Intro to Unix (Linux) shell

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June 2021

Editing of the slides is still in progress :)

About

Asya Shklyar - Senior HPC Engineer

Joined USC CARC this April

Before that Pomona College Director of HPC, consultant for Bioteam, systems engineer and architect for life sciences companies like Myriad Health, ThermoFischer, Roche, and SpaceX

Generalist with the focus on data management

Today's session is meant to be fun!

The materials are courtesy of NCGAS - National Center for Genome Analysis Support at Indiana University
https://ittraining.iu.edu/explore-topics/titles/bionboard/index.html

This session will be recorded and the slides will be provided on the web site

There will be a short break after each session

Contact: shklyar@usc.edu

Questions

Windows or Mac?

Familiarity with Linux, CLI?

Scripting or programming languages?

Area of study/research?

Coming to the special session on NLP?

Any specific areas of interest today?

Unix? Linux?

Linux refers to the kernel of the GNU/**Linux** operating system. More generally, it refers to the family of derived distributions. Developed by Linus Torvalds and the large community of open source developers.

Unix refers to the original operating system developed by AT&T.

https://www.softwaretestinghelp.com/unix-vs-linux/#:~:text=Linux%20refers%20to%20the%20kernel,family%20of%20derived%20operating%20systems.

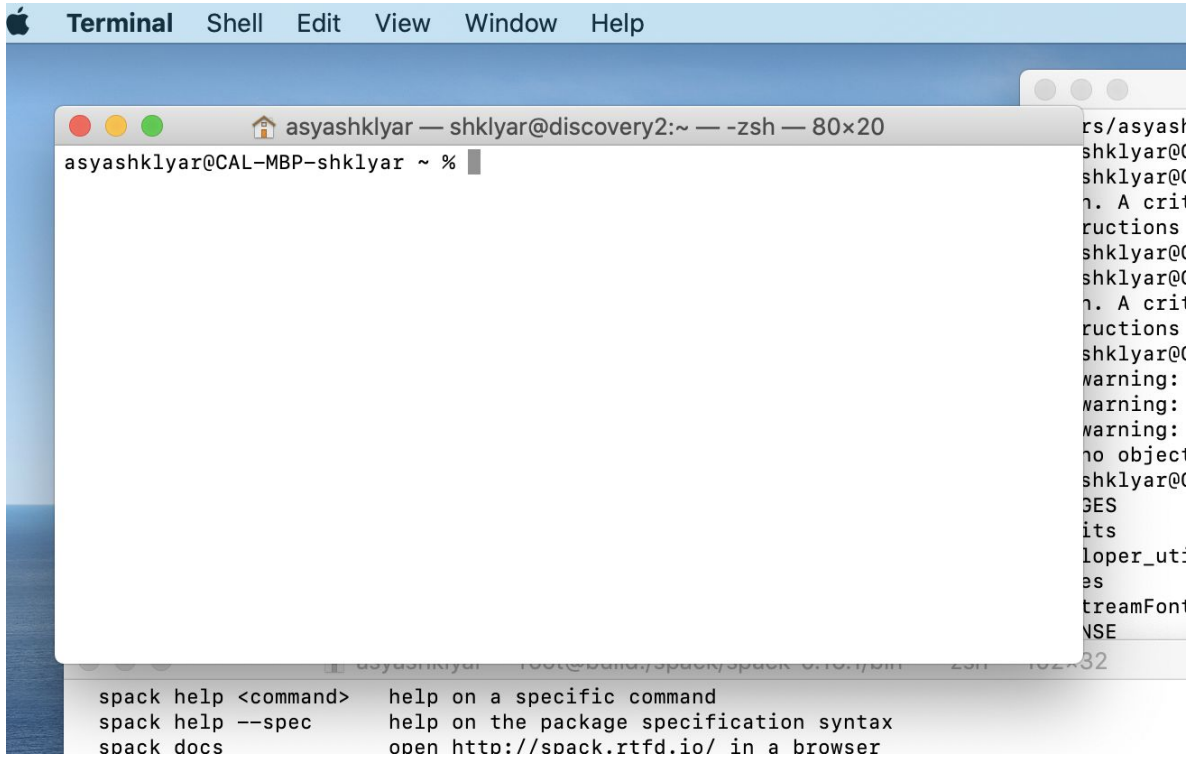
CentOS vs others: Ubuntu, FreeBSD, Red Hat, Scientific Linux, Fedora, Debian

