Unix/Linux Tutorial

EECE 5640

Fall 2017

Julian Gutierrez

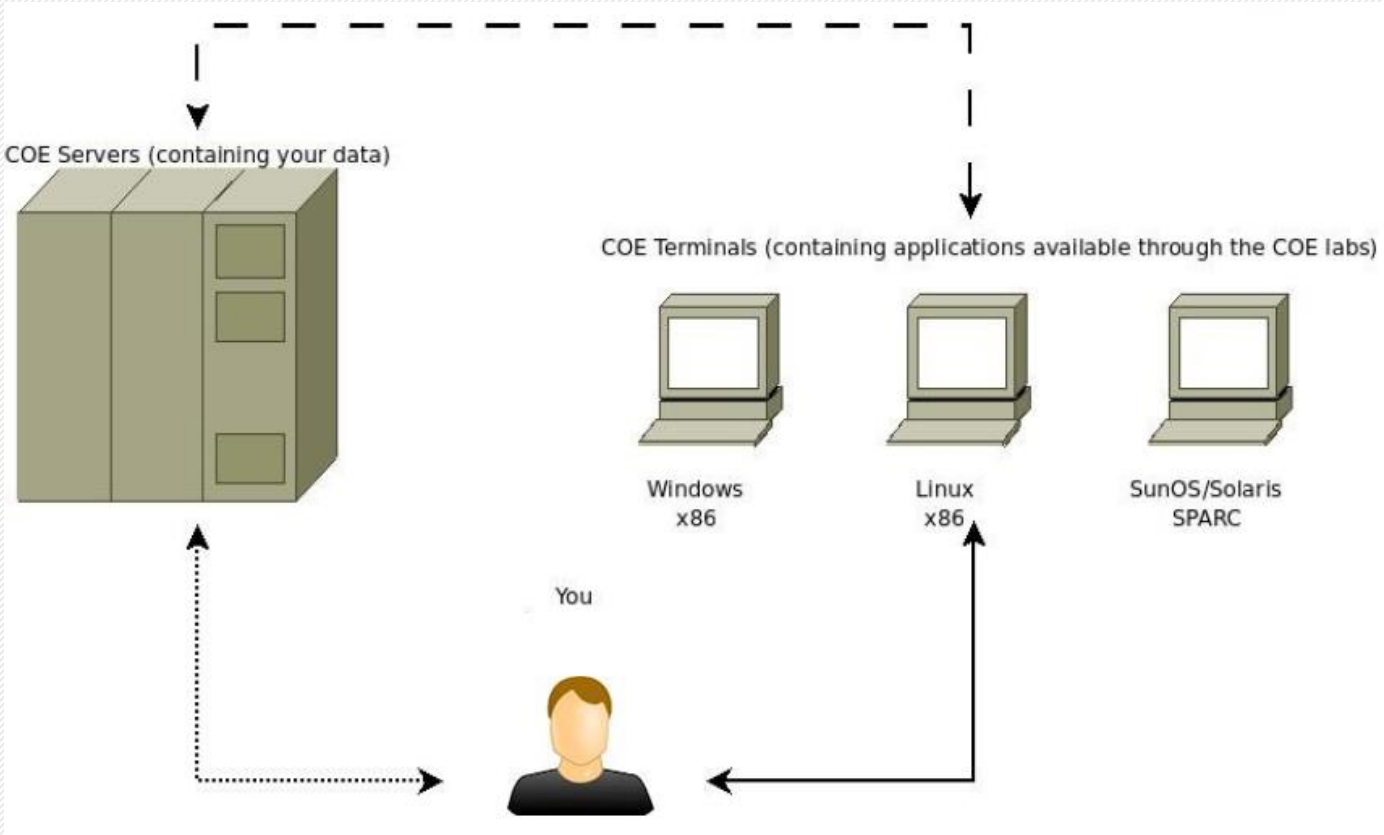
Goal

- To provide you with simple information of what you can do on a server and how to interact with it through different commands
- We will test all of the commands and see some of the examples for bash files/scripts that we can create
  - This means we will go back and forth between presentation and commandline

COE Lab

- Access COE computer through putty/SSH
- Open putty
  - Connect to gateway.coe.neu.edu
  - Enter COE username and password
- Once connected to the COE network, you can access the rest of the computers using ssh
  - ssh -p 27 lingate
  - This is no longer necessary as the login nodes are quite powerful. You can run everything there.

