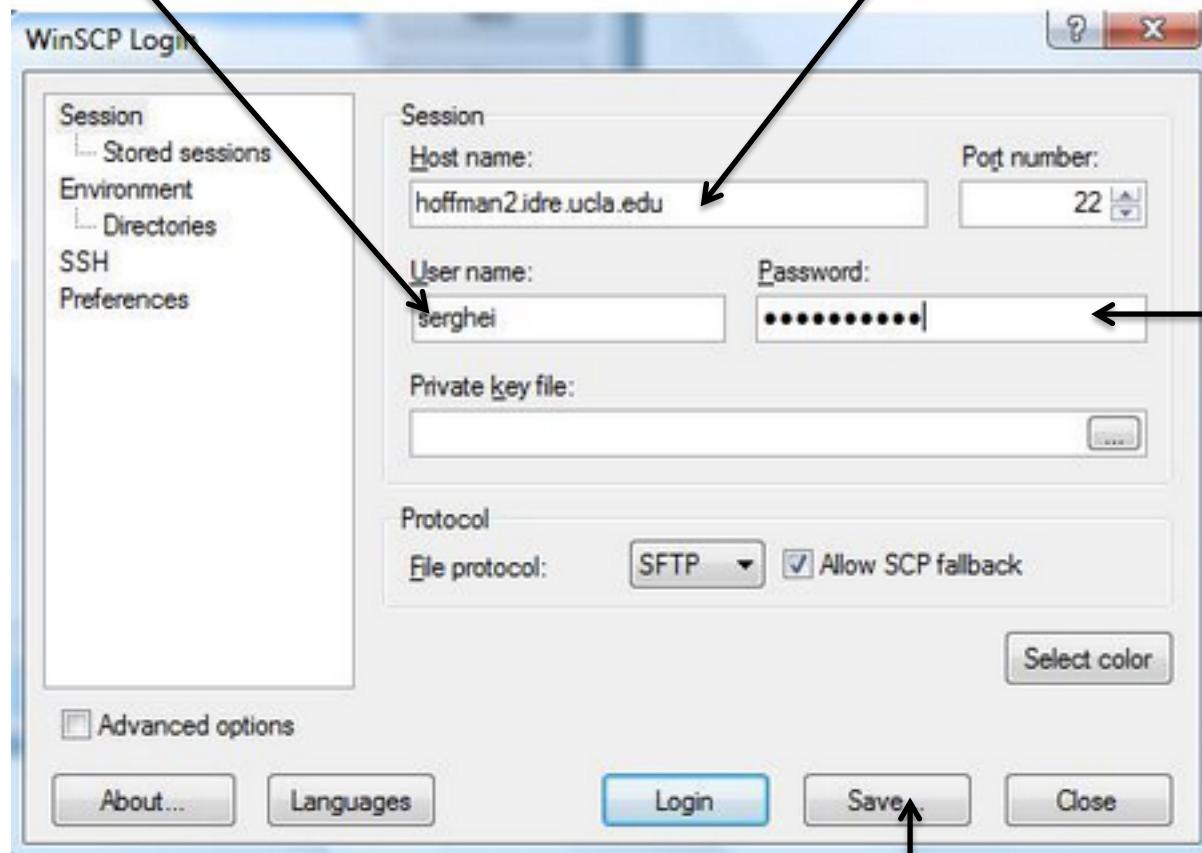


Winscp

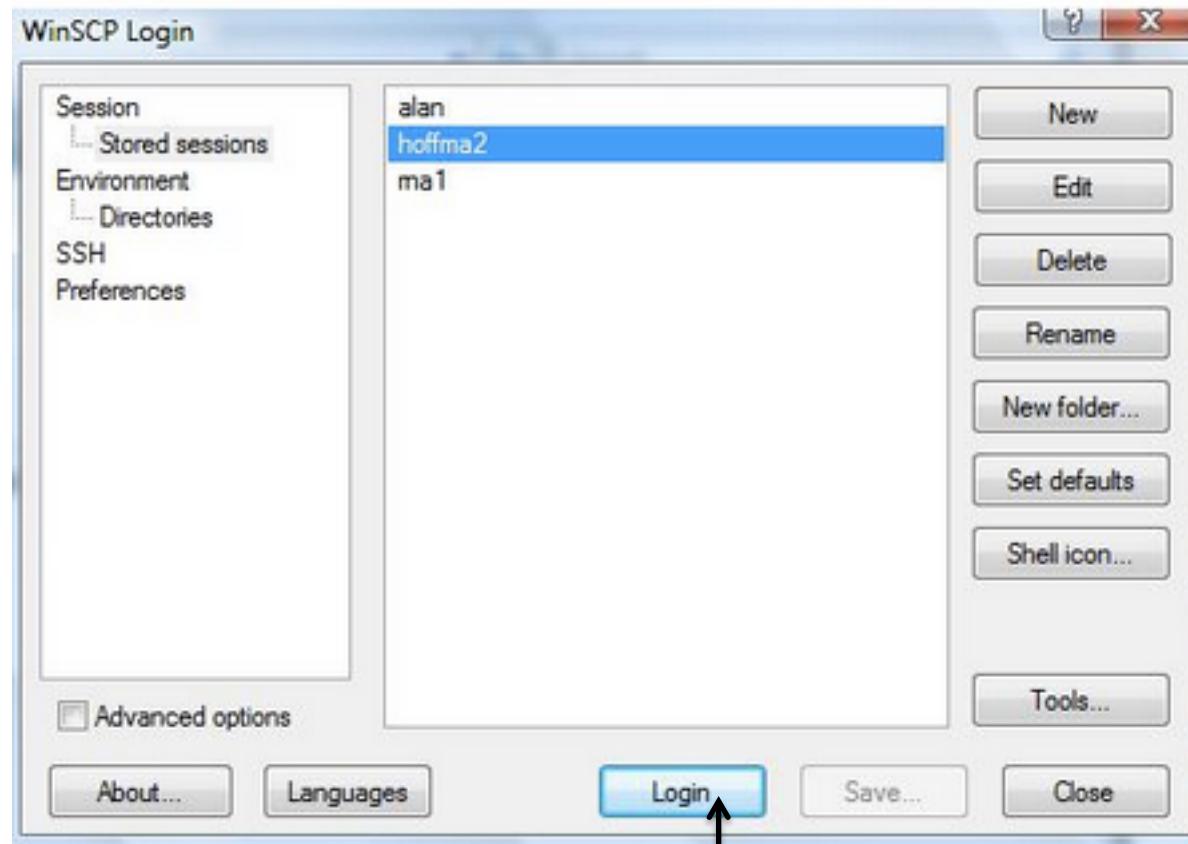
Username

Cluster name

Password



Winscp



Laptop

Hoffman2

The screenshot shows the WinSCP interface with two panels. The left panel, labeled 'Laptop' with an arrow, displays local files in 'C:\Users\Malish\Documents'. The right panel, labeled 'Hoffman2' with an arrow, displays remote files in '/u/home/eeskin/serghei'. Both panels show a list of files with columns for Name and Ext. A status bar at the bottom indicates file sizes and counts.

Name	Ext
..	
Adv GIS	
CV	
DigCart	
G1112_Labs	
GISExam	
GLUT	
GreenCard2010	
My EndNote Library.D...	
My Music	
My Pictures	
My Videos	

Name	Ext
..	
.gnome2	
.mozilla	
.ssh	
11R0092	
hg19	
job-output	
test	
test1	
.bash_history	
.bash_logout	
.bash_profile	



To copy the files between the laptop and cluster, simply drag and drop

Modify your Linux environment

- Add prompted confirmation before any existing file is deleted or overwritten.

cp -i

mv -i

rm -i

Let's practice



- [serghei@login3 test]\$ **mv -i** test.txt
test2.txt
- mv: overwrite `test2.txt'?
- [serghei@login3 test]\$ **rm -i** test2.txt
- rm: remove regular file `test2.txt'?

