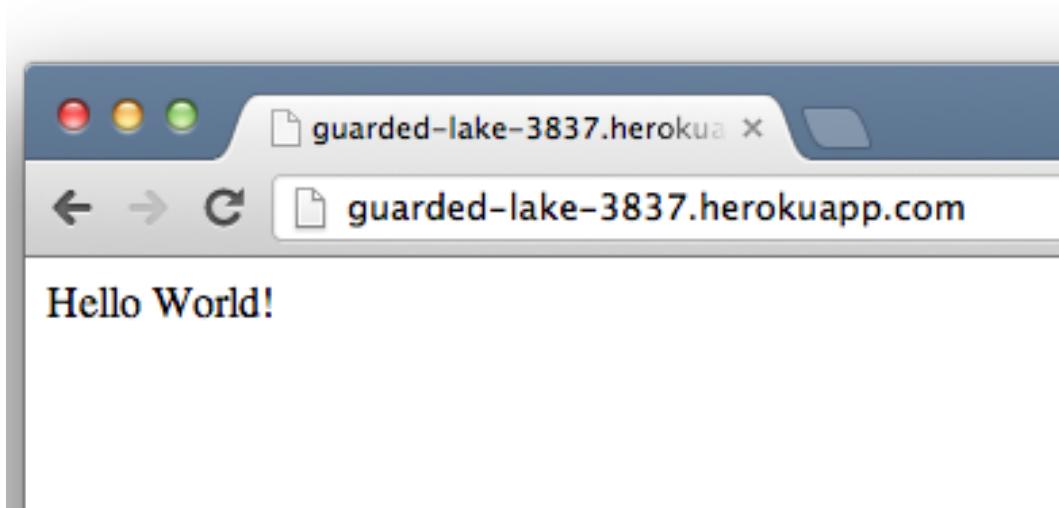


## Interactive Start

### Your First Webapp

Let's get started. Our first goal is to get you set up with a basic development environment and then get a simple page online by following these steps:

1. Set up Google Chrome and your terminal, and sign up for Amazon Web Services (AWS), Github, Heroku, and Gravatar.
2. Initialize and connect to an AWS cloud instance.
3. Clone code from [github.com/heroku/node-js-sample](https://github.com/heroku/node-js-sample), create a new Heroku app and get your page live on the web (Figure 1).

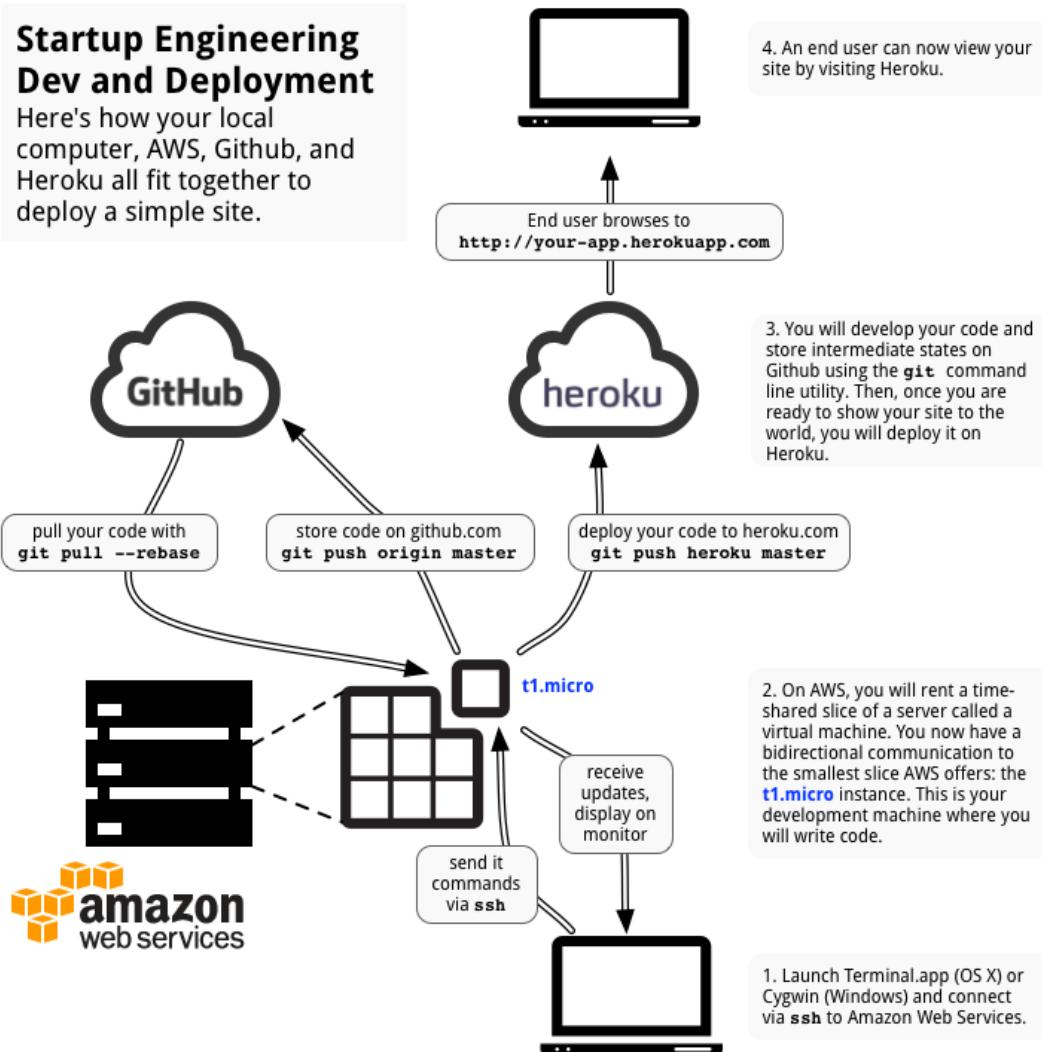


**Figure 1:** Here is what your final goal is: a simple web page up and live on Heroku.

The general concept of how all these services fit together is illustrated in Figure 2. Even if you don't know what all the terms mean, just follow along with the screens in this lecture. We'll review things more formally once you get your simple site online.

## Startup Engineering Dev and Deployment

Here's how your local computer, AWS, Github, and Heroku all fit together to deploy a simple site.

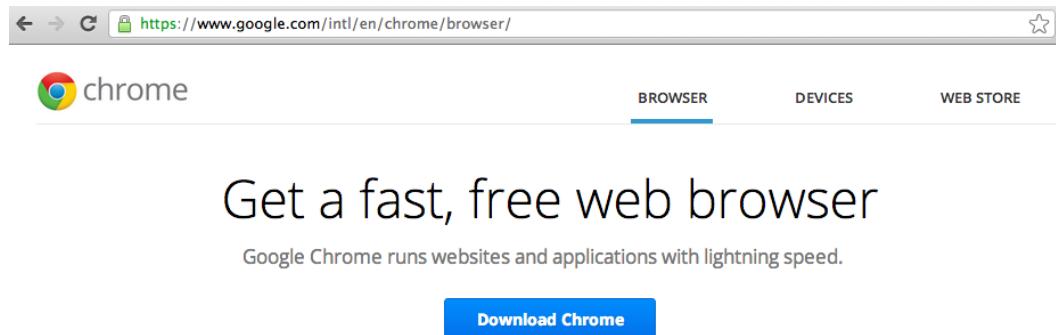


**Figure 2:** Here's how the pieces we set up today will fit together. During the class, you will remotely control an AWS virtual machine from your laptop and use it to edit code, periodically storing the intermediate results on Github. Once you are ready, you will deploy your code to Heroku for viewing by the world. The reason we recommend AWS rather than your local computer for development is that using a **virtual machine** means you can easily **replicate** the development environment. By contrast, it is much more time consuming to get another engineer set up with all the programs and libraries on your local computer. For this lecture, you won't be pushing code to github, but you will be pulling it from `github.com/heroku/node-js-sample`.

## Setup and Signup

### Install Google Chrome

Begin by installing the [Google Chrome web browser](#) and the [User Agent Switcher](#) extension, which you will use to make your browser mimic a smartphone or tablet. Chrome has a number of advanced tools for debugging websites which we will use later on in the class.



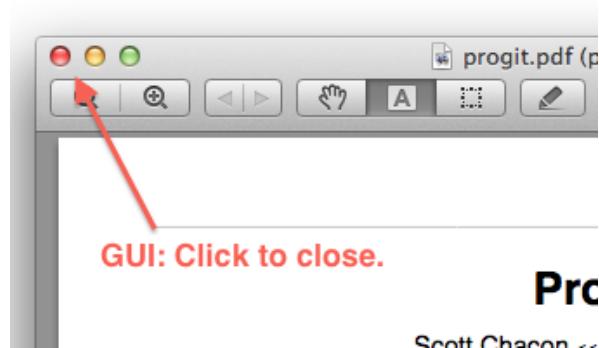
**Figure 3:** Install [Google Chrome](#).



**Figure 4:** Install the [Chrome User Agent Switcher](#), to mimic smartphones/tablets.

## Set up your terminal

A [command line interface](#) (CLI) is a way to control your computer by typing in commands rather than clicking on buttons in a [graphical user interface](#) (GUI). Most computer users are only doing basic things like clicking on links, watching movies, and playing video games, and GUIs are fine for such purposes.



**Figure 5:** Closing an application via the GUI requires a click.

```
balajis@junit:~ - bash - 80x24 - %2
[balajis:~]$ ps xw | grep Preview
 2822 ?? S      1:12.53 /Applications/Preview.app,
_0_376924
 7766 s006 S+    0:00.00 grep Preview
[balajis:~]$ kill 2822   CLI: Type "kill" to close.
[balajis:~]$
```

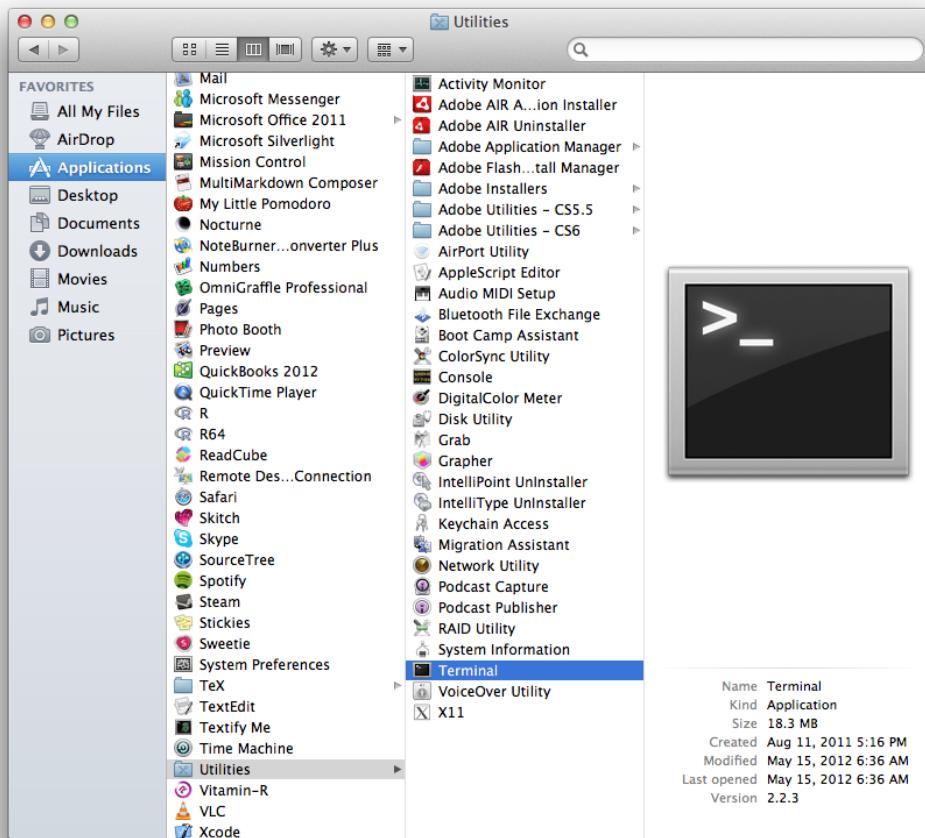
**Figure 6:** Achieving the same task with the CLI by running `kill`.

