Connecting to UNIX/Linux at NJIT

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Previous documents dated 2021 or 2022 such as the ones listed below are superseded by this new document. Many typos have been corrected. This new version is also consistent with Windows 11 in addition to Windows 10.

[Ref1] **Connecting to *UNIX at NJIT, December 23, 2022.**

[Ref2] **Connecting to *NIX at NJIT, December 23, 2021.**

This 2024 document is Part A of a longer document consisting of four parts of a Brief on Unix/Linux at NJIT.

PART A

Connecting to UNIX/Linux at NJIT

Precondition: You have an NJIT-sanctioned laptop or desktop computer that satisfies NJIT computer policies as applicable to the CS Department and/or other NJIT units. As of this writing, you may find the policy at the URL below (URL: Uniform Resource Locator usually referred to as a 'link').

The policy can be summarized as follows: you have a Windows-based computer (Windows 10 or may be a later version such as Windows 11).

https://ist.njit.edu/student-computers

NJIT might start including Mac OSX laptops into the NJIT computer policy. This document does not discuss the Mac OSX option.

1. OSL and AFS machines

[OSL machines] The term OSL at NJIT denotes the Open Systems Laboratory (OSL in short) physically located on the 2nd floor of the GITC (Guttenberg Information Technologies Center) building. The LAB hosts a number of Linux-based machines that are being used for teaching. Such machines are referred to generically as OSL (or osl) machines. NJIT osl machines support the AFS file system. AFS stands for Andrew File System, developed at CMU and is a distributed file system. Whether you login to osl7 or osl21, your home directory is the same and you view your files transparently. Moreover your files can even become accessible in the form of a Windows letter drive (e.g. D:\ drive) if you install a client AFS Windows software on your Windows client machine that maps to a drive letter your AFS (home directory) files.

Such osl machines used to have host names **oslX.njit.edu** or **oslXY.njit.edu** and the host names were mapped to static IP addresses. The X,Y of a previously available host name were digits mapping to integers from 1 to around 31. A given host name used to map to a unique (and static) IP address starting with 128.234.44.51 for osl1.njit.edu, but note that osl31.njit.edu might have mapped to 128.234.44.47, which was non-intuitive.

Effective March 18, 2024 access to these machines has been limited and DHCP is being used instead of static IP addressing. One has to use an alternative host name associated with domain name **resource.campus.njit.edu** and NJIT CISCO Duo 2 Factor authentication is enforced. Thus an appropriate hostname would then be **oslX.resource.campus.njit.edu** substituting for a prior **oslX.njit.edu.** Moreover the new host name maps to the same machine the previous host name mapped but not necessarily to the same IP address.

Effective Fall Semester 2024, access to osl machines WILL require physical presence to and access from the Lab on the 2nd floor of the GITC building.

[AFS machines] At NJIT there are other Linux-based machines with the same configuration and AFS file system support that are remotely accessible through ssh (secure shell). You might need to activate VPN prior to attempting an ssh connection though. These machines are referred to generically as **AFS machines.** Such machines run VMWare on top of Linux, presenting to you a virtual environment.

The simplest way to access such AFS machines is to utilize one of the host names listed below where X and Y are digits mapping to integers from around 2 to around 32.

afsX.njit.edu

afsXY.njit.edu

An alternative way (though not recommended) is to connect to host names

afsconnectZ.njit.edu where Z=1,2,3.

Note that the former host names map to afsconnect1.njit.edu or afsconnect2.njit.edu. At some point in time it was possible to connect to an afsX.njit.edu machine without VPN (from outside of NJIT).

Another option (though not recommeded) is to connect to host names

afsaccessW.njit.edu where W=1,2,3,4.

However things might behave differently from the description below, so you are on your own if you attempt a login to *connect* or *access*.

If all of these combinations look intimidating, effective Fall 2024 you will only have two possibilities for a remote login.

afslogin0.njit.edu

or

afslogin1.njit.edu

In the meantime, before Fall 2024, the easiest way to remember where to connect to by hostname is to replace the prior (before Feb 15, 2024) use of say

osl7.njit.edu

with a (2 factor authentication enabled) connection to

osl7.resource.campus.njit.edu (before Fall 24)

or with a (virtual machine hosted) connection to

afs7.njit.edu (preferred for Summer 24)

instead. Naturally, digit 7 can be replaced accordingly by other single digit or small double digit combinations.

Once more, effective Fall 2024 things will become simpler

(see next page).

afslogin0.njit.edu (Fall 2024)

or

afslogin1.njit.edu (Fall 2024)

1. ***If you plan*** *to connect to any one of the osl machines by visiting NJIT's GITC building, skip Section 2 that follows. In fact a direct login does not require the use of ssh and thus you may skip this document altogether.*
2. ***If you plan*** *to connect to an afs machine and you are inside NJIT, and you are using a* **wired connection** *skip Section 2 that follows.*
3. ***If you plan*** *to connect to an osl machine with the alternative host name that includes the suffix resource.campus.njit.edu and you are inside NJIT you may skip Section 2 below or not.*

4. ***If you plan to*** *connect to an AFS machine in FALL 2024*

   use ***afslogin0.njit.edu***

   or ***afslogin1.njit.edu***

since all other possibilities would become unavailable!

5. *In all cases other than 1,2, and 3 VPN is required, but things can change.*

Uniform Resource Locators of interest

Some URLs (Uniform Resource Locator) of interest are as follows.

0. NJIT computer policies as applicable to the CS Department and other NJIT units are available, as of this writing, at
   https://ist.njit.edu/student-computers
1. [Secure Shell Client for Windows]. The URL for downloading NJIT's copy of MobaXterm, a Windows **secure shell client (ssh)** is shown below. The URL provides also information about using ssh on Mac OSX and Linux. We do not discuss these options. One may also download a copy of MobaXterm of limited functionality directly from the manufacturer. In that case you may not even need to install MobaXterm; for more see manufacture/publisher's web site.
   https://ist.njit.edu/accessing-afs
2. The URL for 'accessing AFS' which means connecting to a linux machine at NJIT is shown below
   https://ist.njit.edu/afs
3. The NJIT VPN URL with links to downloadable VPN clients for Windows, MacOSX and Linux with instructions is shown below.
   https://ist.njit.edu/vpn
4. An NJIT URL with info on *nix commands is shown below.
   https://ist.njit.edu/common-UNIX-commands

In the remainder a reference to osl7.njit.edu is valid through Feburary 14, 2024. Effective February 15, 2024, replace **osl7.njit.edu** in the examples with afs7.njit.edu and effective March 18,2024 one can use, as explained in the previous page a hostname structure such as **osl7.resource.campus.njit.edu** where digit 7 can be substituted with other digits as explained before. Effective Fall 2024, use **afslogin0.njit.edu** or **afslogin1.njit.edu**.

2. OSL and AFS machines

The discussion below uses a client computer that is a WINDOWS 11 machine. This is in accordance with YWCC guidelines. (It also applies to Windows 10 machines.)

NJIT persons have four options of connecting to an AFS or OSL NJIT machine.

(a) Visit the OSL Lab on the 2nd floor of GITC and physically access an OSL machine, or
(b) using a personally owned computer from within NJIT with a wired internet connection one can gain access to an OSL (before Summer 2024) or AFS machine using ssh, or
(c) using a personally owned computer from within NJIT with a wireless internet connection one can gain access to an OSL (before Summer 2024) or AFS machine using ssh,
(d) using a computer from OUTSIDE of NJIT one can gain access to an AFS machine using ssh, and if allowed (course supported) access to an OSL machine using ssh.

A VPN connection may need to be established prior to establishing a secure shell (ssh) connection. The discussion to follow applies definitely to case (d) and in some rare cases to case (c) and both would be referred to as being 'outside of NJIT'.

If you plan to connect to an OSL machine from **outside of NJIT** you must

(1) Detect if a VPN client has been installed previously on your machine. If it is not installed, you should install it first, a process that usually requires a reboot.
We expect Computing students can figure out whether a VPN client is preinstalled or previously installed (by you) on their machine (Settings->Programs or Settings->Apps might provide some information one whether a Cisco Secure VPN client has been installed or not). If a VPN client is not installed, first download such a VPN (Virtual Private Network) client though URL 3 of Section 1, and install it. Installation is done once and might require a reboot or a restart.

(2) **Activate VPN if a VPN client is preinstalled on your machine but is currently deactivated (this is a rare case, since by default it is activated at boot time)**.
If you know how to deactivate it, you should know how to activate it or how to reactivate it.

On my laptop the windows taskbar is at the bottom of the screen, with a Windows icon on the bottom left corner and the time and date information on the bottom right area/corner. In the bottom right area of the taskbar you might see the icon shown below. If not, find an up-arrow in the right area of the task bar, click on it and see if the icon is depicted on the popped up window. For me, it appears as shown below in Figure 1 (the background color might be different from the indicated black depending on a device’s configuration). This means that the VPN client is **ACTIVATED but it is not in USE (‘not connected to the NJIT’ network)**. If the VPN client were in USE, the icon would have appeared as in Figure 1(a) with a yellow lock visible (it also happens that the background is white).