CentOS 7 and 8 debacle-> Rocky Linux

bash - CLI - Command Line Terminal

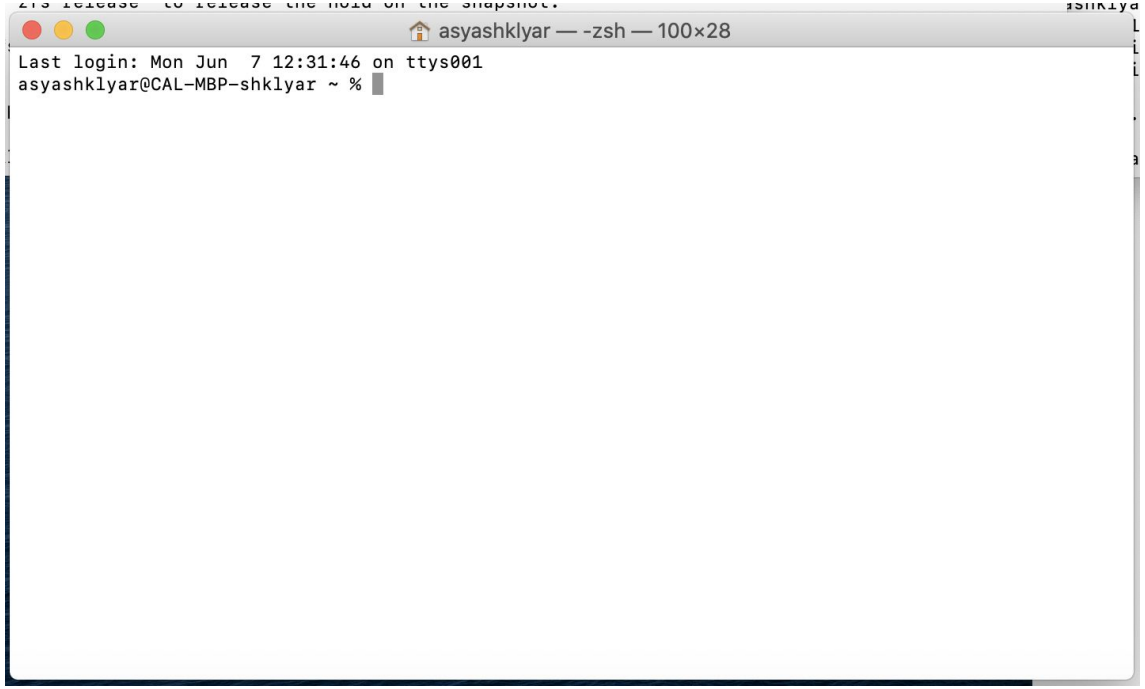
Yes, all of the above

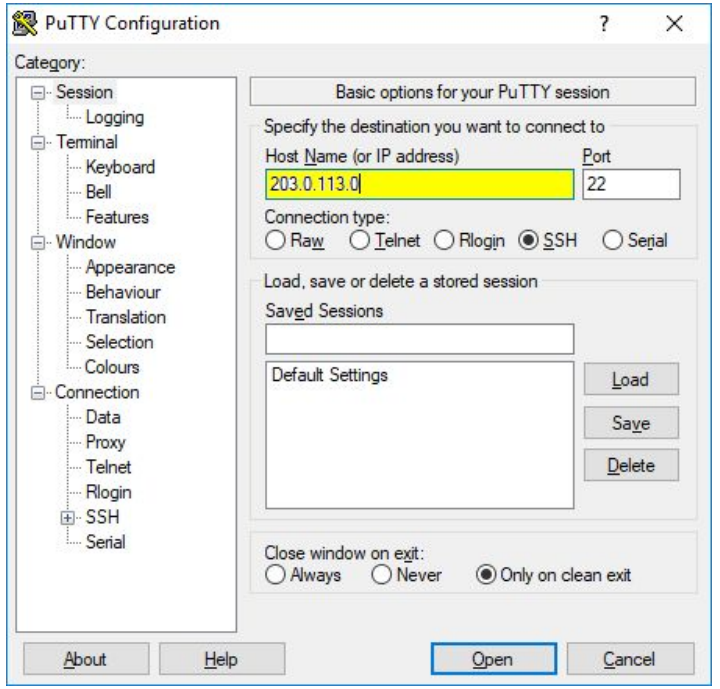
Example: Mac Terminal



How do I login to the HPC environment?

Terminal on Mac (built-in, in Applications, Utilities) or putty/ssh on Windows





https://www.putty.org/ or https://docs.microsoft.com/en-us/windows/wsl/install-win10

How do I login to the HPC environment?

Install Duo app on your phone

ssh yourusername@discovery.usc.edu

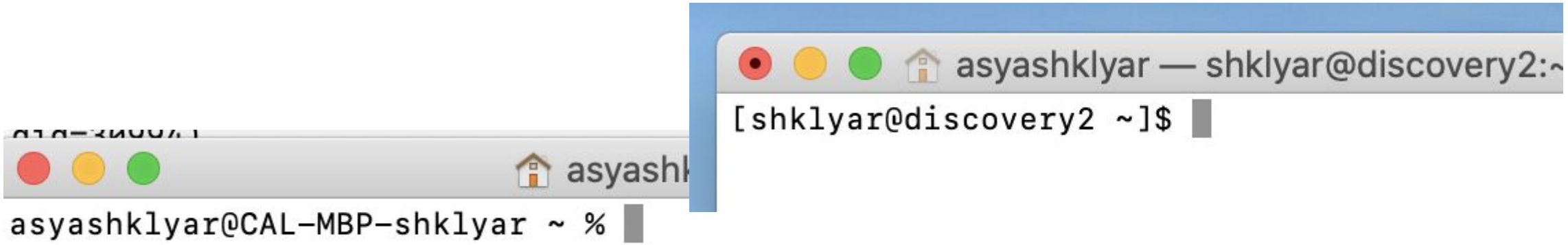
confirm push notification and you are in!

```
asyashklyar@CAL-MBP-shklyar ~ % ssh shklyar@discovery.usc.edu
Duo two-factor login for shklyar

Enter a passcode or select one of the following options:

 1. Duo Push to XXX-XXX-5230
 2. Phone call to XXX-XXX-5230
 3. SMS passcodes to XXX-XXX-5230

Passcode or option (1-3):
```

```
Success. Logging you in...
Last login: Tue Jun  1 13:45:14 2021 from 10.21.37.1
------------------------------------------------------------------------------
         Welcome to the Center for Advanced Research Computing (CARC)
                at the University of Southern California (USC)
------------------------------------------------------------------------------

     CARC website : https://carc.usc.edu
     User portal  : https://hpcaccount.usc.edu/
     User support : https://carc.usc.edu/user-support
     User guides  : https://carc.usc.edu/user-information/user-guides

              ** Unauthorized use/access is prohibited **

If you log on to this computer system, you acknowledge your awareness of and
concurrence with the USC CARC Acceptable Use Policy. USC will prosecute
violators to the full extent of the law.

------------------------------------------------------------------------------

[shklyar@discovery2 ~]$
```

