

How To: X11 Forwarding or, how to get Matlab through SSH

Introduction

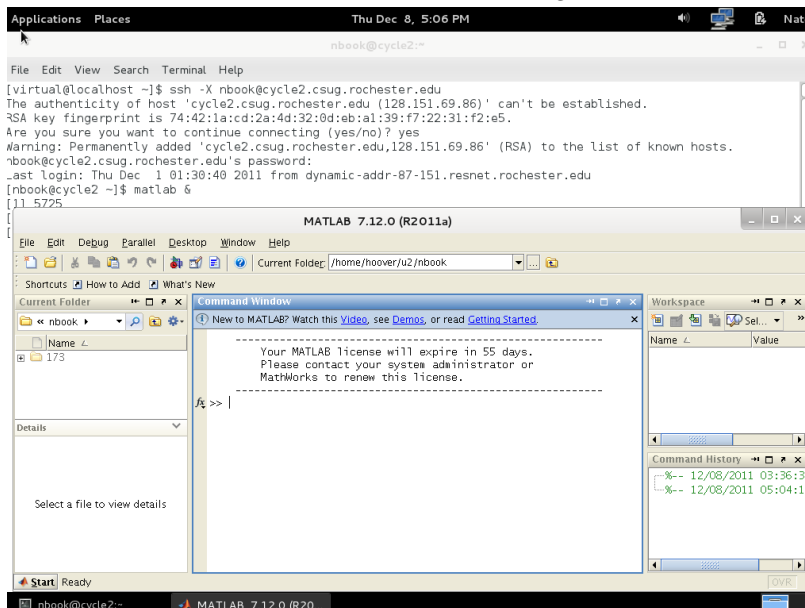
SSH allows you to remotely access the cycle computers to test code for C (gcc, make), Prolog (pl), and Scheme (racket). All of these are accessible via the command-line. If you're on Windows, you are familiar with something simple like PuTTY. On Linux or Mac, a command like `ssh name@host` brings it up for you. It's command-line only and you're stuck wondering, is there something better? Is there some way to access the familiar Dr. Racket interface as opposed to just racket? Is there a way to get the graphical Matlab environment (typing `matlab` just gives an error about a missing display— this is correct since it doesn't know about your display. You might as well ssh from a non-graphical OS for all it cares)? Yes! The trick is **X11 Forwarding**.

Linux and X11

X11 is the 11th version of the X Windows Server (not related to Windows in any way), a protocol allowing window managers to display GUIs on many Linux distributions such as Fedora or Ubuntu. X11 is a server in that applications “connect” to it and send it abstracted GUI information. It also allows *remote* computers to do the same through, for example, SSH. To actually do this on any OS you need two things, OpenSSH and X.Org. The following sections detail this for common operating systems.

Linux/Unix-based

This is astoundingly easy to do on any distribution that comes with X Windows. The only exception is an operating system such as Android that is Linux-based, but does not come with X Windows. Otherwise, just run: `ssh -X name@host`



X11 Forwarding on Linux (Fedora 15): -X tells the SSH server to forward to your X server

The only requirement is that you have X Windows (will be true on Fedora, Ubuntu, Debian, etc.), and that you have the openssh package (probably true out of the box too). Remember, **-X** is uppercase! If you want more tips, look on the last page.

Mac OS X

Apparently, X11 has been part of Mac OS X since version 10.5, and an optional installable component since as early as 10.3. So in any such version, it shouldn't be much different than Linux above. I have no copies of any Mac system anywhere, so I can't help further than in general.

Reference: guides.macrumors.com/Using_X11

Windows: Get Cygwin/X

On Windows (2000, XP, Vista, 7 probably all work), it's a bit more fun. The big thing you need is X Windows that you can forward to. The easiest way to do this is to get Cygwin, because among its packages are OpenSSH and "Cygwin/X", a fairly good X Windows port. Cygwin/X is just a package, just like GCC (which you may have gotten at one point for CSC 172). All you need to download and run is Cygwin's setup.exe: cygwin.com/setup.exe. If you already have Cygwin, then run the setup.exe again to add additional packages (it's like a package manager like yum or apt-get, but it's graphical).

Windows will complain that you downloaded the file from the internet. Windows Firewall (for the people who have it enabled) will complain the file wants to access the internet. Windows Vista/7 will complain that it wants to modify your computer. Click yes, yes, yes...

Click Next; Install from Internet, Next; Choose root (I recommend leaving it "C:\cygwin"), All Users, Next; (leave local package directory, that's just temp files), Next; Direct Connection, Next; Choose any mirror, Next. Now you should finally be at the important screen.

To navigate this, type stuff in the field on the top left to filter results by what you type. Don't press enter. Just type "openssh" so that you get a resulting tree like:

```
- All
  - Net
    openssh  B: [ ]  S: [ ]  823k  openssh: The OpenSSH server and client programs
```

Check the box under the B(inary) column.

Now when you click Next, it will download and install the OpenSSH package for you. But wait, we need more packages. Change the field to filter for the following packages, and include each one:

- xorg-server: required; the X Windows Server of course
- xinit: required to start X11
- xorg-docs: optional; X.Org documentation (man pages)
- x-start-menu-icons: optional; start menu icons, personally I start it using the command-line
- xterm: required, the X terminal
- ...: you don't really need any other packages because the remote server has them most likely, but you can always get more if you like

That's all you need! Click Next to install. Then when it is done, choose to make shortcuts and click Finish.