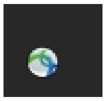


Figure 1.

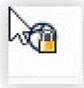
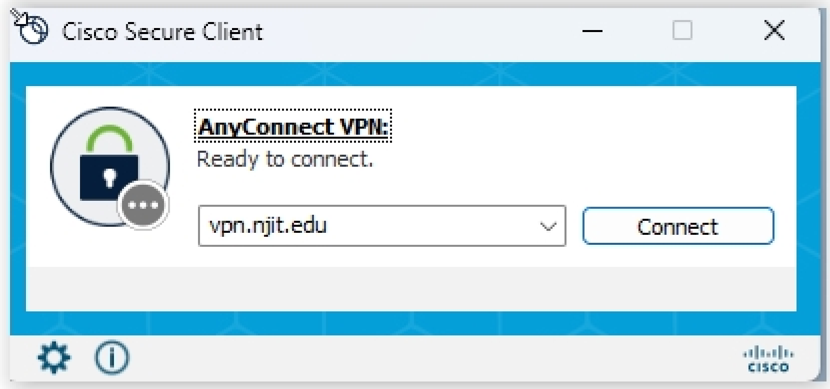


Figure 1(a).

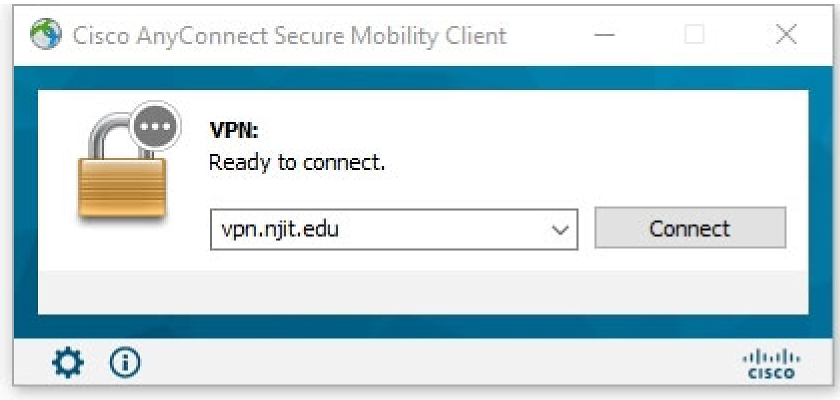
1. You may click on this icon of Figure 1 and the following pop-up window might appear as shown in Figure 2(a). In older versions of the VPN client the window used to look like the one in Figure 2(b) instead.



AnyConnect VPN:
Ready to connect.

vpn.njit.edu

Figure 2(a)



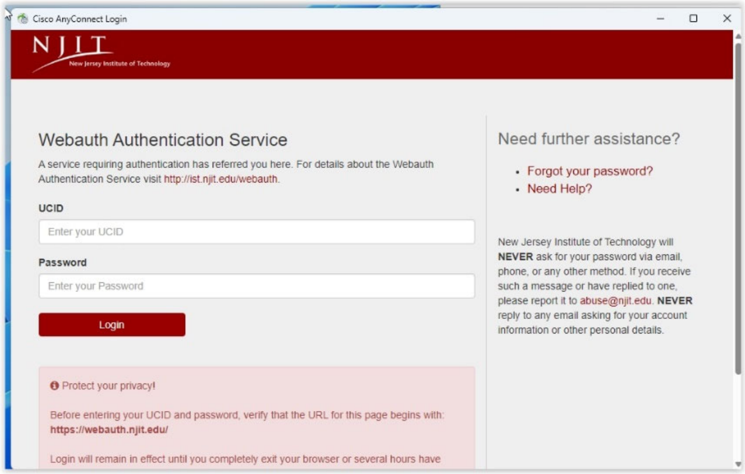
VPN:
Ready to connect.

vpn.njit.edu

Figure 2(b)

2. The Ready to connect message in Figure 2(a) or 2(b) indicates not only that your machine is disconnected (i.e. the VPN client is not in use), but also indicates that your clicking on the button labeled Connect will allow a connection to take place and thus your laptop will become part of the NJIT network. Note also that the button of the windows also indicates a Connect action is available for you. You are about ready to click the Connect button. In the

next step you need to have ready your myUCID credentials (login and password) which must not have expired. After you click connect the pop up window of Figure 3(a) or the one in Figure 3(b) will be shown.



Webauth Authentication Service

A service requiring authentication has referred you here. For details about the Webauth Authentication Service visit http://ist.njit.edu/webauth.

UCID: Enter your UCID

Password: Enter your Password

Protect your privacy!

Before entering your UCID and password, verify that the URL for this page begins with: **https://webauth.njit.edu/**

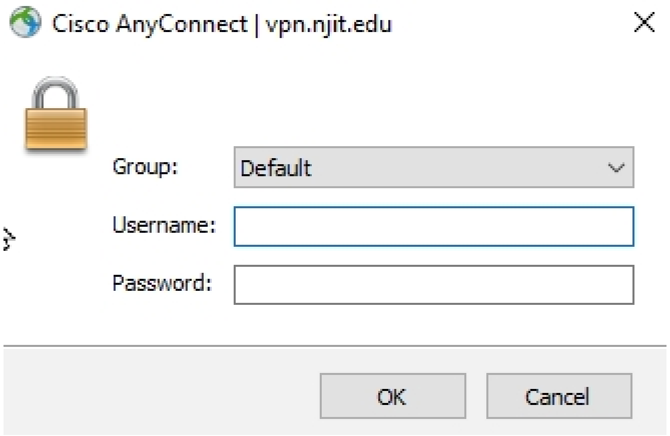
Login will remain in effect until you completely exit your browser or several hours have

Need further assistance?

- Forgot your password?
- Need Help?

New Jersey Institute of Technology will **NEVER** ask for your password via email, phone, or any other method. If you receive such a message or have replied to one, please report it to abuse@njit.edu. **NEVER** reply to any email asking for your account information or other personal details.

Figure 3(a)



Group: Default

Username:

Password:

Figure 3(b)

3. The UCID field of Figure 3(a) or Username: field of Figure 3(b) might have been pre-populated with your myUCID. If not, type in your myUCID login in the UCID or Username: field respectively, and then type in your myUCID password in the Password: field. The use of the TAB button (or SHIFT-TAB button) of the keyboard can help you moving around quickly without a mouse. The Group: option can be left as the Default or you select an alternative according to the user instructions available during the VPN installation process or other information provided by NJIT. If you are presented

with a Figure 3(a) prompt, a 2FA window (DUO factor authentication) might pop up afterwards as well. Follow the DUO instructions then to authenticate.

4. If you have supplied the correct information (correct login name and correct associated password) and 2FA authenticated correctly (if needed), a connection will be established and VPN would be in use and the popup window of Figure 3 will disappear. At that point if you try to locate the VPN icon using the instructions prior to step 1, the icon has a lock on it as shown below in Figure 4.

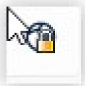
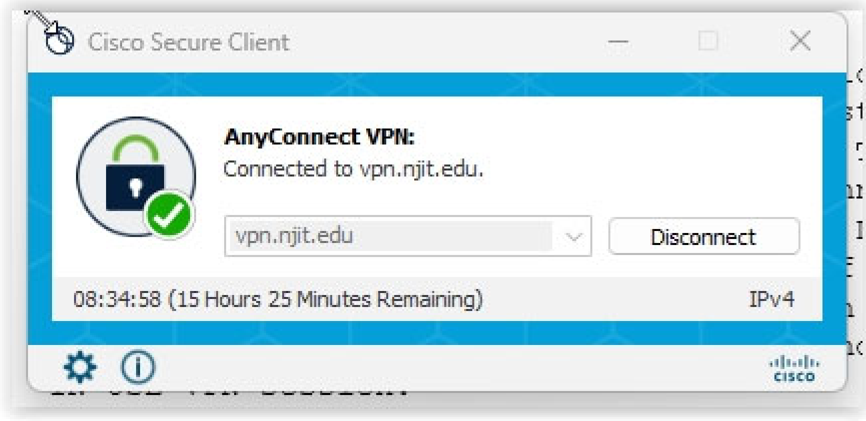


Figure 4.

5.If there was an active connection prior to step 2, and there will be an active connection after step 3, the window of Figure 2 would have looked like Figure 5. The button reads Disconnect now since VPN is in use vs the reading Connect in Figure 2 when VPN was not yet in use. You can click on Disconnect to terminate the VPN connection when it is of no need any more. An alternative is to locate the icon shown in Figure 4, click on it, and it will allow you to disconnect and thus terminate the IN-USE VPN session.



Cisco Secure Client

AnyConnect VPN:
Connected to vpn.njit.edu.

vpn.njit.edu

08:34:58 (15 Hours 25 Minutes Remaining)

IPv4

Figure 5.