But to do industrial strength programming - to analyze large datasets, ship a webapp, or build a software startup - you will need an intimate familiarity with the CLI. Not only can many daily tasks be done *more quickly* at the command line, many others can *only* be done at the command line, especially in non-Windows environments. You can understand this from an information transmission perspective: while a standard keyboard has 50+ keys that can be hit very precisely in quick succession, achieving the same speed in a GUI is impossible as it would require rapidly moving a mouse cursor over a profusion of 50 buttons. It is for this reason that expert computer users prefer command-line and keyboard-driven interfaces.

Much of the class will be spent connecting to a remote cloud computer and executing commands there, rather than executing commands on your local computer. However, to accomplish this you will still want to set up a basic command line on your local computer.

- Mac OS X: Terminal.app

Apple laptops are preferred by many Silicon Valley engineers because they run BSD Unix under the hood. We recommend getting a Mac with an SSD drive if you wish to join a startup in the Valley; it is standard issue at this point. You can gain access to the Unix command line by on a Mac by opening up Terminal.app, located under /Applications/Utilities/Terminal.app



**Figure 7:** Double click /Applications/Utilities/Terminal.app.

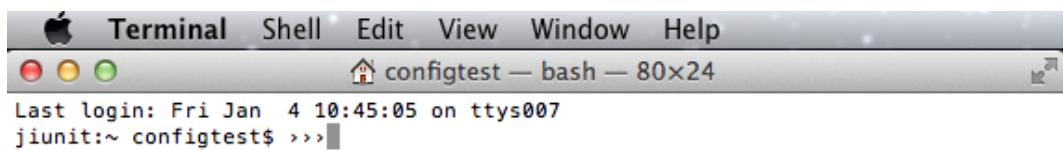


Figure 8: You should see a window like this pop up.

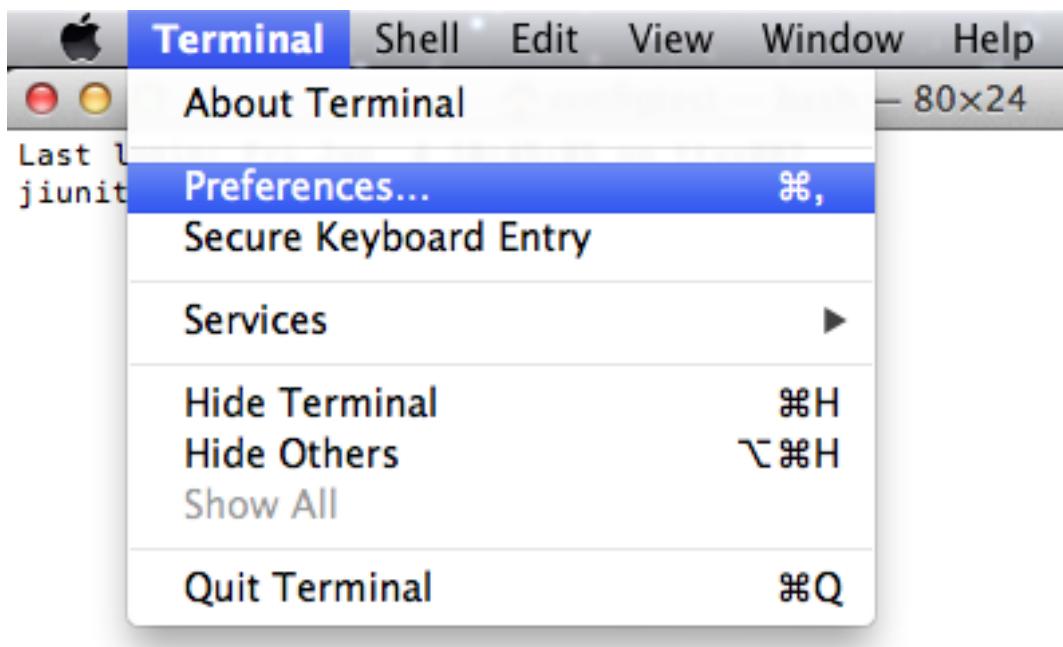
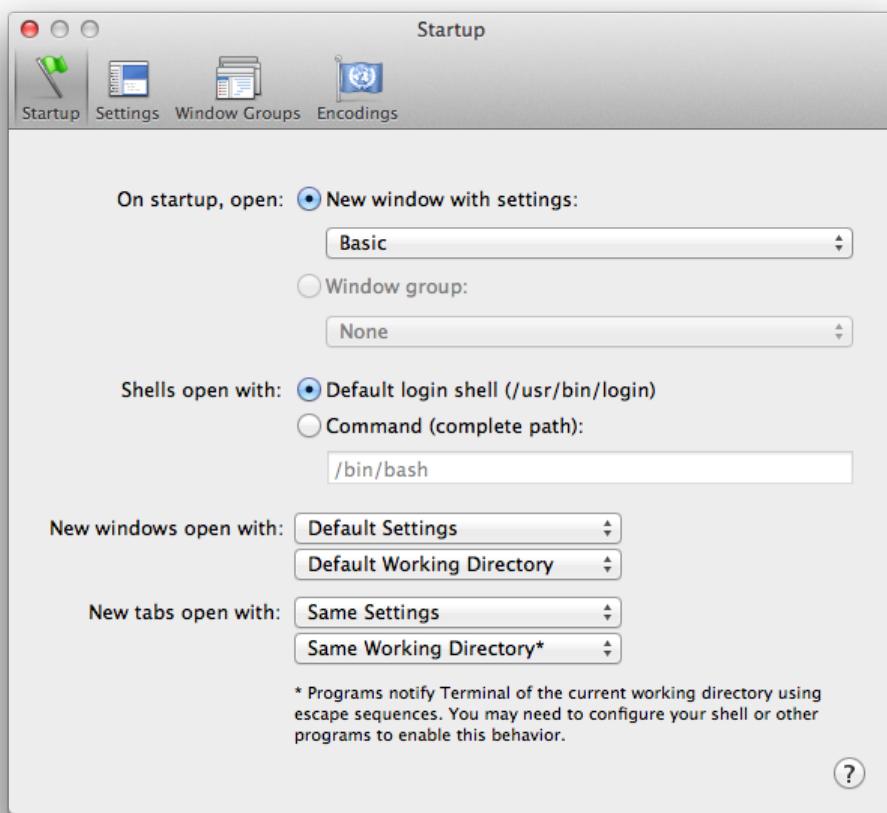
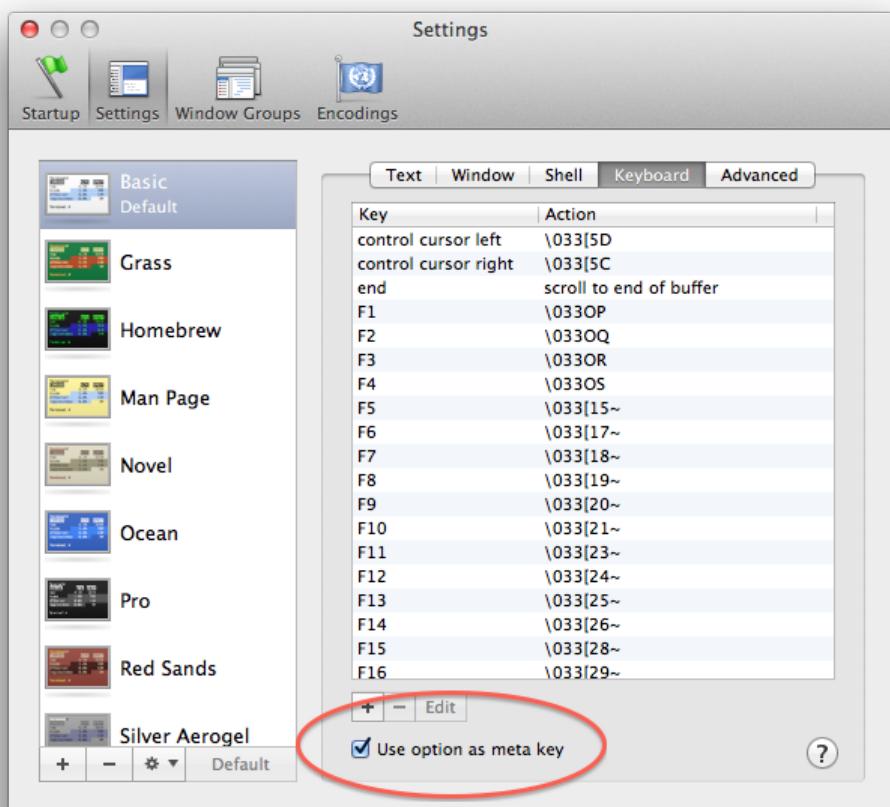


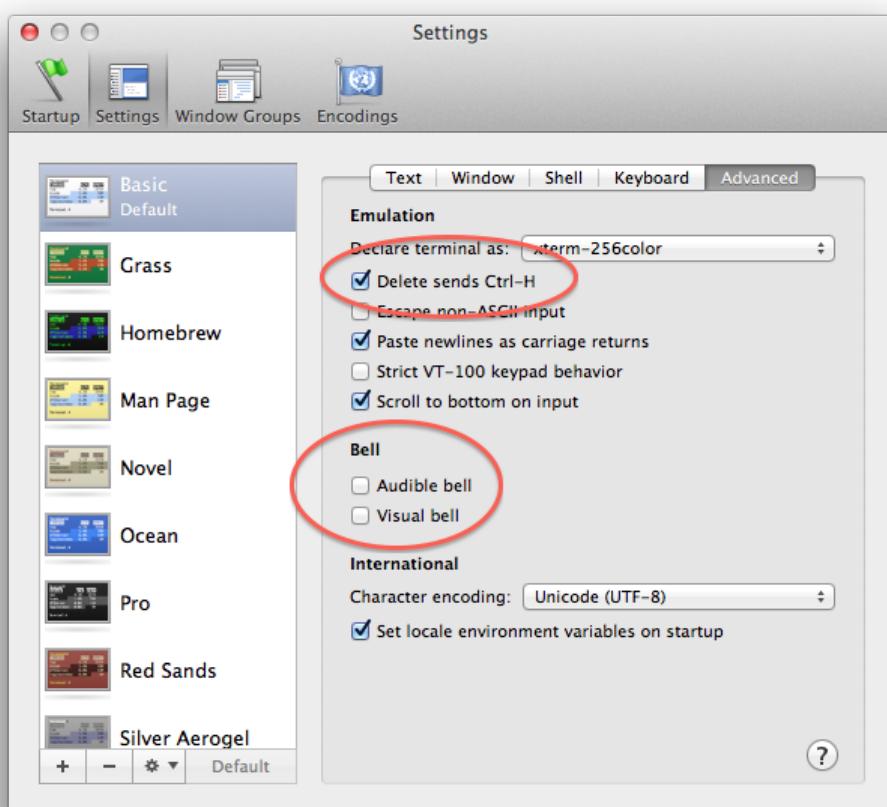
Figure 9: Go to Terminal -> Preferences in the top left.



