Programming Tools

Most of the programming assignments will require using the C language.

We will use a current version of the GCC C compiler.

What's GCC?

- the Gnu Compiler Collection (see gcc.gnu.org)
- a collection of freeware software development tools, including support for C, C++, Objective-C, Fortran, Java, and Ada
- available as part of all Linux and most UNIX-derived operating systems

How do you get it?

- run Linux on your own computer
- use a remote Linux environment (rlogin cluster)

You will have to use the CS Department's rlogin cluster for some assignments in any case.

Linux

Read Chapter 1 of the Sobell book for a history of Linux… really…

There are many Linux distributions (distros)… superiority is a matter of religion.

- the CS Department's rlogin cluster and other servers (more later) are running CentOS
- I use CentOS
- CentOS will be the official platform for testing your assignments
- If you run another distro, any difficulties that arise will be your problem

Linux distributions come in 32-bit and 64-bit versions; I require running 64-bit, but that will entail your installing some additional packages.

In any case, we <u>require</u> you to run 64-bit CentOS 7 on your own computer.

If you do not do so, expect to have problems.

Linux Installation Choices

There are (at least) four options for setting up Linux on your computer:

Using a software virtualization tool to run Linux concurrently with your host OS
- well-supported options are available
- easy to back up your Linux installation in case of problems
- allows straightforward transfer of data between Linux and your host OS
- does not disrupt your current OS setup

Using Hyper-V virtualization support to run Linux concurrently with your host OS
- supported on most x86-64 processors
- does not disrupt your current OS setup

Creating a dual-boot environment for Linux and your current OS
- requires rebooting to change from Linux and your current OS
- fiddly, may break your current OS setup

Running Linux as your only OS
- makes your current OS, and all its apps, unavailable on your computer
- provides the fastest runtime experience

Running Linux on a Windows Host

Here's my advice:

- Install VirtualBox (virtualbox.org).
  - I'm using version 6.0, but recent earlier versions should be fine.
  - follow the VirtualBox/CentOS Installation notes carefully.

- Download a CD/DVD image for installing your chosen distro.
  - I used CentOS-7-x86_64-DVD-1804.iso.

1810 ISO contains a bug – avoid it!

- Install CentOS 7 as a guest OS:
  - follow the VirtualBox/CentOS Installation notes carefully.
  - for installing the VirtualBox Guest Additions (these are essential)

Once you're done, you can boot and run Linux within a virtual machine.

This minimizes your chances of disrupting your existing system setup.

This works best if your computer has at least 8GB of RAM.

Running Linux on Hyper-V

Hyper-V is a Microsoft technology for supporting virtual machines.

It's a Type-1 *hypervisor*: it runs directly on the hardware and prevents other hypervisors from doing the same

So, Hyper-V and VirtualBox do not coexist peacefully.

This is true despite Oracle's claim that VirtualBox 6 does so…

What to do…?

Hyper-V

Hyper-V is not an issue if you are running:

OS-X
Linux
Windows 7 (most likely OK)
Windows 8 (most likely OK)
Windows 10 Home
(possibly other low-end versions of Windows 10

If running these, I recommend just using VirtualBox.

Avoiding Hyper-V

Hyper-V may be an issue if you are running:

Windows 10 Pro, Business or Enterprise

Best tactic: don't turn Hyper-V on;
use VirtualBox

Hyper-V can be turned off:

https://www.petri.com/how-to-disable-hyper-v-completely-in-windows-10

If you do this, read ALL of the discussion and follow it carefully.

Living with Hyper-V

What if you need Hyper-V?

Why would you need Hyper-V?

- to use Docker
- to use some of an ever-expanding list of Windows 10 feature updates
  Device Guard, Credential Guard, Sandbox, . . .

So… now what?

Option 1: switch back and forth
Turn Hyper-V off when you need to use VirtualBox
Turn Hyper-V back on when you need to use it

Note: disabling Hyper-V requires the steps described on the page linked form the previous slide, AND performing a hard reboot.

IOW, you must shutdown and then reboot your machine.