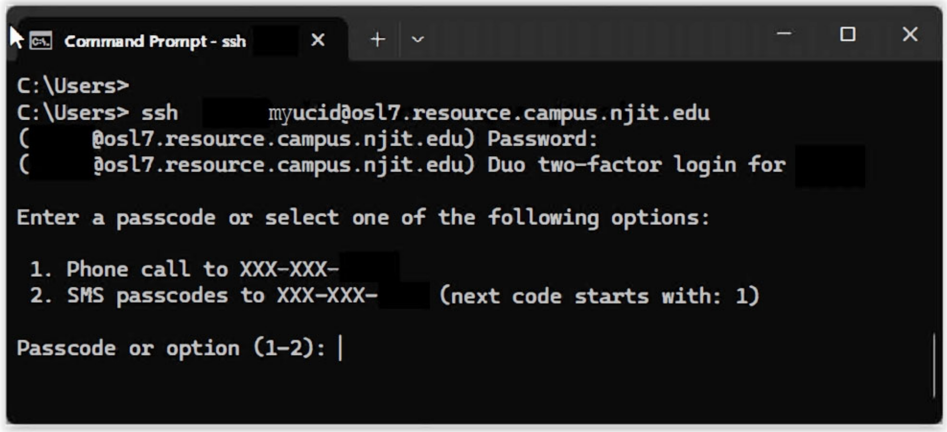
At this point if you are outside of NJIT you have a VPN session in use. The next section deals with the interaction with a secure shell (ssh) client and how it can be used to connect to an OSL (or AFS) machine. If you click the Disconnect button of the window in Figure 5 you terminate the VPN session.

3. Secure Shell Client

If you have activated VPN and established a VPN session per Section 2 instructions,you have an authenticated, network connection-based presence at NJIT.

[Case 3a: Primitive secure shell client through the Windows command prompt/shell window]

Unix, Linux, and OSX machines have a secure shell client pre-installed. It is accessed through the command line inside what some Operating Systems call a terminal. The name of the secure shell client is ssh (acronym for Secure Shell). Windows also includes a command line secure shell client also named ssh. It is accessible through a command shell window or a Powershell window (aka terminal in either case). One needs to write oneself the command (starting with ssh in the second line of the window below; the character after the hypothetical login myucid and before the example target osl7 is the at @ symbol). After pressing the ENTER button, you type in the password and press ENTER again in the third line prompt (Password:) for a 2FA Duo authentication start and get completed.



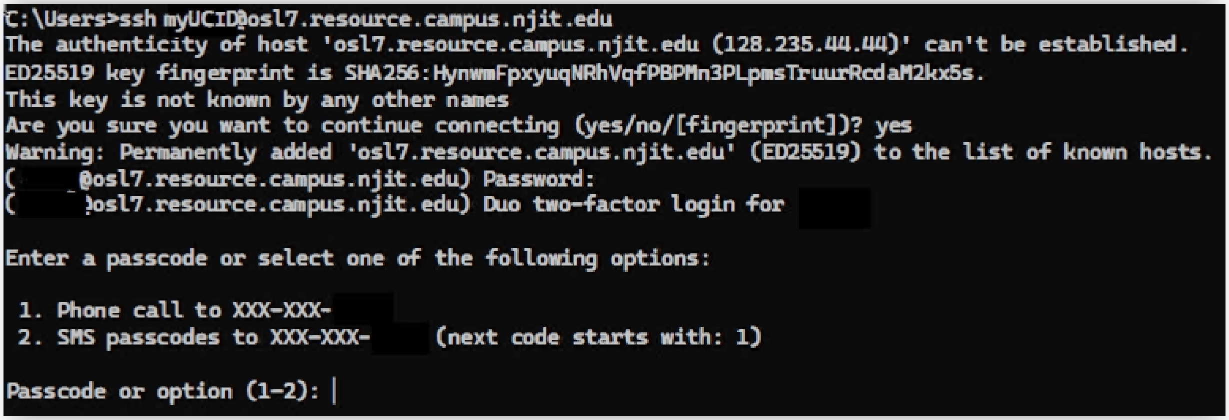
```
C:\Users>
C:\Users> ssh [redacted] myucid@osl7.resource.campus.njit.edu
([redacted]@osl7.resource.campus.njit.edu) Password:
([redacted]@osl7.resource.campus.njit.edu) Duo two-factor login for [redacted]

Enter a passcode or select one of the following options:

 1. Phone call to XXX-XXX-[redacted]
 2. SMS passcodes to XXX-XXX-[redacted] (next code starts with: 1)

Passcode or option (1-2): |
```

If this is the first time connected you may get more warning information and the screen information might look like the following one.



```
C:\Users>ssh myUCID@osl7.resource.campus.njit.edu
The authenticity of host 'osl7.resource.campus.njit.edu (128.235.44.44)' can't be established.
ED25519 key fingerprint is SHA256:HynwmFpxyuqNRhVqfPBPMn3PLpmsTruurRcdaM2kx5s.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'osl7.resource.campus.njit.edu' (ED25519) to the list of known hosts.
([redacted]@osl7.resource.campus.njit.edu) Password:
([redacted]@osl7.resource.campus.njit.edu) Duo two-factor login for [redacted]

Enter a passcode or select one of the following options:

 1. Phone call to XXX-XXX-[redacted]
 2. SMS passcodes to XXX-XXX-[redacted] (next code starts with: 1)

Passcode or option (1-2): |
```

[Case 3b. MobaXterm.]

NJIT makes available to students and instructors a commercial graphical-based secure shell client known as MobaXTerm. Go to the NJIT IST site where software is available and download and then install it from there if you have not already installed it. One can also download it and then install it through the NJIT URL below (if the URL still works).

https://ist.njit.edu/how-connect-afs-mobaxterm

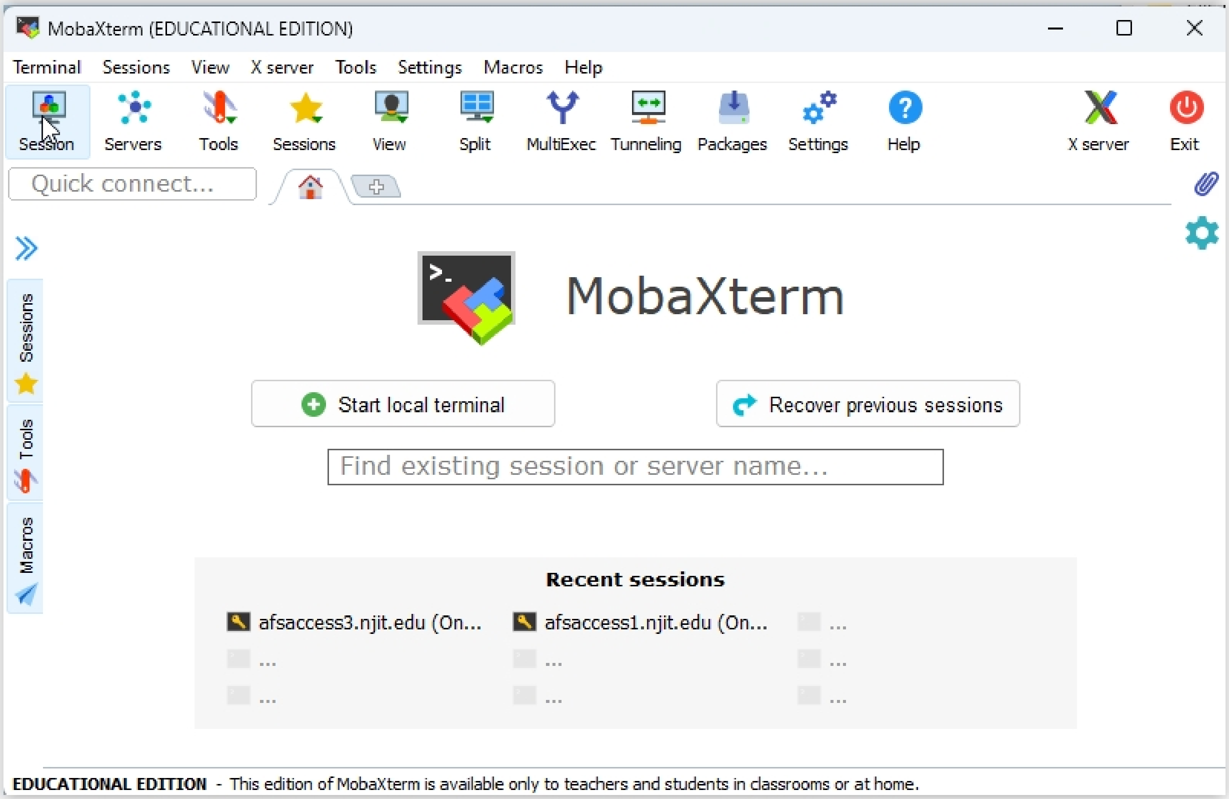
Another option is to go to the commercial MobaXterm web-site

https://mobaxterm.mobatek.net/

and download from the web-site and then install a free limited-capability Home-Edition version.