**Figure 10:** Here's your preference window. There are only a few preferences we need to tweak.



**Figure 11:** Click *Settings* (in the top row of buttons) and then “Keyboard”. Click “Use option as meta key”. You’ll need this for *emacs*.



**Figure 12:** Now click Advanced and set the “Delete sends Ctrl-H” setting. This is useful for Ubuntu.

- Windows: Cygwin

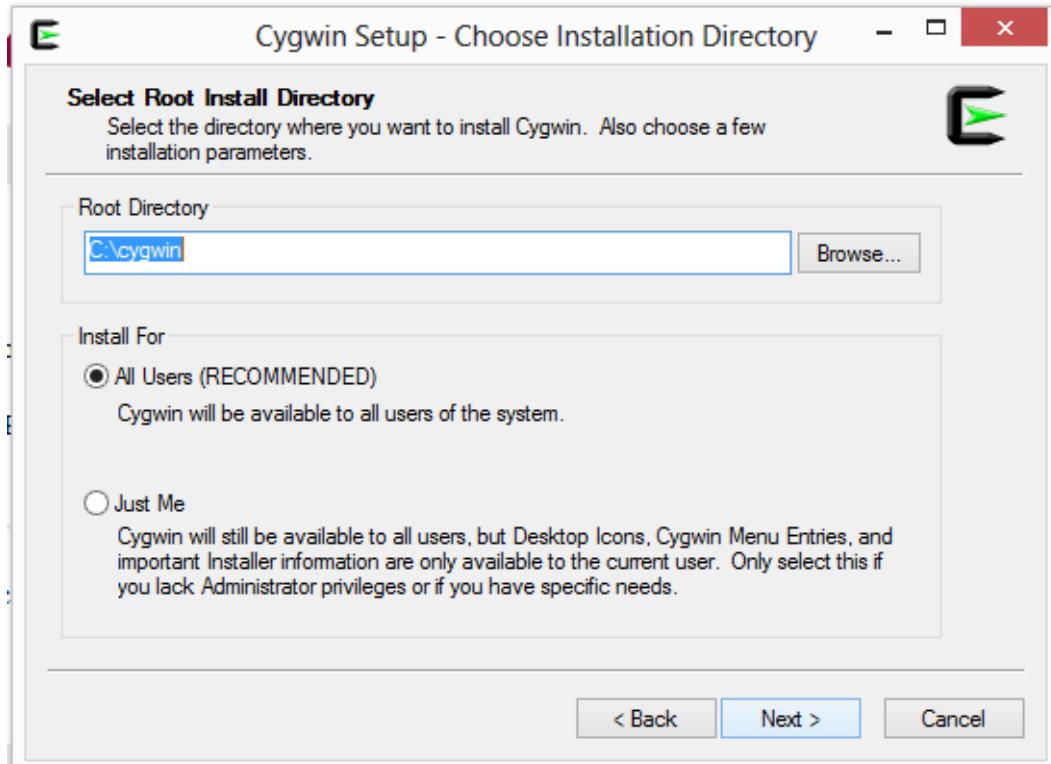
Relatively few startups use Windows computers for their primary development machines, in part because command line support has historically been something of an afterthought. For the many students who still run Windows, for the purposes of this course we are recommending that you use Cygwin to get a Unix-like environment on your Windows computer. Install Cygwin from [cygwin.com/setup.exe](http://cygwin.com/setup.exe) as shown:



**Figure 13:** *Cygwin* provides a *Linux-like* command line environment on *Windows*.



**Figure 14:** Download [cygwin.com/setup.exe](http://cygwin.com/setup.exe) and double-click it.



**Figure 15:** Set up access for all users in the default directory `C:\cygwin`

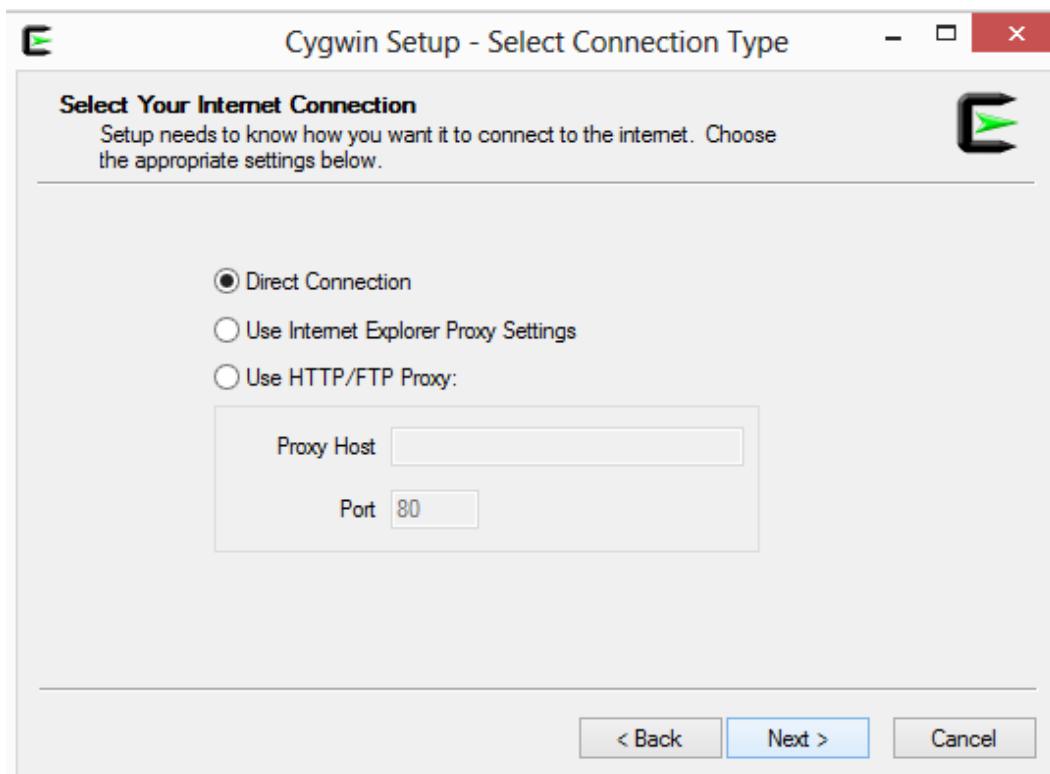


Figure 16: Select “Direct Connection”.

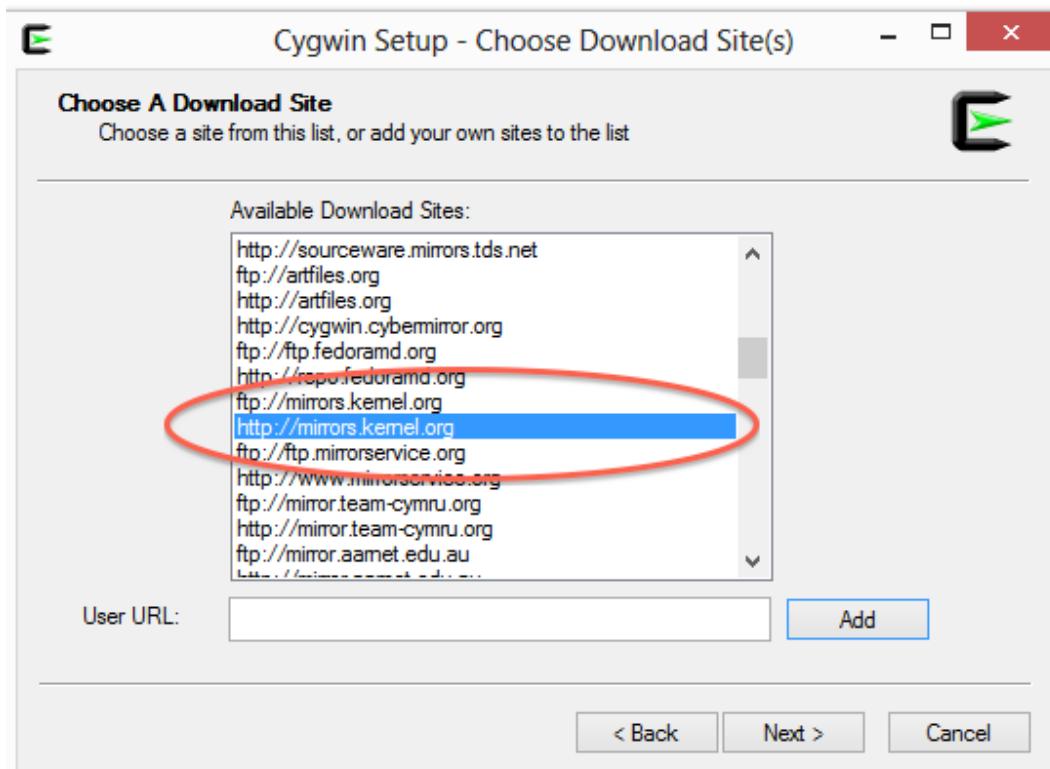


Figure 17: Use `http://mirrors.kernel.org` for fast downloading. This is the Linux Kernel site.

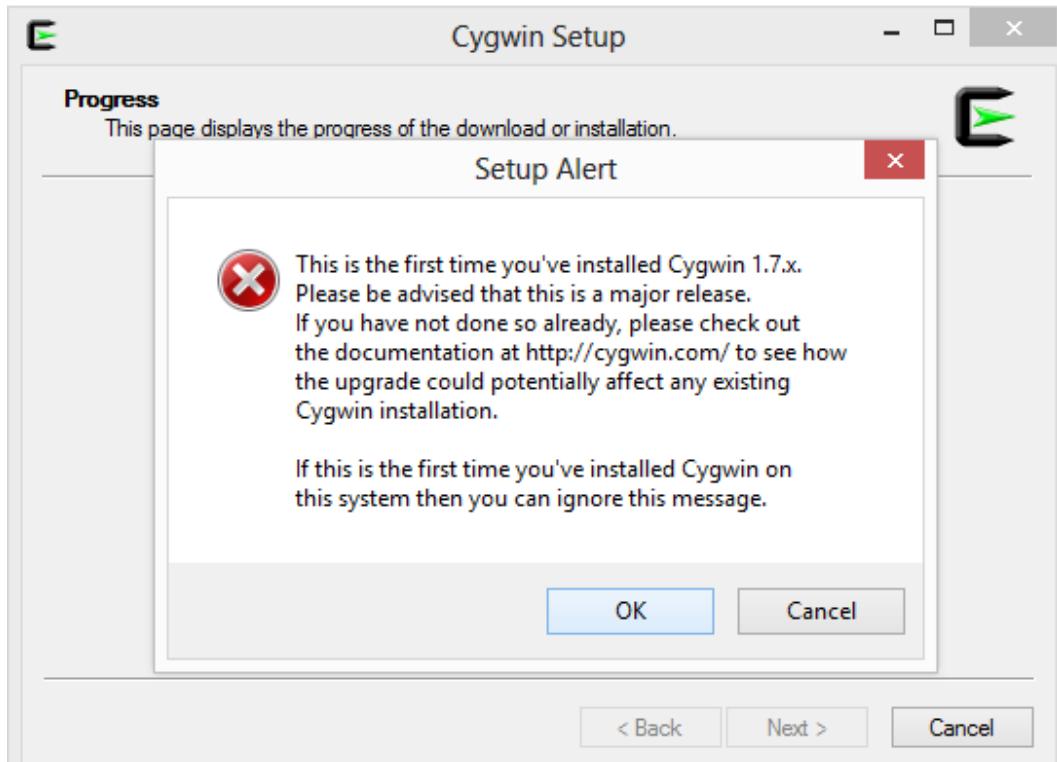


Figure 18: Click OK here.

