

Setting up Linux for a remote connection & Basic Linux Command Lines

Turn in a report for each two labs. Please submit electronically through CANVAS.

Original authors: John Uehlin and Chris Rudell

Last modified: Ivan Zhao & Fucheng Yin

Last Updated: April 1, 2021

Please contact *Chris Rudell (instructor)* with questions

1. Introduction and Linux Set-Up for your Personal Computer

Computer Aided Design (CAD) software and many of the advanced engineering software packages run on CPU platforms that utilize a Unix/Linux operating system. An example is the software that will be used for this class to analyze complicated circuits. Cadence Virtuoso® is the industry standard for integrated circuit design and includes all the features necessary to design a complete system-on-chip (SoC) from schematic capture to layout, and fabrication. However, this must be run in the Linux environment and the instructional machines that reside in Sieg Hall. You will not be able to do your work in this class from Sieg Hall during this pandemic, unfortunately. Alternatives to physically sitting in the Sieg Hall Lab exist, but you need to install software on your PC or Mac that allows you to make a virtual connection from your personal computer to the education servers on campus. Even if you are familiar with the Cadence tools and the Linux environment, please **try to organize your directory structure like this tutorial and that found in the Lab 1 instructions**.

Connecting to a Server

The Linux workstations designated for class use are found in Sieg 118. You can log into these machines with your EE department login and UW NetID password; the password should be the same that is attached to your UW NetID. There are several ways to access the Linux workstations. First and easiest is physically login to a workstation in Sieg 118, but the pandemic prohibits us from doing this. You can also login via Secure Shell (SSH) to work remotely. You can use your preferred SSH client for remote access. This tutorial covers both **PuTTY** and **TightVNC**. PuTTY comes pre-installed on Windows machines, you can also download it [here](#) if you don't find it on your PC. One major advantage of using TightVNC over a viewer like PuTTY is the ability to return to your Unix session after closing out of the application. In short, when you login into Unix using TightVNC, you will see all your windows and "Xterms" from the previous session. Your work and simulations can continue uninterrupted. However, when X11 is used with PuTTY, you will need to start a new Unix session every time you login. As such, you cannot turn your computer off during long simulations. With TightVNC you can power down your computer and all your Unix/Cadence work is preserved, allowing simulations to continue running, until you have a chance to go back to your TightVNC session.

MobaXTerm is another free client that works well but is not endorsed by the ECE department.

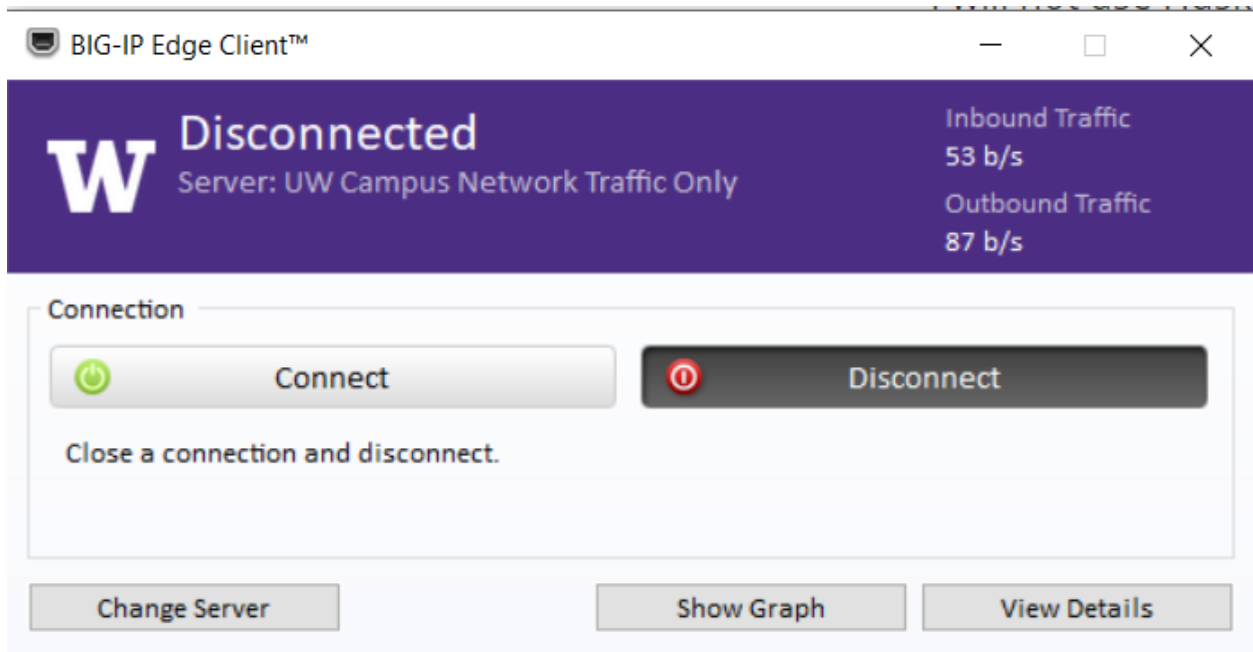
Husky OnNet VPN

Remote access to the ECE Linux machines requires the use of UW's Husky OnNet VPN, which provides a secure connection for the user and is mandatory for the distance control of UW's network.