How do I know if I am still on my computer or on a remote node?

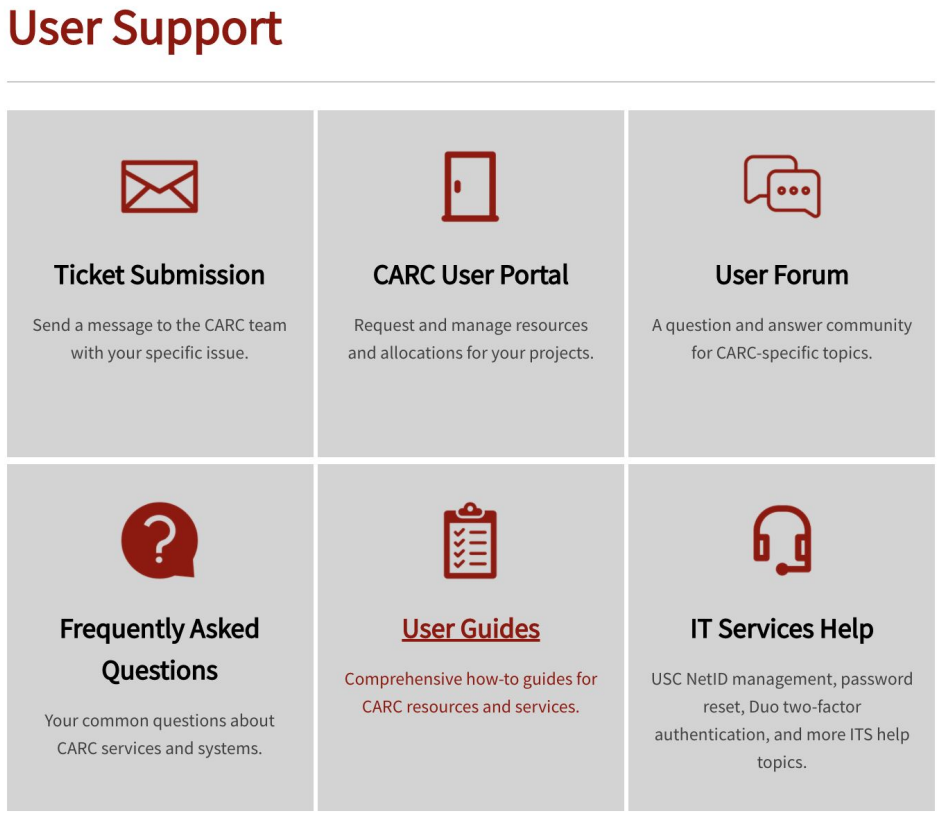
Pay attention to your username and the computer name in the prompt



More information about Discovery and other CARC resources

https://carc.usc.edu/

https://carc.usc.edu/services/hpc



How do I know where my files are?

ls (list) or ls -lah (for more details)

```
[shklyar@discovery2 ~]$ ls
~                                PonyLinux          sarus            test_python.py
module_avail_before_sarus_install  ponysay          script.sh        ubuntu_latest.sif
ondemand                         r-base_latest.sif  spack_List.txt
[shklyar@discovery2 ~]$
```

```
[shklyar@discovery2 ~]$ ls -lah
total 91K
-rw-rw----    1 shklyar shklyar   56 May 28 19:10 ~
drwxr-x---   14 shklyar shklyar   24 Jun  3 09:25 .
drwxr-xr-x 2967 root    root    2.9K Jun  7 07:00 ..
-rw-------    1 shklyar shklyar 5.8K Jun  7 13:04 .bash_history
-rw-r-----    1 shklyar shklyar  193 Apr 16 01:03 .bash_profile
-rw-r-----    1 shklyar shklyar  485 May 28 16:51 .bashrc
drwxrwx---    3 shklyar shklyar    1 Apr 21 12:51 .cache
drwx------    4 shklyar shklyar    2 Apr 21 12:51 .config
-rw-------    1 shklyar shklyar    0 May 27 17:33 .lesshst
drwx------    3 shklyar shklyar    1 May  5 14:49 .local
-rw-rw----    1 shklyar shklyar  18K May 26 14:23 module_avail_before_sarus_install
drwxr-xr-x    3 shklyar shklyar    1 Apr 27 13:59 ondemand
drwxr-----    3 shklyar shklyar    1 Apr 15 13:26 .pki
drwxr-xr-x   10 shklyar shklyar   24 Jun  2 14:26 PonyLinux
drwxr-xr-x   15 shklyar shklyar   23 Jun  2 14:30 ponysay
-rwxrwx---    1 shklyar shklyar 294M May  5 14:52 r-base_latest.sif
drwxrwxr-x    3 shklyar shklyar    2 May 25 09:59 sarus
-rwxrw----    1 shklyar shklyar  179 May 28 19:20 script.sh
drwx------    3 shklyar shklyar    1 May  5 14:48 .singularity
drwxrwxr-x    3 shklyar shklyar    2 May 24 18:44 .spack
-rw-rw-r--    1 shklyar shklyar  53K May 24 15:57 spack_List.txt
drwx------    2 shklyar shklyar    6 May 27 16:06 .ssh
-rw-rw----    1 shklyar shklyar   23 May 28 19:21 test_python.py
-rwxrwx---    1 shklyar shklyar  27M May  5 14:48 ubuntu_latest.sif
drwxr-xr-x    2 shklyar shklyar    1 Jun  3 09:25 .vim
-rw-------    1 shklyar shklyar 4.7K Jun  3 09:25 .viminfo
```

