

Short Read Sequencing Analysis Workshop

Day 2

Learning the Linux Compute Environment

Get Github open to srworkshop
Get terminal open

Review of Day 2 Videos

- **Video 1 – SSH and VPN Introduction**
 - How SSH and VPNs work when accessing remote servers
- **Video 2 – Remote Rsync / Reading Files**
 - Looking at files on a remote server and getting them to your computer
- **Video 3 – Searching / editing Files, Pipes, and Outputs**
 - Pieces of your basic toolkit for working on a Linux server
- **Video 4 – Directory Permissions**
 - Managing who can see and execute different things on the server

Important things to know about Linux

1. It seems harder but it has advantages
2. File systems (how do I get places?)

Find a unix/linux cheat sheet

The
commands
might be
named
weirdly

Cheat
sheets on
[Github](#)

Unix/Linux Command Reference

FOSSwire.com

File Commands	System Info
ls - directory listing ls -al - formatted listing with hidden files cd dir - change directory to <i>dir</i> cd - change to home pwd - show current directory mkdir dir - create a directory <i>dir</i> rm file - delete <i>file</i> rm -r dir - delete directory <i>dir</i> rm -f file - force remove <i>file</i> rm -rf dir - force remove directory <i>dir</i> * cp file1 file2 - copy <i>file1</i> to <i>file2</i> cp -r dir1 dir2 - copy <i>dir1</i> to <i>dir2</i> ; create <i>dir2</i> if it doesn't exist mv file1 file2 - rename or move <i>file1</i> to <i>file2</i> if <i>file2</i> is an existing directory, moves <i>file1</i> into directory <i>file2</i> ln -s file link - create symbolic link <i>link</i> to <i>file</i> touch file - create or update <i>file</i> cat > file - places standard input into <i>file</i> more file - output the contents of <i>file</i> head file - output the first 10 lines of <i>file</i> tail file - output the last 10 lines of <i>file</i> tail -f file - output the contents of <i>file</i> as it grows, starting with the last 10 lines	date - show the current date and time cal - show this month's calendar uptime - show current uptime w - display who is online whoami - who you are logged in as finger user - display information about <i>user</i> uname -a - show kernel information cat /proc/cpuinfo - cpu information cat /proc/meminfo - memory information man command - show the manual for <i>command</i> df - show disk usage du - show directory space usage free - show memory and swap usage whereis app - show possible locations of <i>app</i> which app - show which <i>app</i> will be run by default
Process Management	Compression
ps - display your currently active processes top - display all running processes kill pid - kill process <i>id pid</i> killall proc - kill all processes named <i>proc</i> * bg - lists stopped or background jobs; resume a stopped job in the background fg - brings the most recent job to foreground fg n - brings job <i>n</i> to the foreground	tar cf file.tar files - create a tar named <i>file.tar</i> containing <i>files</i> tar xf file.tar - extract the files from <i>file.tar</i> tar czf file.tar.gz files - create a tar with Gzip compression tar xzf file.tar.gz - extract a tar using Gzip tar cjf file.tar.bz2 - create a tar with Bzip2 compression tar xjf file.tar.bz2 - extract a tar using Bzip2 gzip file - compresses <i>file</i> and renames it to <i>file.gz</i> gzip -d file.gz - decompresses <i>file.gz</i> back to <i>file</i>
File Permissions	Network
chmod octal file - change the permissions of <i>file</i> to <i>octal</i> , which can be found separately for user, group, and world by adding: <ul style="list-style-type: none">4 - read (r)2 - write (w)1 - execute (x) Examples: chmod 777 - read, write, execute for all chmod 755 - rwx for owner, rx for group and world For more options, see man chmod .	ping host - ping <i>host</i> and output results whois domain - get whois information for <i>domain</i> dig domain - get DNS information for <i>domain</i> dig -x host - reverse lookup <i>host</i> wget file - download <i>file</i> wget -c file - continue a stopped download
SSH	Installation
ssh user@host - connect to <i>host</i> as <i>user</i> ssh -p port user@host - connect to <i>host</i> on port <i>port</i> as <i>user</i> ssh-copy-id user@host - add your key to <i>host</i> for <i>user</i> to enable a keyed or passwordless login	Install from source: ./configure make make install dpkg -i pkg.deb - install a package (Debian) rpm -Uvh pkg.rpm - install a package (RPM)
Searching	Shortcuts
grep pattern files - search for <i>pattern</i> in <i>files</i> grep -r pattern dir - search recursively for <i>pattern</i> in <i>dir</i> command grep pattern - search for <i>pattern</i> in the output of <i>command</i> locate file - find all instances of <i>file</i>	Ctrl+C - halts the current command Ctrl+Z - stops the current command, resume with fg in the foreground or bg in the background Ctrl+D - log out of current session, similar to exit Ctrl+W - erases one word in the current line Ctrl+U - erases the whole line !! - repeats the last command exit - log out of current session

* use with extreme caution.

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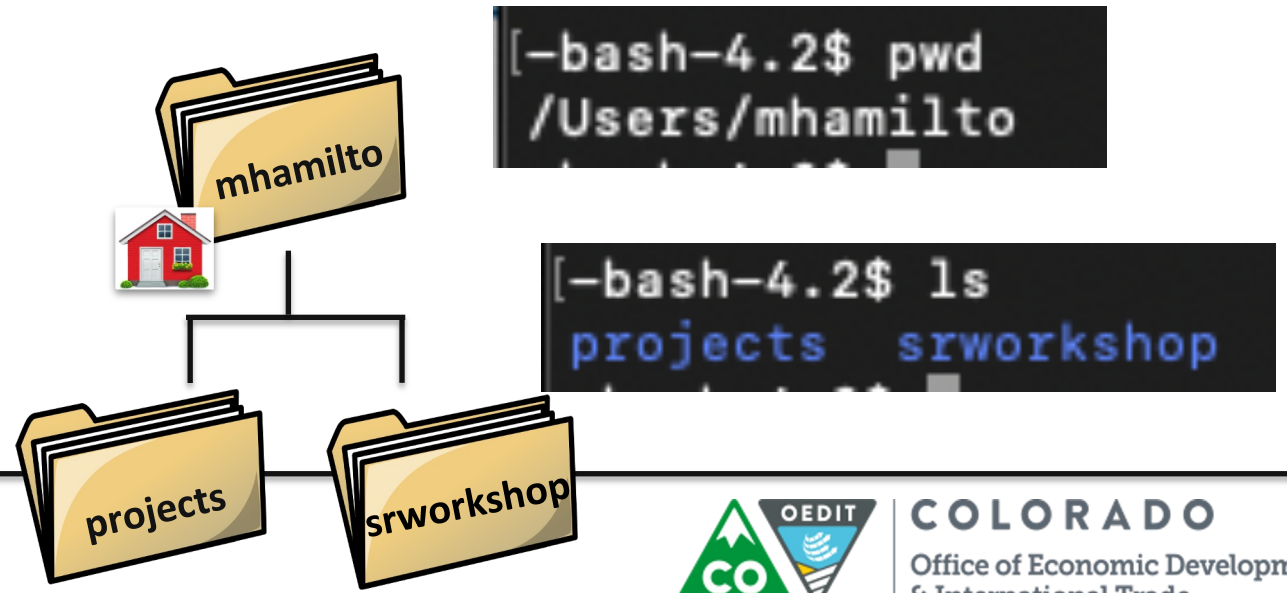
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In Unix/Linux everything is organized as a hierarchy