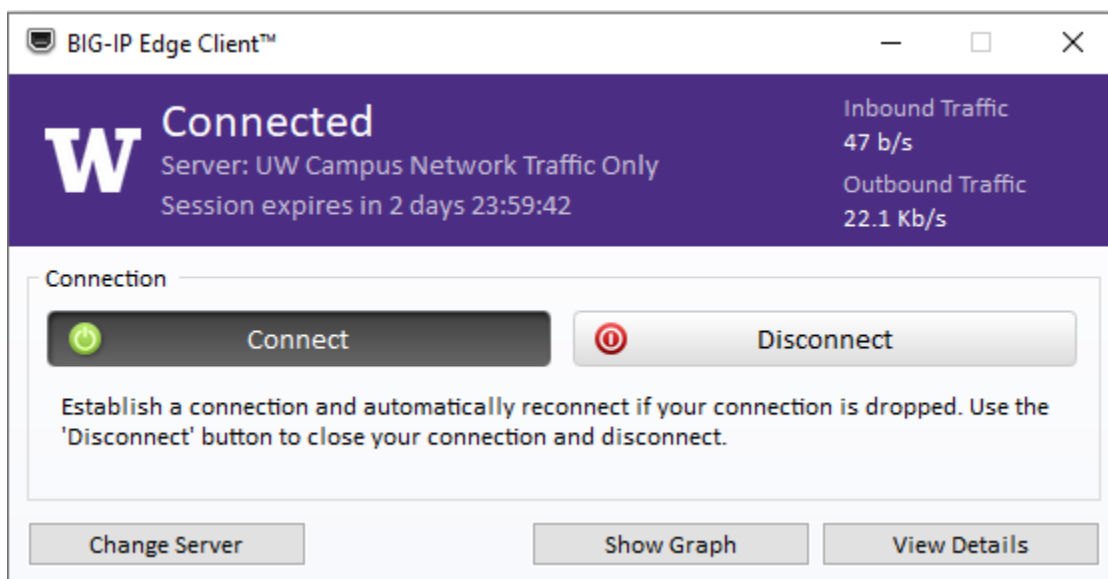
Download Link:

<https://www.lib.washington.edu/help/connect/husky-onnethttps://itconnect.uw.edu/connect/uw-networks/about-husky-onnet/use-husky-onnet/terms-conditions/>

After the installation is finished, launch the application named “**BIG-IP Edge Client**”. The following window will pop out:



Click on the “**Connect**” Button and the app will lead you to a webpage where you need to enter your UW netID and password. After the authentication is finished, you could now access the UW internal network.



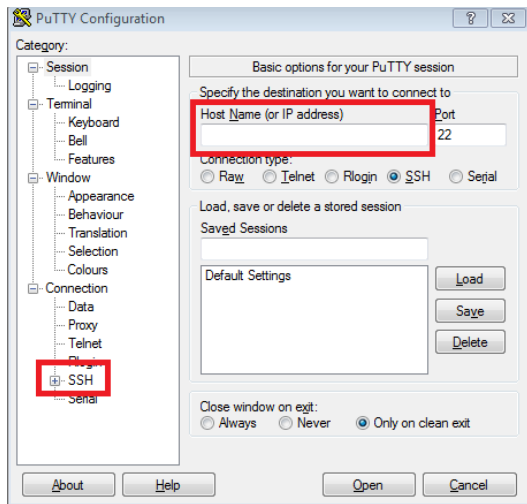
Please make sure you stay connected for the whole time when you're trying to access the linux machines.

SSH via PuTTY

If you don't already have a copy of PuTTY installed on your computer, you can go to the ECE department website and follow the link to the download site.

<https://vannevar.ece.uw.edu/computing/EESoftwareCatalog.html>

Open PuTTY and you should see the below window. Insert your desired hostname into the SSH tab of PuTTY, shown below (make sure to include your username):



Valid academic Host Names are as follows:

linux-lab-###.ece.uw.edu (###=041-080)

Physical workstations in Sieg 118

linuxsrv01.ece.uw.edu

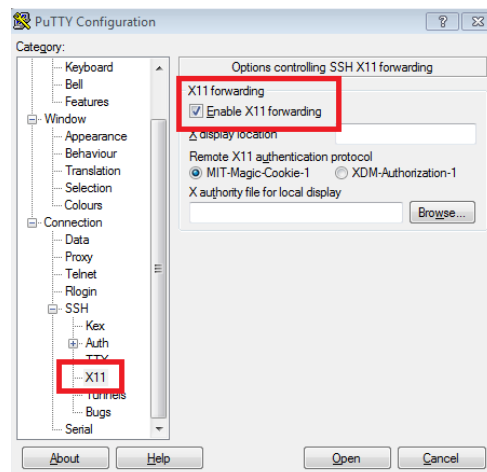
Large server for remote use

Fastest option, for multiple users

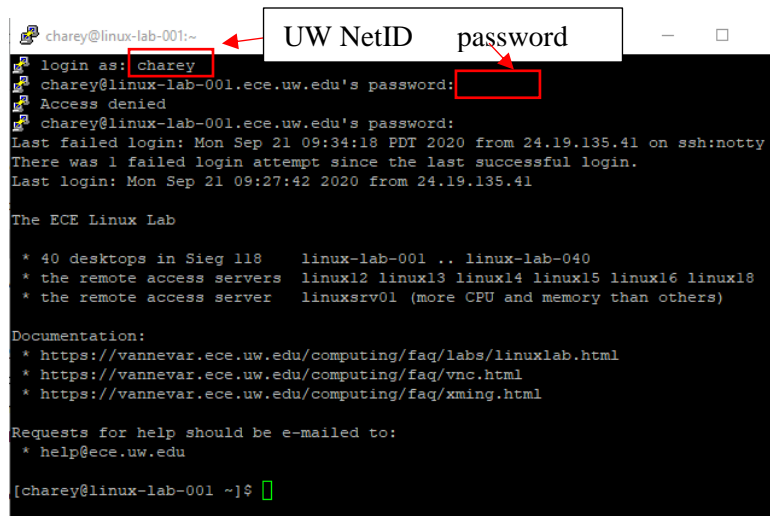
linux##.ece.uw.edu (##=12-16 and 18)