manual pages aka man pages

"man ls"

use "/" to search

```
LS(1)                    BSD General Commands Manual                    LS(1)

NAME
     ls -- list directory contents

SYNOPSIS
     ls [-ABCFGHLOPRSTUW@abcdefghiklmnopqrstuwx1%] [file ...]

DESCRIPTION
     For each operand that names a file of a type other than directory, ls displays its
     name as well as any requested, associated information.  For each operand that names a
     file of type directory, ls displays the names of files contained within that direc-
     tory, as well as any requested, associated information.

     If no operands are given, the contents of the current directory are displayed.  If
     more than one operand is given, non-directory operands are displayed first; directory
     and non-directory operands are sorted separately and in lexicographical order.

     The following options are available:

     -@      Display extended attribute keys and sizes in long (-l) output.

     -1      (The numeric digit ``one''.)  Force output to be one entry per line.  This is
             the default when output is not to a terminal.

     -A      List all entries except for . and ..  Always set for the super-user.

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

     -B      Force printing of non-printable characters (as defined by ctype(3) and current
:
```

A great text-based tutorial (for later):

https://swcarpentry.github.io/shell-novice/

Schedule

	Setup	Download files required for the lesson
00:00	1. Introducing the Shell	What is a command shell and why would I use one?
00:05	2. Navigating Files and Directories	How can I move around on my computer? How can I see what files and directories I have? How can I specify the location of a file or directory on my computer?
00:45	3. Working With Files and Directories	How can I create, copy, and delete files and directories? How can I edit files?
01:35	4. Pipes and Filters	How can I combine existing commands to do new things?
02:10	5. Loops	How can I perform the same actions on many different files?
03:00	6. Shell Scripts	How can I save and re-use commands?
03:45	7. Finding Things	How can I find files? How can I find things in files?
04:30	Finish	

The actual schedule may vary slightly depending on the topics and exercises chosen by the instructor.

Edit on GitHub / Contributing / Source / Cite / Contact

Using The Carpentries style version 9.5.3.

Cheat Sheets

https://devhints.io/bash

https://github.com/LeCoupa/awesome-cheatsheets/blob/master/languages/bash.sh

```
##############################################################################
# FILE COMMANDS
##############################################################################


ls                          # lists your files in current directory, ls <dir> to print files in a specific directory
ls -l                       # lists your files in 'long format', which contains the exact size of the file, who owns the file and who has
ls -a                       # lists all files in 'long format', including hidden files (name beginning with '.')
ln -s <filename> <link>     # creates symbolic link to file
readlink <filename>         # shows where a symbolic links points to
tree                        # show directories and subdirectories in easilly readable file tree
mc                          # terminal file explorer (alternative to ncdu)
touch <filename>            # creates or updates (edit) your file
mktemp -t <filename>          # make a temp file in /tmp/ which is deleted at next boot (-d to make directory)
cat <filename>              # prints file raw content (will not be interpreted)
any_command > <filename>    # '>' is used to perform redirections, it will set any_command's stdout to file instead of "real stdout" (gene
more <filename>             # shows the first part of a file (move with space and type q to quit)
head <filename>             # outputs the first lines of file (default: 10 lines)
tail <filename>             # outputs the last lines of file (useful with -f option) (default: 10 lines)
vim <filename>              # opens a file in VIM (VI iMproved) text editor, will create it if it doesn't exist
mv <filename1> <dest>       # moves a file to destination, behavior will change based on 'dest' type (dir: file is placed into dir; file:
cp <filename1> <dest>       # copies a file
```

Books

https://www.linuxlinks.com/excellent-free-books-learn-bash/

2. Advanced Bash Scripting Guide by Mendel Cooper

Advanced Bash-Scripting Guide is an in-depth exploration of the art of scripting. Almost the complete set of commands, utilities, and tools is available for invocation by a shell script.