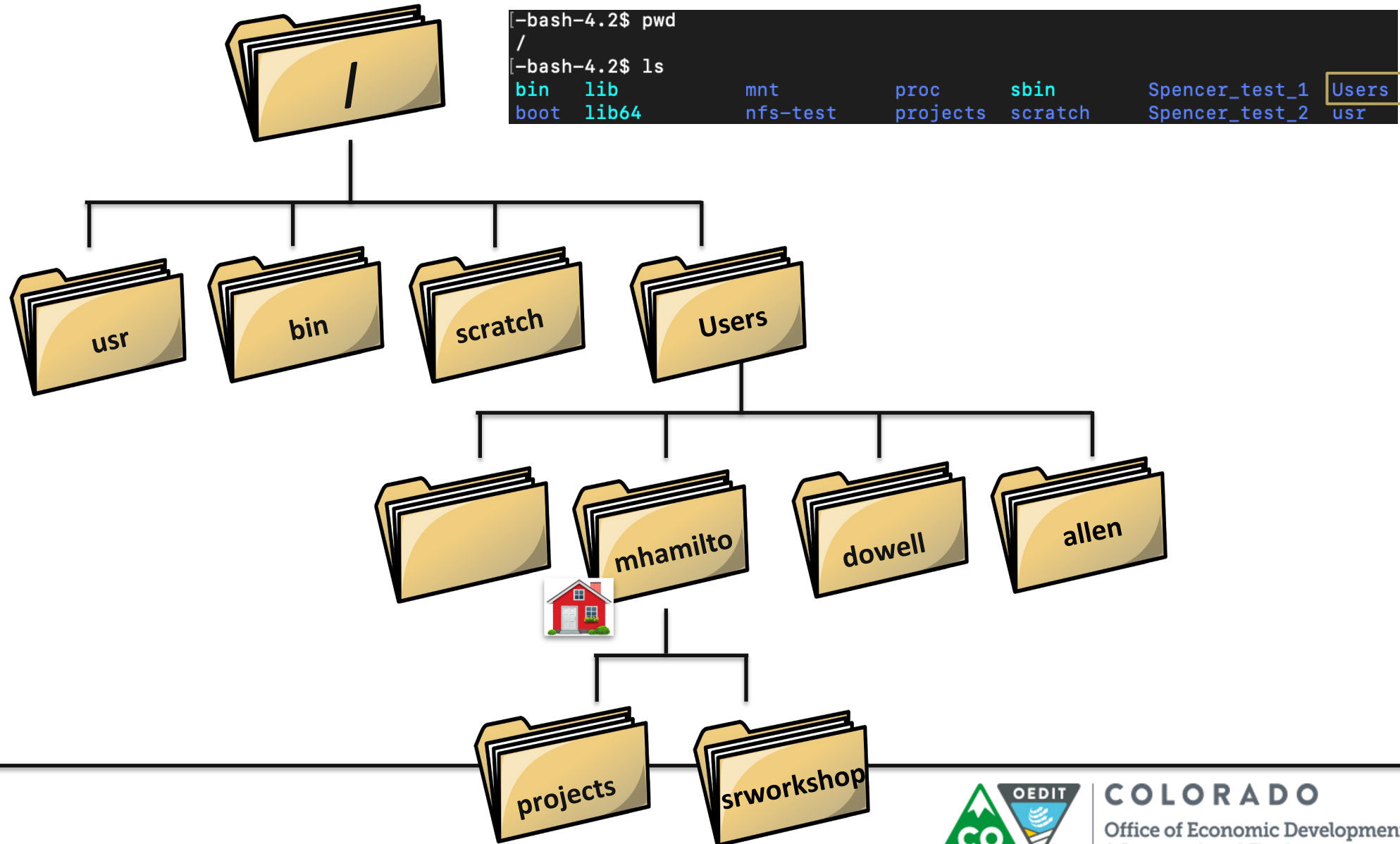
pwd “print working directory”

ls “list” – list files

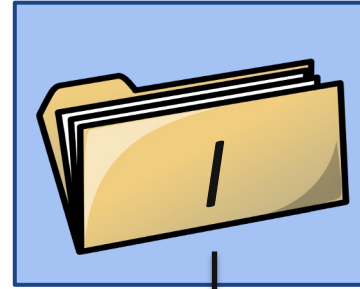
cd “change directory”



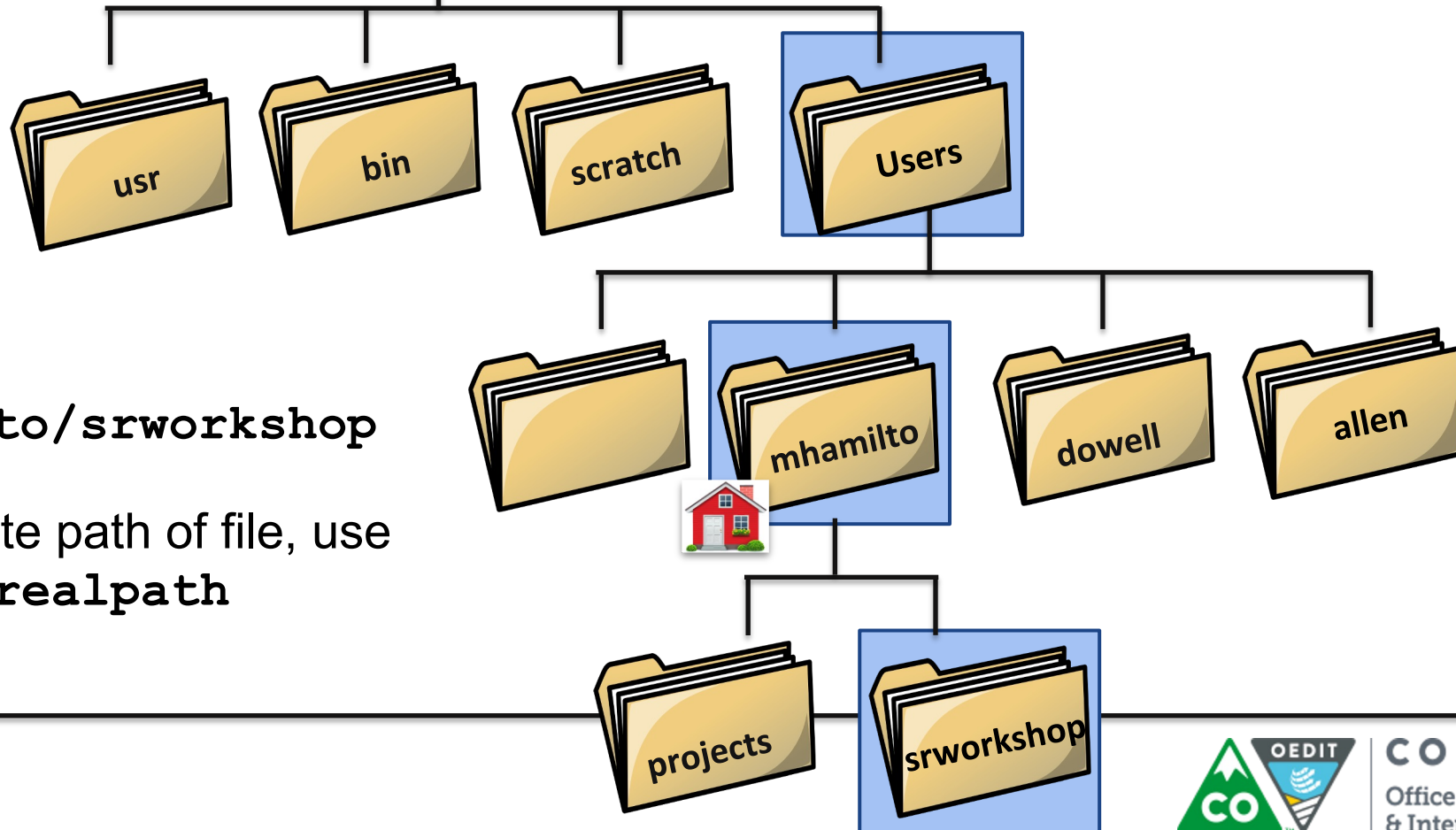
In Unix everything is organized as a hierarchy



