

COEN 145 : Parallel Computing

Lab 2 : Debugging, Profiling, and Compiler Tricks

Unix

- Becoming familiar with working from the command line interface (CLI) on Unix systems is critical especially if a GUI isn't offered.
- **VirtualBox, VMWare, Dual-Boot, Portable-OS, etc**

Use the following command to access usage information and optional parameters

```
$ man (manual) command_name
```

```
$ man man
```

```
MAN(1)                                General Commands Manual                                MAN(1)
NAME
    man, apropos, whatis - display online manual documentation pages

SYNOPSIS
    man [-adho] [-t | -w] [-M manpath] [-P pager] [-S mansect] [-m arch[:machine]] [-p [sptrv]] [mansect] page ....
    man -f [-d] [-M manpath] [-P pager] [-S mansect] keyword ....
    whatis [-d] [-s mansect] keyword ....
    man -k [-d] [-M manpath] [-P pager] [-S mansect] keyword ....
    apropos [-d] [-s mansect] keyword ....

DESCRIPTION
    The man utility finds and displays online manual documentation pages. If mansect is provided, man restricts the search to the specific section of the manual.

    The sections of the manual are:
    1. General Commands Manual
    2. System Calls Manual
    3. Library Functions Manual
    4. Kernel Interfaces Manual
    5. File Formats Manual
    6. Games Manual
    7. Miscellaneous Information Manual
    8. System Manager's Manual
    9. Kernel Developer's Manual

    Options that man understands:

    -M manpath
        Forces a specific colon separated manual path instead of the default search path. See manpath(1). Overrides the MANPATH environment variable.

    -P pager
        Use specified pager. Defaults to "less -sR" if color support is enabled, or "less -s". Overrides the MANPAGER environment variable, which in turn overrides the PAGER environment variable.

    -S mansect
        Restricts manual sections searched to the specified colon delimited list. Defaults to "1:8:2:3:3lua:n:4:5:6:7:9:l". Overrides the MANSECT environment variable.

    -a
        Display all manual pages instead of just the first found for each page argument.

    -d
        Print extra debugging information. Repeat for increased verbosity. Does not display the manual page.

    -f
        Emulate whatis(1). Note that only a subset of options will have any effect when man is invoked in this mode. See the below description of whatis options for details.

    -h
        Display short help message and exit.

    -k
        Emulate apropos(1). Note that only a subset of options will have any effect when man is invoked in this mode. See the below description of apropos
```

(Shortcuts - USE THESE)

Tab : autocomplete, view files prior to seeing ls

Home/End : Front or End of line

Common and useful commands

(Navigation)

```
$ cd { . | .. | directory_name | path_to_directory }  
$ pwd (print working directory)  
$ ls {-alt} (list directory)  
$ tree directory_name (list recursively)
```

(File Creation)

```
$ { vi | vim | touch | emacs | ... } file_name  
$ mkdir {-p} path/to/directory | ./directory_name  
$ chmod {(+/-)rwx}{000-777} file_name
```

(Environment Variables)

```
$ export ENV_VAR=0 (set)  
$ echo $ENV_VAR (get)
```

(Pipes (/) and Redirects (> | >>))

```
$ echo "Hello World" { >> | > } file.txt  
$ cat file.txt (concatenate / print)  
$ ps (process_status) {-x} | grep "string_to_find"  
$ kill -9 pid (stop process execution)
```

Connecting to HPC (WAVE) and transferring files

scp (secure copy), **sftp** (secure-file-transfer-protocol),
rsync

SSH Configuration

<https://linuxize.com/post/using-the-ssh-config-file/>

<https://linuxize.com/post/how-to-setup-passwordless-ssh-login/>

~/ ⇒ /path/to/usr/home

~/ ⇒ /Users/alex (OSX)

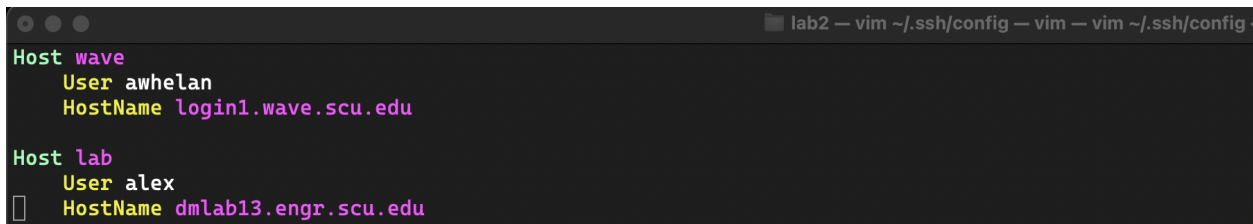
~/ ⇒ /home/alex (Ubuntu)

~/ ⇒ /WAVE/users/unix/awhelan (Rocky-Linux/HPC)

```
$ mkdir -p ~/.ssh && chmod 700 ~/.ssh
```

```
$ touch ~/.ssh/config
```

```
$ chmod 600 ~/.ssh/config
```



```
lab2 — vim ~/.ssh/config — vim — vim ~/.ssh/config
Host wave
  User awhelan
  HostName login1.wave.scu.edu

Host lab
  User alex
  HostName dmlab13.engr.scu.edu
```

Contents of ~/.ssh/config

```
$ ssh wave
```

```
$ ssh lab
```

If connecting from home make sure to set up SCU's VPN or if connecting from campus (i.e. eduroam) need to install **ClearGuard** and **Sophos**.

<https://www.scu.edu/technology/get-connected/networking/how-to-access-vpn/>

SSH Keybased Authentication (Passwordless Login)

(Generate Key for HostName)

```
$ ssh-keygen -t rsa -b 4096 -C "username@scu.edu"
```

Enter file in which to save the key (/home/yourusername/.ssh/id_rsa):

```
$ [Enter/Return]
```

Enter passphrase (empty for no passphrase):

```
$ [Enter/Return]
```

```
$ [Enter/Return]
```

(Copy public key from local to remote machine)

```
$ ssh-copy-id "User@HostName"
```

Repeat the above steps for any additional Hosts

SFTP

You can now use the **sftp** command in place of **ssh** to login to the remote machine and transfer files. The main syntax used is **get / put**

```
$ sftp wave
```

```
$ put {-R} current-working-dir/file-to-transfer
```

```
$ get {-R} current-working-dir/file-to-transfer
```

sftp also supports wildcard (*) replacement (i.e. globbing)

```
$ get -R *.txt
```

[X11 forwarding]

ssh -X, is an SSH protocol that enables users to run graphical applications (VSCODE, PyCharm, etc) on a remote server and interact with them using their local display and I/O devices.

GDB / Valgrind & Effective Debugging Techniques

"The first 90 percent of the code accounts for the first 10 percent of the development time. The remaining 10 percent of the code accounts for the other 90 percent of the development time."

—Tom Cargill, Bell Labs

- Binary Search (Execution Flow)

```
1    ...  
2    ...  
3    ...  
4    print("Here")  
5    ...  
6    ...  
7    ...  
8    ...
```

If our program prints but still crashes we can **probably** assume the error is somewhere lower. Repeat these steps recursively to at the very least narrow down which *EXACT* line of code is causing the issue.

- GDB (GNU Debugger)

TODO

1. Fix gdb_tut.c using the tricks we learned in lab
2. Submit the Makefile along with the source code of gdb_tut.c
3. Format will be explained in lab