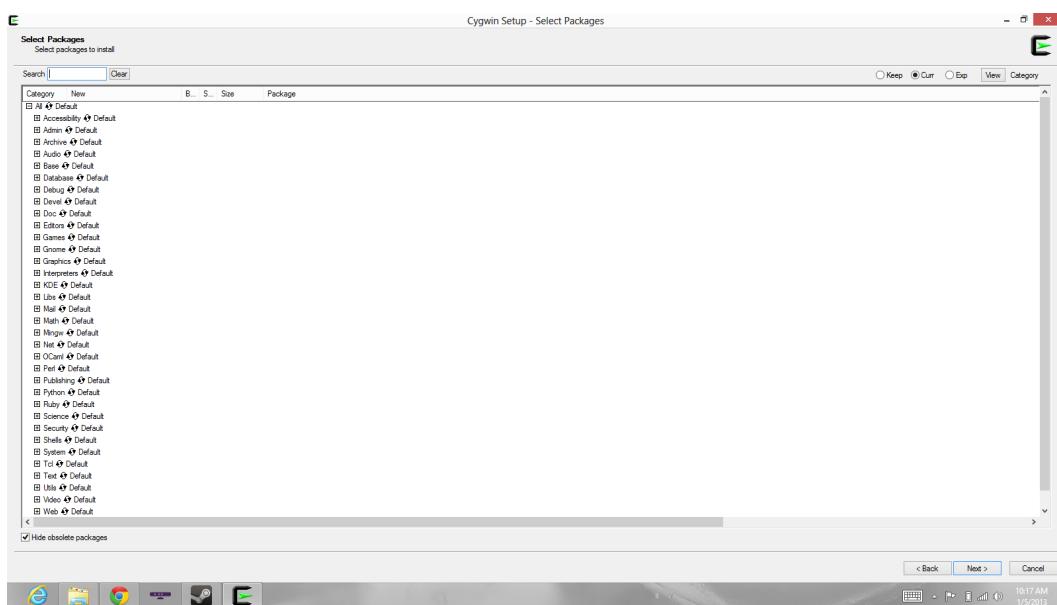


Figure 19: You now need to select some packages to install.

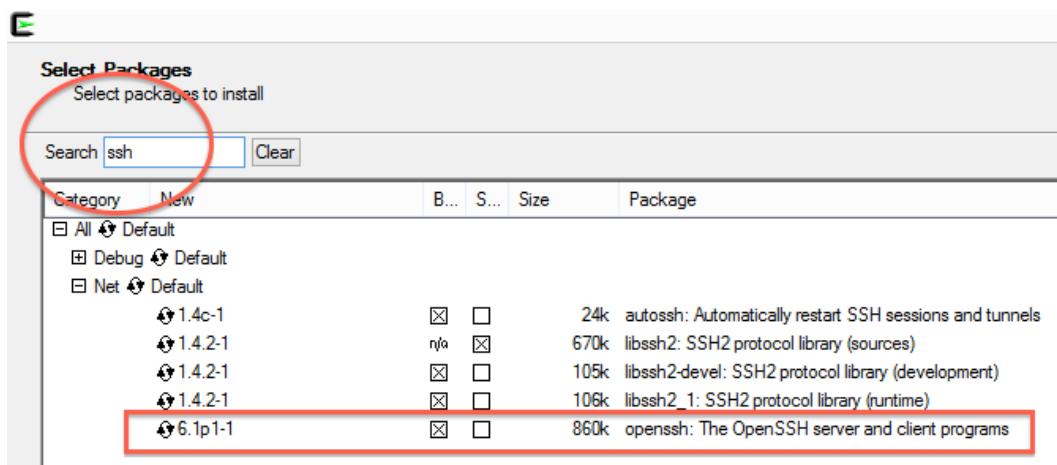


Figure 20: Type in *ssh* and select OpenSSH (what's shown is overkill but doesn't hurt).

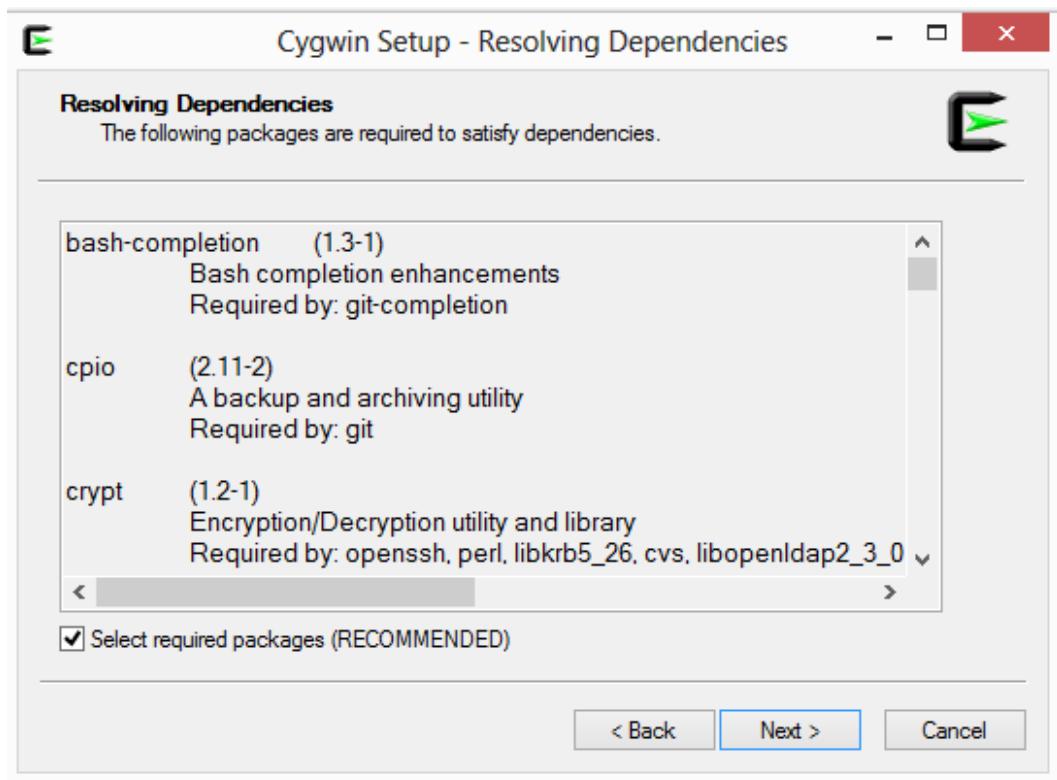


Figure 21: Go ahead to the next screen.

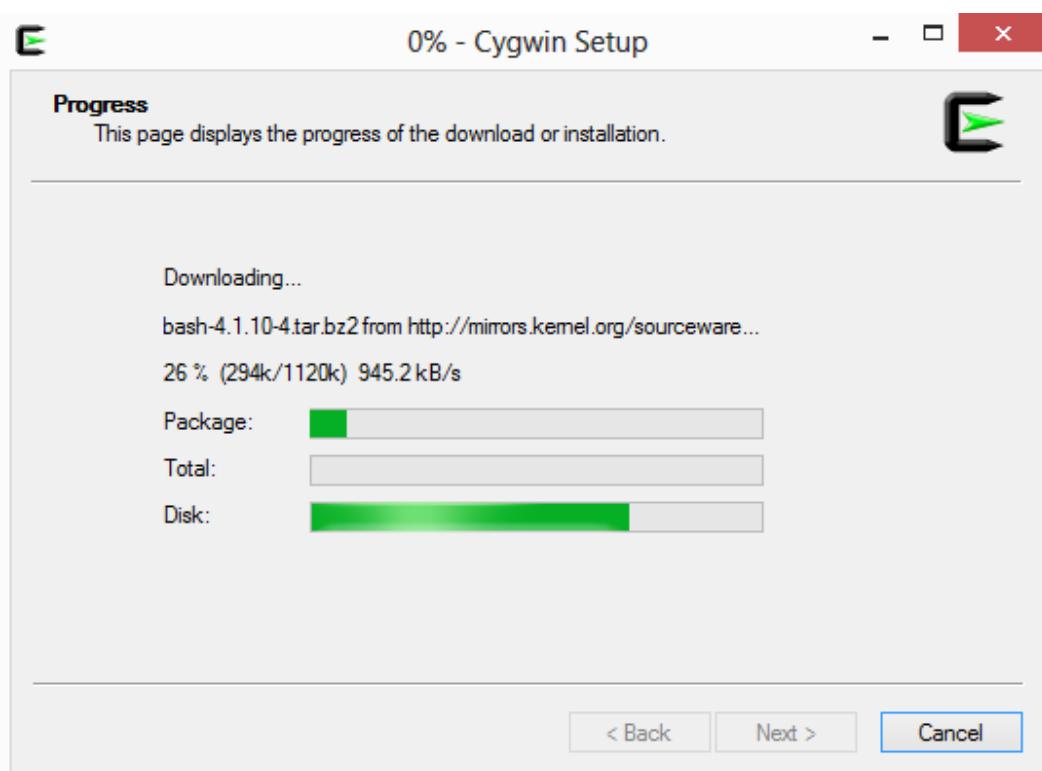


Figure 22: Wait for setup to complete.