Windows: Use Cygwin/X

Now to use Cygwin/X:

1. Start Cygwin Bash Shell (it would be on your Start Menu or Desktop).
2. Start the X server with: `startxwin`

You may get things that appear like these warnings:

```
Nate@NATEDELLE6510 ~
```

```
$ startxwin
```

```
0 [main] startxwin 4840 exception::handle: Exception: STATUS_ACCESS_VIOLATION
```

```
22367 [main] startxwin 4840 open_stackdumpfile: Dumping stack trace to startxwin.exe.stackdump
```

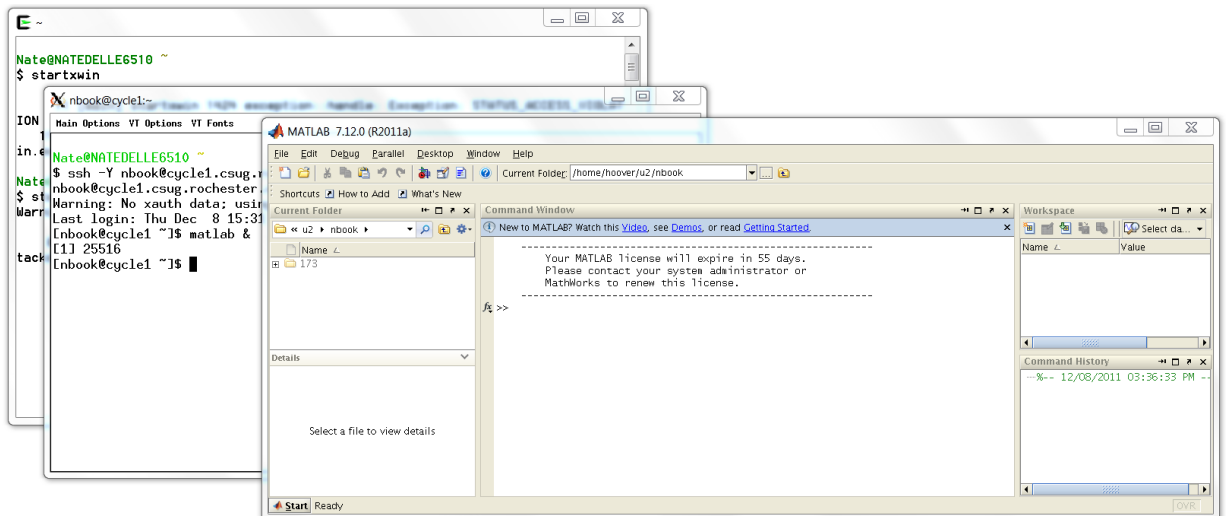
```
Nate@NATEDELLE6510 ~
```

```
$ startxwin: XFree86_VT property unexpectedly has 0 items instead of 1
```

```
Warning: Missing charsets in String to FontSet conversion
```

But as long as you get an X icon in your system tray that has the tooltip "Cygwin/X Server:0.0" or something similar, then it works (you can right click the icon to open another X-based app at any time, for example another terminal). I don't know how to fix or hide the errors, but they don't seem to affect anything.

3. In the terminal (xterm) that opens, type `ssh -Y name@host` (uppercase -Y)
4. When connected, type `matlab &` to open Matlab. Here's a screenshot of it:



X11 Forwarding on Windows 7: -Y tells the server to forward to your Cygwin/X server at "localhost:0.0"

5. If you got this, you're basically done! If you want more tips, look on the last page.

Reference: x.cygwin.com/docs/ug/cygwin-x-ug.html

\$DISPLAY Variable

To allow X forwarding, SSH has to use a variable called "DISPLAY". In step 3, I did the `ssh` command inside the `xterm` window because then this variable isn't always necessary. If you want to SSH from outside of the `xterm` (where you typed `startxwin`, for example), you have to type this command beforehand:

```
export DISPLAY="localhost:0.0"
```

`localhost` is of course your local computer, and `0.0` is the pair of numbers you saw in the system tray tooltip. You sometimes have to do this for some remote apps like `gedit` (GNU editor, like Notepad), even when inside `xterm`.

-X Versus -Y

The `-X` and `-Y` parameters do about the same thing, letting you X forward over SSH. The difference is that `-X` disables some functionality to make it more secure (ex. no one can find the cycle machines and spy on what you're doing). It does not function with some remote apps, or at all on Cygwin/X (their philosophy is that it's a false sense of security and it doesn't always work anyway), so you have to use `-Y` in those cases. `-Y` means that you "trust" the SSH server. I assume we do...

Bash &

The shell allows you to place a `&` after any command so that the terminal does not wait for completion before allowing you to type more commands. This is especially useful for graphical applications like Matlab because you might want to manipulate files or do something unrelated while you have Matlab open. Make sure SSH stays connected though!

Windows with PuTTY

I read a claim that Cygwin/X works with PuTTY, but I haven't tested. It's easier to just use Cygwin while you're on it anyway.

OpenSSH Includes Secure Copy

```
scp source destination
```

is a command provided by OpenSSH as well, allowing you to copy files from/to your SSH account. This is useful if you'd like the ability to use Cygwin exclusively for SSH. Type `scp` with no arguments to see its format. Note, Cygwin's paths start different (technically a fake mount called "cygdrive"), use `/`, are case sensitive, and spaces are escaped by `\`.

Example: `C:\My Folder\myfile.c` will be `/cygdrive/c/My\ Folder/myfile.c` for `scp`.

Other Remote Apps

The servers already have many graphical programs, some useful, some not...:

- `xterm`: graphical terminal
- `gedit`: graphical editor
- `drracket`: Dr. Racket
- `matlab`: Matlab
- and many more, including `gvim` (`vi` but in a window), `gimp`, and `google-chrome`