Legacy servers for remote use

Make sure that X11 forwarding is enabled, as shown below. This allows the SSH host to forward active GUI windows (similar to the Windows OS) to your client desktop. If you're running SSH from a Linux machine, make sure you use the *SSH -X11* option to enable X11 forwarding. ***Include a screen capture of your putty window with the necessary menus completed in report.***



Hit "Open" to start the SSH session. This will open a Linux terminal on the host machine. You will need to login using your UW NetID and password.



```
charey@linux-lab-001:~
login as: charey
charey@linux-lab-001.ece.uw.edu's password:
Access denied
charey@linux-lab-001.ece.uw.edu's password:
Last failed login: Mon Sep 21 09:34:18 PDT 2020 from 24.19.135.41 on ssh:notty
There was 1 failed login attempt since the last successful login.
Last login: Mon Sep 21 09:27:42 2020 from 24.19.135.41

The ECE Linux Lab

* 40 desktops in Sieg 118    linux-lab-001 .. linux-lab-040
* the remote access servers linux12 linux13 linux14 linux15 linux16 linux18
* the remote access server  linuxsrv01 (more CPU and memory than others)

Documentation:
* https://vannevar.ece.uw.edu/computing/faq/labs/linuxlab.html
* https://vannevar.ece.uw.edu/computing/faq/vnc.html
* https://vannevar.ece.uw.edu/computing/faq/xming.html

Requests for help should be e-mailed to:
* help@ece.uw.edu

[charey@linux-lab-001 ~]$
```

Note from Rui: here I am using the linux-lab-001 server, the following instruction written by John and Chris with linuxsvr001. You should get the idea that they are just different server, but the procedure to connect is the same.

Configuring VNC

Please see the ECE department website on installing either VNC which typically works well for PCs.). For running tightVNC on Mac OS you need a java compiler to run the viewer. **Mac** users have run into issues with VNC and we recommend using alternatives such as X2Go (Check the next section for instructions). Send Rui an email if you have any question about mac. For different flavors of VNC downloads, please see the following department website:

<https://vannevar.ece.uw.edu/computing/faq/vnc.html>

On this webpage, scroll down to the heading, “Connect using TightVNC”. Note, TightVNC is Java based, as such, if your computer does not already have Java installed you will need to do so. You can download Java at the site provided by the ECE webpage above, labeled, “Oracle’s current Java Runtime”. The Java download is straightforward.

With Java installed on your computer, you can now the “TightVNC” installation package. The ECE website will redirect you to another website that contains the TightVNC install program. From the ECE website, click on TightVNC Java Viewer”. We recommend that you copy the install program to your computer, then make a copy of TightVNC to your desktop. Once at the TightVNC website, scroll down until you see the following “Java Viewer” version of TightVNC, you don’t want the “Windows” version of TightVNC.

Download TightVNC Java Viewer (Version 2.8.3)

TightVNC Java Viewer works on any system where Java is supported. It requires Java SE version 1.6 or later.

Download and unzip/untar this directory.

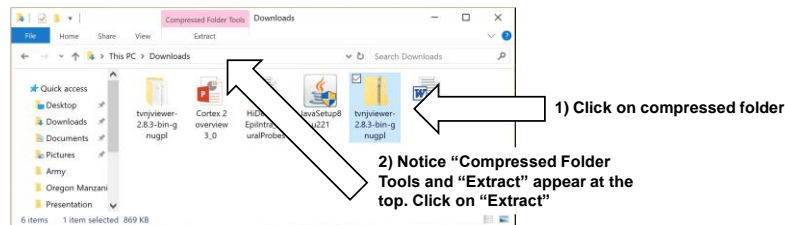


- [TightVNC Java Viewer JAR in a ZIP archive](#) (890,473 bytes)

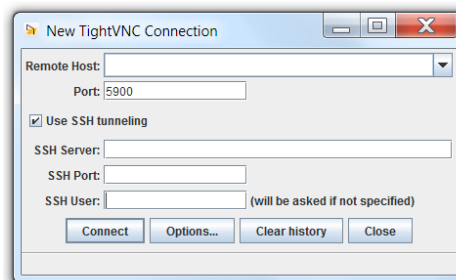
You can also download TightVNC Java Viewer source code (or [purchase a commercial license](#)):

- [Java Viewer source code, zipped archive](#) (560,872 bytes)

Note: Once you download this file it will be in a compressed format. You need to “unzip” or “untar” this file using software that may already be available on your laptop. If not, you will need to download the most appropriate software to untar/unzip this directory. For the latest versions of Windows, you can go to the folder that has the compressed file you just downloaded. You can extract in two steps, 1) click on the folder to uncompress and 2) go to the tool bar at the top of the folder and select “Extract”, this is shown below.