COE Lab Architecture

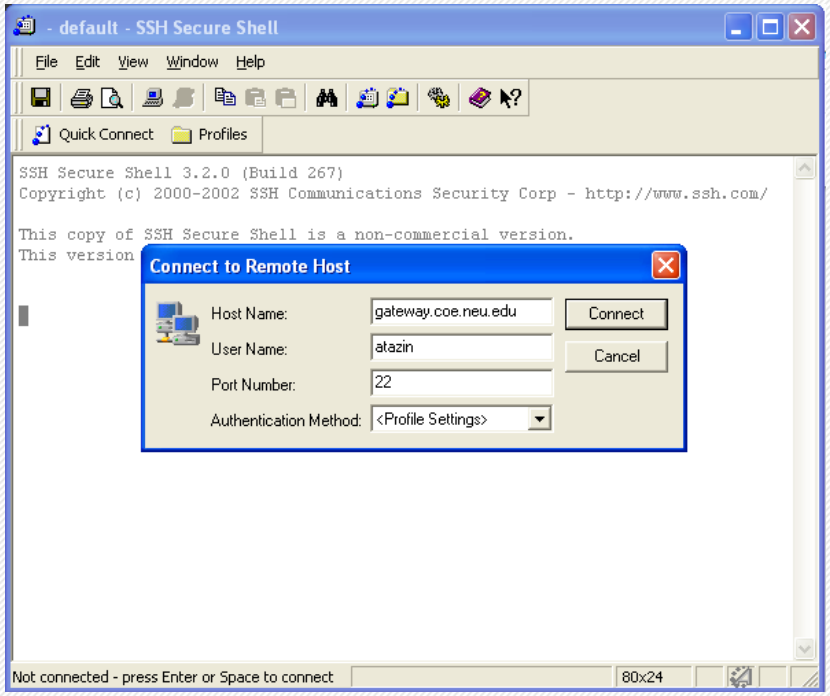


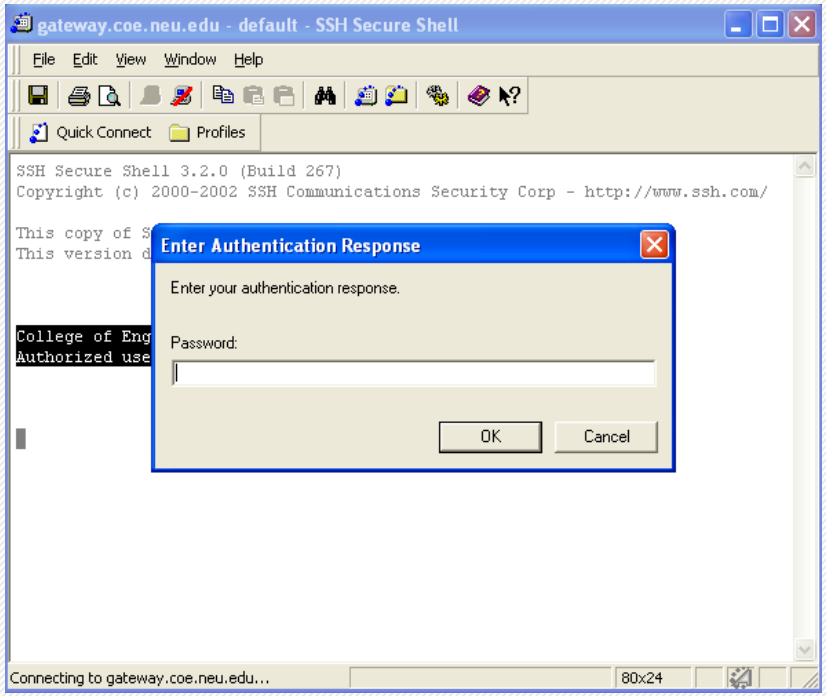
Access COE Lab remotely

- SSH
  - “secure shell”: a network protocol for secure data communication
  - Typically used to log into a remote machine and execute commands in command-line
- SSH tools
  - In Windows: putty
  - In Linux/Mac: ssh is already installed, can be used directly from a terminal