The discussion below is for a Windows client using **Mobaxterm** not the command line ssh client nor any other graphical client.

1. Invoke Mobaxterm. An icon on your desktop might be available for clicking on it similar to the icon on the left of MobaXterm shown in Figure 6. A window as shown in Figure 6 will pop up. Depending on your settings and customizations, it might look different from the one in Figure 6. Click on the top left corner the icon whose label is Session (the mouse cursor in Figure 6 below is on top of that Session icon).



EDUCATIONAL EDITION - This edition of MobaXterm is available only to teachers and students in classrooms or at home.

Figure 6.

2. After clicking the button "Session", a window like the one shown below in Figure 7 will pop up. You choose session type SSH (top left icon, mouse cursor is indicated on top of it) and click on it.

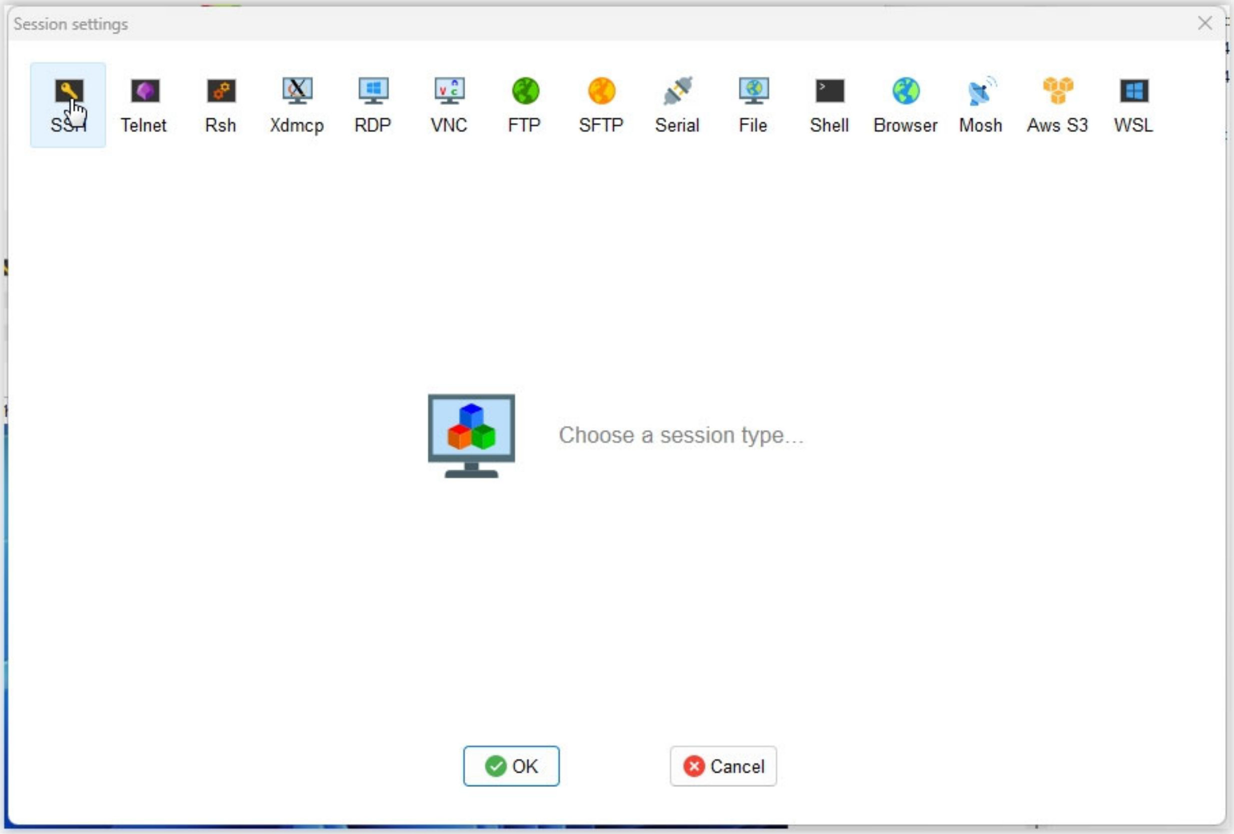
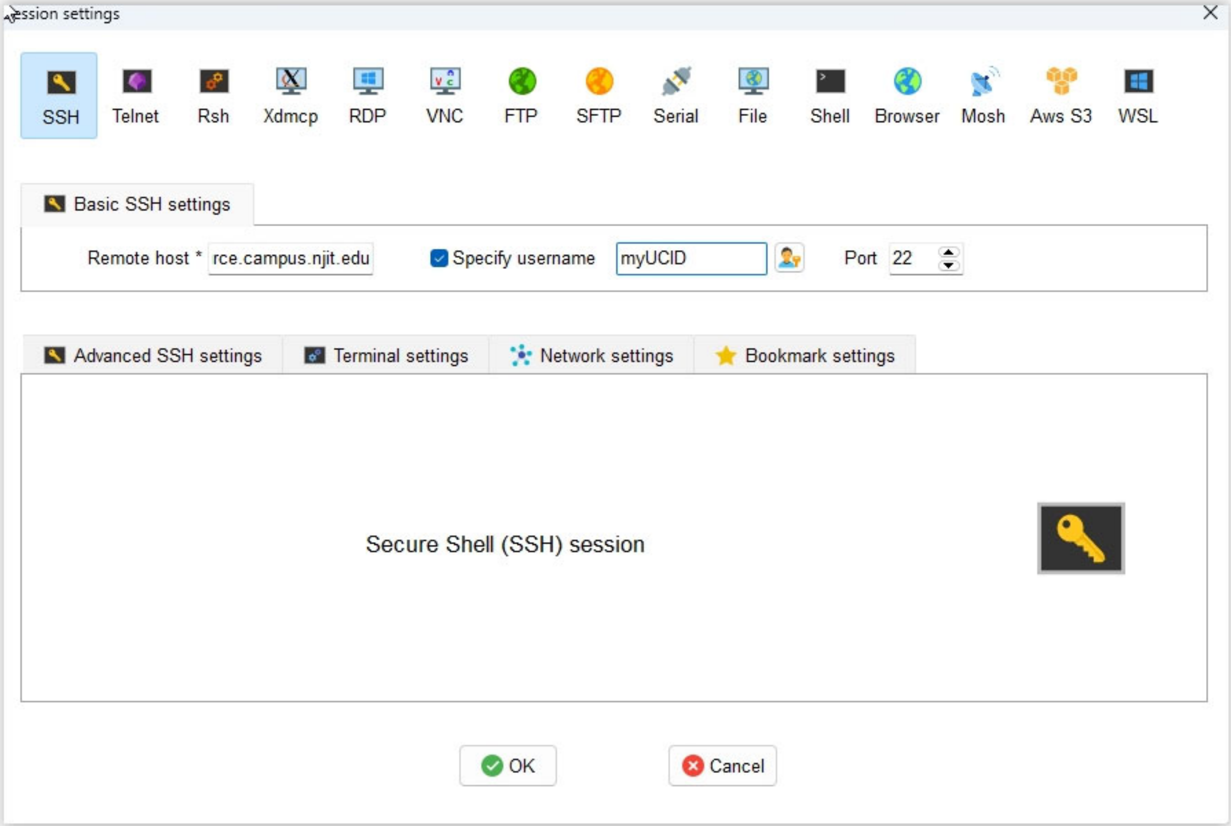


Figure 7.

3. You then get the window shown in Figure 8 below. In the **"Remote Host"** tab you write in the name of the osl machine you plan to connect to. You click and check on the button on the left of Specify username and on the text area on the right of Specify Username you type in your own myUCID. You might have to overwrite an indicated prefilled <default>. When you are done click on the **OK** button at the bottom.

In the example below I used the following.

Example: In the **Remote host*** I typed: osl7.resource.campus.njit.edu
but only past of the host name is visible through the box
In the **Specify username** after checking the box I typed a fictitious myUCID as an example : myUCID
Use your own myUCID and thus replace the text myUCID as needed, and the desired osl machine as needed;noting also that from time to time some osl machines become unavailable temporarily.