Run the executable .jar file in the main folder, tightvnc-jviewer.jar. Note: definitely add a shortcut for tightvnc to your desktop, this will save time later when you return. The following window will appear:



Now we are ready to start the VNC server on whichever Linux machine you choose to use. This tutorial is using linuxsrv01, but this process will work on any of the servers or physical machines mentioned in the PuTTY section. You will need to open a terminal on the Linux machine of your choice. We recommend using SSH (PuTTY) to login for this step. In short, we use the SSH terminal simply to run the “vncserver” commands, to tell the linux machines that you are going to open a new TightVNC session. Once we have established a new VNC session, you can now launch TightVNC from your laptop to access the session that we created. To launch a new VNC session, you will need to become familiar with some simple commands to run on the Linux server.

The example terminal below shows some of the commands you will need to start and kill a VNC server session:

```
[jpu@linuxsrv01 ~]$ vncserver -interface 127.0.0.1 -geometry 1800x1000
New 'linuxsrv01.ee.washington.edu:1 (jpu)' desktop is linuxsrv01.ee.washington.edu:1
Starting applications specified in /homes/jpu/.vnc/xstartup
Log file is /homes/jpu/.vnc/linuxsrv01.ee.washington.edu:1.log

[jpu@linuxsrv01 ~]$
[jpu@linuxsrv01 ~]$
[jpu@linuxsrv01 ~]$
[jpu@linuxsrv01 ~]$ vncserver -list

TigerVNC server sessions:

X DISPLAY #    PROCESS ID
:1          28153
[jpu@linuxsrv01 ~]$
[jpu@linuxsrv01 ~]$
[jpu@linuxsrv01 ~]$
[jpu@linuxsrv01 ~]$ vncserver -kill :1
Killing Xvnc process ID 28153
[jpu@linuxsrv01 ~]$
```

“vncserver” is the program name, and various dash options manipulate the program “vncserver” command to add some options to manipulate the graphics. The `–interface` and `–geometry` options specify trusted interface addresses and window size (in pixels), respectively. For maximum security, always use the `–interface` option.

To start your session, use:

```
vncserver -interface 127.0.0.X
```

Where “X” is the number of your VNCserver session, in

this case “1”.

To view open sessions, use:

```
vncserver -list
```

To kill (close) open sessions, use (# is the number of the session to be killed):

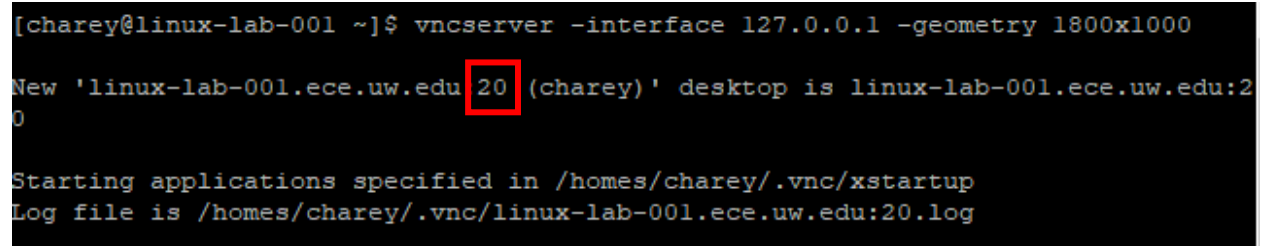
```
vncserver -kill :#
```

note: there is a space between “-kill” and “:”

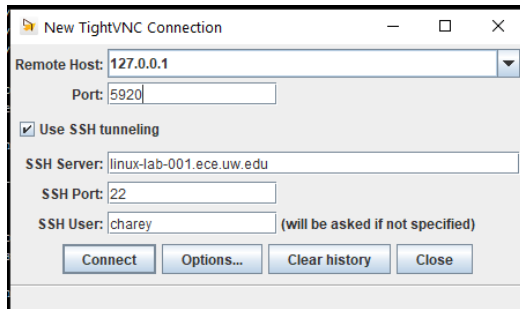
After you use `vncserver -interface` (without killing them of course), return to your personal computer to view the VNC session opened on the Linux server. Fill out the TightVNC connection window as below (replace jcrudell with your own netID):

A couple points worth mentioning relate to the “Remote Host” and “Port” fields. The number “127.0.0.1” is called the “Loop Back number”. For your PC, the number should always be “127.0.0.X” where “X” is the VNCserver session number, in this case “1”. Similarly, the Port field should contain “590X”, where again, “X” is the VNCserver session number, in this case “1”. ***Include a screen capture of your TightVNC Connect Window*** (like above) after filling out the menu with your information. You will be asked to fill in the password of your vnc account(the password of your NetID) and the host password(the password you set when you first use vncserver command)

Note by Rui: in practice we found situations where people type in 127.0.0.1, their session number is not 1. For example, here I type in 127.0.0.1, the session number is 20 however.