Absolute path



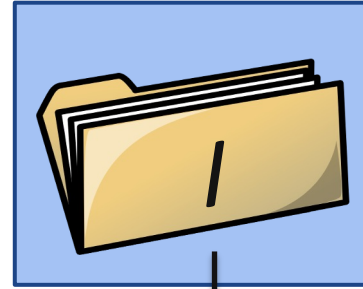
```
-bash-4.2$ pwd
/  
-bash-4.2$ ls  
bin  lib      mnt      proc      sbin      Spencer_test_1  Users  
boot lib64    nfs-test projects  scratch    Spencer_test_2  usr
```



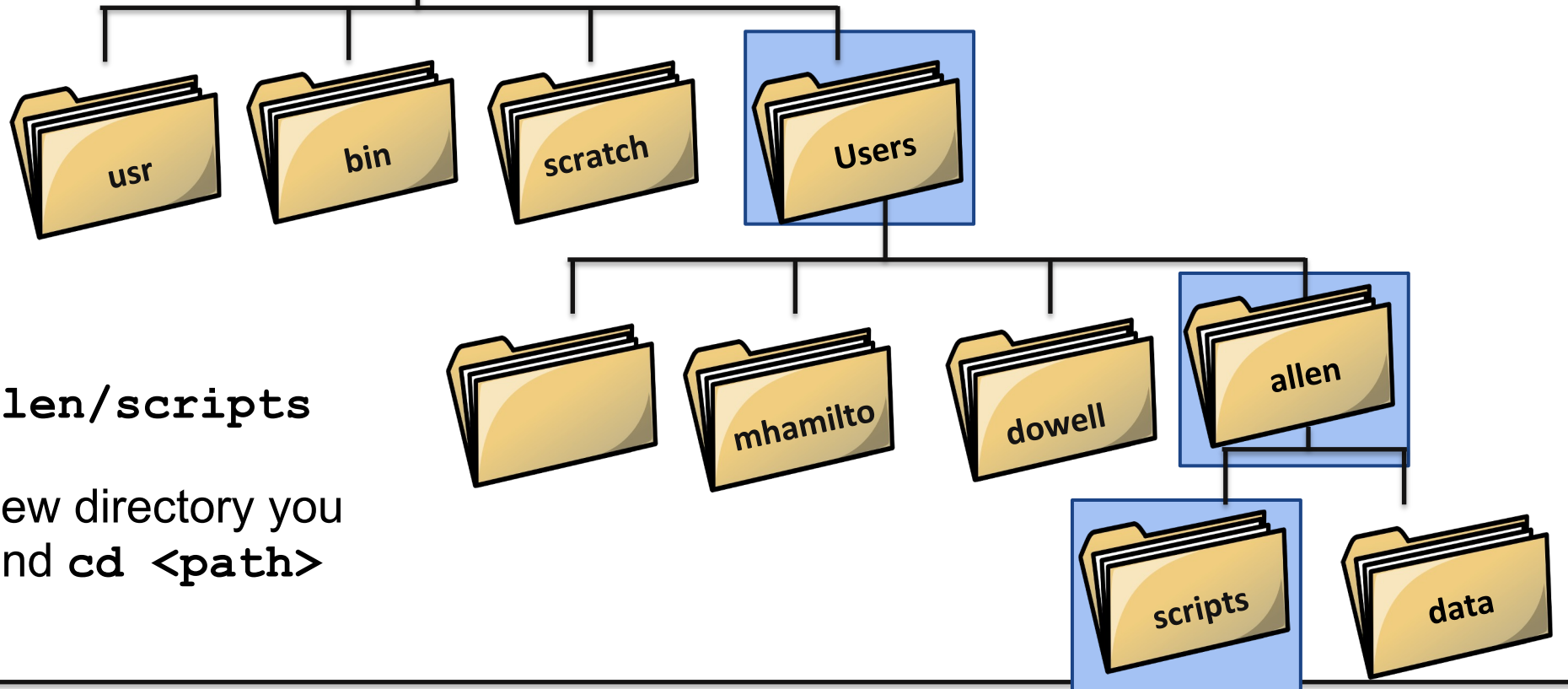
`/Users/mhamilto/srworkshop`

*To get the absolute path of file, use
command `realpath`

Absolute path

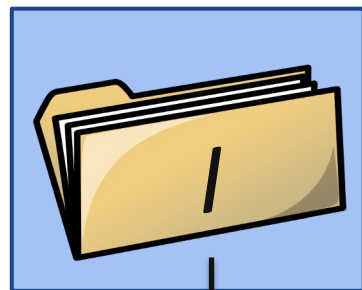


```
-bash-4.2$ pwd
/  
-bash-4.2$ ls  
bin  lib      mnt      proc      sbin      Spencer_test_1  Users  
boot lib64    nfs-test projects  scratch    Spencer_test_2  usr
```

