NREL|HPC

NREL HPC Introduction: Linux Basics

HPC Operations

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Presentation by: HPC User Operations Team

Slide Conventions

- Verbatim command-line interaction:

  “$” precedes explicit typed input from the user.

  “↲” represents hitting “enter” or “return” after input to execute it.

  “**…**” denotes text output from execution was omitted for brevity.

  “#” precedes comments, which only provide extra information.

```
$ ssh hpc_user@eagle.nrel.gov↲ # Login externally
    …
Password+OTPToken: # Your input will be invisible
```

- Command-line executables in prose:

  “The command `scontrol` is very useful.”

Sections

1 Mac and Windows SSH Setup

2 Remote System Interaction

3 Linux Command Line basics

4 Basics of SSH

5 Permissions

https://www.nrel.gov/hpc/training.html

Terminal: Mac vs. Windows

- Mac has a built-in terminal emulator
  - Open Terminal.app
  - '⌘+space' and search "terminal" or Applications>Utilities>Terminal.app
  - If you plan to live most of your life in a terminal, iTerm2 allows additional functionality.
- Windows uses cmd or powershell (no ssh?)
  - Windows does not have ssh capability by default
  - There are many options available
- For this tutorial, we will use PuTTY for Windows
  - Visit https://www.nrel.gov/hpc/putty-ssh-gateway.html
  - Go to PuTTY website and download the .exe file
  - Most new computers use 64-bit but if you don't know it's best to go with 32

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Connect to Eagle

- From Terminal.app simply use:

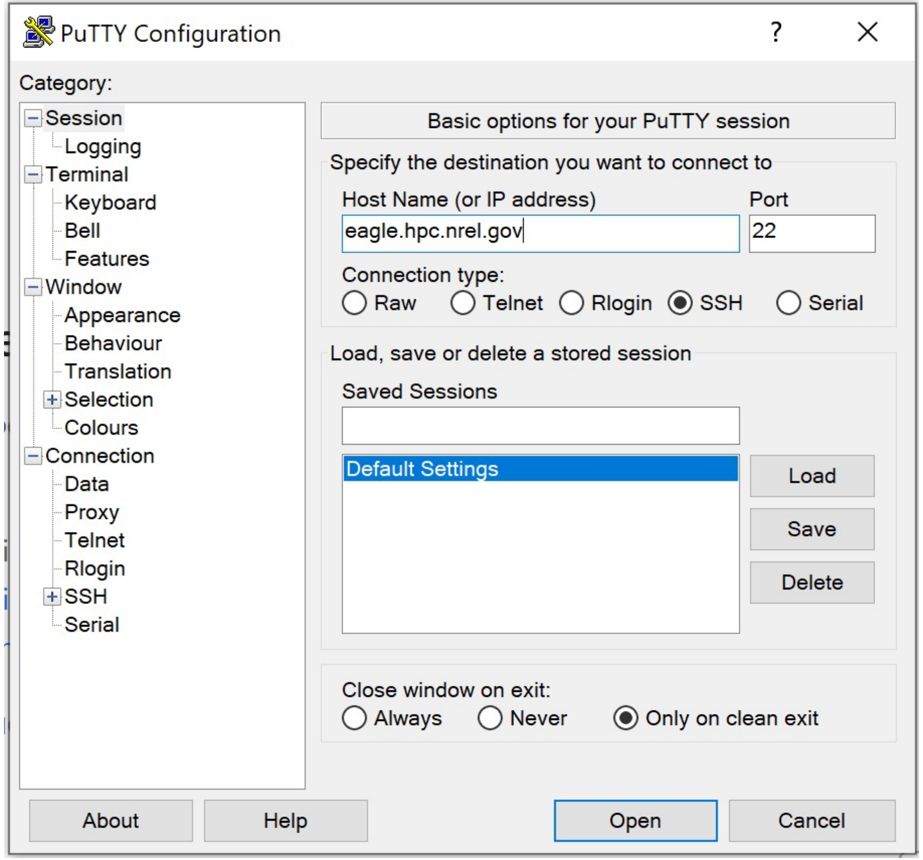
```
[user@mac ~]$ ssh hpc_user@eagle.hpc.nrel.gov↲
```

- Notice your terminal prompt when logged into a remote system:

```
[hpc_user@el1 ~]$
```

- This prompt indicates your commands are being launched on the remote system (in the example above, the system is `el1.hpc.nrel.gov`)
- Note that this is a separate machine with its own operating system—changes you make from this prompt are not happening on your local workstation that you are typing the commands from.