The book explains:

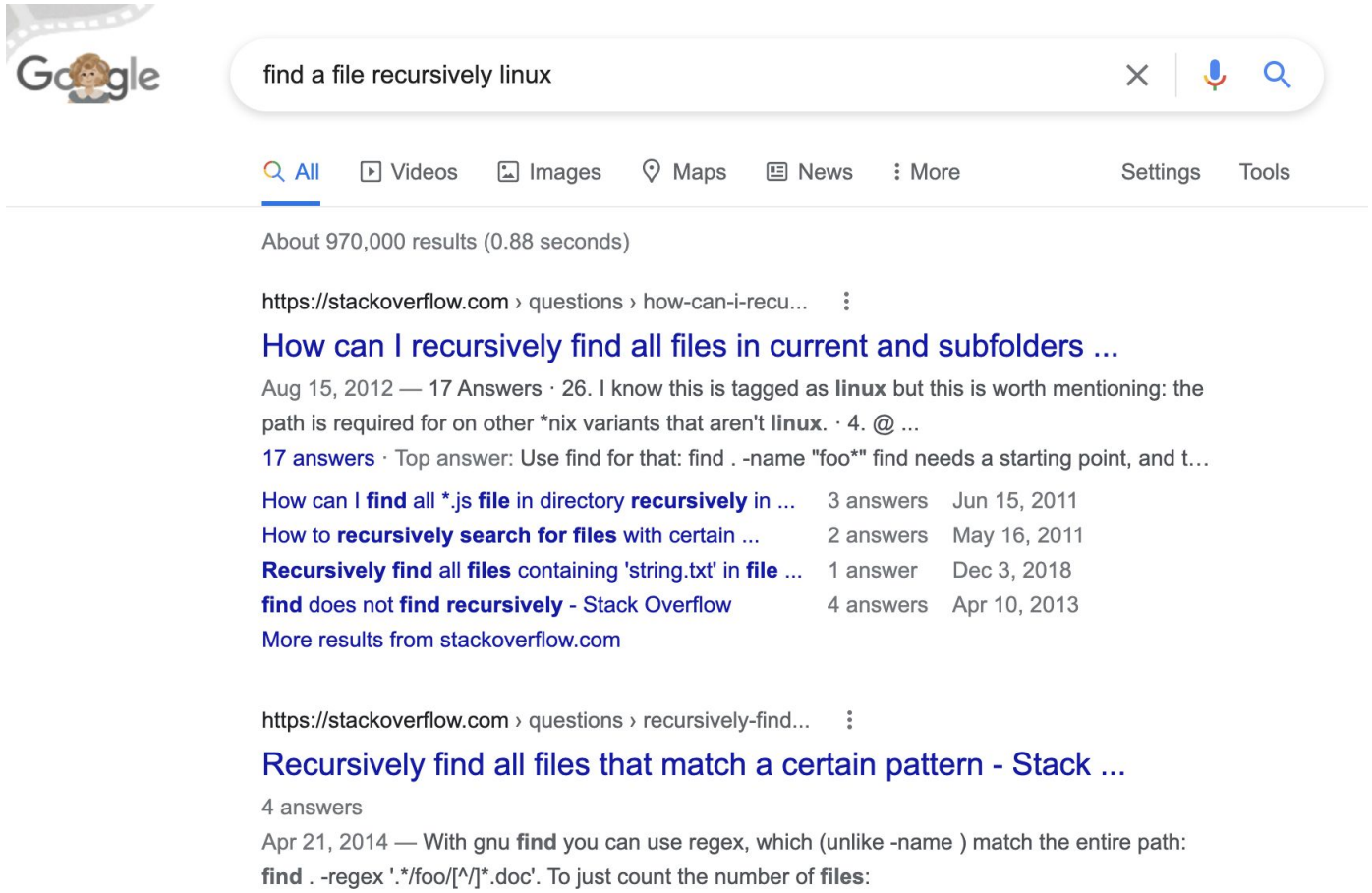
- Basics such as special characters, quoting, exit and exit status.
- Beyond the Basics including loops and branches, command substitution, arithmetic expansion, recess time.
- Commands – Internal commands and builtins; External filters, programs and commands; System and Administrative Commands.
- Advanced topics: Regular Expressions, Here Documents, I/O Redirection, Subshells, Restricted Shells, Process Substitution, Functions, Aliases, List Constructs, Arrays, Indirect References, /dev and /proc, Of Zeros and Nulls, Debugging, Options, Gotchas, Scripting with Style.

This book is in the public domain.

Read the book

Don’t be shy to google

“find file recursively linux”



Where am I?