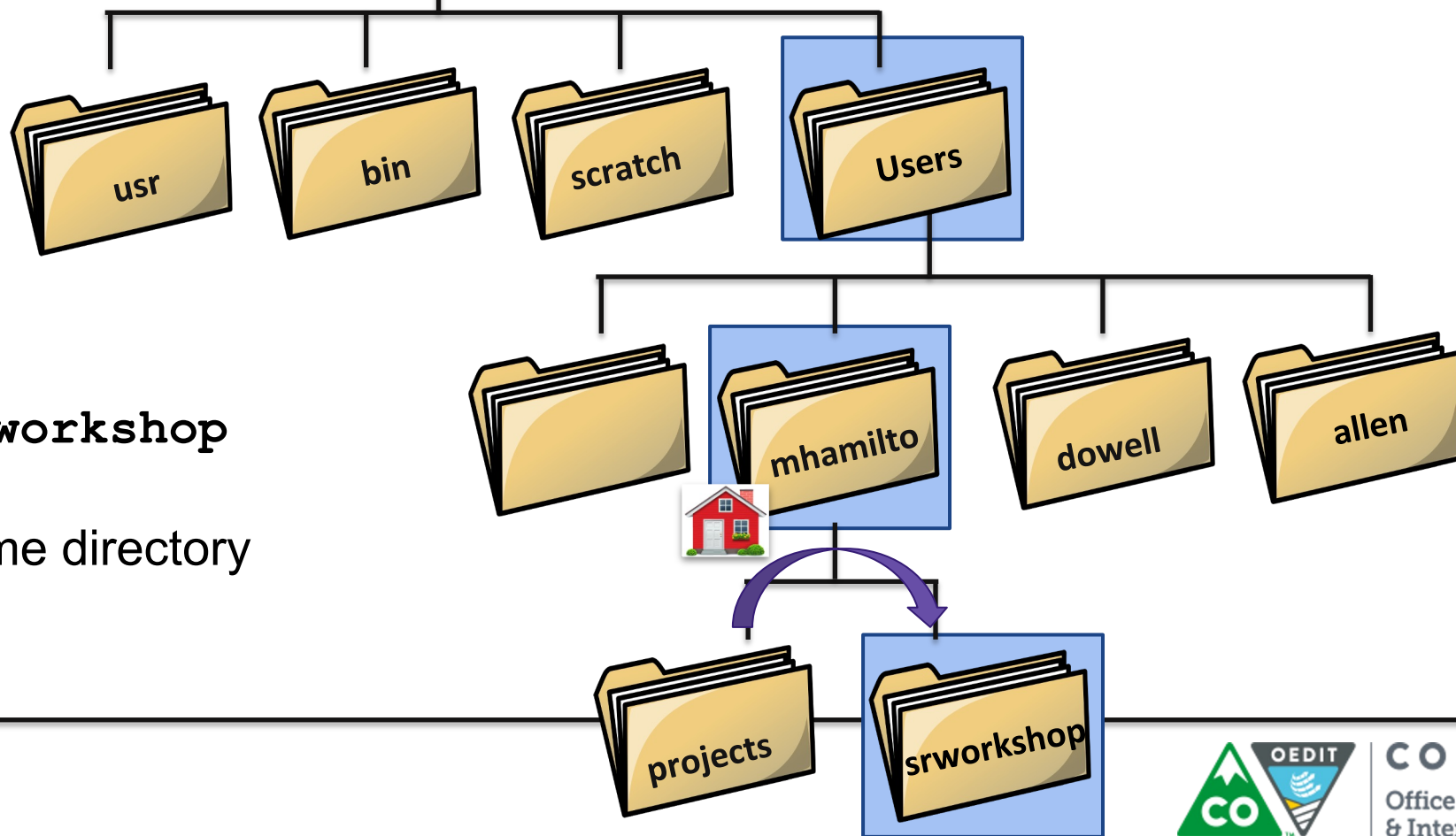


`cd /Users/allen/scripts`

*to move into a new directory you
can use command `cd <path>`



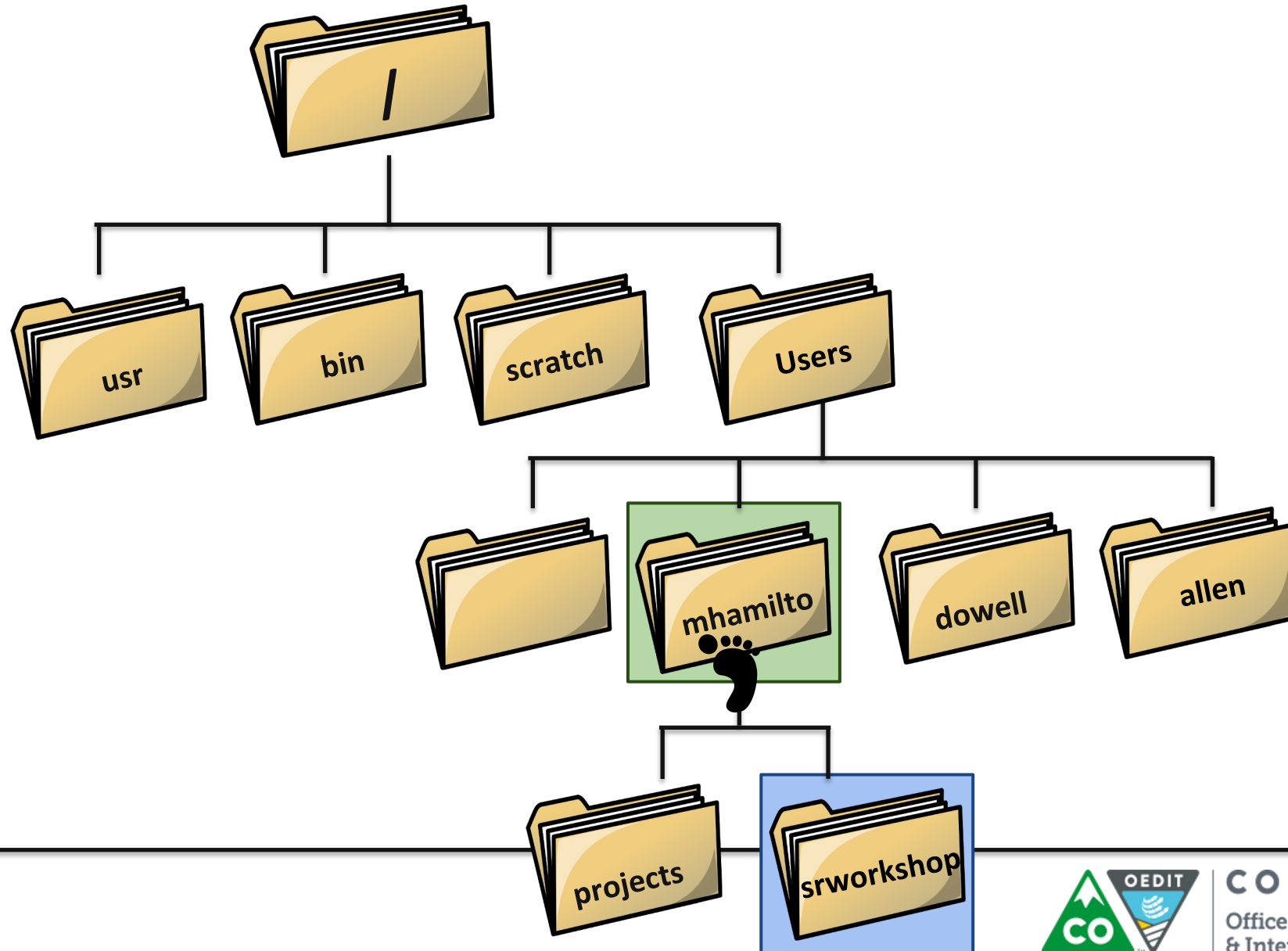
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-bash-4.2$ pwd
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bin  lib      mnt      