SSH

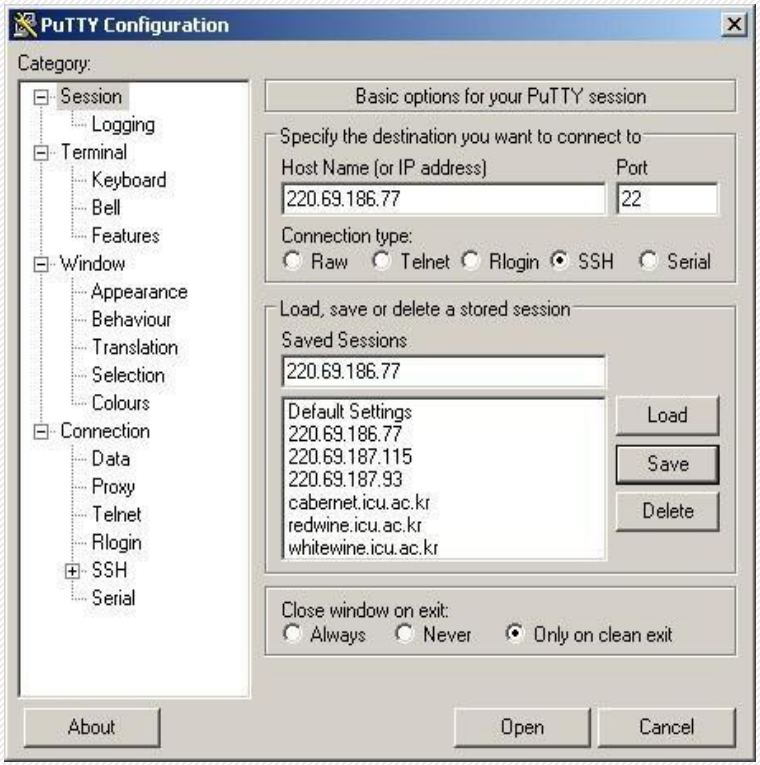
- Logging into the gateway server



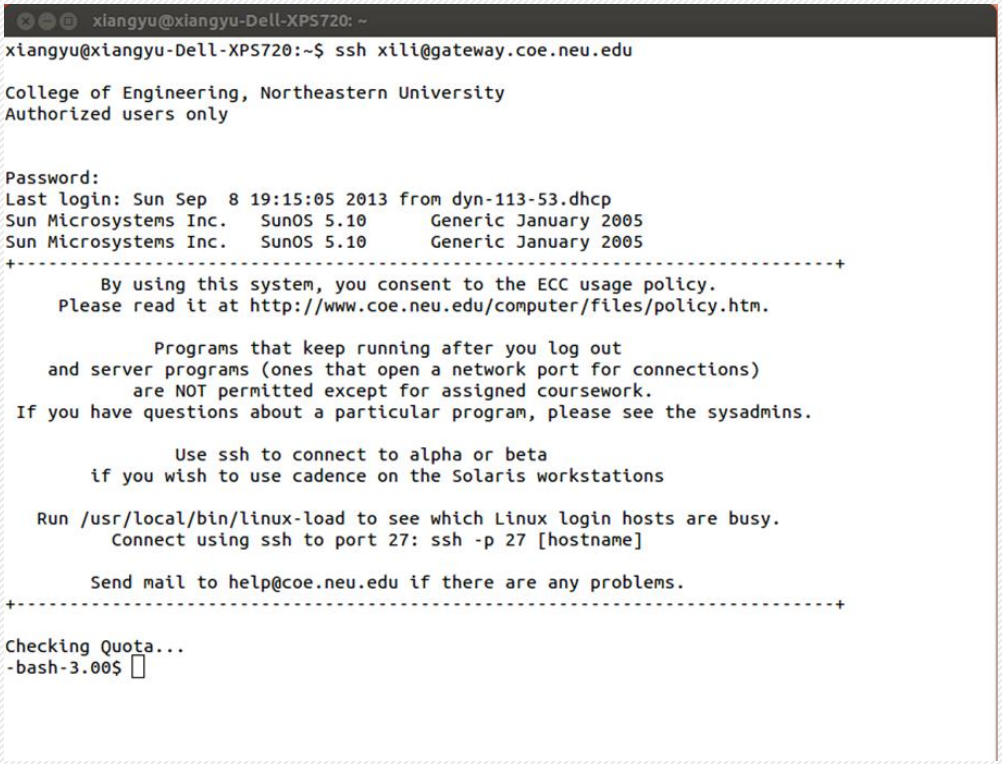


SSH – Using Putty

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



SSH – Using Linux Terminal



Transferring Files

- Two ways to transfer files
  - SFTP or SCP

SCP

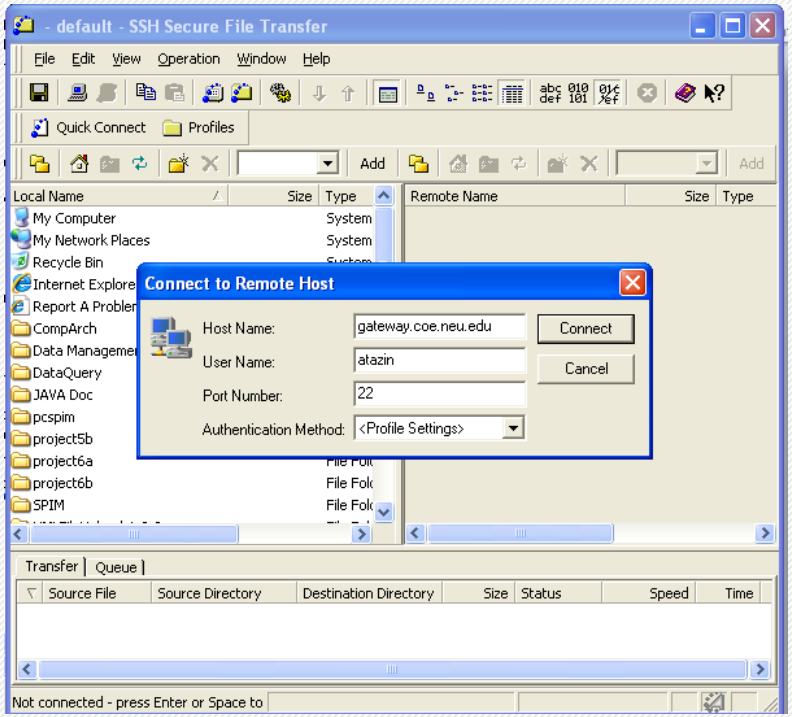
- Command line transfer
  - Use gateway.coe.neu.edu
  - Can move a file from local computer to your account on the COE computers
- Example
  - scp localfile.txt user@gateway.coe.neu.edu:~/localfile.txt
  - scp user@gateway.coe.neu.edu:~/localfile.txt localfile.txt

SFTP

- Secure file transfer protocol
- Implementation has Windows GUI (available on COE Windows machines)
- FileZilla is another option for your personal computer