pwd

```
[shklyar@discovery2 ~]$ pwd
/home1/shklyar
[shklyar@discovery2 ~]$
```

Other disks and file systems

“df -h” and “mount”... and “du -ksh”... and “less” and “grep” and “/”

```
Filesystem      Size  Used Avail Use% Mounted on
devtmpfs        126G     0  126G   0% /dev
tmpfs           126G  1.2M  126G   1% /dev/shm
tmpfs           126G  3.3G  123G   3% /run
tmpfs           126G     0  126G   0% /sys/fs/cgroup
/dev/sda4       3.9G  652M  3.0G  18% /
/dev/sda5       7.8G  2.9G  4.5G  40% /usr
/dev/sda2       486M   27M  431M   6% /boot
/dev/sda7       176G  1.1G  166G   1% /var
/dev/sda6        32G  101M   30G   1% /tmp
apps:/spack     1.7T  382G  1.4T  23% /spack
beegfs_nodev    483T   49T  434T  11% /home1
beegfs_nodev    7.6P  2.7P  4.9P  36% /project
beegfs_nodev    709T  557T  152T  79% /scratch2
beegfs_nodev    806T  647T  159T  81% /scratch
tmpfs            26G     0   26G   0% /run/user/352098
tmpfs            26G     0   26G   0% /run/user/327602
tmpfs            26G     0   26G   0% /run/user/268648
tmpfs            26G     0   26G   0% /run/user/172734
tmpfs            26G     0   26G   0% /run/user/351147
tmpfs            26G     0   26G   0% /run/user/356650
tmpfs            26G     0   26G   0% /run/user/600305
tmpfs            26G     0   26G   0% /run/user/329077
```

```
/dev/sda2 on /boot type ext4 (rw,relatime,data=ordered)
/dev/sda7 on /var type ext4 (rw,relatime,data=ordered)
/dev/sda6 on /tmp type ext4 (rw,relatime,data=ordered)
sunrpc on /var/lib/nfs/rpc_pipefs type rpc_pipefs (rw,relatime)
apps:/spack on /spack type nfs4 (ro,relatime,vers=4.1,rsize=1048576,wsize=1048576,namlen=
255,hard,proto=tcp,timeo=600,retrans=2,sec=sys,clientaddr=10.125.0.197,local_lock=none,ad
dr=10.125.0.88)
beegfs_nodev on /home1 type beegfs (rw,relatime,cfgFile=/etc/beegfs/beegfs-client-home1.c
onf,_netdev)
beegfs_nodev on /project type beegfs (rw,relatime,cfgFile=/etc/beegfs/beegfs-client-proje
ct.conf,_netdev)
beegfs_nodev on /scratch2 type beegfs (rw,relatime,cfgFile=/etc/beegfs/beegfs-client-scra
tch2.conf,_netdev)
beegfs_nodev on /scratch type beegfs (rw,relatime,cfgFile=/etc/beegfs/beegfs-client-scrat
ch.conf,_netdev)
```

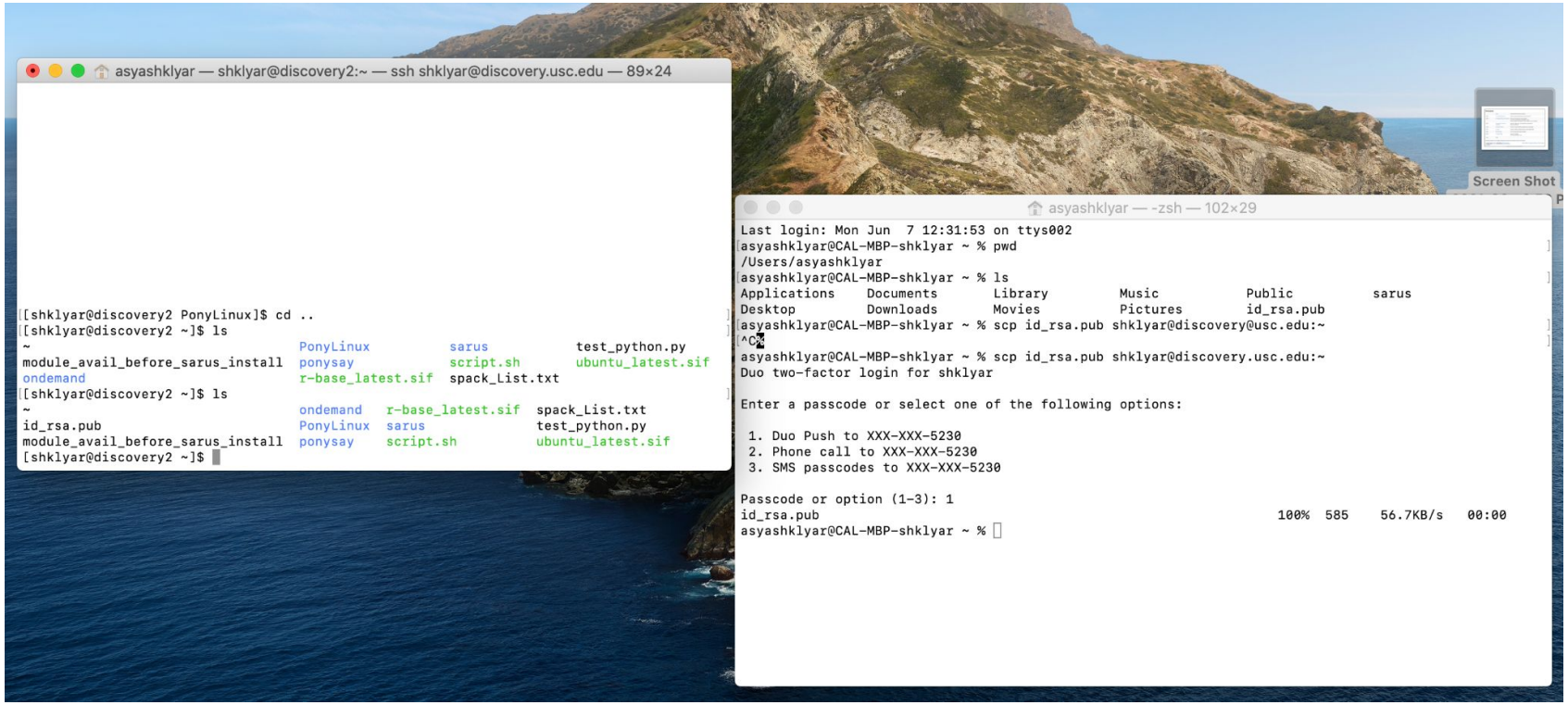
How do I go to another directory?