proc      sbin      Spencer_test_1  Users  
boot lib64    nfs-test  projects  scratch   Spencer_test_2  usr
```



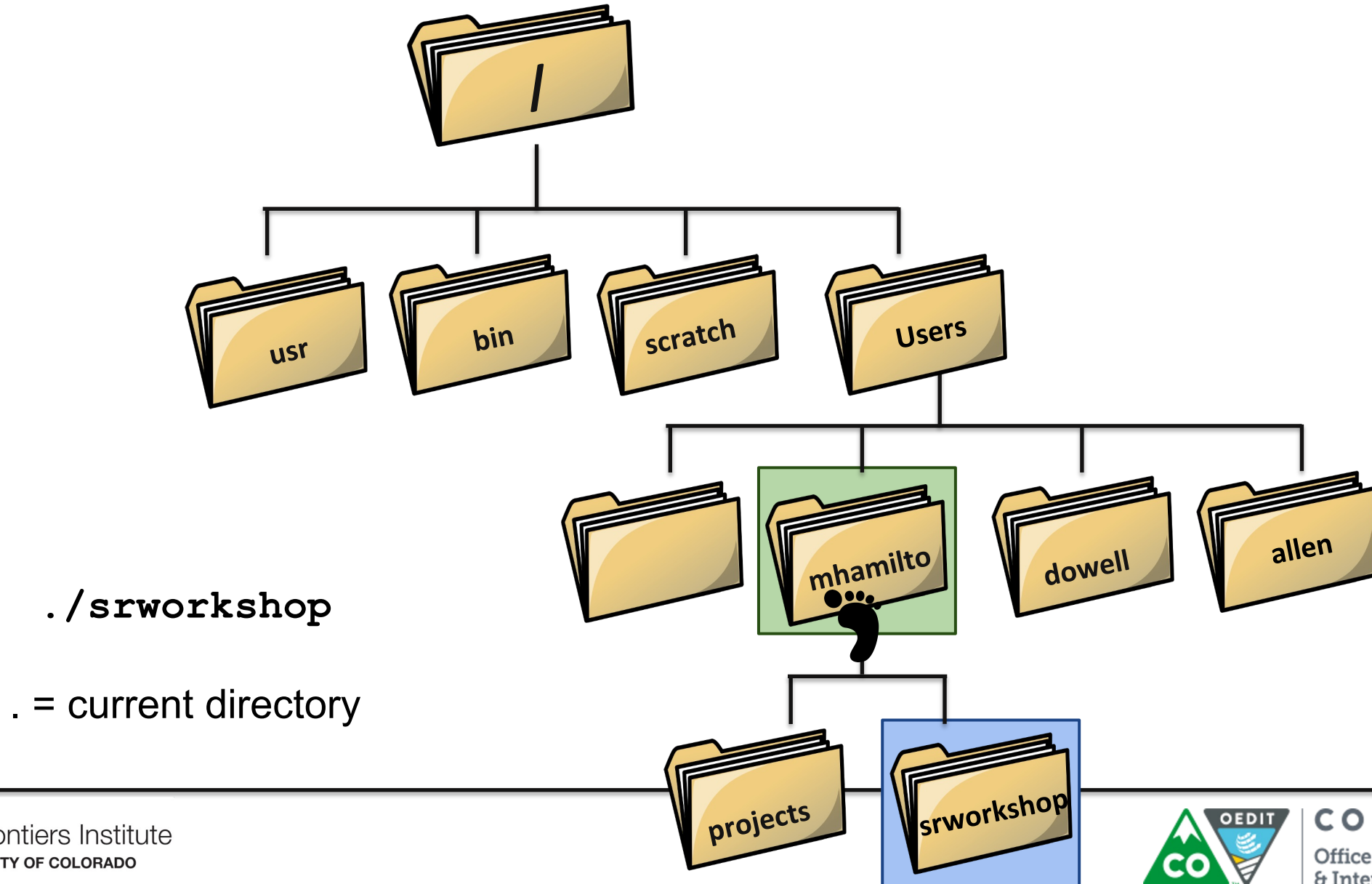
`cd ~/srworkshop`

~ = your home directory

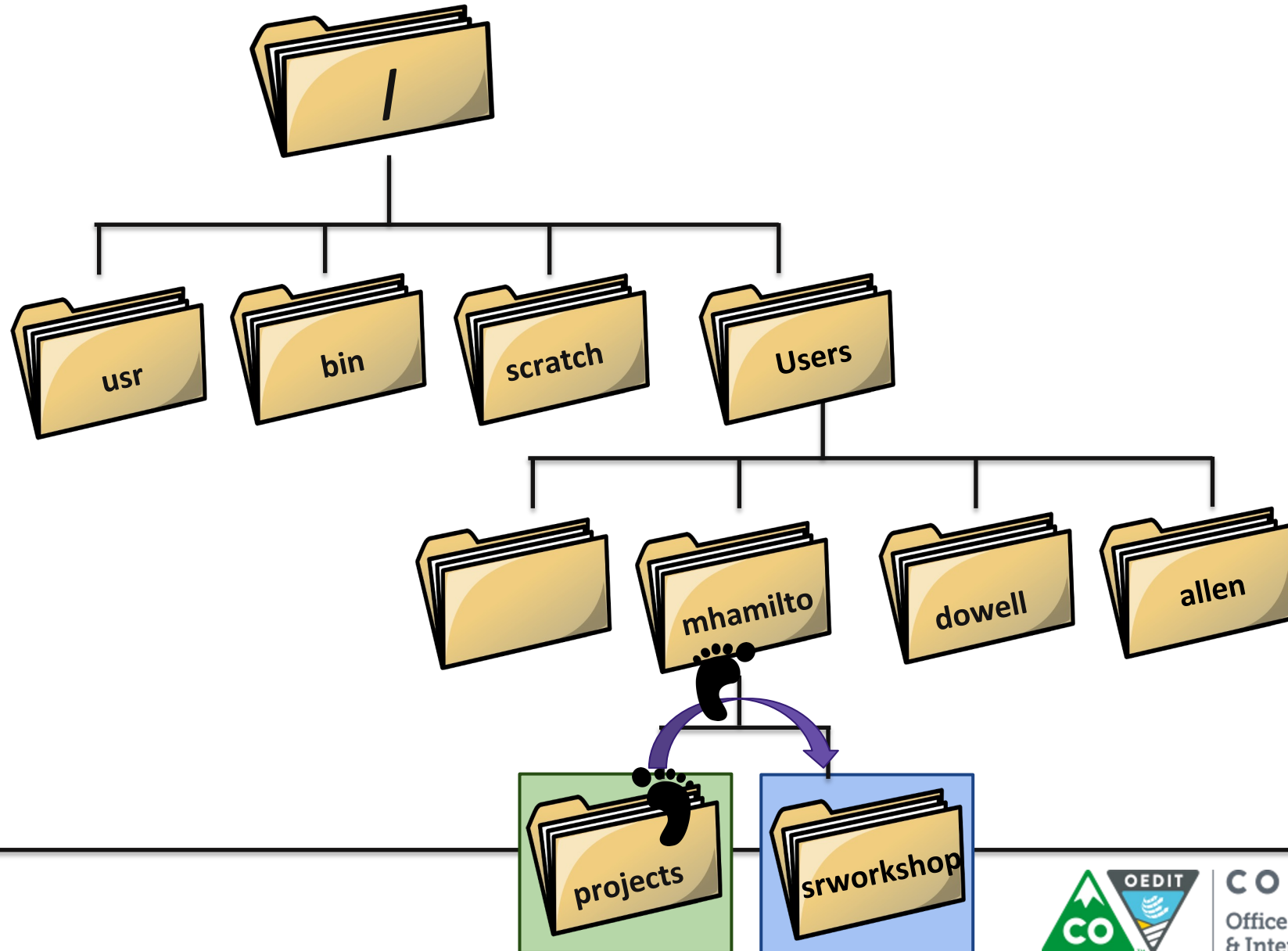
Relative path



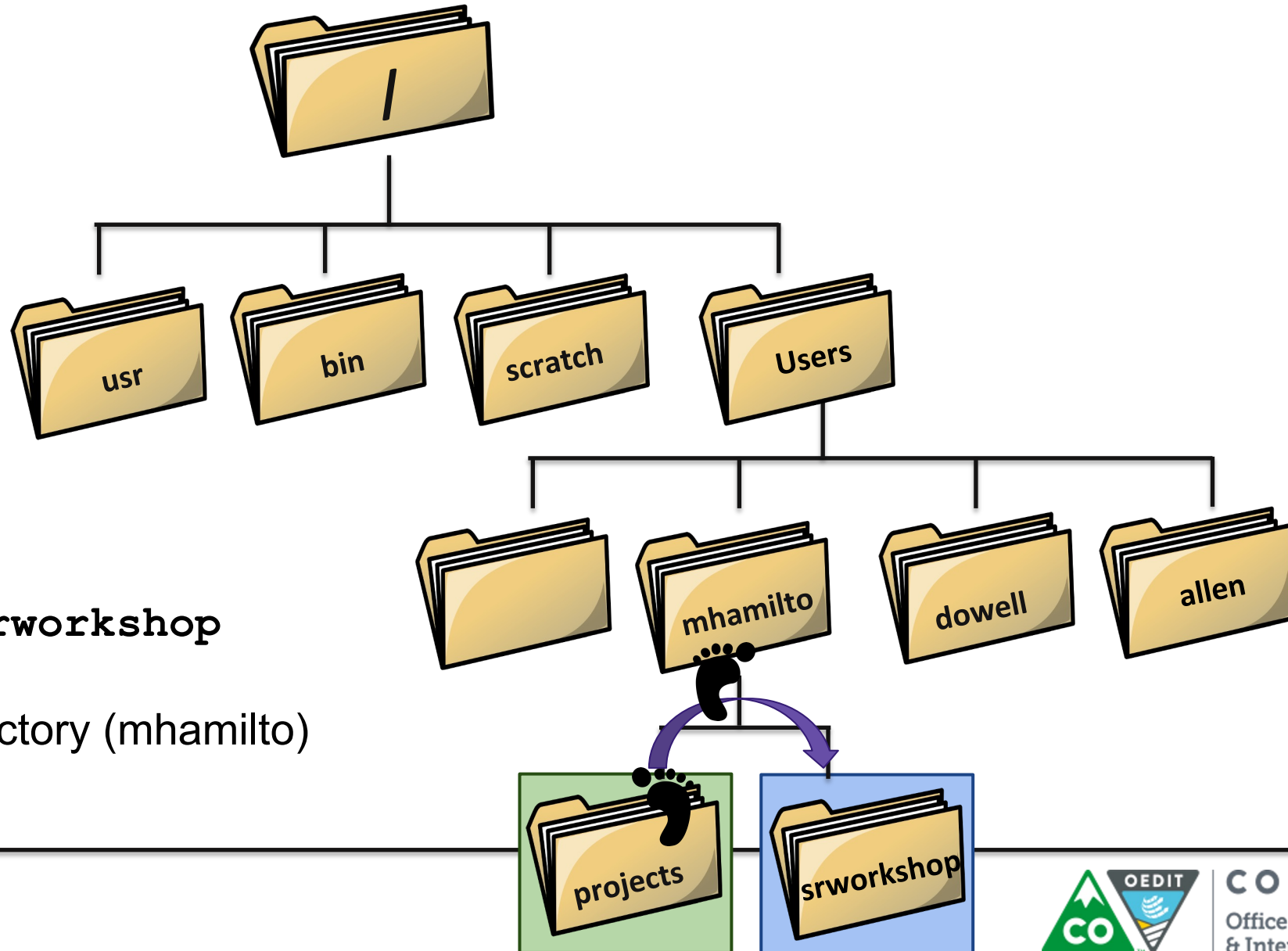
Relative path