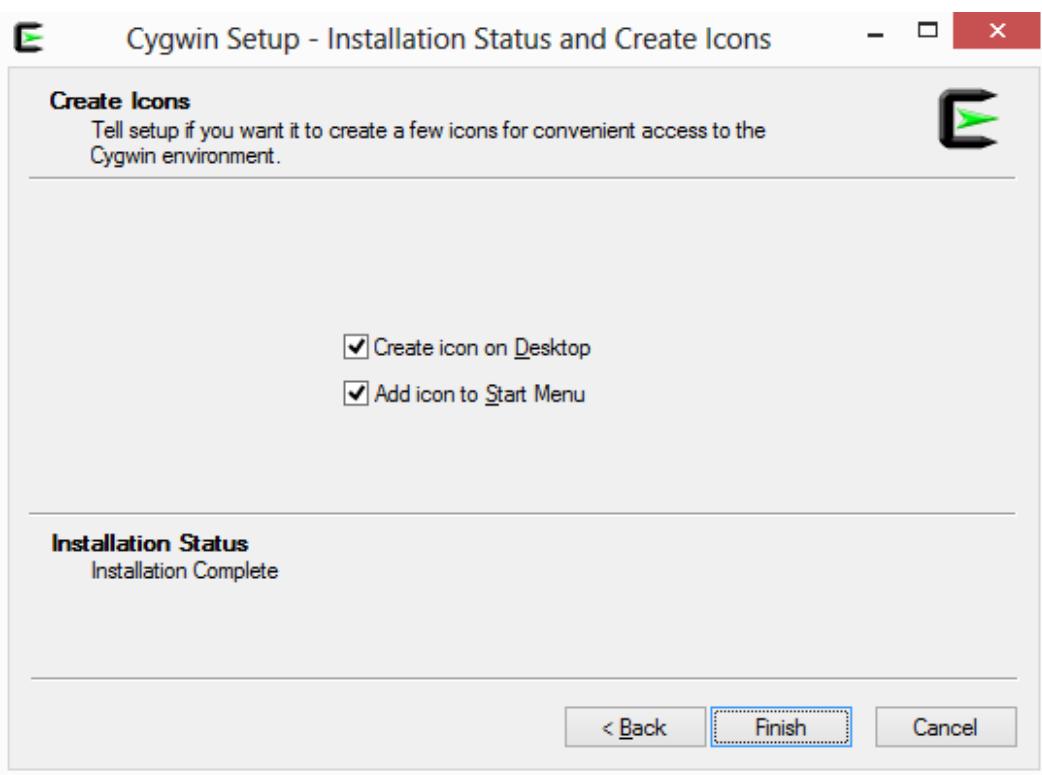


Figure 23: You now have a command-line interface on Windows. Double click the Desktop Cygwin icon to boot up a terminal.

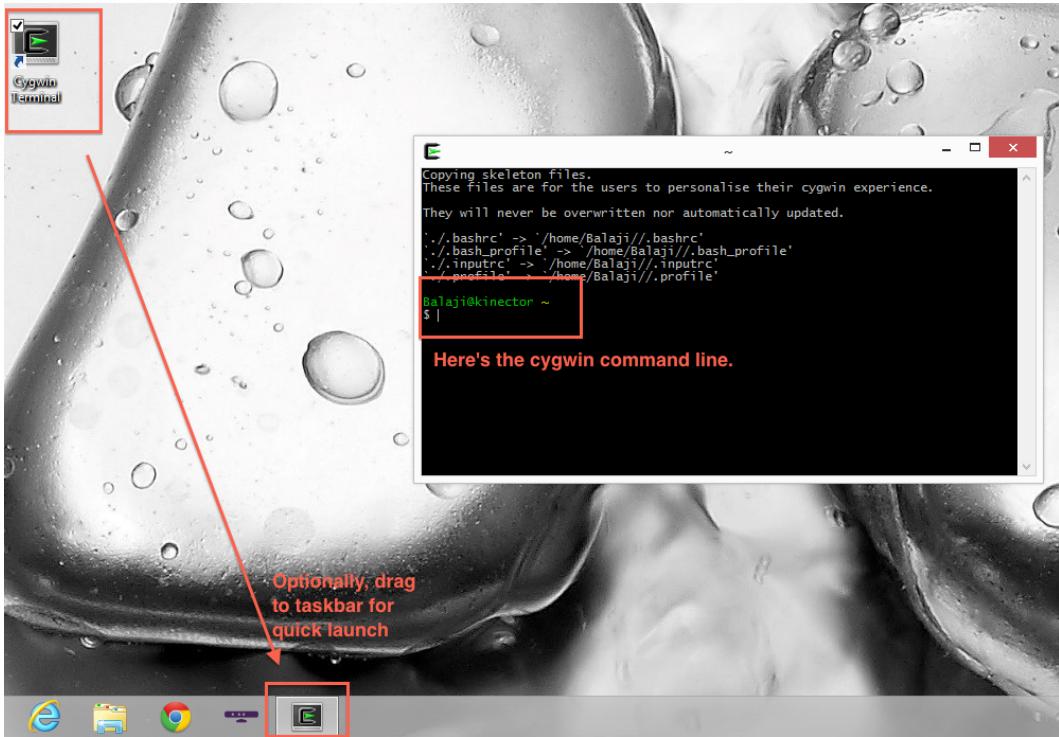


Figure 24: Upon first boot, your Cygwin terminal should show a message like this.

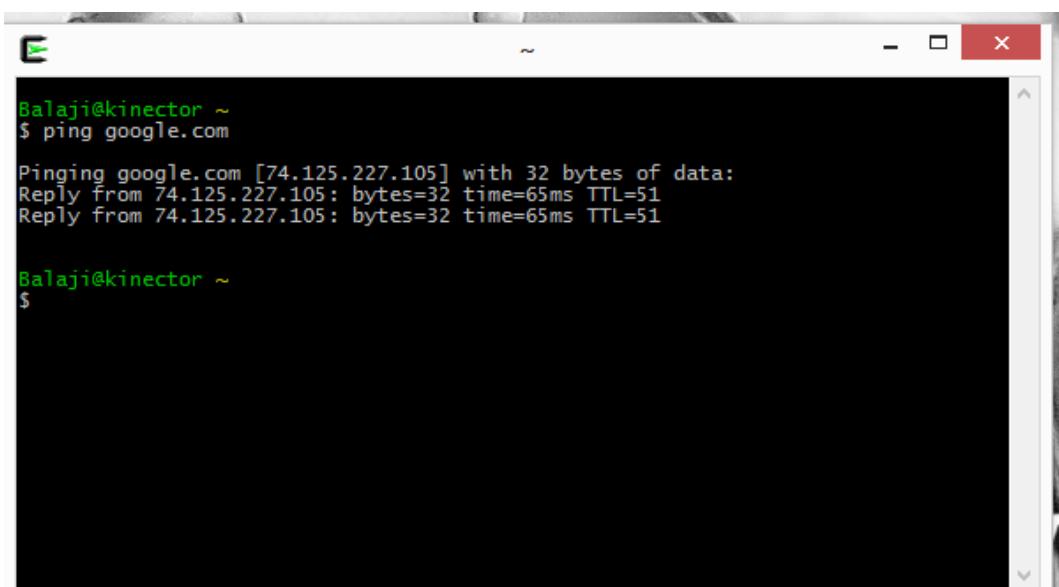


Figure 25: You can confirm it works by typing in `ping google.com` and seeing a Reply.

Besides Cygwin, it is also possible to use a pure SSH client like [Putty](#), a browser-based client like the [Chrome Secure Shell](#), or the native [Windows Powershell](#). The reason we prefer Cygwin is threefold. First, some commands are best done locally. Second, of these alternatives, the environment that Cygwin provides is closest to the environment on a real Unix box, so we don't need to change the instructions around too much for each platform. Third, the local Cygwin environment can be configured to be very similar to the remote environment on your AWS machine (though a Mac will get even closer).

- Linux: Terminal

If you are using Linux, you probably already know how to open up the Terminal. But just in case, here are [instructions for Ubuntu](#).

### **Sign up for AWS, Gravatar, Github, and Heroku**

Now that you have your browser (Chrome) and your terminal (Terminal.app or Cygwin), you will begin by signing up for four webservices:

- Github: [github.com](http://github.com)
- Gravatar: [gravatar.com](http://gravatar.com)
- Amazon Web Services: [aws.amazon.com](http://aws.amazon.com)
- Heroku: [heroku.com](http://heroku.com)

Over the course of this class, you will use Github to store code, Gravatar to identify yourself in public git commits and pull requests, AWS as a development environment for writing code, and Heroku for deploying your code on the web.

- **AWS Signup**

Let's begin by getting you set up with Amazon Webservices. You will need an email account, your cellphone, and your credit card with you to begin. Please use the same email account/phone/credit card for all services used in this course; this will save you headaches related to service synchronization. Note also that the credit card will only be billed if you exceed the free usage tier. We'll talk about this later, and Amazon has some checks in place to prevent you from using too much, but right now you won't be billed. Begin by going to <http://aws.amazon.com> and then following the sequence of screens as shown below:

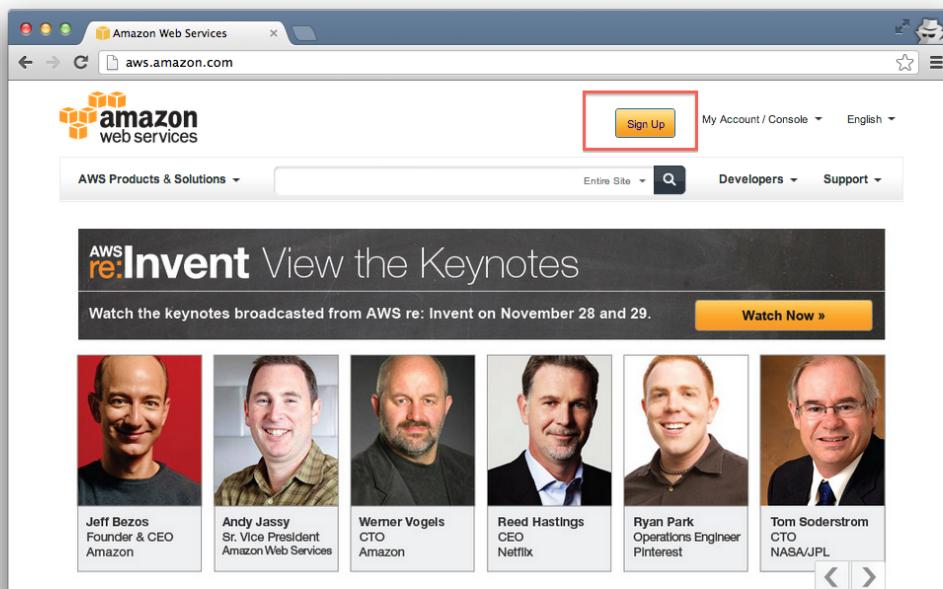
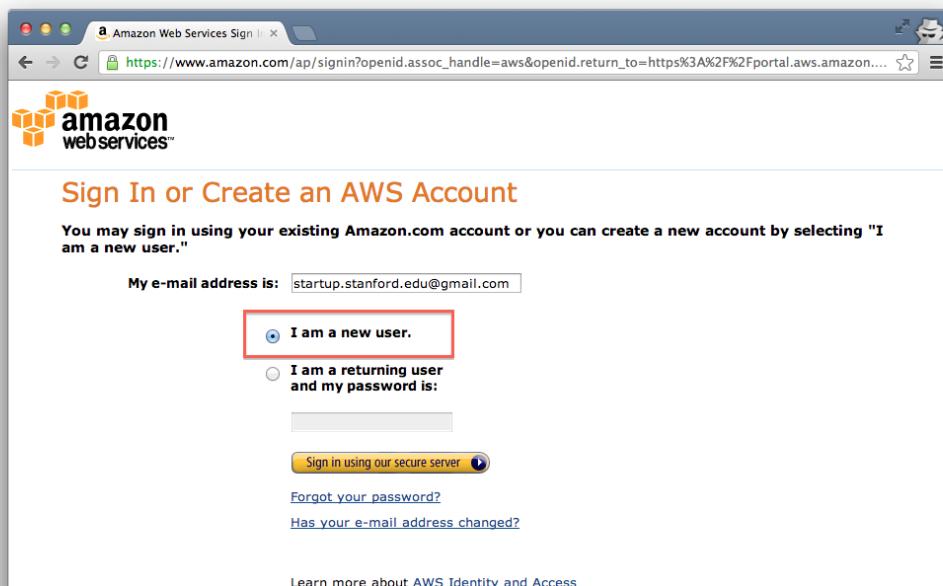


