Remote Connection to the Zoo

1 Introduction

The Zoo computers can be used in three different ways:

1. Come to the Zoo and log in directly on one of the Zoo consoles with the new 24” displays.

2. Log in from another computer via ssh and use the command line tools.

3. Create a Virtual Network Computing (VNC) remote Zoo desktop on another computer. This provides a full graphical interface to the Zoo environment.

Being there in person is the most satisfying and trouble-free method. It has the added advantage of putting you in the laboratory with others who can often answer your technical questions. Connecting via ssh is fast and easy, but you are limited to Zoo applications that have command line interfaces. To make remote use of graphical tools such as the Eclipse integrated development environment, you will want to set up a VNC connection. This document explains how.

2 Why not run Eclipse (or Xcode or Visual C++) locally?

Eclipse is by no means the only or even best IDE for developing C++, nor is the version of g++ installed on the Zoo (version 4.3.2) the only good C++ compiler. The reason for preferring the tools on Zoo is that the Zoo is the target environment for the programs you develop in this course. While code developed on another platform might compile and run correctly on the Zoo, it also might not. The reasons for such compatibility problems are many. The development environment might fail to flag errors in your program which happen to violate the standard and hence are not portable to another system. It might provide optional tools or libraries that are not available on the Zoo. It might provide a different version of the tool which doesn’t work in quite the same as the version on the Zoo.

The best way to avoid compatibility problems is to use the same software that will be used to grade your assignments. That means, develop and test on the Zoo, not elsewhere. VNC makes this possible even when you cannot be physically present in the Zoo.

3 What do I need to run VNC?

You will need two things: an SSH (secure shell) client and a VNC viewer.
3.1 SSH client

SSH is used both to make the initial contact with the Zoo and to establish an encrypted tunnel between your machine and the Zoo for use by VNC.

Most Linux distributions and Mac OS X already have ssh installed. For Windows machines, you will need to install an SSH client such as putty that supports tunneling. Putty can be downloaded here: [http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html](http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html).

3.2 VNC viewer

The VNC viewer on your machine talks to the VNC server on the Zoo, so you will need to install a VNC viewer if one is not already installed. Many Linux distributions furnish a VNC viewer, although it won’t necessarily be installed by default. The Zoo machines provide the TightVNC server and viewer. Fedora supplies the TigerVNC viewer which works perfectly well with the TightVNC server. Other VNC viewers such as RealVNC can also be used, although they won’t necessarily all give equally good performance.

The TightVNC viewer can be downloaded for most platforms here: [http://www.tightvnc.com/download.html](http://www.tightvnc.com/download.html). Unfortunately, TightVNC does not have a Mac version on its website. You may try one of the following as an alternative:

- Chicken of the VNC [http://sourceforge.net/projects/cotvnc/](http://sourceforge.net/projects/cotvnc/)

4 Establishing a VNC Connection

Establishing a VNC connection logically involves four steps:

1. Use ssh to log into a Zoo node.
2. Start a VNC server on the Zoo node.
3. Create an ssh tunnel.
4. Start a VNC viewer on your machine to connect to the Zoo server over the tunnel.

Depending which SSH client and VNC viewer you are using, some of these steps can be combined. For example, most SSH implementations allow you to log in to a remote node and establish a tunnel (using port forwarding) at the same time, thereby combining steps 1 and 3. On the other hand, some VNC viewers will create an SSH tunnel and then connect through it, combining steps 3 and 4.

4.1 Using SSH to connect to a Zoo node

4.1.1 SSH on Linux and Mac OSX

Linux machines and Macs with OSX should have a version of OpenSSH already installed. Open a terminal window, run the following command, and follow the prompts to log in:
ssh node.zoo.cs.yale.edu

The special name node.zoo.cs.yale.edu selects one of the Zoo nodes automatically for you. You should make note of which node you are actually connected to in case you need to go back to it.