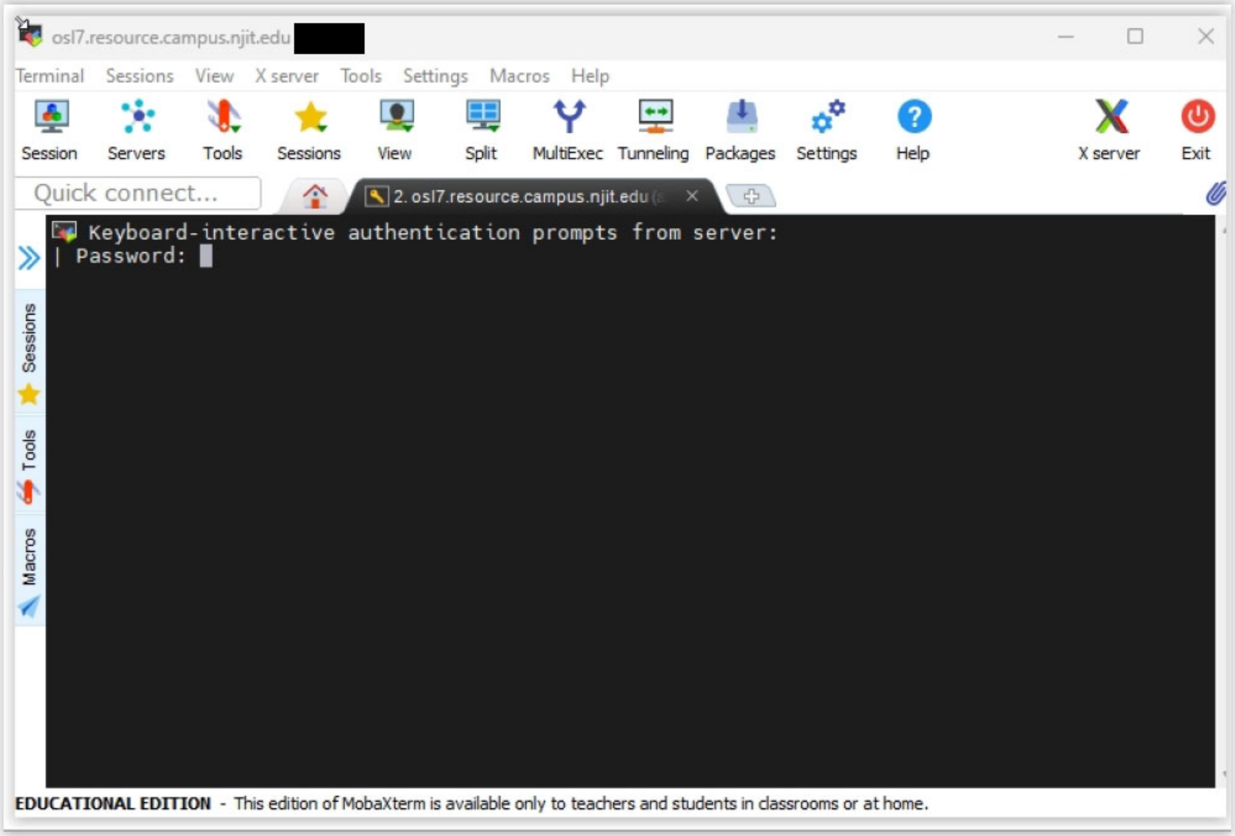
Remote host * rce.campus.njit.edu

☑ Specify username myUCID

Port 22

Figure 8.

4. The following session appears as shown in Figure 9. You are prompted for your own myUCID pasword. (You have already typed in your login in the Specify username field earlier in the previous window). Type it in to the right of the Password: prompt starting with the current position of the white rectangular cursor and do not forget to press the ENTER button of the keyboard when you are done typing in your password. Note that if you mistyped a character, correcting it with a Backspace might now work. Let the system detect the error and re-prompt you with a Password:



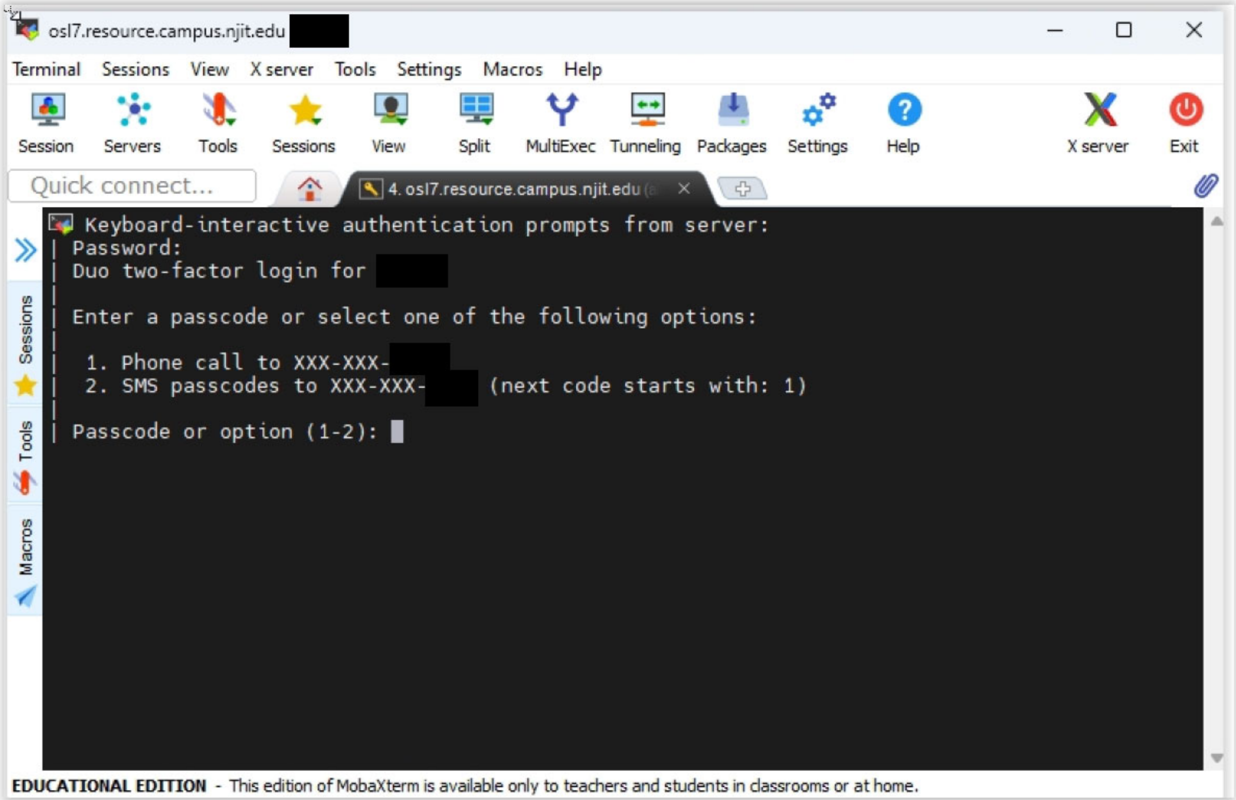
osl7.resource.campus.njit.edu [redacted]

```
Keyboard-interactive authentication prompts from server:
| Password: █
```

EDUCATIONAL EDITION - This edition of MobaXterm is available only to teachers and students in classrooms or at home.

Figure 9.

5. The follow-up activity after correctly typing your password is shown in Figure 10. If you typed it incorrectly the Password: prompt will reappear following possibly an appropriate error message (explained earlier). A DUO two-factor authenticated login pops up. Deal with it as needed.

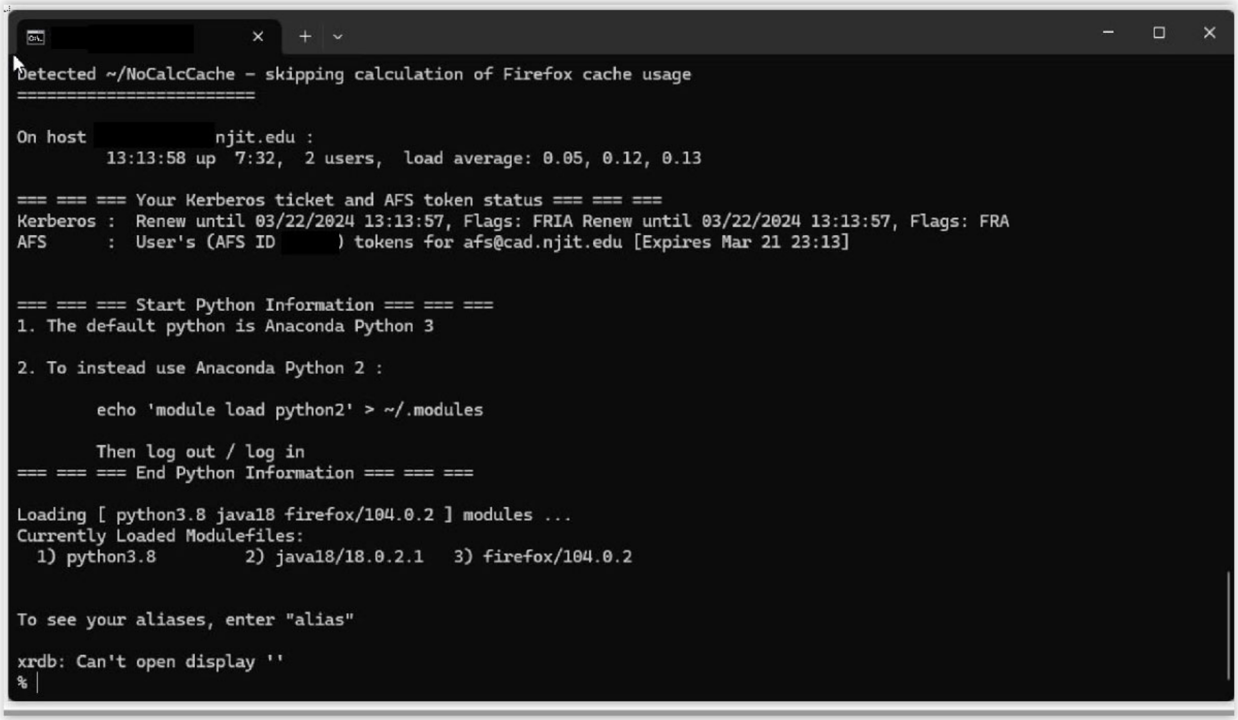


```
Keyboard-interactive authentication prompts from server:
| Password:
| Duo two-factor login for [redacted]
|
| Enter a passcode or select one of the following options:
|
|  1. Phone call to XXX-XXX-[redacted]
|  2. SMS passcodes to XXX-XXX-[redacted] (next code starts with: 1)
|
| Passcode or option (1-2):
```

EDUCATIONAL EDITION - This edition of MobaXterm is available only to teachers and students in classrooms or at home.