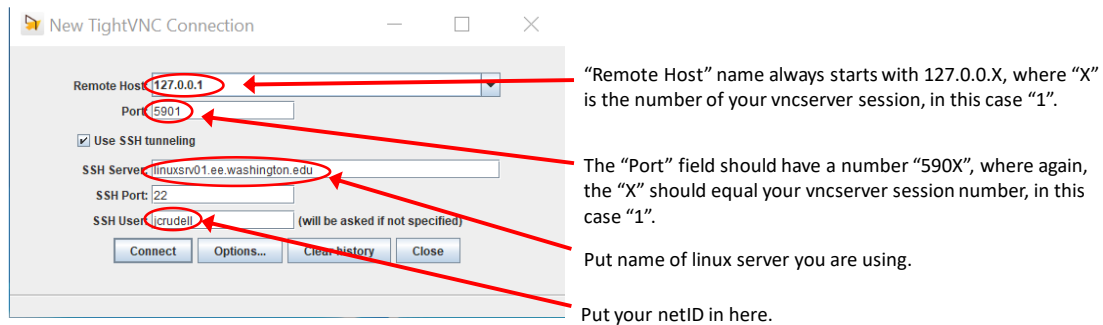
A terminal window screenshot with a black background and green text. The first line shows the command: `[charey@linux-lab-001 ~]$ vncserver -interface 127.0.0.1 -geometry 1800x1000`. The second line shows the output: `New 'linux-lab-001.ece.uw.edu:20 (charey)' desktop is linux-lab-001.ece.uw.edu:20`. The number '20' in the output is highlighted with a red square. The third line shows: `Starting applications specified in /homes/charey/.vnc/xstartup`. The fourth line shows: `Log file is /homes/charey/.vnc/linux-lab-001.ece.uw.edu:20.log`.

In this case, you need to type in your remote host as you type in the vncserver command, in the port blank however, you need to put 59XX, where XX is the #session, namely the number after : when you type in `vncserver -list`. The following setup works.

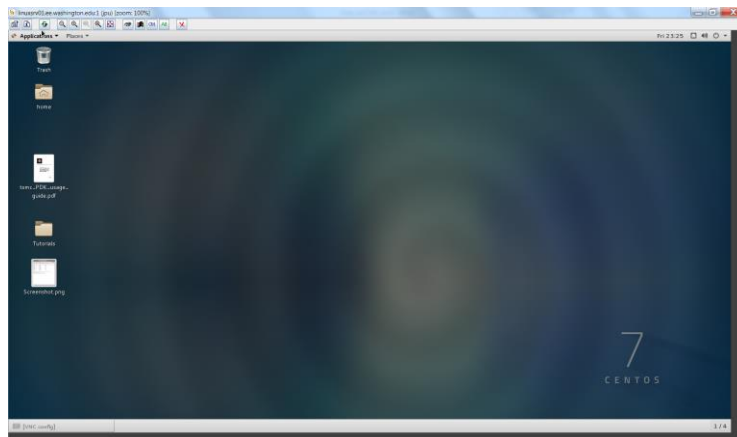


In case you don't remember the password, you could use this command to reset the host password:

`vncpasswd ~/.vnc/password`



This will open a virtual desktop on the Linux machine, like shown below. This desktop operates just as if you physically opened a Linux desktop. When you close the VNC viewer window, everything done on the desktop will remain open until the session is killed on a terminal (as described above) or the Linux computer restarts.

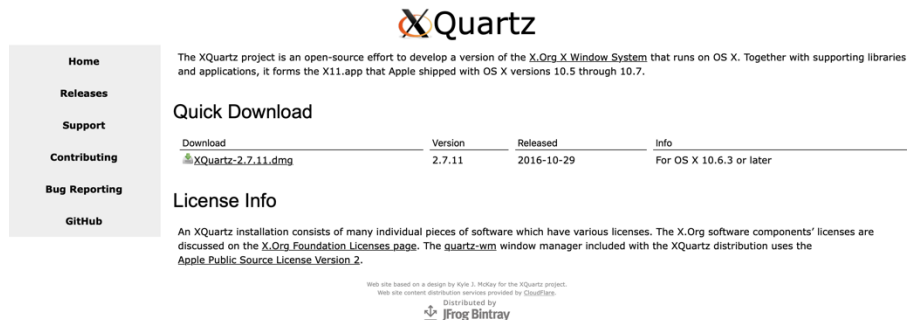


Include a screen capture of your TightVNC Window as shown above. Please make sure you have one linux prompt open, inside the VNC window. Make sure the prompt in the linux window is clear, so we can identify your username.


Connecting via X2Go

If you use Mac OS, we recommend you use X2Go to connect to the servers (You can also try it if you prefer using the Windows edition too). On the Mac, you first need to make sure you have the latest version of

XQuartz installed. Please go to <https://www.xquartz.org> and download the latest version. Install it using the dmg file on your computer.



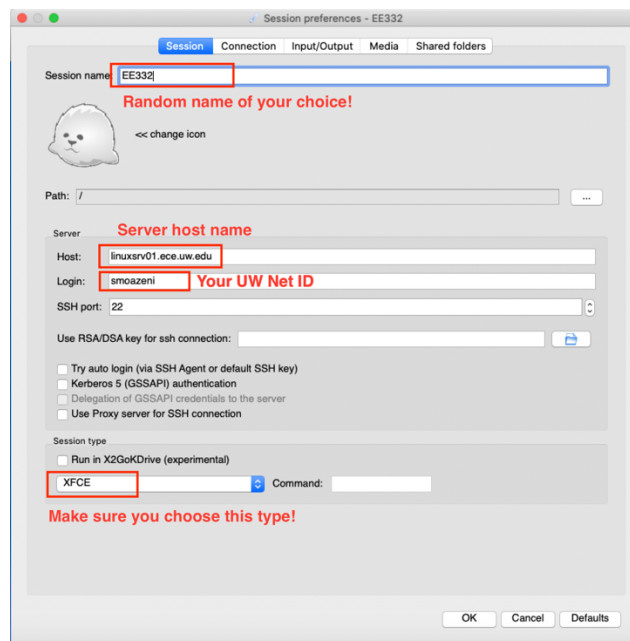
Next, you need to install the latest version of X2Go for Mac from <https://wiki.x2go.org/doku.php>