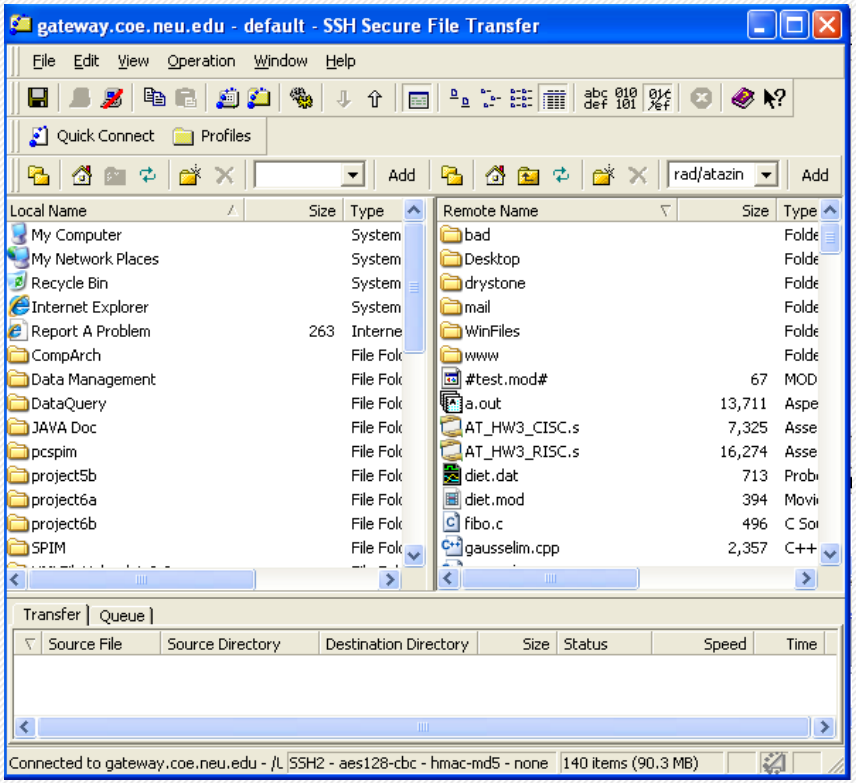
SFTP

- Logging into the gateway server



SFTP

- Directory listing



The Shell

- Whenever you login to a Unix system you are placed in a program called the shell
  - Bottom left of your screen
  - To get your work done, you enter commands at this prompt
- The shell acts as a command interpreter
- Takes each command and passes it to the operating system kernel to be acted upon
- It then displays the results of this operation on your screen
- As soon as you login, the shell (bash) will execute the following file:
  - ~\.bashrc
    - This file configures your shell, and you can modify it to do whatever you want
  - ~\.bash_aliases
    - This file is to load any “shortcuts” you want to have

General Commands

- Shells
  - Bourne Shell, Bourne-Again Shell, Korn Shell
  - sh, bash, ksh
- Who is connected to the server/workstation?
  - who
- Path
  - echo $path

General Commands

- Executable location
  - Whereis <filename>
- Full path to Current directory
  - pwd
- Running processes
  - ps
- Close connection
  - exit

Navigation Commands

- Change directory (can receive relative and absolute paths)
  - cd
  - cd .. (change to parent directory)
  - cd ~ (change to home directory)
  - cd / (change to root directory)
- List files and folders
  - ls (ls -a, ls -l, etc)

Navigation Commands

- Execute file
  - ./a.out
- Finding files
  - find / -name game (search starting with root)
- Viewing File Content
  - more/less or cat
- Man pages
  - Man <command>

File and Directory Commands

- Copy file
  - cp file.doc newfile.doc
  - cp filename /tmp
- Copy all files to a directory
  - cp * /home/tom/backup
- Copy recursively
  - cp -R /currentdir/* /home/tom/backup

File and Directory Commands

- Create directory
  - mkdir <dirname>
- Rename file
  - mv <oldfile> <newfile>
- Delete file
  - rm <filename>
- Delete directory recursively
  - rm -R <dirname>
  - BE VERY CAREFUL!!!

Files and Directories

```
Seconds% ls -l
total 104
-rwxr-xr-x   1 mfuess   systems     7316 Oct  6 15:45 nonres
-rw-r--r--   1 mfuess   systems     3048 Oct  6 01:12 nonrestoringdiv.c
-rw-r--r--   1 mfuess   systems     6879 Oct  6 12:57 nonrestoringdiv.s
-rw-rw-rw-   1 mfuess   systems    17542 Oct  6 13:44 nonrestoringdiv_lingate.s
drwxr-sr-x   2 mfuess   systems     4096 Oct 13 19:03 output
drwxr-sr-x   7 mfuess   systems     4096 Jun 17 20:24 pin-2.6
-rw-------   1 mfuess   systems      102 Oct  7 21:27 pin.log
```

↑
Type of file: - =normal file, d=directory, l=symbolic link, etc…

```
Seconds% ls -l
total 104
-rwxr-xr-x   1 mfuess   systems     7316 Oct  6 15:45 nonres
-rw-r--r--   1 mfuess   systems     3048 Oct  6 01:12 nonrestoringdiv.c
-rw-r--r--   1 mfuess   systems     6879 Oct  6 12:57 nonrestoringdiv.s
-rw-rw-rw-   1 mfuess   systems    17542 Oct  6 13:44 nonrestoringdiv_lingate.s
drwxr-sr-x   2 mfuess   systems     4096 Oct 13 19:03 output
drwxr-sr-x   7 mfuess   systems     4096 Jun 17 20:24 pin-2.6
-rw-------   1 mfuess   systems      102 Oct  7 21:27 pin.log
```

↑
Permissions for owner of file: r=read, w=write, x=execute, -=no permission

Files and Directories

```
Seconds% ls -l
total 104
-rwxr-xr-x   1 mfuess   systems     7316 Oct  6 15:45 nonres
-rw-r--r--   1 mfuess   systems     3048 Oct  6 01:12 nonrestoringdiv.c
-rw-r--r--   1 mfuess   systems     6879 Oct  6 12:57 nonrestoringdiv.s
-rw-rw-rw-   1 mfuess   systems    17542 Oct  6 13:44 nonrestoringdiv_lingate.s
drwxr-sr-x   2 mfuess   systems     4096 Oct 13 19:03 output
drwxr-sr-x   7 mfuess   systems     4096 Jun 17 20:24 pin-2.6
-rw-------   1 mfuess   systems      102 Oct  7 21:27 pin.log
```