Figure 10.

6. A secure shell connection is then established from your Windows laptop (the client, running Mobaxterm) to the remote Linux machine (the OSL machine that will be referred to as a host, server, or remote machine) that run a shell program named bash (for Bourne again shell). The shell program is a program that runs on the remote machines and interacts with the OS system (Linux) of the remote machine: it accepts commands from a USER who is running the bash shell, interprets these commands, and requests the OS to execute a program related to the input command and display the output, if any, on the same window. The user is typing a command, the bash shell is interpreting, the OS is executing (running) a program (or programs) relevant to the execution of the command . The program's name is usually the command's name indicated. Do not forget every time you type in a command, complete the command by pressing the ENTER button. ENTER tells the bash shell that the input is over and bash should start interpreting it and acecuting it through the OS. **You will be typing commends in the CLIENT windows machine's MobaXterm but your commands will be interpreted and executed by the REMOTE OSL machine (bash and OS respectively) and the output on the REMOTE OSL machine will be displayed on the CLIENT windows machine's MobaXterm window (black area of Figure 10 or 11)**. This back and forth relay of information is realized by the ssh client of Mobaxterm and a ssh server running on the remote host. Figure 11 below indicates this. At the bottom of Figure 11 we see some information on the remote machine bash shell's output. There is a **USER specific prompt** that for my case is the percent sign (%) that starts the last line of the window of Figure 11. Your prompt is going to be different from mine and most likely a default one. It is customizable and my case it has been customized to be the percent sign. Next to the prompt you see or not a space (empty) area and next to it the **cursor** that looks like a vertical bar. The cursor is the bash shell's messaging to you that it is ready to accept your input! The window indicated we might call it the **login area.**



[redacted]

```
Detected ~/NoCalcCache - skipping calculation of Firefox cache usage
========================

On host [redacted]njit.edu :
         13:13:58 up  7:32,  2 users,  load average: 0.05, 0.12, 0.13

=== === === Your Kerberos ticket and AFS token status === === ===
Kerberos :  Renew until 03/22/2024 13:13:57, Flags: FRIA Renew until 03/22/2024 13:13:57, Flags: FRA
AFS      :  User's (AFS ID [redacted]) tokens for afs@cad.njit.edu [Expires Mar 21 23:13]


=== === === Start Python Information === === ===
1. The default python is Anaconda Python 3

2. To instead use Anaconda Python 2 :

        echo 'module load python2' > ~/.modules

        Then log out / log in
=== === === End Python Information === === ===

Loading [ python3.8 java18 firefox/104.0.2 ] modules ...
Currently Loaded Modulefiles:
  1) python3.8         2) java18/18.0.2.1   3) firefox/104.0.2


To see your aliases, enter "alias"

xrdb: Can't open display ''
% 
```

Figure 11

7. If you encounter a Window similar to that of Figure 12, retype in your myUCID password in the field SSH-browser:Password (this usually pops up if you try to connect to an AFS machine). This is an authorization from you to be able to transfer files from the Client to the Remote Server or the other way around. You would also be able to browse the filesystem on the remote machine (your AFS files) through a primitive graphical interface and would also be able to upload to it or download to your local (client) machine files.(If you are not interested in uploading/download files, you may ignore it and cancel it.)

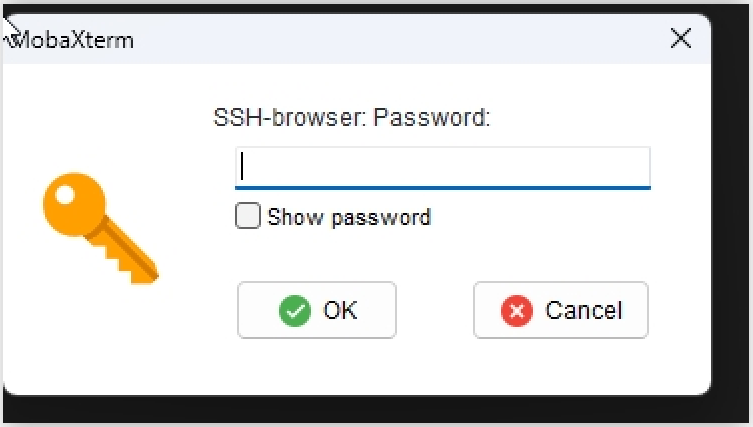
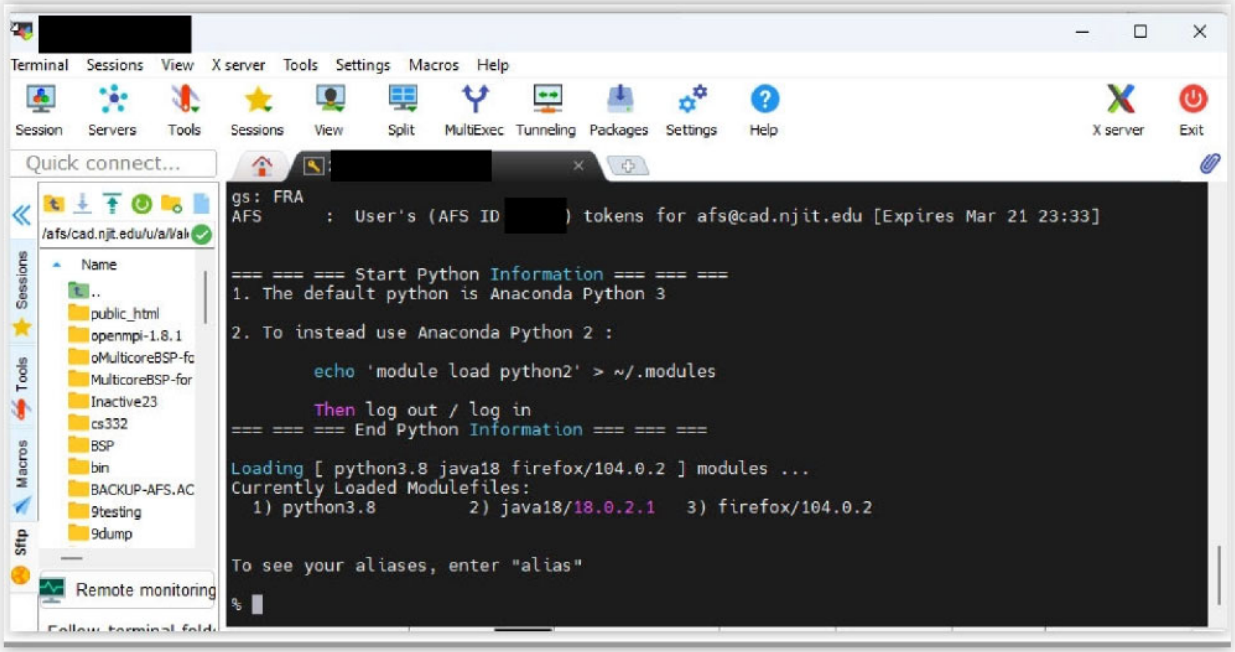


Figure 12

8. You may be able to expand the left area by pointing your mouse cursor to the thick vertical bars surrounding the login area. Then the window will include not only your login area (black background) but some additional information as indicated in Figure 13 below. You might explore other options of MobaXterm. Moreover it is possible to **upload files (from the client machine to the remote host) or download files (from the remote host to the client machine).**

   Familiarize with mobaxterm (read its online manual/help).



```
gs: FRA
AFS      :  User's (AFS ID [redacted]) tokens for afs@cad.njit.edu [Expires Mar 21 23:33]


=== === === Start Python Information === === ===
1. The default python is Anaconda Python 3

2. To instead use Anaconda Python 2 :

        echo 'module load python2' > ~/.modules

        Then log out / log in
=== === === End Python Information === === ===

Loading [ python3.8 java18 firefox/104.0.2 ] modules ...
Currently Loaded Modulefiles:
  1) python3.8          2) java18/18.0.2.1   3) firefox/104.0.2


To see your aliases, enter "alias"

% 
```

Figure 13.