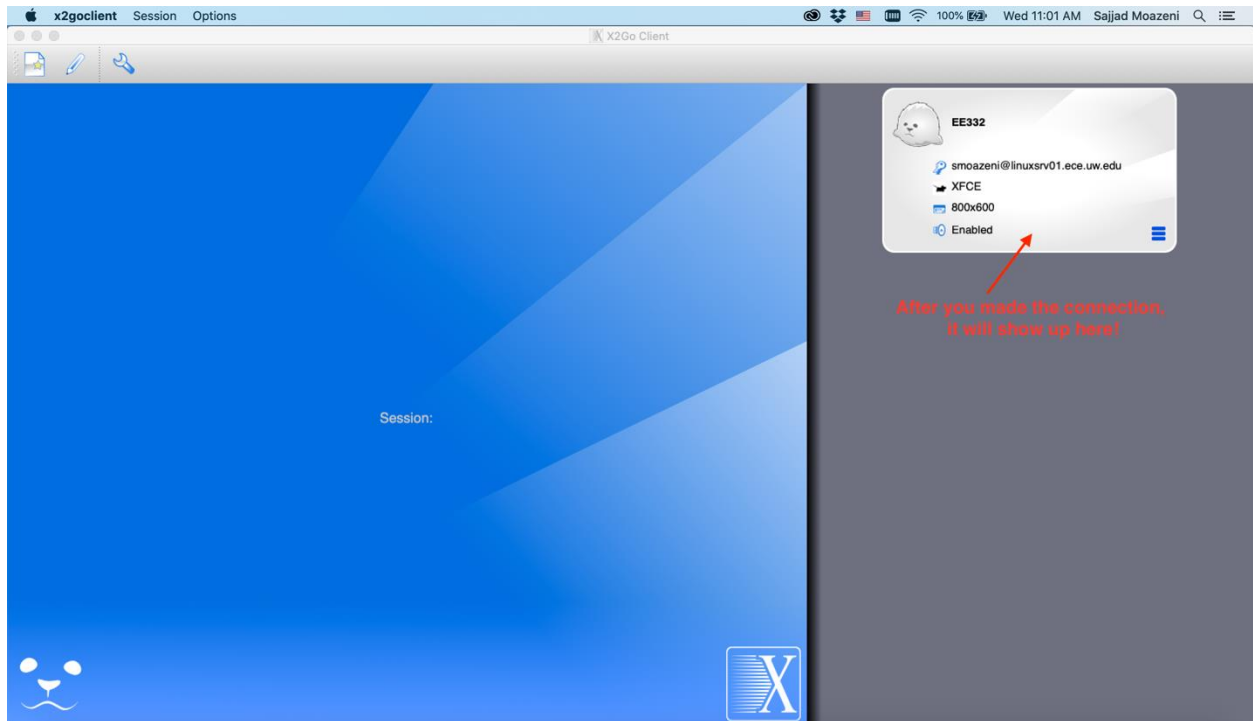
Get X2Go

- Installing X2Go (client/server)
- Download X2Go Client (Windows installer (7 and Later), OS X 10.9 and higher DMG, OS X 10.11 and higher DMG or macOS 10.13 and higher DMG)
- Download X2Go Client nightly builds (Windows (untested)) (OS X (untested, dependencies possibly older))
- Download PyHoca-GUI (Windows installer (XP and Later))

After opening the software, click on the icon on top left side to make a new connection with configurations shown below:



After clicking OK the connection is made and shown on the right side panel. Simply double click on it and enter your password to log in.



You can use the following link from the department to setup X2GO as well, but the steps are the same as above: <https://vannevar.ece.uw.edu/computing/faq/x2go.html>.

2. Basic Linux command lines

Brief Introduction to Linux

Linux is an open-source operating system kernel. It's widely used in Internet servers thanks to its advantages such as fast, secure and free compared with Windows servers.

A shell is a program that receives commands and send it to Linux to process. Linux OS has a Graphic User Interface (GUI) or Command Line Interface (CLI).

Here is a list of most useful commands you may need in this course. Please open the shell terminal and explore the Linux command line!

Basic Linux commands

1. **pwd** - print working/current directory

```
[charey@linux-lab-001 Desktop]$ pwd
/home/charey/Desktop
```

pwd

2. **cd** - change directory. Use if in the form of **cd filedirectory**. If you do not know the files in current directory, you could use **ls** command as described below. You can use **Tab** key to auto-complete the next directory name.