Alias

- enables a replacement of a string by another string

cp/mv/rm → cp/mv/rm -i

- Go to home directory : cd
- Open file .bash_profile: \$ vi .bash_profile
- Add in the end of the file the following lines:

```
alias cp='cp -i'  
alias mv='mv -i'  
alias rm='rm -i'
```

- Restart the session



Let's practise

- [serghei@login3 test]\$ **mv** test.txt test2.txt
- mv: overwrite `test2.txt'?

- [serghei@login3 test]\$ **rm** test2.txt
- rm: remove regular file `test2.txt'?

Summary

pwd - report your current directory

cd <to where> - change your current directory

ls <directory> -list contents of directory

cp <old file> <new file> - copy file

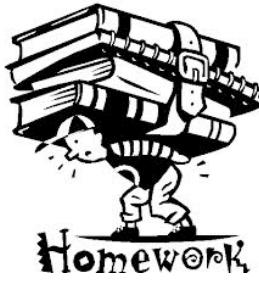
cp -r <old dir> <new dir> - copy a directory and its contents

mv <old file/dir> <new file/dir> - move (or rename)

rm <file> -delete a file

rm -r <dir> - remove a directory and its contents

mkdir <new directory name> -make a directory



1. Create directory “practice” in your home directory
2. Inside directory “practice” create files p.a and p.b
3. Create a copy of file p.a(p_copy.a) and rename file p.b (new name : practice.b)
4. Delete all files ending with b