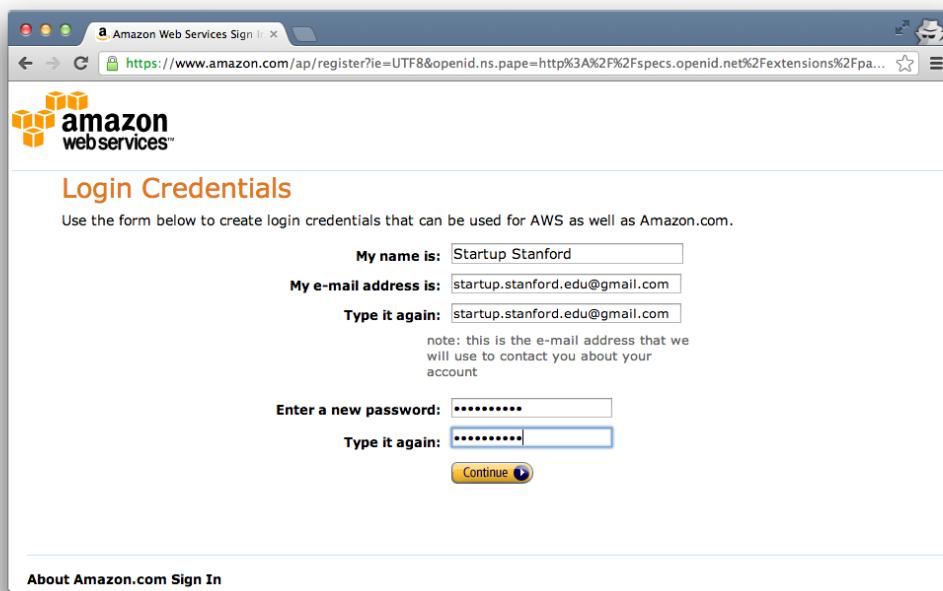
Figure 26: The AWS homepage. Click “Sign Up” at the top.

A screenshot of the AWS sign-up form. The page title is "Amazon Web Services Sign In or Create an AWS Account". It instructs users they can sign in with an existing Amazon account or create a new one. A radio button for "I am a new user" is selected. Below it, another radio button for "I am a returning user and my password is:" is present. There is a text input field for the password. At the bottom of the form are links for "Sign in using our secure server", "Forgot your password?", and "Has your e-mail address changed?". A link "Learn more about AWS Identity and Access" is also visible.

Figure 27: The signup form.



**Figure 28:** Register as a new user.



**Figure 29:** Set up your login.

Amazon Web Services Sign Up

Contact Information

\* required fields

**Full Name\***: Startup Stanford

**Company Name**: Stanford University

**Country\***: United States

**Address Line 1\***: [REDACTED]  
Street address, P.O. box, company name, c/o

**Address Line 2**: [REDACTED]  
Apartment, suite, unit, building, floor, etc.

**City\***: [REDACTED]

**State, Province or Region\***: [REDACTED]

**ZIP or Postal Code\***: [REDACTED]

**Phone number\***: [REDACTED]

Security Check

Image:

Try a different image

Why do we ask you to type these characters?

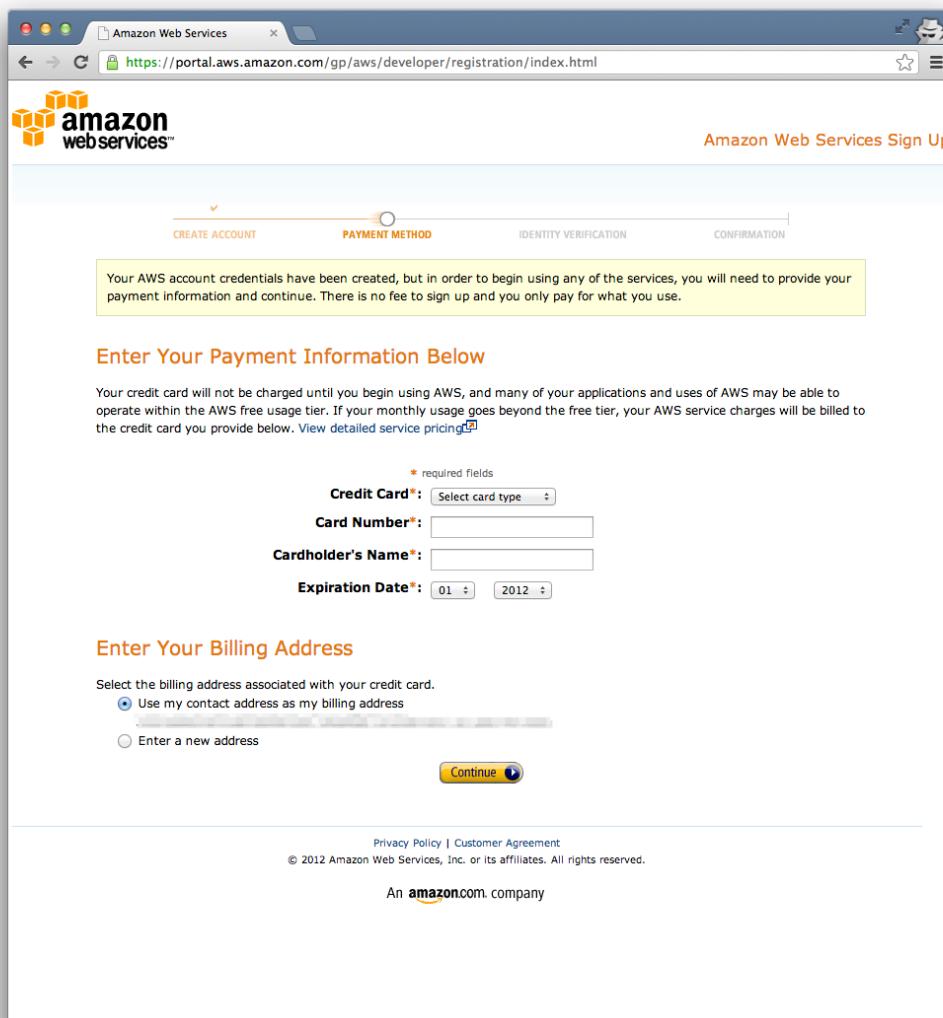
Type the characters in the above image\*: LHRPRT  
Having Trouble? Contact us.

AWS Customer Agreement

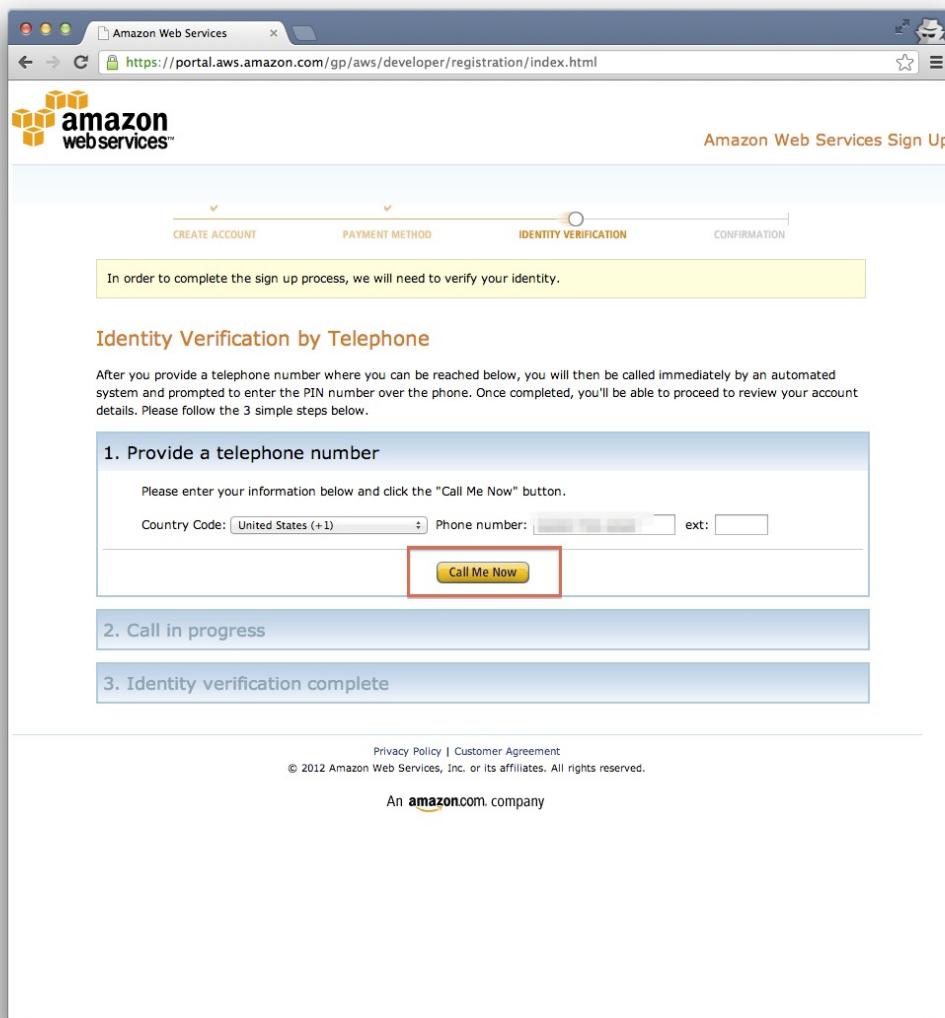
Check here to indicate that you have read and agree to the terms of the Amazon Web Services Customer Agreement. [\[link\]](#)