↑ Permissions for members of the group

```
Seconds% ls -l
total 104
-rwxr-xr-x   1 mfuess   systems     7316 Oct  6 15:45 nonres
-rw-r--r--   1 mfuess   systems     3048 Oct  6 01:12 nonrestoringdiv.c
-rw-r--r--   1 mfuess   systems     6879 Oct  6 12:57 nonrestoringdiv.s
-rw-rw-rw-   1 mfuess   systems    17542 Oct  6 13:44 nonrestoringdiv_lingate.s
drwxr-sr-x   2 mfuess   systems     4096 Oct 13 19:03 output
drwxr-sr-x   7 mfuess   systems     4096 Jun 17 20:24 pin-2.6
-rw-------   1 mfuess   systems      102 Oct  7 21:27 pin.log
```

↑ Permissions for everyone

Files and Directories

```
Seconds% ls -l
total 104
-rwxr-xr-x   1 mfuess   systems     7316 Oct  6 15:45 nonres
-rw-r--r--   1 mfuess   systems     3048 Oct  6 01:12 nonrestoringdiv.c
-rw-r--r--   1 mfuess   systems     6879 Oct  6 12:57 nonrestoringdiv.s
-rw-rw-rw-   1 mfuess   systems    17542 Oct  6 13:44 nonrestoringdiv_lingate.s
drwxr-sr-x   2 mfuess   systems     4096 Oct 13 19:03 output
drwxr-sr-x   7 mfuess   systems     4096 Jun 17 20:24 pin-2.6
-rw-------   1 mfuess   systems      102 Oct  7 21:27 pin.log
```

↑
Number of links to file or directory contents.

```
Seconds% ls -l
total 104
-rwxr-xr-x   1 mfuess   systems     7316 Oct  6 15:45 nonres
-rw-r--r--   1 mfuess   systems     3048 Oct  6 01:12 nonrestoringdiv.c
-rw-r--r--   1 mfuess   systems     6879 Oct  6 12:57 nonrestoringdiv.s
-rw-rw-rw-   1 mfuess   systems    17542 Oct  6 13:44 nonrestoringdiv_lingate.s
drwxr-sr-x   2 mfuess   systems     4096 Oct 13 19:03 output
drwxr-sr-x   7 mfuess   systems     4096 Jun 17 20:24 pin-2.6
-rw-------   1 mfuess   systems      102 Oct  7 21:27 pin.log
```

↑
Owner

Files and Directories

```
Seconds% ls -l
total 104
-rwxr-xr-x   1 mfuess   systems     7316 Oct  6 15:45 nonres
-rw-r--r--   1 mfuess   systems     3048 Oct  6 01:12 nonrestoringdiv.c
-rw-r--r--   1 mfuess   systems     6879 Oct  6 12:57 nonrestoringdiv.s
-rw-rw-rw-   1 mfuess   systems    17542 Oct  6 13:44 nonrestoringdiv_lingate.s
drwxr-sr-x   2 mfuess   systems     4096 Oct 13 19:03 output
drwxr-sr-x   7 mfuess   systems     4096 Jun 17 20:24 pin-2.6
-rw-------   1 mfuess   systems      102 Oct  7 21:27 pin.log
```

↑ Group

```
Seconds% ls -l
total 104
-rwxr-xr-x   1 mfuess   systems     7316 Oct  6 15:45 nonres
-rw-r--r--   1 mfuess   systems     3048 Oct  6 01:12 nonrestoringdiv.c
-rw-r--r--   1 mfuess   systems     6879 Oct  6 12:57 nonrestoringdiv.s
-rw-rw-rw-   1 mfuess   systems    17542 Oct  6 13:44 nonrestoringdiv_lingate.s
drwxr-sr-x   2 mfuess   systems     4096 Oct 13 19:03 output
drwxr-sr-x   7 mfuess   systems     4096 Jun 17 20:24 pin-2.6
-rw-------   1 mfuess   systems      102 Oct  7 21:27 pin.log
```