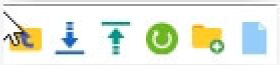


Figure 14(a) : Navigation area

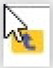


Figure 14(b) : File/Filesystem Navigation

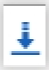
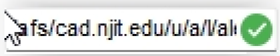


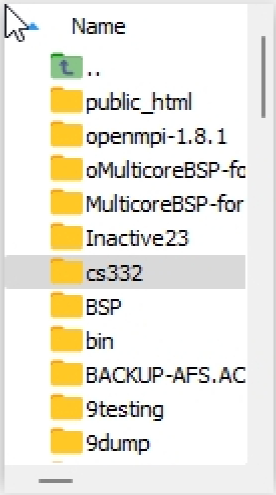
Figure 14(c) : Download blue button

Figure 14(d) : Upload green button



afs/cad.njit.edu/u/a/l/al

Figure 14(e) : AFS directory info(name)



Name
..
public_html
openmpi-1.8.1
oMulticoreBSP-fc
MulticoreBSP-for
Inactive23
cs332
BSP
bin
BACKUP-AFS.AC
9testing
9dump

Figure 14(f) : AFS home directory (files)

The main area (black background, Figure 13) on the right side is FOR MY configuration the remote host (osl7). The secondary area on the left shows information about my file area on the remote machine's filesystem. As soon as ssh established a connection to the remote host, the remote host mounted my files on the file server that is supported by it (the remote host). The file server supports a distributed file system known as AFS (Andew File System). My files are available at a default location in the filesystem; the location is known as the home directory. My home directory ends with my UCID. Let us say for the sake of an example that myUCID is almn12.Beneath a sequence of icons and on the left side of a green checkmark you may observe a path name that maps to my home directory

/afs/cad.njit.edu/u/a/l/almn12

(several times it appears as /afs/cad/u/a/l/almn12)
The part of the directory /a/l maps to the first two letters of myUCID. For you the part /a/l/almn12 would definitely be different.

Type in commands such as date, pwd, hostname, who, ps etc. If you need more information about a command type in after the prompt and the curson the word man (for manual) and after a space the name of the command and then press the ENTER button. A manual page is displayed for the command in question. If in doubt how to exit from the manual page press q for quit or sometimes x for exit might also work.

A command to confirm my home directory. This command is

```
     pwd
```

Command pwd is short for print working directory (and current working directory is my home directory). It prints the current working directory in the filesystem mounted to my UCID account.
Then I moved away from my home directory by entering another directory I have already created: cs332.
I typed the command: **cd cs332**
Command cd is short for change (working) directory and the argument to cd is either a full directory path or a relative one. In my case I am going to move into directory cs332 that is located inside my home directory. It is thus a relative directory description, relative to my home directory.
A command: **pwd**
after the cs cs332 confirms that the new working directory is not

```
     /afs/cad/u/a/l/almn12
```

any more but

```
     /afs/cad/u/a/l/almn12/cs332
```

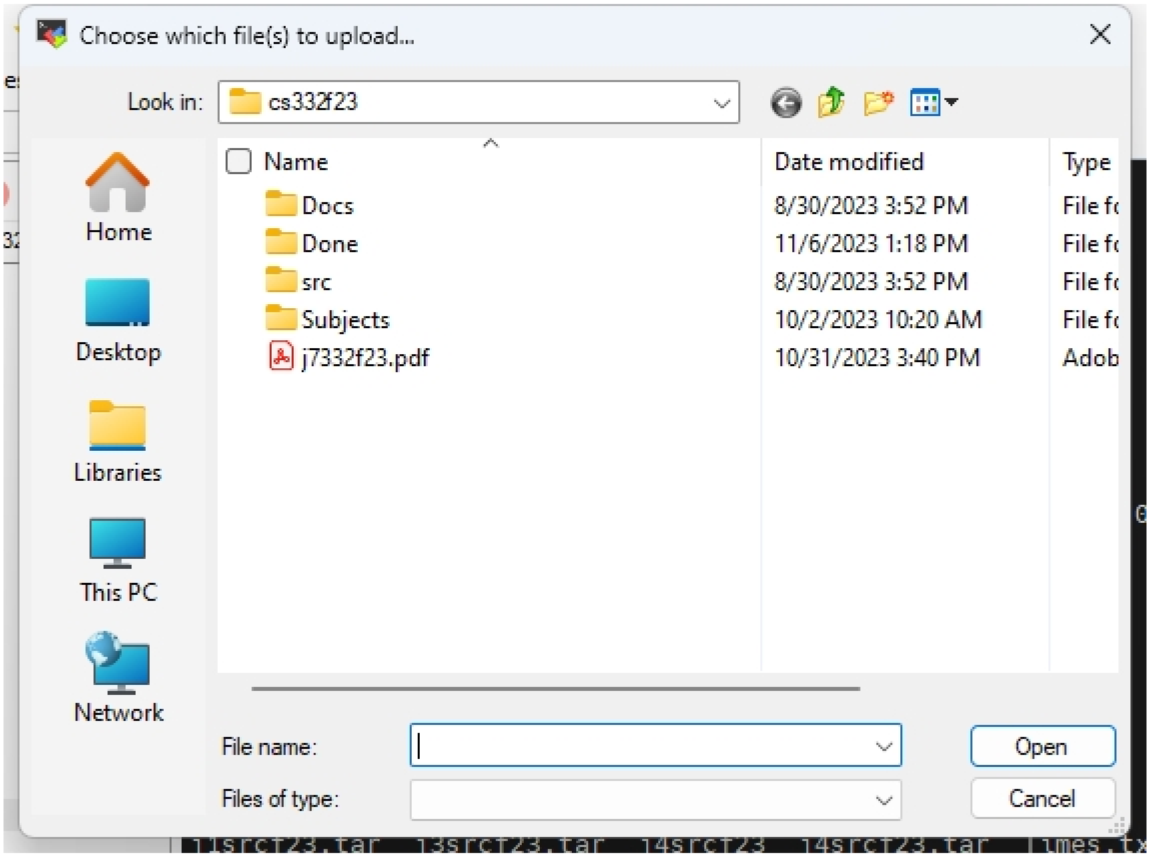
Looking at the left (white area) we observe the corresponding changes effected.

Furthermore, on the left area panel earlier identified in Figure 14(e) the info there reflects my current directory than my original home directory.

One of the icons,

⤒

is the upload icon to upload a file from the client (Windows) machine to the remote host (Linux osl7.njit.edu machine). If you click on it a window like the one below may open; you may navigate around it and pick a directory and from within it a file that you might decide to upload to the remote host or a file directly from within the directory displayed in the window (cs332f23 in this example) if such a file exists (eg the pdf file j7332f23.pdf).



Choose which file(s) to upload...