Create Account and Continue

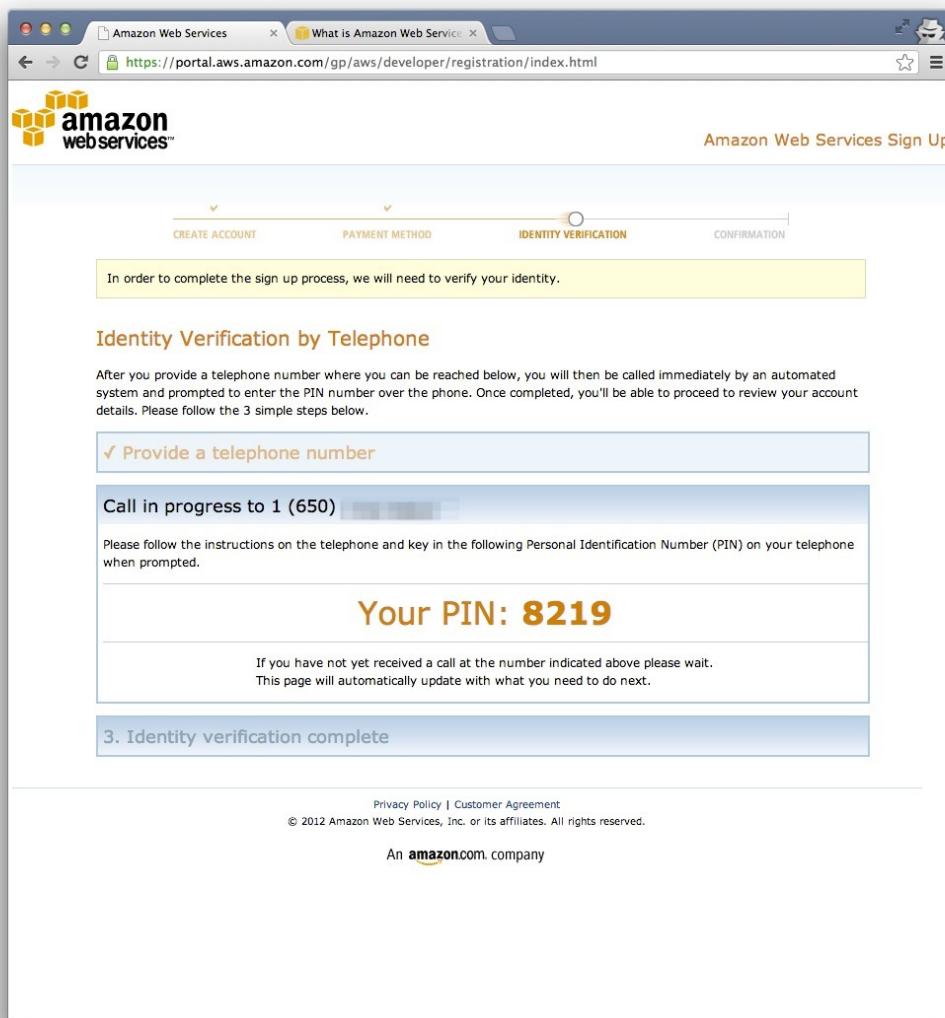
Figure 30: Enter address and complete CAPTCHA.



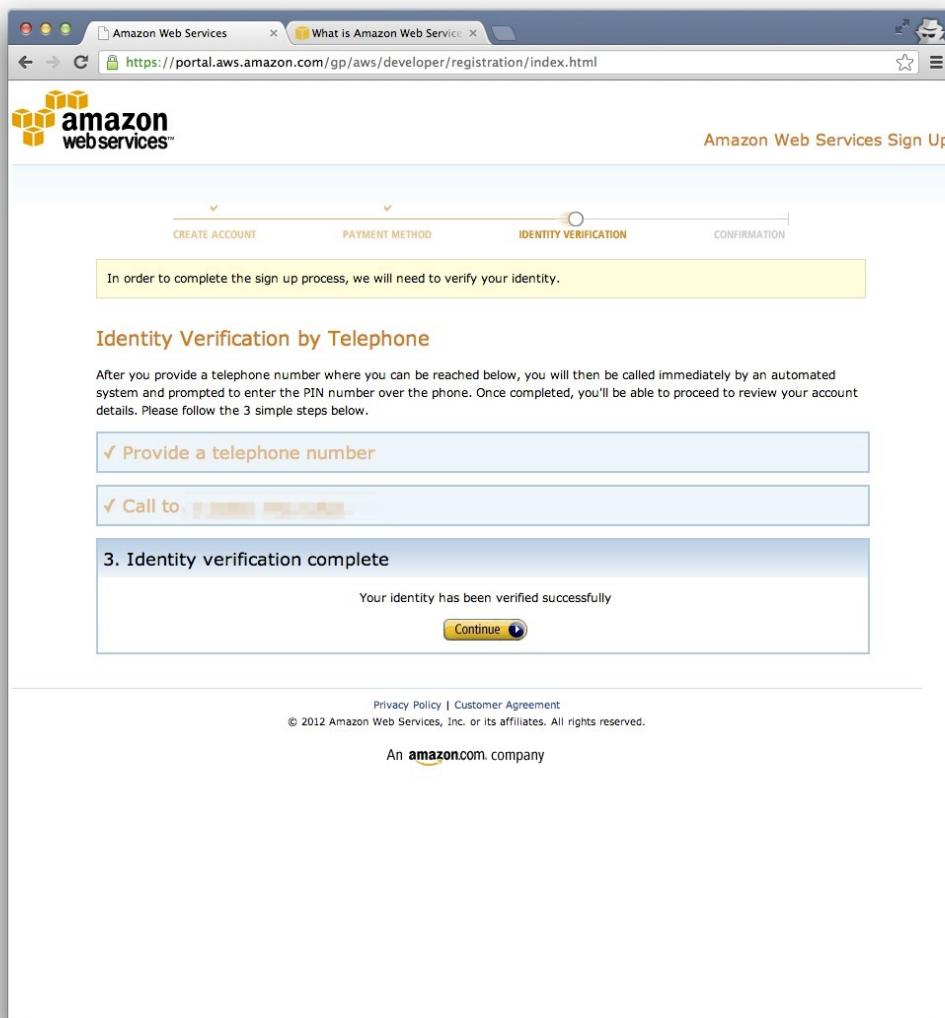
**Figure 31:** Set up your credit card.



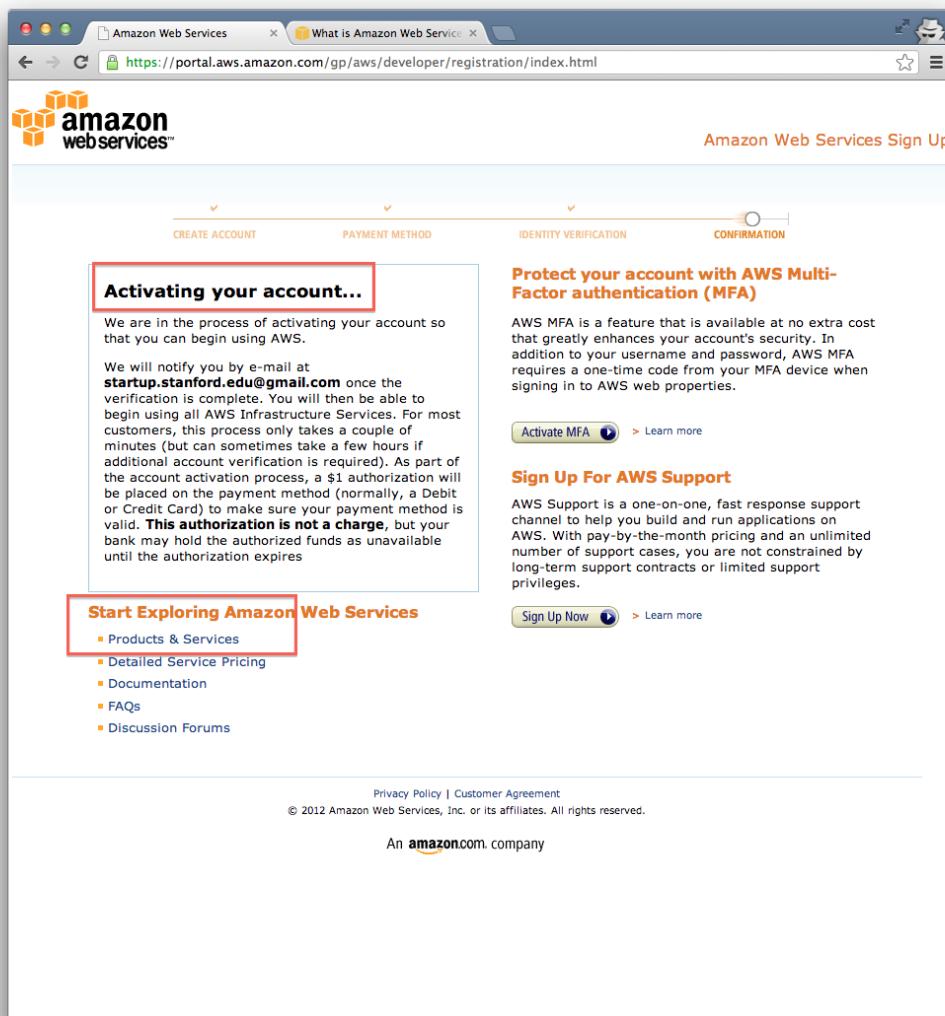
**Figure 32:** Begin phone verification.



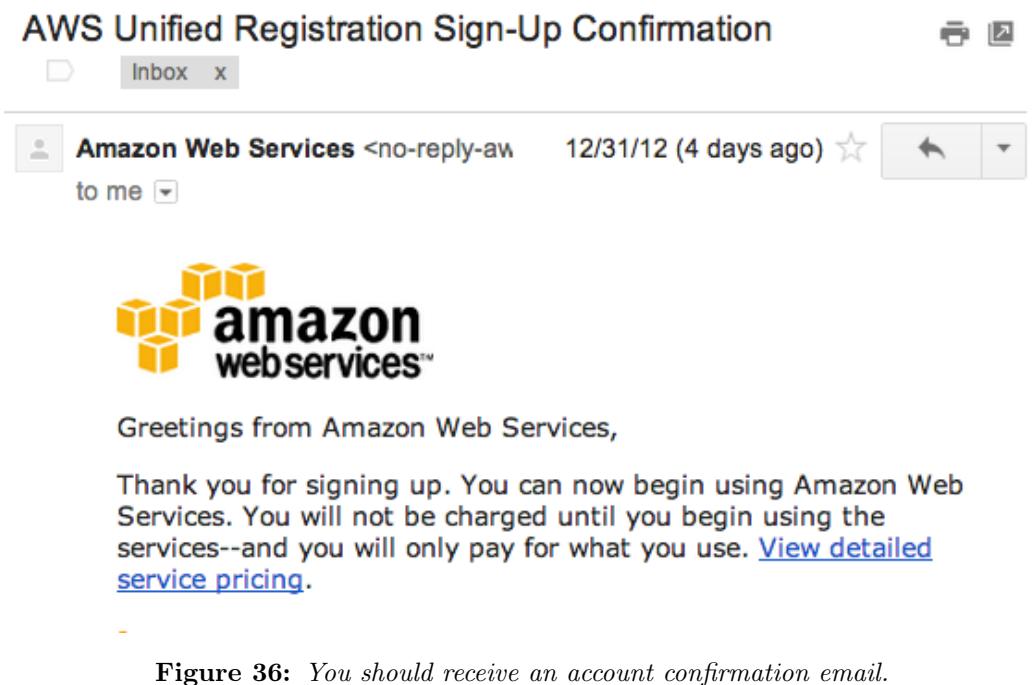
**Figure 33:** When called, enter in your PIN followed by an asterisk ('\*').