Simply doing a Windows restart will NOT be sufficient.

Living with Hyper-V

Option 2: forget running a CentOS VM and dual-boot instead

https://www.tecmint.com/install-centos-7-alongside-windows-10-dual-boot/

Be warned:

- raises specter of hosing your machine and having to reinstall everything
- therefore, backup all your files first!

- requires hard reboot to switch from your primary OS to CentOS

Living with Hyper-V

Option 3: set up a CentOS VM using Hyper-V

https://linuxhint.com/install_centos_hyperv/

Be warned:

- fiddly, IMO
- follow the instructions carefully!

- the CentOS VM seems to be slower when running this way
- I've had display scaling issues with my attempts to do this… YMMV

Living with Hyper-V

Option 4: use rlogin instead

Be warned:

- less convenient (network latency, no GUI tools)
- requires an SSH client if you are running Windows (see software.cs.vt.edu for SSH Secure Shell Client)

OTOH:

- you'll have to do some assignments on rlogin anyway
- CS 3214 requires using rlogin for more or less everything

Running Linux on an OS X Host

Essentially, follow the instructions for a Windows Host, but install the version of VirtualBox for OS X.

Note:

- OS X is not Linux (or UNIX), and that prior students have experienced issues when trying to use the OS X native version of the GCC C compiler in this course.
- Those problems will go away if you run Linux.
- If you decline to do that, you may have to use the rlogin cluster (more later) for all of the UNIX-related and C programming assignments.

SLO Accounts

The CS Department uses a single-logon system (SLO) for many of its resources:

- rlogin cluster
- CS software site

If you are a CS major and have previously taken a CS course at VT, you should already have an account.

If not, or if you've forgotten your SLO password, go to the following link and rectify the problem:

https://admin.cs.vt.edu/

Note that you will need this to access some of the resources necessary for this course.

SSH: secure shell for remote access

Secure shell is a network protocol for secure communication.

An SSH client is supplied with UNIX/Linux, and with OS X.

Windows users should Google for “SSH Secure Shell Client” or for “PuTTY”, which are freely available for non-commercial use.

See software.cs.vt.edu for downloads.

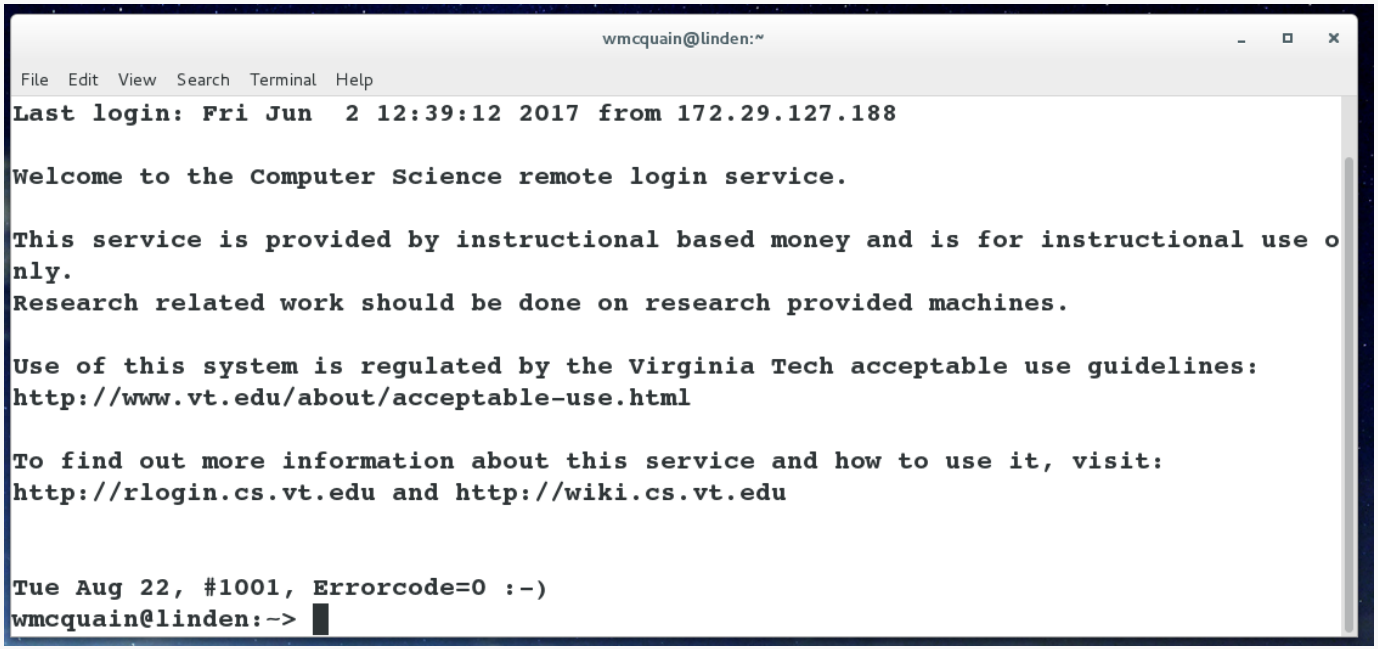
You will use an SSH client to access the rlogin cluster for certain assignments.