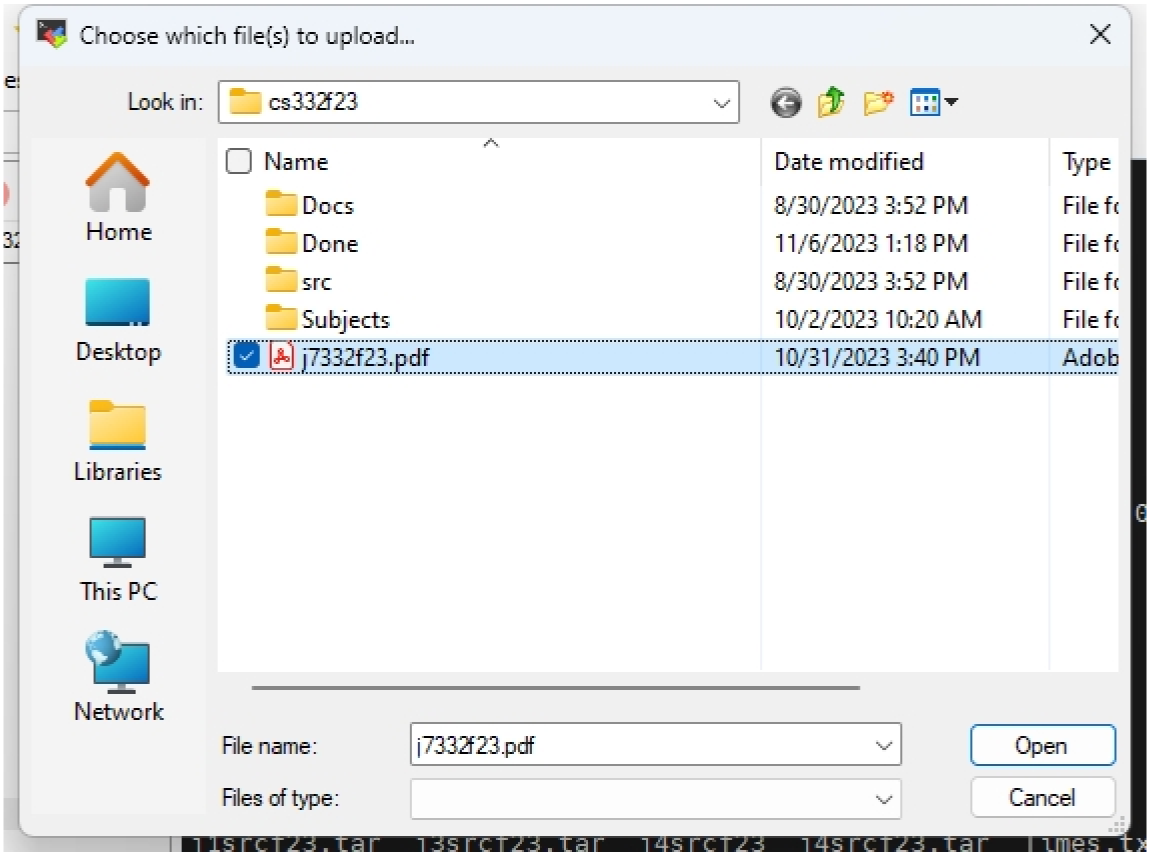
Look in: cs332f23

Name	Date modified	Type
Docs	8/30/2023 3:52 PM	File fo
Done	11/6/2023 1:18 PM	File fo
src	8/30/2023 3:52 PM	File fo
Subjects	10/2/2023 10:20 AM	File fo
j7332f23.pdf	10/31/2023 3:40 PM	Adob

File name:

Files of type:

I decided to select the j7332f23.pdf file and then things change as follows.



Choose which file(s) to upload...

Look in: cs332f23

Name	Date modified	Type
Docs	8/30/2023 3:52 PM	File fo
Done	11/6/2023 1:18 PM	File fo
src	8/30/2023 3:52 PM	File fo
Subjects	10/2/2023 10:20 AM	File fo
☑ j7332f23.pdf	10/31/2023 3:40 PM	Adob

File name: j7332f23.pdf

Files of type:

By clicking on Open (dialog box), an upload is initiated. Depending on the size of the file to be uploaded the upload might get completed within a few seconds or more. As soon as it gets completed, the left hand (white area)of the MobaXterm session shows the uploaded file (compare the named files now vs the named file in a prior screenshot). This is shown on the window on the next page.

To convince yourselves I typed in the right window (black area)

the command **ls**

prior to and after the upload.

It is quite clear that one more additional file has been added into directory cs332.

At this point you are ready to start interacting with the remote host. Type in Unix/Linux commands, and when done typing them, press the ENTER button and observe the output. If you are not familiar with Unix or Linux there are several tutorials or summaries out there. Pick the one you are more comfortable with it.

Finally, to terminate the session type exit. (Sometimes, quit or logout might also work.) You will 'logout' from the remote host.

If you are done with MobaXterm, terminate it by clicking on its top right corner the X symbol that will 'kill' the window. Likewise locate the icon of Figure 4 and stop VPN. The icon of Figure 4 will revert to its form in Figure 1. At that point if you rightclick on Figure 1 you will be able to deactivate VPN. Deactiving VPN is NOT EQUIVALENT to an uninstall.

PART B

Limited UNIX command overview

4. Limited Unix command overview

In a Unix system, a user is logged on to the system by providing a set of credentials (login name and an associated password), a process already familiar to you from the earlier sections of this document. At NJIT we call the credentials MyUCID credentials consisting of a myUCID (login name) and a myUCID password.

Immediately after the login has been completed successfully the Unix environment would become available to the logged on user and a program (process) would start executing in the user's environment after the user's login: the Unix shell process.

The UNIX shell process would allow the user to interact with the operating system and start, stop, suspend and resume the execution of services provided by the OS or create and manage user created processes. These services are programs and when run they become processes. The definition of a process is ‘a program in execution’. All interaction is done through the terminal and its associated keyboard that was used by the user to gain access to the system: the user types in commands to the shell and after the shell interprets these commands, it invokes services of the OS to execute/realize those user commands as needed and as privileged. The OS might decline to execute some of these commands for safety or security reasons based on the credentials (privileges) of the user.

To keep interaction short UNIX commands to the shell are short and sometimes intuitive. For example command **ls** is short for list, **cat** for catenate (list contents), **mkdir** for make directory, **ps** for process status, **cd** for change directory, **pwd** for print working directoy, **mv** for move, and **cp** for copy.

Moreover, the UNIX shell provides command line editing, and history of interactions with the shell thus allowing for editing a previously lengthy command instead of retyping it before re-execution or repeating a frequently executed command by easily recalling it from a history of prior interactions.

Every command of the shell such as ls, ps, mv, cp, pwd, cat, cd, is an executable program residing in secondary memory (disk). It was originally written in C and compiled and assembled subsequently into the executable file named ls, ps, etc. Thus typing a command such as

```
%  ls
```

would cause the shell (an OS process) to load the program named ls from secondary memory into main memory, thus turning it into a process and then executing it as needed.

A reminder: the % is the shell prompt. You do not type it. It is output by the shell to remind you that 'I, the shell, have your full attention: please type in your request'. Moreover when you do so and type your request (ls in this case) do not forget to tell the shell that you are done when you are done typing your command. You do so by pressing the ENTER key of the keyboard at the end.

At that moment the shell interprets your input (in the example above it is an ls), the text between the prompt and the ENTER, and executes it as needed. Every execution of a process in linux (in this case ls) by default creates and interacts with three files associated and connected with three devices:

(a) standard input also known to the user as the file with fd (file descriptor) 0,

(b) standard output with fd equal to 1, and

(c) standard error with fd equal to 2.

Unless the shell is instructed otherwise by you, standard input is associated with your terminal's keyboard, and standard output and standard error are both associated with the terminal's screen.

Moreover in Linux, multiple commands can be executed one after the other in the command line. Thus

```
% ls ; date ; echo "Hi"
```

Thus in the above example after ls is executed, the current date and time is printed, and afterwards a message gets printed on the standard output, the terminal used by the user.

Moreover in Linux, multiple commands can interact with each other with a mechanism known as an unnamed pipe. A pipe is a FIFO (First In First Out) queue that accepts input from the output of one command and generates output that will become the input of another command. Thus

```
% ls | egrep filename
```

consists of the command ls that prints the contents of the current directory (this description makes sense after you read the next section if you are not familiar with any operating system's structure) and directs this output to the unnamed pipe indicated by the pipe | symbol. The unnamed pipe indicated receives as input the transmitted by ls output and then it generates its own output that is to become the   input of the command egrep. The command egrep filters its input by discarding all lines that do not contain the string/word filename and thus preserving to the output that it will generate the lines that contain the string filename. The combined execution thus prints the output lines of ls that contain the string filename.

Pipes can allow multiple cascade communication such as the following one.

```
% ls –l |  egrep filename | sort  | less
```

A list of useful commands

```
% pwd          #print current working directory

% cd path      # change the current working directory to path

% cd           # if you are lost go to (i.e. cd) to home
directory

% cd /         # goto the root of the filesystem

% man pwd      # manual page for command pwd

% man cd       # manual page for cd

% whoami

% who

% date

% hostname

% cal          # calendar; use also eg. cal 5 2023

% stat filename

% ls path      # list contents of directory path

% ls filename  # confirm whether filename exists

% ls           # list contents of current working directory
% ls .         # same as ls; . alias for current directory
% ls ..        # list contents of parent directory
% ls –l        # equivalent to ls -l .
% ls -l filename
% ls -l directory        %ls -l path
% ls –a        # Hidden files . and .. included
% ls –lai      # the inode (numeric name of the file) is also listed on the extrement left.
% ls -lR       # R for recursive ; r means reverse!
% ls file*     # list all files starting with file
% ls *file     # list all files ending with file
```

The characters after a dash are option of the command (eg. ls)

```
% rm file      # delete a file
```

or

```
% rm pathTofile
```

but

```
% rmdir directory        # remove an empty directory
% rmdir pathTodirectory  # remove an empty directory
% mkdir newdirectory     # create a new directory
% rm –rf file       # A pretty dangerous command... Avoid it.
% rm –rf directory  # A pretty dangerous command... Avoid it.
% mkdir directory   # Create a directory
% mv oldname newname  # rename file
% mv olddir  newdir   # rename a directory (newdir must not preexist)
% cp file1 file2      # make a copy of file file1
```

```
% cat filename           #list contents of filename
% more filename          #similar to less
% less filename          # controlled flow version of cat
# head filename
# head -10 filename      # print 10 first lines of filename
% tail -10 filename      # last 10 lines
% egrep me file          # search for me in file
% echo string            # string on screen
% wc filename            # num of chars, lines, words in file
% ps                     # process status
% ps -ef |egrep myID
% sleep 10               # screen freezes for 10sec
```