↑ Date

Files and Directories

```
Seconds% ls -l
total 104
-rwxr-xr-x   1 mfuess   systems     7316 Oct  6 15:45 nonres
-rw-r--r--   1 mfuess   systems     3048 Oct  6 01:12 nonrestoringdiv.c
-rw-r--r--   1 mfuess   systems     6879 Oct  6 12:57 nonrestoringdiv.s
-rw-rw-rw-   1 mfuess   systems    17542 Oct  6 13:44 nonrestoringdiv_lingate.s
drwxr-sr-x   2 mfuess   systems     4096 Oct 13 19:03 output
drwxr-sr-x   7 mfuess   systems     4096 Jun 17 20:24 pin-2.6
-rw-------   1 mfuess   systems      102 Oct  7 21:27 pin.log
```

↑ Time

```
Seconds% ls -l
total 104
-rwxr-xr-x   1 mfuess   systems     7316 Oct  6 15:45 nonres
-rw-r--r--   1 mfuess   systems     3048 Oct  6 01:12 nonrestoringdiv.c
-rw-r--r--   1 mfuess   systems     6879 Oct  6 12:57 nonrestoringdiv.s
-rw-rw-rw-   1 mfuess   systems    17542 Oct  6 13:44 nonrestoringdiv_lingate.s
drwxr-sr-x   2 mfuess   systems     4096 Oct 13 19:03 output
drwxr-sr-x   7 mfuess   systems     4096 Jun 17 20:24 pin-2.6
-rw-------   1 mfuess   systems      102 Oct  7 21:27 pin.log
```

↑ Name

Files and Directories

- To change permissions of a file or directory you use the following command:
  - Chmod 775 <files>
- Each number applies to the permissions column as a bit mask.
- There are many ways of using chmod so you can use man chmod to better understand the command.

gcc Compilation

- Compile file
  - gcc myfile.c (produces a.out executable)
- Build *output* to an output file
  - gcc myfile.c -o myfile
- Generate assembly
  - gcc -S myfile.c
- Compiler optimization levels
  - gcc -O<n> myfile.c

Text Editors

- Emacs
- Vi
- Pico
- Many more…

Vi

- Console (screen) oriented text editor
- Has two modes of operation
  - *Command mode* with commands which cause action to be taken on the file
  - *Insert mode* in which entered text is inserted into the file