cd yourdirectory

```
[shklyar@discovery2 ~]$ cd PonyLinux/
[shklyar@discovery2 PonyLinux]$ ls
CHANGES              installation_instructions.md  ponyicon.png  runQuiz.sh      Section_Three_dev  Utilities.sh
Credits              JetstreamFont.png             Ponylinux.sh  runTutorial.sh  Section_Two
Developer_utilities  LICENSE                       ponysay       Section_One     splash.txt
Images               minibash.sh                   README.md     Section_Three   starbucks.txt
[shklyar@discovery2 PonyLinux]$
```

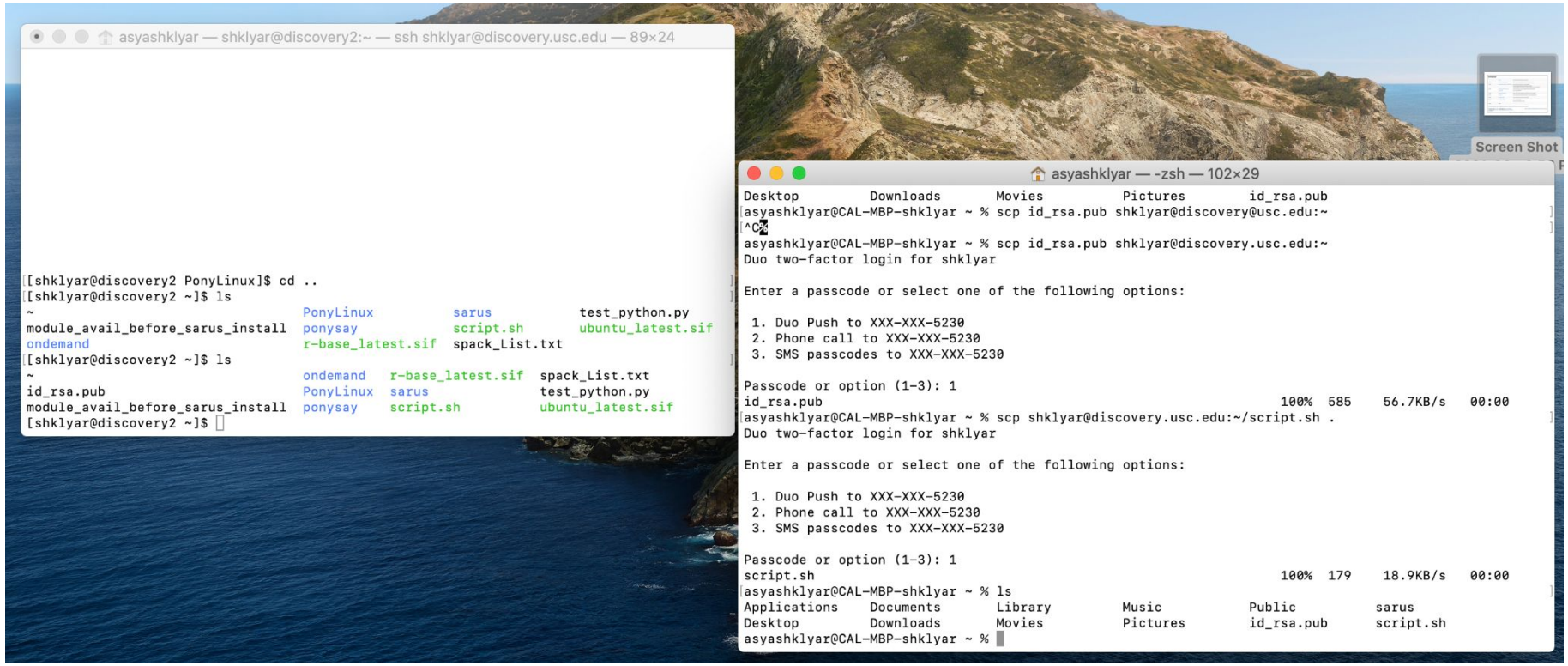
How do I copy a file to the node?

scp yourfile yourusrername@discovery.usc.edu:~



How do I get my data out?

scp yourusername@discovery.usc.edu:~/yourfile .



Practicum: Pony Linux - Introduction

Welcome to PonyLinux!

PonyLinux is a very basic tutorial on using the **command line** in Unix operating systems, such as Ubuntu Linux.

Walk through a series of tutorial sections that will teach you different **commands**, what they do, and how to use them. The tutorials are interactive, with mini sessions to ensure you get more practice and engagement. Your task will be to take the knowledge you gained during the tutorials to find the Princess in the dungeon! So go on brave one, and be a hero while learning about Linux!