PuTTY



PuTTY Configuration

Basic options for your PuTTY session

Specify the destination you want to connect to

Host Name (or IP address): eagle.hpc.nrel.gov

Port: 22

Connection type: ○ Raw ○ Telnet ○ Rlogin ● SSH ○ Serial

Load, save or delete a stored session

Saved Sessions

Default Settings

Close window on exit: ○ Always ○ Never ● Only on clean exit

Eagle Login Nodes

Internal		**External (Requires OTP Token)**	
Login	DAV	Login	DAV
eagle.hpc.nrel.gov	**eagle-dav.hpc.nrel.gov**	eagle.nrel.gov	eagle-dav.nrel.gov

Direct Hostnames	
Login	DAV
el1.hpc.nrel.gov	ed1.hpc.nrel.gov
el2.hpc.nrel.gov	ed2.hpc.nrel.gov
el3.hpc.nrel.gov	ed3.hpc.nrel.gov

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Command-Line

- Command Structure

```
[user@mac ~]$ command  [-option(s)]  [argument(s)]...
```

- A command-line interface (CLI) is a means of user interaction with a computer program by issuing successive commands as lines of text.
- The program which handles the interface is called a shell.
- Bourne Again Shell (bash) is most widely used and is default for many Linux distributions.
- Why CLI?
  – Many reasons!

Getting Started with the Command-Line

- Most commonly used commands:

  `man` - get a detailed ***manual*** entry about any terminal command

  `ls` - ***list*** files and directories in the current working directory

  `mkdir` - ***make*** a new ***directory*** with the name given as an argument

  `cd` - ***change*** the current working ***directory*** to a given path

  `nano` - beginner-friendly text-editor, can edit and create file contents

  `mv` - ***move*** a file to a new location and/or name

  `cp` - ***copy*** a file's contents to a new given filename

  `rm` - ***remove*** files or directories

  `cat` - print the contents of a file (can ***concatenate*** many files' contents)

  `less` - see contents of a file with features to make reading easier

  `scp` - ***securely copy*** a file to or from a remote device over a network

Pipe and Redirection

- You have the ability to redirect standard streams
- Using greater than (>) you can capture the output of a command to a file.

```
# The following will capture the output of the ls command
in a file called output.ls

[user@mac ~]$ ls -al > output.ls↲
```

- Using pipe (|) we can "pipe" the output from one command to the next.

```
# The following will "pipe" the output of the ls command to
the grep command.

[user@mac ~]$ ls -1 | wc -l↲
```

Command-Line Continued

- “foreground” processes will print to your active terminal and prevent additional commands from being submitted until they have completed.
- “background” processes may or may not print to your active terminal, but they won’t block you from typing in more commands.
- If a foreground command is running and you want to cancel it, hit Ctrl + C
- If a command is running and you want to pause it, use Ctrl + Z
  - While halted, use the `fg` (foreground) command to resume its execution
  - Or use the `bg` (background) command to change it to a background process
  - If you have `several` background processes, you can refer to them by index with `%` (e.g. to foreground the second job you `bg’`d you can use `fg %2`)
  - Use `jobs` to see all `bg`’d processes and their indexes
- Append an `&` to a command to launch in the background from the start
  - Background commands will still print to your terminal unless redirected—they may look as though they’re overwriting your input but that’s not the case.