4.1.2 SSH Tunneling with Putty on Windows

The instructions below describe how to use Putty on Windows to both open an SSH session to a Zoo node and also to forward the VNC over the same connection. The first VNC server to be started on a node uses port 5901, the second 5902, and so forth, so these are the ports that need to be forwarded from the Zoo node back to your machine.

1. Connect to a free node in the zoo by using node.zoo.cs.yale.edu as the host. You can also substitute a specific node name.

2. To avoid having to perform all of these steps every time you bring up putty, enter this same value in the saved sessions textbox and click “save.”

3. Select the new item from the saved session list and click “load.” You will now be editing the details for your saved session information.

4. Before connecting, go to Connection > SSH > Tunnels on the left menu.

5. You will need to add the ports that you will be using. Usually the ports will be 5901 or 5902, but if there is a lot of activity you may have higher ports. For each port you add, in the destination text field, add localhost:portnumber. So, to add port 5901, you should put “localhost:5901” in the destination field.

6. Once you have added some ports, go back to the Session option on the left panel.

7. Make sure “only on clean exit” is selected at the bottom before connecting.

8. Click “save.” This step is important since it will save the session information you just edited so that you don’t have to add all the ports again the next time you want to connect. For future connections, you can just select the correct option in the saved sessions list and click “load” before connecting.

9. To connect, click “open.” Once a command prompt pops up, log yourself in.

4.2 Setting up the VNC Server

Regardless how you have connected to the Zoo, here are the instructions for starting the VNC server.

1. Go to the command line interface created by SSH. This will be Putty in Windows, or the command prompt used in the immediately preceding step for Linux/OSX.

2. Run the command vncserver. To set the window size, run vncserver -geometry 800x600 (or whatever your preferred resolution is) instead of just vncserver.

3. If this is the first time you have used vncserver, you will be asked to set up your server at this point, and will need to supply a password for it. You will be asked for this password when running the VNC Viewer.
4. Once set up, you will get a message like this:

```
New 'X' desktop is grizzly:1
```

Make note of the node name and the number at the end, which is the X display number. Your server is listening on port 5900+n, where n is the display number. When using Putty with SSH tunneling, that port must have been added previously to the list of ports to be forwarded to the local node.

If 5900+n is higher than any port you added when configuring Putty, you’ll have to close Putty, restart it, add the new port(s), and then connect again. Before closing Putty, be sure to shut down the server cleanly as described in Section 5.

4.3 Setting up the VNC viewer

4.3.1 On Windows

If using Windows, open up TightVNC Viewer and tell it to connect to localhost:n. From the example above, this would be localhost:1. You should get a window asking for the password you created earlier.

Do not make the mistake of connecting directly to grizzly:n. This will also work, but it will open an ordinary (unencrypted) TCP connection to the node “grizzly”, and your connection password will go out in the clear. By connecting to localhost:n, you are sending your connection through the SSH-encrypted tunnel previously created.

4.3.2 On Linux

With Linux, it is possible to set up port forwarding with the initial SSH connection and then connect the VNC viewer to localhost:n as described above for Windows. However, the Linux VNC viewer command supports the -via option that creates an SSH tunnel and connects the viewer through it all in one go.

From another window, give the command

```
vncviewer -via nodename.zoo.cs.yale.edu localhost:n
```

Following the example above, this would be

```
vncviewer -via grizzly.zoo.cs.yale.edu localhost:1
```

After entering the password created when running vncserver, a remote desktop should show up.

5 Exiting Cleanly

When you are done using the Zoo node, you must exit cleanly and make sure you do not leave behind running Xvnc server processes. (The command vncserver is used to create and terminate the server; the server itself is called Xvnc.) If you forget to kill the server, it will continue to run even after you log out. The next time you or anyone else runs vncserver, a new Xvnc process is created and assigned the next larger display number.

The safest way to clean up is to issue the command

```
vncserver -kill :n
```
where $n$ is :1 or :2 etc. depending on the display number $n$ that was shown to you when
the server started. You can also use the command

    killall Xvnc

to kill all of the Xvnc server process that you own.