Vi Command Mode

- To enter command mode hit ESC, type the command, and hit RETURN

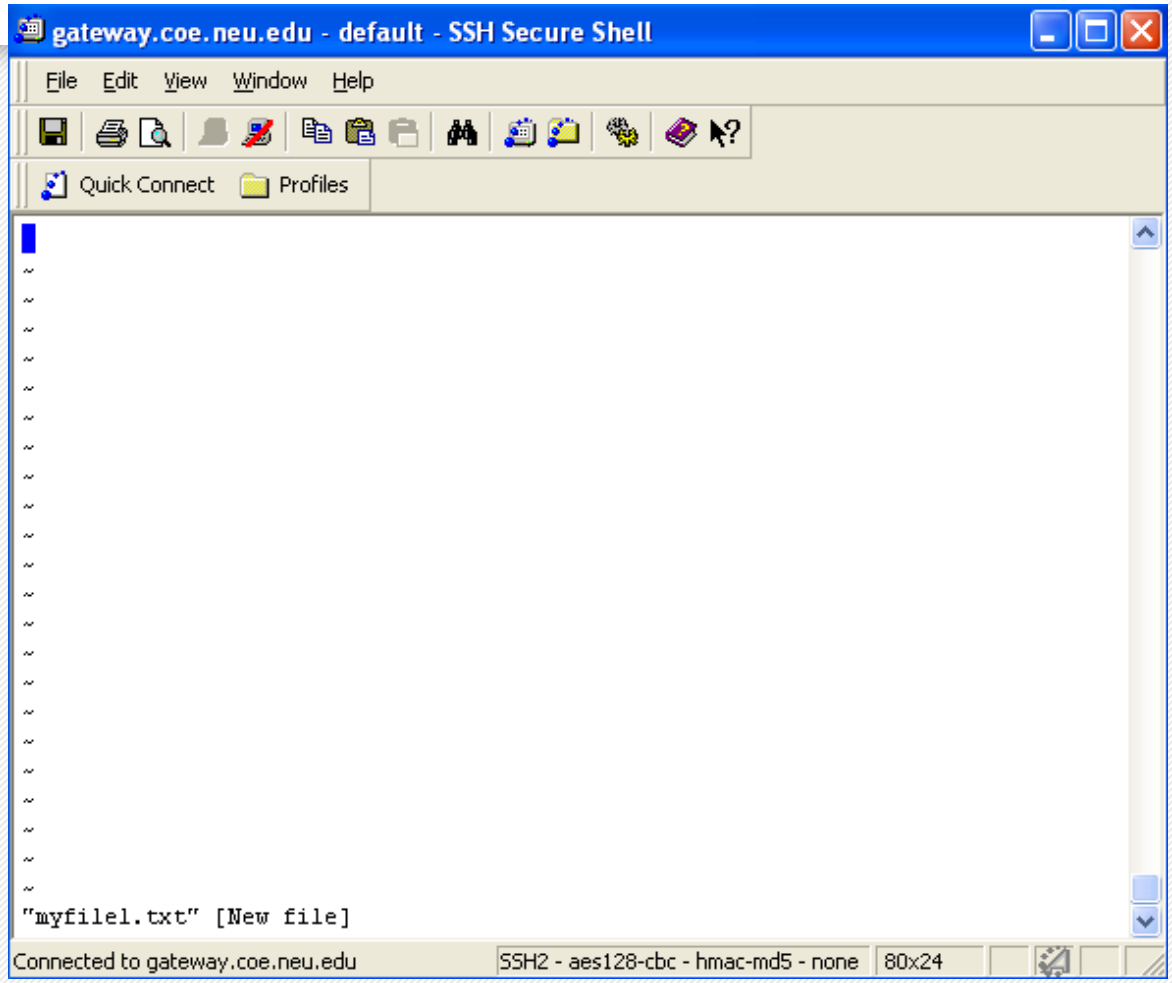
Vi Commands

- Start Vi
  - vi myfile.txt
- Save modified file
  - ESC, :w<return>
- Save modified file and exit Vi
  - ESC, :x<return>
- Exit Vi without saving changes
  - ESC, :q!<return>

Vi Insert Mode

- Can edit text
- Can move cursor using arrow buttons
- To enter this mode and exit command mode hit ESC and then hit s.

Vi User Interface



Advanced Commands

- Pipes and redirections
  - Passing the output of a command to the next one
  - Examples:
    - ls -la | head -1 # transfers the output of ls command to head
    - cat file | grep –c # same
    - ./command > file.log #stores command output in the file
- Grep
  - grep searches input files for lines containing a match to a given pattern list
- Sed
  - The sed stream editor is a text editor that performs editing operations on information coming from standard input or a file
- Awk
  - Awk is both a programming language and text processor that can be used to manipulate text data in very useful ways

Connecting to the COE machines

- ssh <user>@gateway.coe.neu.edu
  - Input password
  - You're set
- There are multiple login nodes each contain a different /tmp/ folder. You can connect to Theta (where the file is, by using the following command in the coe login server).
  - ssh –p 27 Theta
  - Input password again

Advanced Commands

- Hands on experiment example
- Copy /tmp/linux_tutorial/tutorial.tar.gz into your home directory
- Unzip file (using alias shown before)
- Lots of experiments results. Look at the directory structure. Read some of these log files.

1. Find a command using pipes that can find the GPU execution time for all experiments for “cuda-basic”, remove the expression “Total GPU Execution Time” to just display the actual time, and store it in a file.

- Example output of how each line should look:

    results/zorder-sobel/tree/cuda-basic/4-1.log: 5.944800 ms

Advanced Commands

2. What would you change if you only want to keep the time for the experiment and remove everything else?
3. Why is this useful?

Advanced Commands

Answers (there are many ways of doing this)

1. Command:
```
grep "GPU Execution Time" results/*/*/cuda-basic/*.log | sed "s/Total GPU Execution Time\://“ > file.log
```
2. Command:
```
grep "GPU Execution Time" results/*/*/cuda-basic/*.log | awk '{print $5} > file2.log
```
3. When you’re running multiple experiments, you can search for information and display it however you want in a very convenient manner

Simple Scripting

- Lets look at the examples available on the scripts folder.
- What do they do?

Any questions?

- You can ask on Piazza
- How to use a command?
  - Use man <command>
  - You can ask Google!

Find out More

http://www.mcsr.olemiss.edu/unixhelp/

Or…… use google ☺