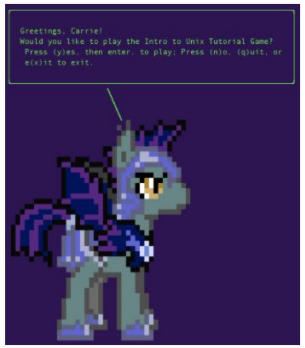
Practicum: Pony Linux - Content

SECTION ONE

Section one introduces the structure of things that are typed into the **command line**, and the concept that programs can be run using text. We delve into basic movement between folders and showing what is inside a folder. Understanding and setting permission to view, open, and change files and folders is covered, as well as how to read the contents of a file.

We go over the following **commands**:

```
cd
ls
pwd
find
chmod
less
```



Section One wraps up with a challenge. Use the commands you learned during the tutorials to defeat a dungeon set up using files and folders right in the Linux environment. Your goal is to find the Princess in the dungeon with the knowledge you earned in the tutorial.

Practicum: Pony Linux - Content

SECTION TWO

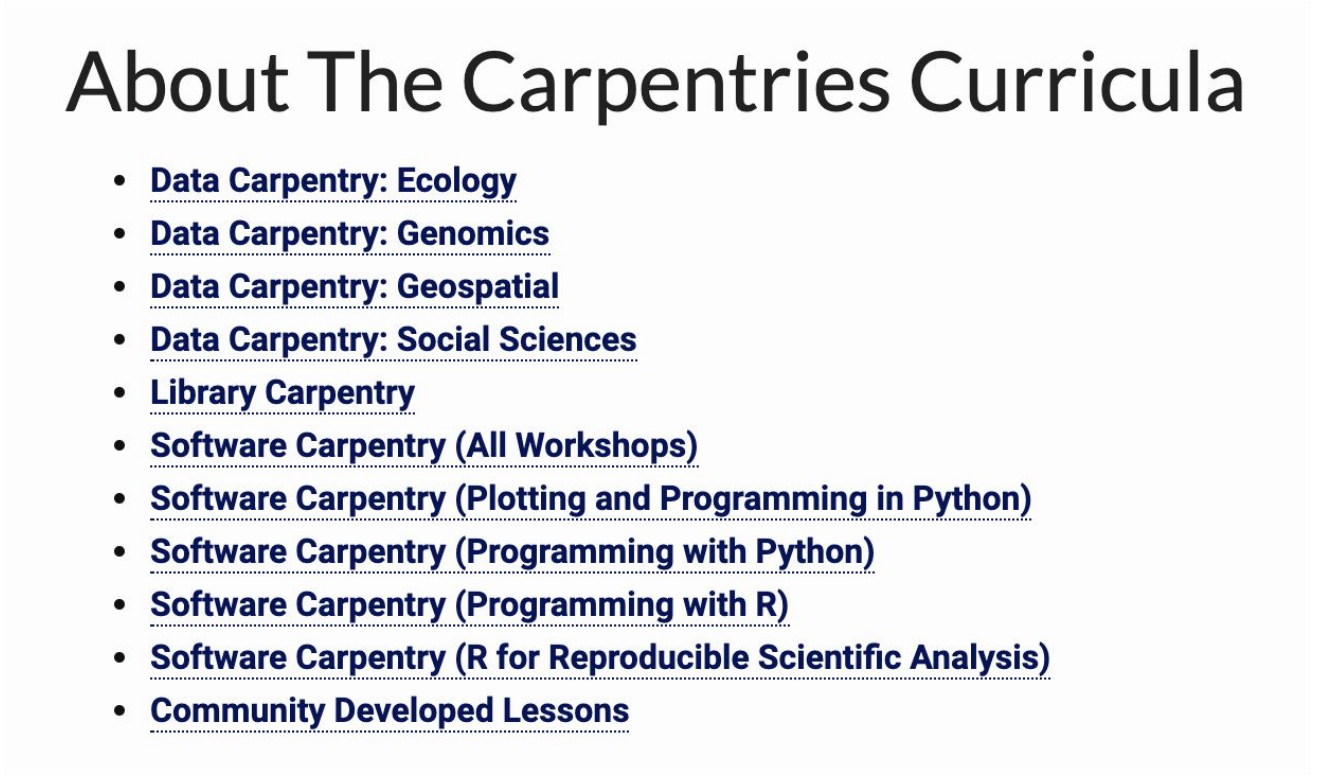
We go over the following **commands**:

```
head
tail
wc
cat
less
nano
cp
alias
mv
rm
touch
mkdir
```

The goals of section two will be to start getting into more bash commands that will introduce you to file handling in Linux - how to read, edit, generate, and remove files. Your goal is to use your new skills to navigate the dungeon, which is now a ruin and overrun with animals, to find the Princess's key.

More learning!

https://datacarpentry.org/lessons/



Learning Subscriptions available at USC

LinkedIn Learning (Lynda)

https://www.linkedin.com/learning/learning-bash-scripting-2/learning-bash-scripting

Pluralsight

https://www.pluralsight.com/courses/bash-shell-scripting

Upcoming workshops

NVIDIA

- July 25th and August 28th - Wednesday - all day
- Watch the web site for the registration information

Practicum: Pony Linux - Let's do this!

Normally we would do this:

Log in to Discovery

Load the module

But, between the lack of time and my Internet issues yesterday I am going to use a local install and you are welcome to follow it.

https://github.com/NCGAS/PonyLinux

This will be available to use after the bootcamp on Discovery.

Happy Learning!