Note: directory tips

- . means current directory
- ~ means home directory
- .. means directory before

Example: cd .. means go to the directory before

3. ls - list all file names in the current directory. Hidden files could be seen using **ls -a**

```
[charey@linux-lab-001 Desktop]$ cd ..
[charey@linux-lab-001 charey]$ ls
Desktop  Downloads  Music  Public  Templates
Documents EE332      Pictures simulation Videos
[charey@linux-lab-001 charey]$ ls -a
.          .dbus          .libmgr      Templates
..         Desktop       .local       Videos
.bash_history Documents     .mozilla     .vnc
.bash_logout Downloads     Music        .Xauthority
.bash_profile EE332        Pictures     .xfce4-session.verbose-log
.bashrc    .esd_auth    .pki         .xfce4-session.verbose-log.last
.cache     .gnupg       Public       .xscreensaver
.config    .history     simulation
.cshrc     .ICEauthority .source
[charey@linux-lab-001 charey]$
```

ls

4. mkdir - create a folder. **mkdir directoryName**

```
[charey@linux-lab-001 charey]$ mkdir newFolder
[charey@linux-lab-001 charey]$ ls
Desktop  Downloads  Music  Pictures  simulation  Videos
Documents EE332      newFolder Public  Templates
```

mkdir

5. rmdir/rm - rmdir can remove an empty directory. rm can remove any directory. **rmdir directoryName** or **rm directoryName**

```
[charey@linux-lab-001 charey]$ rmdir newFolder/
[charey@linux-lab-001 charey]$ ls
Desktop  Downloads  Music  Public  Templates
Documents EE332      Pictures simulation Videos
```

rmdir

Note: after the command, you could add options as we mentioned in man, here I do a demo about how to use it. For rm, it has options -d, -f, -I and so forth.

-f Attempt to remove the files without prompting for confirmation, regardless of the file's permissions.

-r Attempt to remove the file hierarchy rooted in each file argument.

So, try **rm -r -f someDirectory** means delete all the files in the directory without asking permission.

6. touch - create a file, **touch fileName**

```
[charey@linux-lab-001 charey]$ touch createdbyTouch.txt
[charey@linux-lab-001 charey]$ ls
createdbyTouch.txt Documents EE332 Pictures simulation Videos
Desktop Downloads Music Public Templates
```

touch

7. **man** - show manual page for a command **man commandName**

```
CP(1)                                User Commands                                CP(1)
NAME
  cp - copy files and directories

SYNOPSIS
  cp [OPTION]... [-I] SOURCE DEST
  cp [OPTION]... SOURCE... DIRECTORY
  cp [OPTION]... -t DIRECTORY SOURCE...

DESCRIPTION
  Copy SOURCE to DEST, or multiple SOURCE(s) to DIRECTORY.

  Mandatory arguments to long options are mandatory for short options
  too.

  -a, --archive
      same as -dR --preserve=all

  --attributes-only
      don't copy the file data, just the attributes
```

man

8. **cp** - copy files, takes two arguments, the first is the location of the file to be copied and the second is to copy to where **cp fileToBeCopied copyToWhere**

```
[charey@linux-lab-001 charey]$ cd EE332/
[charey@linux-lab-001 EE332]$ ls
cadence
[charey@linux-lab-001 EE332]$ mkdir cmd_exercise
[charey@linux-lab-001 EE332]$ ls
cadence cmd_exercise
[charey@linux-lab-001 EE332]$ cd cmd_exercise/
[charey@linux-lab-001 cmd_exercise]$ touch file1.txt
[charey@linux-lab-001 cmd_exercise]$ cp file1.txt file2.txt
[charey@linux-lab-001 cmd_exercise]$ ls
file1.txt file2.txt
```

Touch & cp

9. **mv** - move files or rename the file. Two arguments similar to cp command

```
[charey@linux-lab-001 cmd_exercise]$ mv file2.txt ..
[charey@linux-lab-001 cmd_exercise]$ cd ..
[charey@linux-lab-001 EE332]$ ls
cadence cmd_exercise file2.txt
```

mv

10. **echo** - move data, typically text into a file **echo data >> fileName**

11. **cat** - display the contents of a file **cat fileName**

```
[charey@linux-lab-001 EE332]$ cd cmd_exercise/
[charey@linux-lab-001 cmd_exercise]$ echo Hello class >> file1.txt
[charey@linux-lab-001 cmd_exercise]$ cat file1.txt
Hello class
```

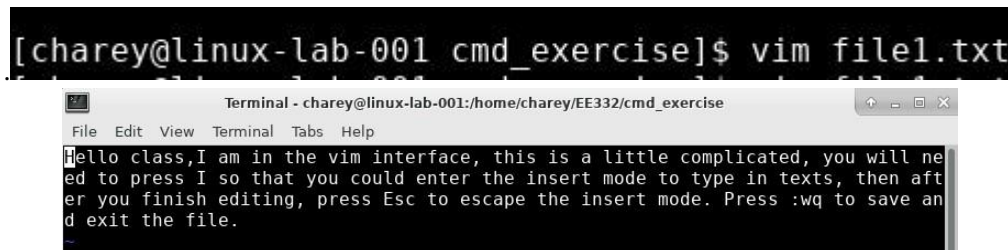
Echo & cat

12. nano/vi - bring up Linux built-in text editor in the command line. Sometimes this could be nasty, you can always edit the text file in GUI by double click the file. **nano/vi fileName**, if filename dose not exist in current directory, this command will create the file