rlogin Cluster

The rlogin cluster is a collection of computers, each running CentOS, that are available to for students taking CS courses at VT.

To access the cluster, open a Linux terminal and enter the following command using your VT email PID:

```
ssh <PID>@rlogin.cs.vt.edu
```



Status and other information can be found at:

http://rlogin.cs.vt.edu/

SSH: login without a password

You can set up keys that allow you to ssh to your rlogin account without using a password.

From a Linux or Cygwin terminal on your machine, use the ssh-keygen command to create a key pair; the session will resemble this:

```
1003 wmcquain@centosvm in ~> ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/home/wmcquain/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/wmcquain/.ssh/id_rsa.
Your public key has been saved in /home/wmcquain/.ssh/id_rsa.pub.
The key fingerprint is:
38:ca:59:93:13:e7:94:41:7d:d9:21:a0:a0:54:2e:fc wmcquain@centosvm
The key's randomart image is:
+--[ RSA 2048]----+
|    ..o.o....o.. |
|   o o . +. o..  |
|    + o =  .     |
|     o B         |
|      E S        |
|   . + +         |
|    +            |
|                 |
|                 |
+-----------------+
```

Convenient, not mandatory

SSH: login without a password

Then, use the ssh-copy-id command to install the key on the remote system:

```
1004 wmcquain@centosvm in ~> ssh-copy-id -i ~/.ssh/id_rsa.pub rlogin.cs.vt.edu
. . .
wmcquain@rlogin.cs.vt.edu's password:
. . .
Now try logging into the machine, with:   "ssh 'rlogin.cs.vt.edu'"
and check to make sure that only the key(s) you wanted were added.

1005 wmcquain@centosvm in ~> ssh rlogin.cs.vt.edu
Last login: Mon Jun 26 20:04:56 2017 from c-73-251-28-86.hsd1.va.comcast.net

Welcome to the Computer Science remote login service.
. . .
Tue Aug 22, #1001, Errorcode=0 :-)
wmcquain@hornbeam:~>
```

Convenient, not mandatory

SSH: login without a password

You should now ssh to your rlogin account and see if your key file only contains what you would expect:

```
wmcquain@hornbeam:.ssh> cat authorized_keys
ssh-rsa
. . . wmcquain@centosvm

wmcquain@hornbeam:.ssh> A
```