Relative path



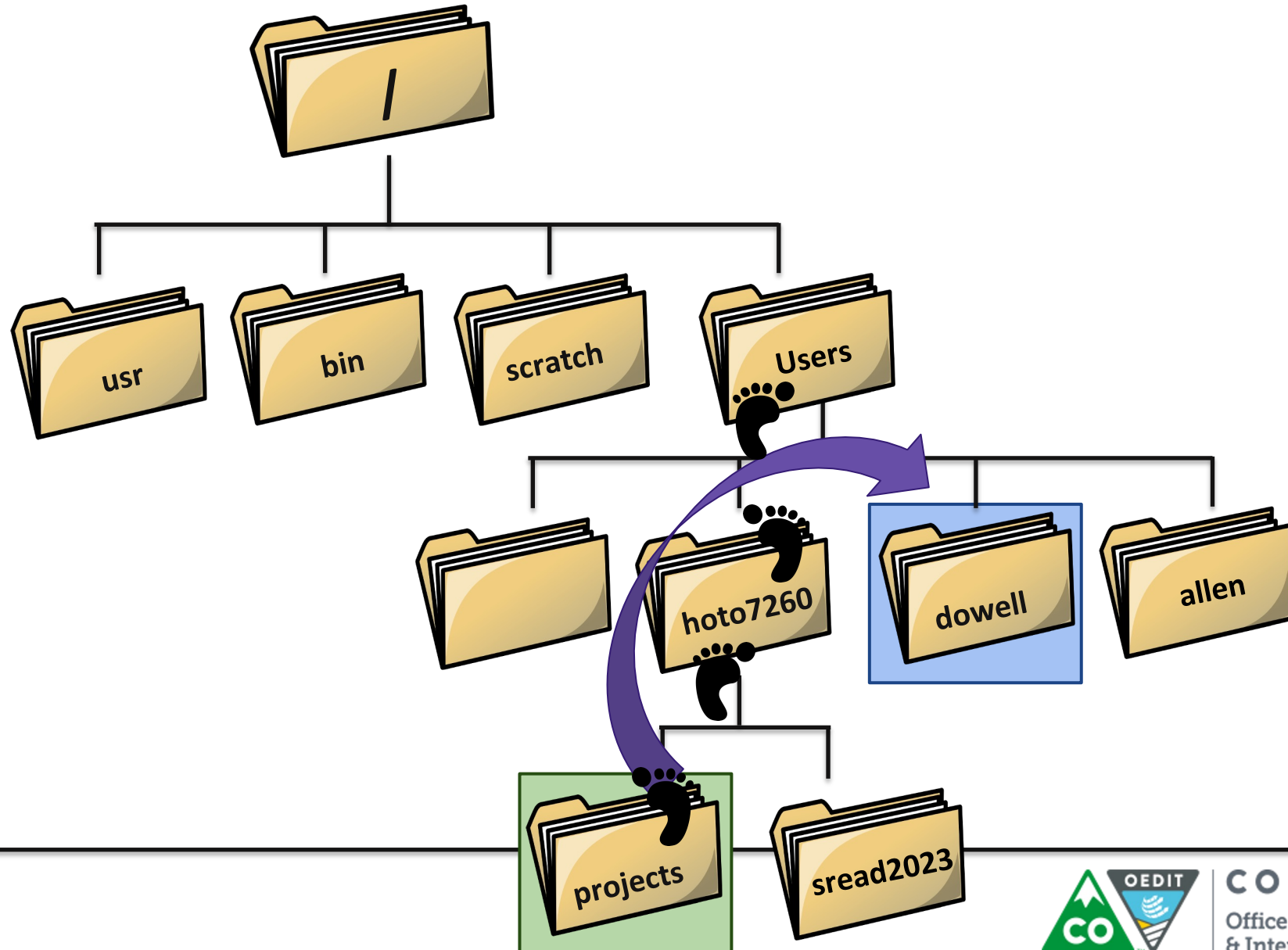
Relative path



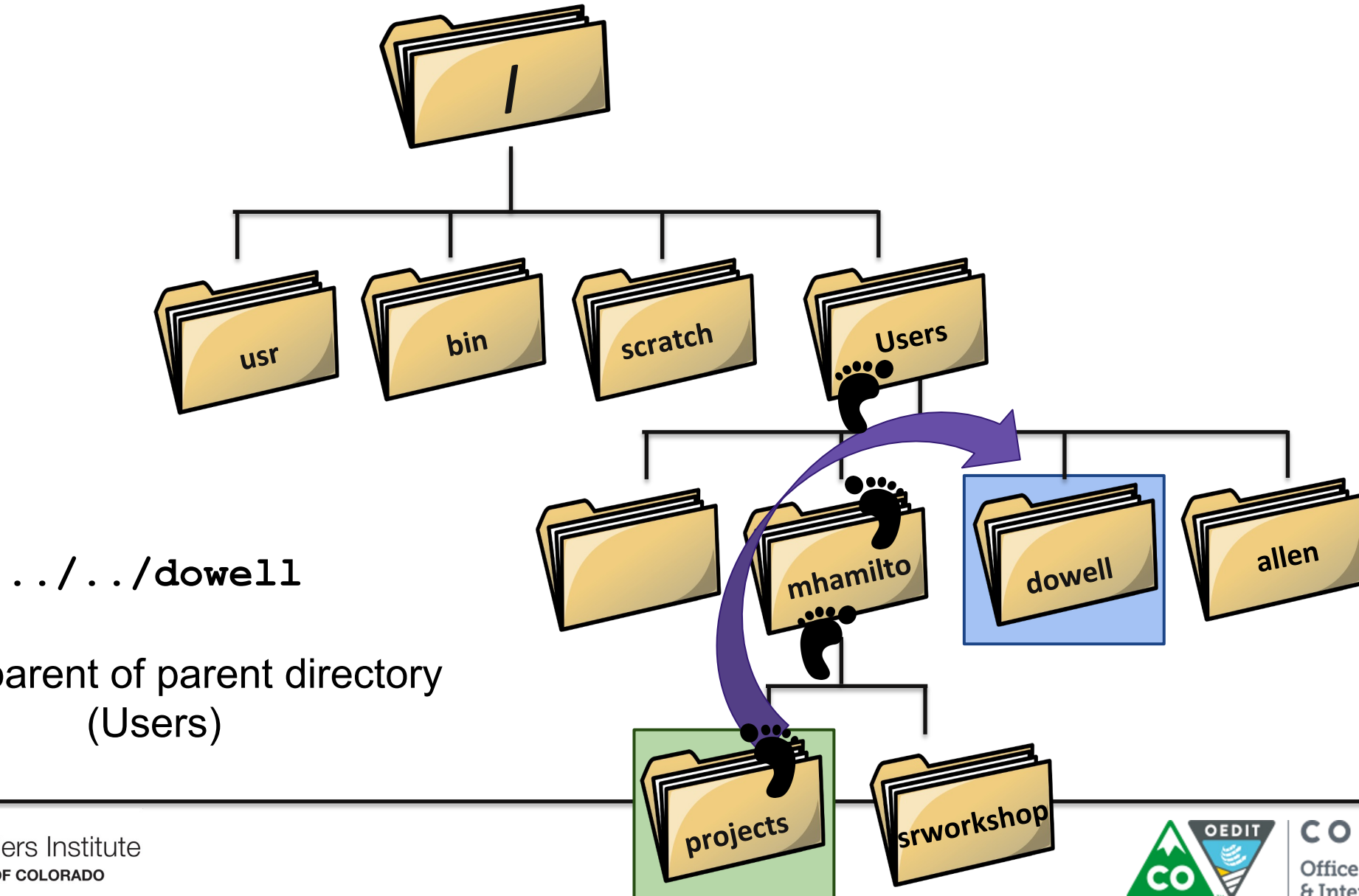
`cd ../srworkshop`

`..` = parent directory (mhamilto)

Relative path



Relative path



Questions?



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Important things to know about Linux

1. It seems harder but is sometimes WAY easier
2. File systems (how do I get places?)
3. Linux tools don't care about file extensions: *Make sure you are using the correct one.*

Important things to know about Linux

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4. ls & man

1. Type **ls** in your directory