6 Using the Remote Desktop

When the remote desktop is opened, it starts a new X session. X is very general and
can start any of several different window managers. By default, VNC uses the simple twm
window manager.

6.1 Using twm

When the remote desktop first opens under twm, you should see a window with a command
prompt showing. You can use this as you would a command prompt on the Zoo. If you type
eclipse, you may see a strange grid show up and nothing will happen. This will happen
any time a window pops up. The grid allows you to pick where you want the new window
to appear by clicking somewhere on the screen.

If you accidentally close the command prompt, click and hold anywhere on the remote
desktop and select “Xterm.” To move files back and forth between your computer and the
one you are remotely connected to, you will still need to use putty or another program like
WinSCP.

Eclipse may occasionally experience some strange problems when being used remotely.
Parts of the window may not display correctly (being a black box or blank space), and the
program itself may stall. The entire remote desktop may stall as well, especially if your
Internet connection is very slow or unreliable (particularly for wireless connections where
the signal strength varies a lot over a short period of time). If this happens and you are
unable to fix the problem from within the remote desktop window itself, you may still exit
cleanly as described below and force the remote desktop to disconnect. To be safe, after
running vncserver -kill :$n$, check for any residual processes running before closing the
command prompt used to start vncserver. You do not want to leave orphaned processes
behind when you exit.

6.2 Using Gnome or KDE

When logging in locally from a Zoo console, most users choose to use either the Gnome or
the KDE desktop. To have the same experience when using VNC, you will need to tell the
VNC server what window manager or desktop to run.

When the VNC server starts, it runs the script

    ~/.vnc/xstartup

The first time you run VNC server, it will create such a script for you if it doesn’t already
exist. The one it creates will probably start the twm window manager described above. For
example, here is the script that VNC created for me:
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#!/bin/sh

xrdb $HOME/.Xresources
xsetroot -solid grey
xterm -geometry 80x24+10+10 -ls -title "$VNCDESKTOP Desktop" &
twm &

This script loads my .Xresources file, sets the background color of the root window, start an xterm process, and then passes control to the twm window manager.

I chose to replace ~/.vnc/xstartup with

#!/bin/sh
xsetroot -solid grey
[ -r $HOME/.Xresources ] && xrdb $HOME/.Xresources
[ -r $HOME/.Xmodmap ] && xmodmap $HOME/.Xmodmap
startkde
killall Xvnc

This sets the background color, loads my .Xresources and .Xmodmap files (to change key bindings) only if those files exist in my home directory, and then it starts up KDE. If the user logs out of KDE, then the script kills all running Xvnc servers that the user owns.

7 Automating the Connection from Linux Clients

If you are running a Linux client, you can use the following script to automate the process of establishing a VNC connection to the Zoo. Here is the script zoovnc that I use:

#!/bin/tcsh -f
#
# Start vnc viewer on zoo node and connect to it

set hostWin='(ssh node.zoo.cs.yale.edu vncserver -geometry 1540x1120) |& \\
    sed -n "s/^New 'X' desktop is //p"

echo $hostWin

if ( $%hostWin == 0 ) then
    echo "Connection failed"
    exit 1
endif

set remoteHost=`echo $hostWin | awk -F: '{print $1}`.zoo.cs.yale.edu
set remoteWindow=`echo $hostWin | awk -F: '{print $2}`

echo "New 'X' desktop started on ${remoteHost}:${remoteWindow}"
echo "Starting vncviewer on ${remoteHost}"

vncviewer -via ${remoteHost} localhost:${remoteWindow}
echo "Shutting down Xvnc on host $remoteHost"
ssh $remoteHost vncserver -kill :$remoteWindow

This script first uses ssh to connect to the Zoo and start a server. Next, it extracts the host name and window number to the shell variables remoteHost and remoteWindow, respectively. It then starts the VNC viewer. When the viewer exists, it goes back to the host and kills the server in case it is still running.