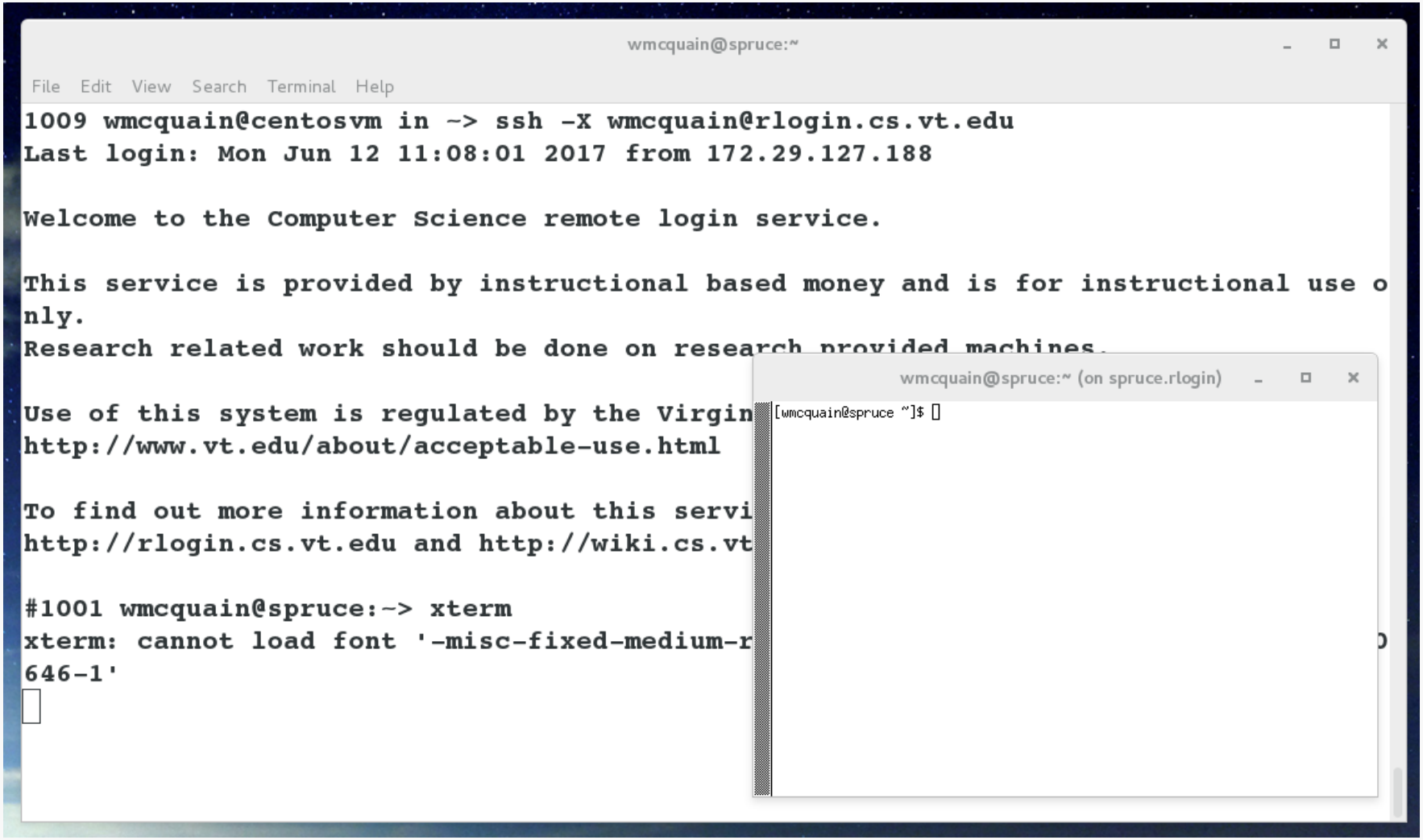
The only authorized key entry corresponds to my login from my local machine.

Now, I can ssh to the cluster without having to provide a password.

Convenient, not mandatory

SSH: opening an X tunnel

Many Linux applications have a graphical user interface; you can execute those on the server (rlogin cluster machine) by using the –X switch when you invoke ssh:



So…

Get to work!

Create an installation of Linux on your laptop/tablet.
- Use VirtualBox or not, your choice.
- Use CentOS 7

Get an SLO account (if you don't already have one) and make sure you know your password.

If you like, set up password-free login (via ssh) to your `rlogin.cs.vt.edu` account.

See the first assignment on the course website!!