Command-Line Continued

- Use Ctrl+D or `logout` to end your end your session on the remote system.
- Use Ctrl+L or `clear` to fill your terminal window with whitespace to remove text clutter
- Use Ctrl+R to search for words in your command-line history in reverse chronological order
- Use the `history` command to view a list of commands you've ran recently
- Use the tab key to auto-complete commands that your terminal can run

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SSH Config

On your local machine, modify `~/.ssh/config` to create convenient aliases for various systems you may access (note that ~ is expanded to your /home directory)

```
$ cat ~/.ssh/config↲
Host eg
    User hpc_user
    HostName eagle.hpc.nrel.gov

Host ed
    User hpc_user
    HostName eagle-dav.hpc.nrel.gov

$ ssh eg↲
[hpc_user@el2 ~] $
```

SSH Keys

Using the magic of RSA encryption and public/private keys, you can securely login to systems using SSH without providing a password every single time.

```
# The following should be executed on your local workstation

$ ls ~/.ssh/id_rsa || ssh-keygen↲ # Generate RSA keys if none exist

ls: /Users/hpc_user/.ssh/id_rsa: No such file or directory
Generating public/private rsa key pair.
     … # Follow on-screen CLI prompts if necessary
+----[SHA256]-----+

$ ssh-copy-id eg↲
Password:**********↲ # Last time you’ll need to enter your password!
     …
[hpc_user@el2 ~] $
```

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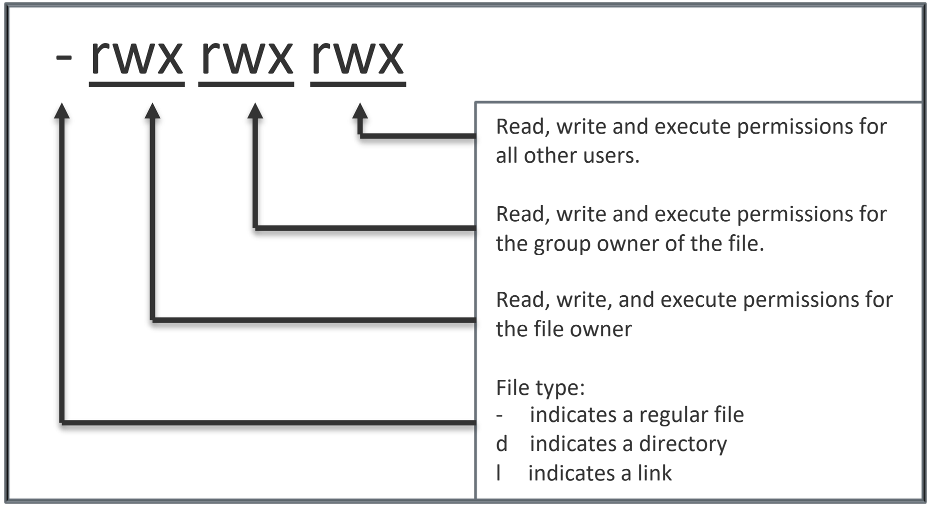
Linux Permissions

```
[hpc_user@el2 ~] $ ls -l↲
-rw-r-----. 1 hpc_user hpc_user      1393 Mar 26 13:51 text_file.txt
drwxrwxr-x. 7 hpc_user hpc_user      3072 Dec 20 10:49 name_of_directory
drwxr-xr-x. 9 hpc_user hpc_project   8464 Apr 29 15:50 project_shared_directory
-rwxrwxr-x. 1 hpc_user hpc_user       905 Mar 20 10:00 executable_script.sh
-rw-------. 1 hpc_user hpc_user    126135 May 31 10:33 secret_file.txt
```



- rwx rwx rwx

Read, write and execute permissions for all other users.

Read, write and execute permissions for the group owner of the file.

Read, write, and execute permissions for the file owner

File type:
- -   indicates a regular file
- d   indicates a directory
- l   indicates a link

Permissions commands:

chown - change owner
chgrp - change group
chmod - modify file permissions

Feedback is Appreciated!

If you have any suggestions to improve this presentation we invite you to share with us at HPC-Help@nrel.gov

Thank You

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