```
(base) hopekirby@cu-biot-3-10 Demo % ls
R_script.R          text_file.genes.out
text_file           text_file.txt
```

2. What else can **ls** do?
man ls

Highlights

-a Include directory entries whose names begin with a dot ('.').

All

-l (The lowercase letter "ell".) List files in the long format, as described in the The Long Format subsection below.

Long

The Long Format

If the **-l** option is given, the following information is displayed for each file: file mode, number of links, owner name, group name, number of bytes in the file, abbreviated month, day-of-month file was last modified, hour file last modified, minute file last modified, and the pathname. If the file or directory has extended attributes, the

```
shum@sol:~$ ls -l
total 20
drwx----- 2 shum  staff  4096 Jan 16 22:04 Mail
drwx----- 3 shum  staff  4096 Jan 16 14:15 csc128
drwxr-xr-x  2 shum  staff  4096 Jan 13 16:42 public
drwxr-xr-x  2 shum  staff  4096 Jan 16 14:07 public_html
-rw-r--r--  1 shum  staff   628 Jan 15 20:04 verse
```

Annotations for the `ls -l` output:

- file type**: Indicated by the first character of the file mode (e.g., `d` for directory, `-` for regular file).
- permissions**: Indicated by the next nine characters (e.g., `drwxr-xr-x`).
- number of hard links**: Indicated by the number of links (e.g., `2`).
- user (owner) name**: Indicated by the owner name (e.g., `shum`).
- group name**: Indicated by the group name (e.g., `staff`).
- size**: Indicated by the file size in bytes (e.g., `4096`).
- date/time last modified**: Indicated by the date and time (e.g., `Jan 16 22:04`).
- filename**: Indicated by the filename (e.g., `Mail`).

Legend for permissions:

- rwx**: permissions for the user (owner).
- rwX**: permissions for the group.
- rwX**: permissions for others (everyone).
- r**: readable.
- w**: writable.
- x**: executable.



File permissions

- Important for sharing files
- Change with **chmod**
- Watch the video!

	u g o			754		
access	r	w	x	r	w	x
binary	4	2	1	4	2	1
enabled	1	1	1	1	0	1
result	4	2	1	4	0	1
total	7	5	4			

The next three fields are three characters each: owner permissions, group permissions, and other permissions. Each field has three character positions:

1. If **r**, the file is readable; if **-**, it is not readable.
2. If **w**, the file is writable; if **-**, it is not writable.
3. The first of the following that applies:

- S** If in the owner permissions, the file is not executable and set-user-ID mode is set. If in the group permissions, the file is not executable and set-group-ID mode is set.
- s** If in the owner permissions, the file is executable and set-user-ID mode is set. If in the group permissions, the file is executable and setgroup-ID mode is set.
- x** The file is executable or the directory is searchable.
- The file is neither readable, writable, executable, nor set-user-ID nor set-group-ID mode, nor sticky. (See below.)

These next two apply only to the third character in the last group (other permissions).

- T** The sticky bit is set (mode 1000), but not execute or search permission. (See `chmod(1)` or `sticky(7)`.)
- t** The sticky bit is set (mode 1000), and is searchable or executable. (See `chmod(1)` or `sticky(7)`.)

Highlights cont...

Highlights:

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-h When used with the **-l** option, use unit suffixes: Byte, Kilobyte, Megabyte, Gigabyte, Terabyte and Petabyte in order to reduce the number of digits to four or fewer using base 2 for sizes. This option is not defined in IEEE Std 1003.1-2008 ("POSIX.1").

“Human readable”

Questions?



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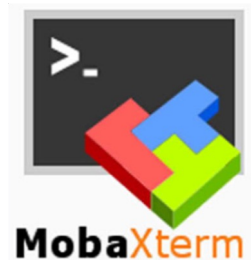
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```
rutendosigauke — ssh fiji — 146x47
[-bash-4.2$ ls -l
total 89
lrwxrwxrwx 1 root root 7 Nov 2 2017 bin -> usr/bin
dr-xr-xr-x 5 root root 4096 Oct 24 2018 boot
drwxr-xr-x 20 root root 3660 Nov 22 15:29 dev
drwxr-xr-x 130 root root 12288 May 16 20:10 etc
drwxr-xr-x 3 root root 4096 Nov 2 2017 home
lrwxrwxrwx 1 root root 7 Nov 2 2017 lib -> usr/lib
lrwxrwxrwx 1 root root 9 Nov 2 2017 lib64 -> usr/lib64
drwxr-xr-x 2 root root 6 Nov 2 2017 localscratch
drwx----- 2 root root 16384 Nov 2 2017 lost+found
drwxr-xr-x 2 root root 4096 Nov 5 2016 media
drwxr-xr-x 2 root root 4096 Nov 5 2016 mnt
drwxr-xr-x 130 root root 4096 Apr 15 10:10 opt
dr-xr-xr-x 561 root root 0 Oct 24 2018 proc
drwxr-xr-x 8 root root 4096 Feb 27 18:36 projects
drwxr-xr-x 3 root rinnLab 4096 Mar 13 2018 rinnlab
dr-xr-x-- 9 root root 4096 May 16 08:55 root
drwxr-xr-x 35 root root 1240 May 20 11:10 run
lrwxrwxrwx 1 root root 8 Nov 2 2017/sbin -> usr/sbin
drwxr-xr-x 4 root root 2 Aug 2 2017 scratch
drwxrwxr-x 4 biof-sbsuser SEQADMIN 4096 Oct 23 2018 sequencing
drwxr-xr-x 4 root root 4096 Jan 7 09:43 spencerlab
drwxr-xr-x 2 root root 4096 Nov 5 2016 srv
dr-xr-xr-x 13 root root 0 Nov 8 2018 sys
drwxrwxrwt 33 root root 4096 May 20 11:38 tmp
drwxr-xr-x 19 root root 0 May 20 11:38 Users
drwxr-xr-x 13 root root 4096 Nov 2 2017 usr
drwxr-xr-x 23 root root 4096 Nov 2 2017 var
-bash-4.2$
```

```
rutendosigauke — ssh fiji — 152x51
[-bash-4.2$ ls -l
total 89
lrwxrwxrwx 1 root root 7 Nov 2 2017 bin -> usr/bin
dr-xr-xr-x 5 root root 4096 Oct 24 2018 boot
drwxr-xr-x 20 root root 3660 Nov 22 15:29 dev
drwxr-xr-x 130 root root 12288 May 16 20:10 etc
drwxr-xr-x 3 root root 4096 Nov 2 2017 home
lrwxrwxrwx 1 root root 7 Nov 2 2017 lib -> usr/lib
lrwxrwxrwx 1 root root 9 Nov 2 2017 lib64 -> usr/lib64
drwxr-xr-x 2 root root 6 Nov 2 2017 localscratch
drwx----- 2 root root 16384 Nov 2 2017 lost+found
drwxr-xr-x 2 root root 4096 Nov 5 2016 media
drwxr-xr-x 2 root root 4096 Nov 5 2016 mnt
drwxr-xr-x 130 root root 4096 Apr 15 10:10 opt
dr-xr-xr-x 565 root root 0 Oct 24 2018 proc
drwxr-xr-x 8 root root 4096 Feb 27 18:36 projects
drwxr-xr-x 3 root rinnLab 4096 Mar 13 2018 rinnlab
dr-xr-x-- 9 root root 4096 May 16 08:55 root
drwxr-xr-x 35 root root 1240 May 20 11:10 run
lrwxrwxrwx 1 root root 8 Nov 2 2017/sbin -> usr/sbin
drwxr-xr-x 4 root root 2 Aug 2 2017 scratch
drwxrwxr-x 4 biof-sbsuser SEQADMIN 4096 Oct 23 2018 sequencing
drwxr-xr-x 4 root root 4096 Jan 7 09:43 spencerlab
drwxr-xr-x 2 root root 4096 Nov 5 2016 srv
dr-xr-xr-x 13 root root 0 Nov 8 2018 sys
drwxrwxrwt 33 root root 4096 May 20 11:49 tmp
drwxr-xr-x 19 root root 0 May 20 11:45 Users
drwxr-xr-x 13 root root 4096 Nov 2 2017 usr
drwxr-xr-x 23 root root 4096 Nov 2 2017 var
-bash-4.2$
```

Make the terminal comfortable to work in:

- Make the windows large
- Open multiple windows and/or tabs
- Change font sizes etc. ((For Mac: Command + Plus/Minus, For Windows, find Text size in Preferences))



Start Worksheet Part 1

Remember to make the terminal comfortable to work in:

- Make the windows large
- Open multiple windows and/or tabs
- Change font sizes etc. ((For Mac: Command + Plus/Minus, For Windows, find Text size in Preferences)

You can move on to Part 2 when
finished with Part 1

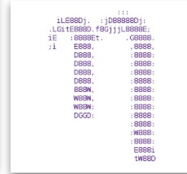
If you haven't already, start Worksheet Part 2

Done with Part 2 already?

1. Get started on the homework!
2. Practice the commands in the cheat sheets linked on Github
3. Help a peer out!

What is Vim ?

- Vim is a free, open source terminal based text editor
 - Edit content of human-readable files
- Several options exist for terminal text editors
 - Emacs
 - Nano
 - Sublime
 - Visual Studio Code



The End

Questions??

Don't forget the homework.

Help session in JSCBB A108 from 1-3pm

Watch videos for Day 3