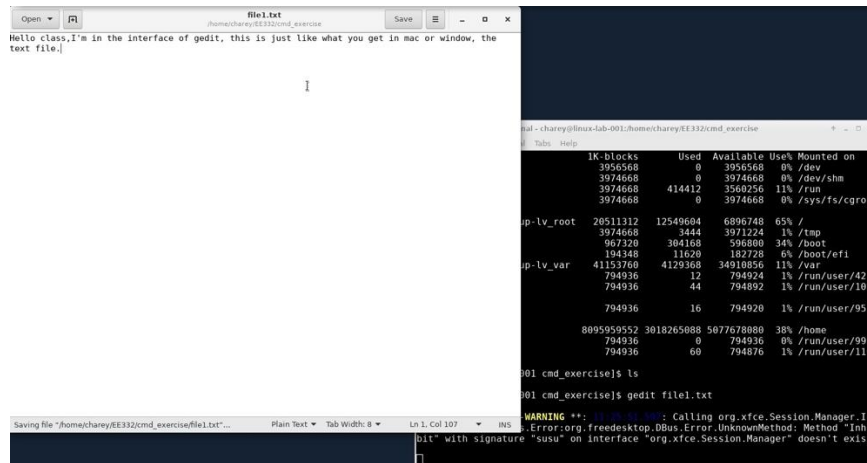


nano

13. gedit/vim – the gedit/vim text editor. **gedit/vim filename** The gedit is pretty similar to what you would normally expected in windows or IOS. The vim editor is a bit complicated, after enter the vim editor interface, you need to press **I** key to enter the insert mode. In the insert mode, you can edit your text file just like normal txt editor, after editing, press **Esc** key to get out of insert mode. Type **:wq** to save and quit vim editor

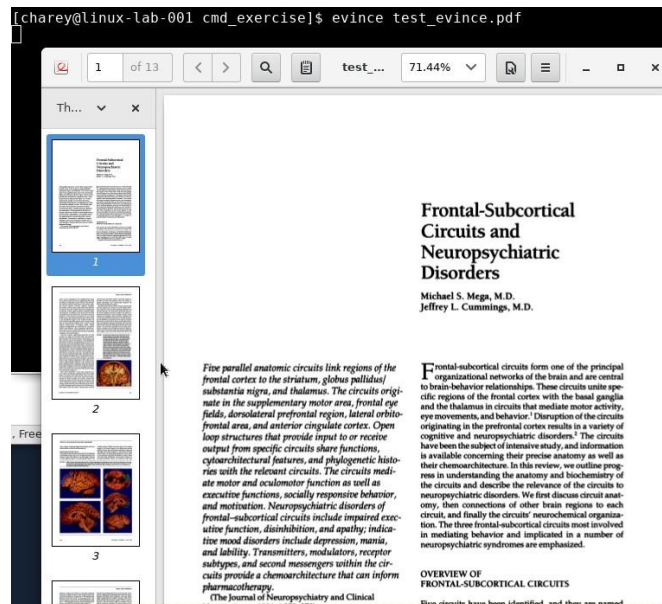


Vim



gedit

14. evince – evince is a free and open source document viewer, you could use this command to open a pdf file. **evince fileName**



evince

15. sudo - "Super User Do", carry out the command with administrative/root privileges. It's widely used command, for example when you download and install a new package to your account

16. df - view available disk space

```
[charey@linux-lab-001 cmd_exercise]$ df
Filesystem            1K-blocks      Used Available Use% Mounted on
devtmpfs               3956568         0    3956568   0% /dev
tmpfs                  3974668         0    3974668   0% /dev/shm
tmpfs                  3974668    414412    3560256  11% /run
tmpfs                  3974668         0    3974668   0% /sys/fs/cgroup
p
/dev/mapper/VolGroup-lv_root 20511312 12549604    6896748  65% /
tmpfs                  3974668     3444    3971224   1% /tmp
/dev/sda2              967320     304168    596800   34% /boot
/dev/sda1              194348     11620    182728   6% /boot/efi
/dev/mapper/VolGroup-lv_var 41153760 4129368    34910856  11% /var
tmpfs                  794936       12    794924   1% /run/user/42
tmpfs                  794936       44    794892   1% /run/user/102
8961
tmpfs                  794936       16    794920   1% /run/user/951
233
128.95.42.3:/home      8095959552 3018265088 5077678080  38% /home
tmpfs                  794936         0    794936   0% /run/user/993
tmpfs                  794936        60    794876   1% /run/user/110
5188
```

df

17. tar - compress/uncompress different types of tar archives .tar, .tar.gz, .tar.bz2 and so forth. It has many different options to use, for example **tar -cvf** for creating a .tar archive, **tar -xvf** to uncompress the tar archive.

18. zip - create a compressed zip archive similar to tar command, but easier to use ``zip filename"/^`unzip fileName"

19. apt-get - install packages, usually use company with **sudo** command

References

[1] <https://maker.pro/linux/tutorial/basic-linux-commands-for-beginners>

More about command line

<https://www.howtogeek.com/412055/37-important-linux-commands-you-should-know>

<https://www.hostinger.com/tutorials/linux-commands>

Deliverable

Make sure you get yourself familiar with the commands mentioned in this instruction. Prepare yourself with the connection to server since we need that for our next labs! There is only one deliverable for this lab. Please grab a screen capture of your VNC session with an xterm unix prompt showing your uwnetid. Dump the screen capture into a word file or equivalent and write a short paragraph on your experience with this lab, any troubles you ran into and things you learn. Submit a half page to one page report in CANVAS.