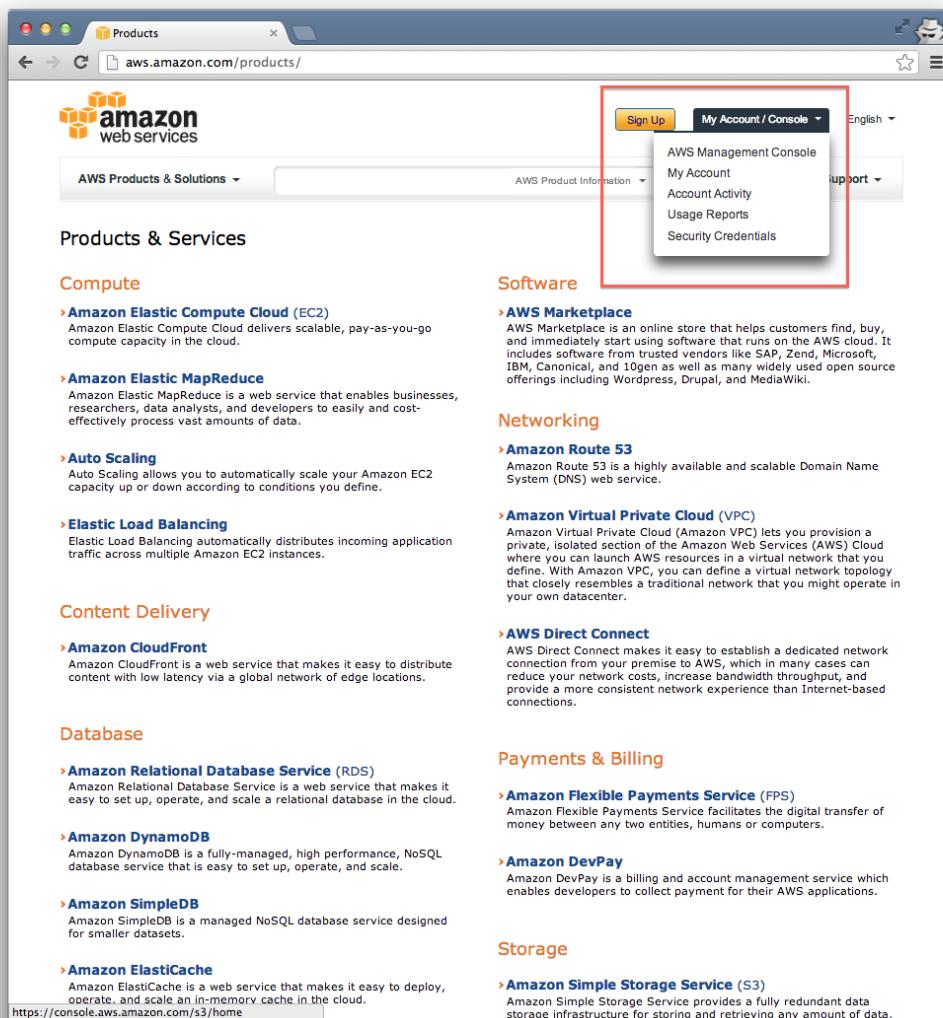
**Figure 34:** *Identity verification complete.*



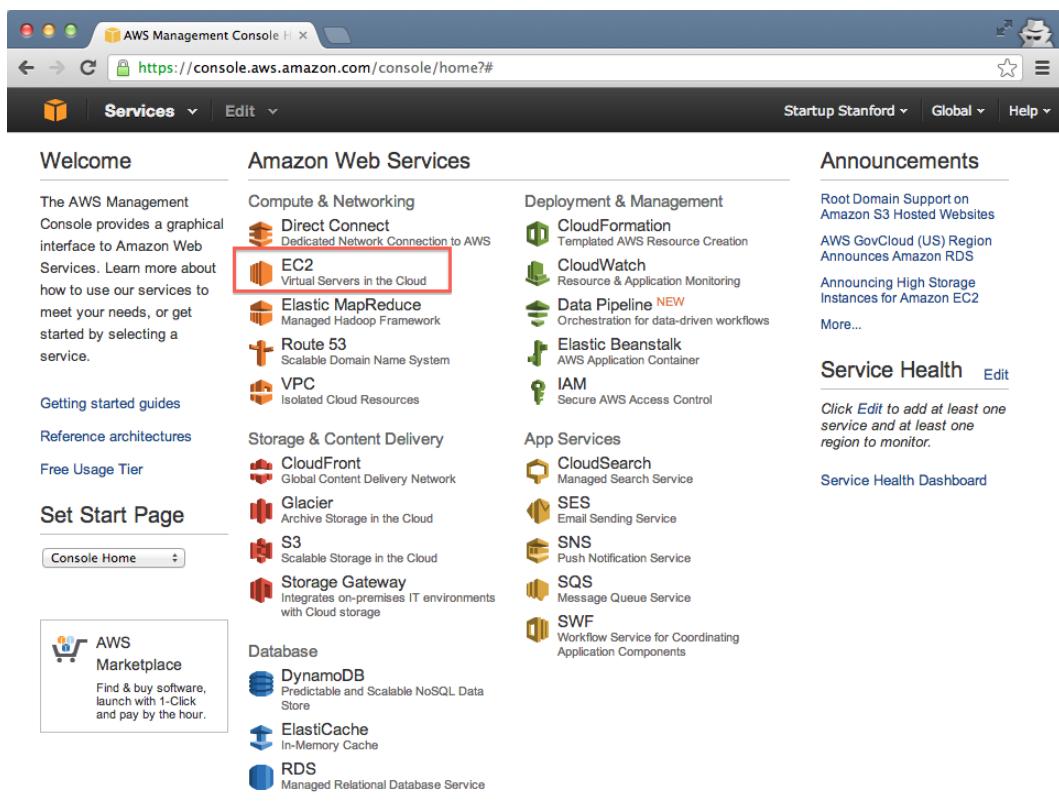
**Figure 35:** Account activation is now beginning. This may take a while.



**Figure 36:** You should receive an account confirmation email.



**Figure 37:** Go to [aws.amazon.com/products](https://aws.amazon.com/products) and click ‘My Account Console’ to log in.

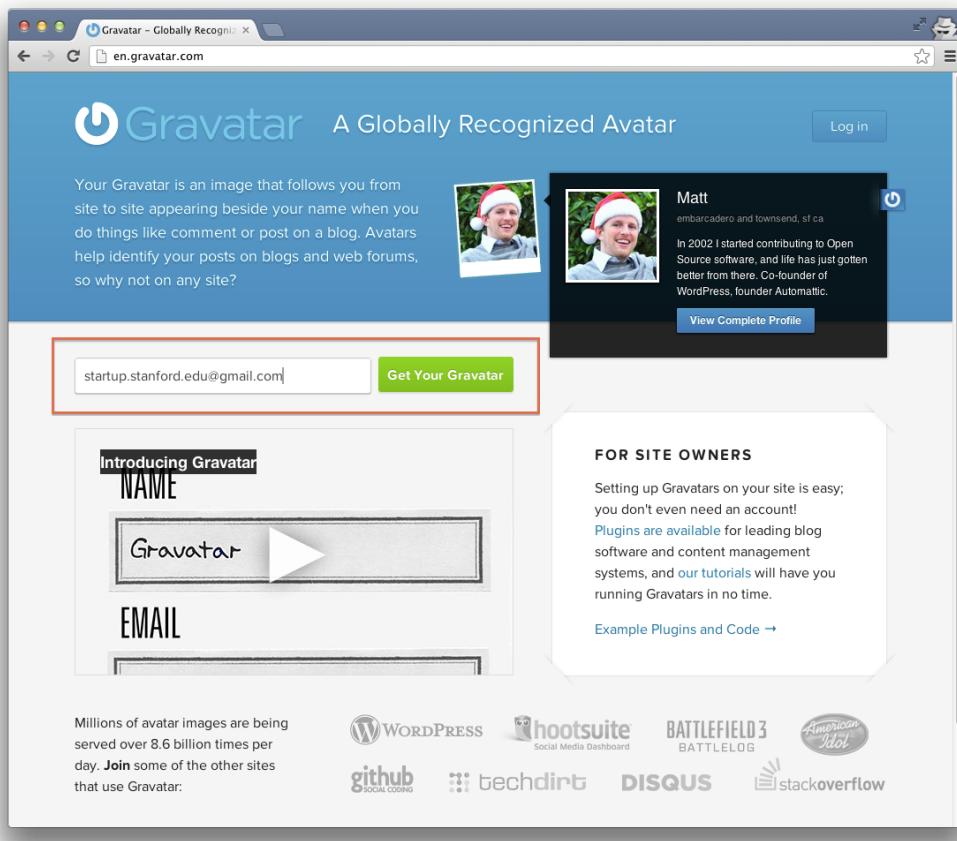


**Figure 38:** Now you have an active AWS dashboard. EC2 (boxed) will be of particular interest to us soon.

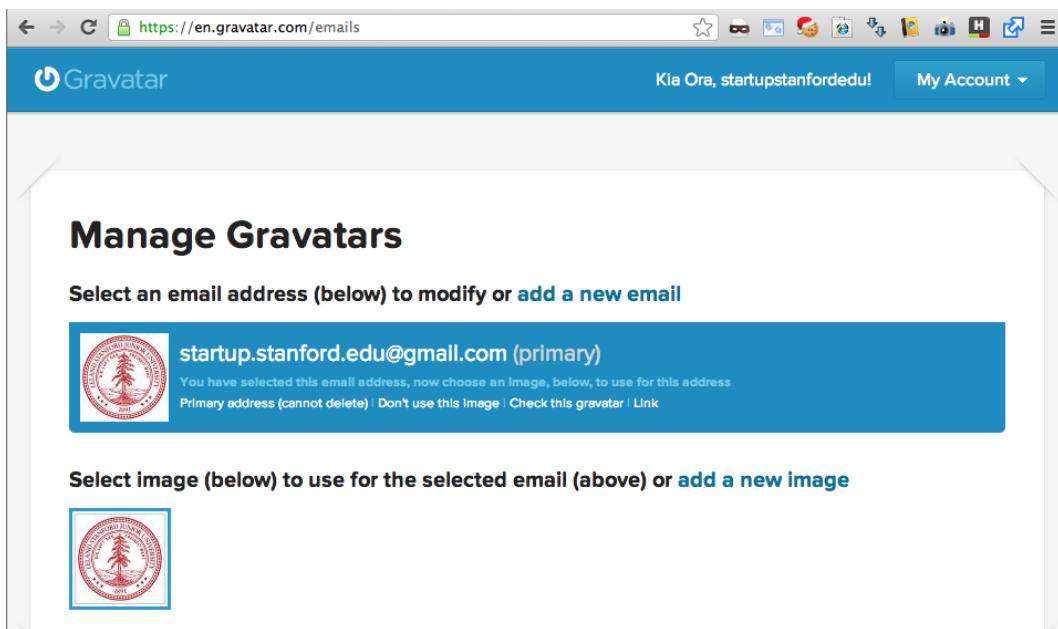
Fantastic. You now have access to a variety of AWS services. Let's keep going and we'll come back to this dashboard as the class progresses.

- Gravatar Signup

The next step is to get your Gravatar account set up, so that you have a *globally recognizable avatar* that will be used to identify your git commits. A Gravatar is very similar to the small image that appears next to your comments on Facebook, except that it is used by sites outside of Facebook, such as Github. Begin by going to <http://www.gravatar.com> and then work through the following steps:



**Figure 39:** Go to the gravatar homepage to get started.

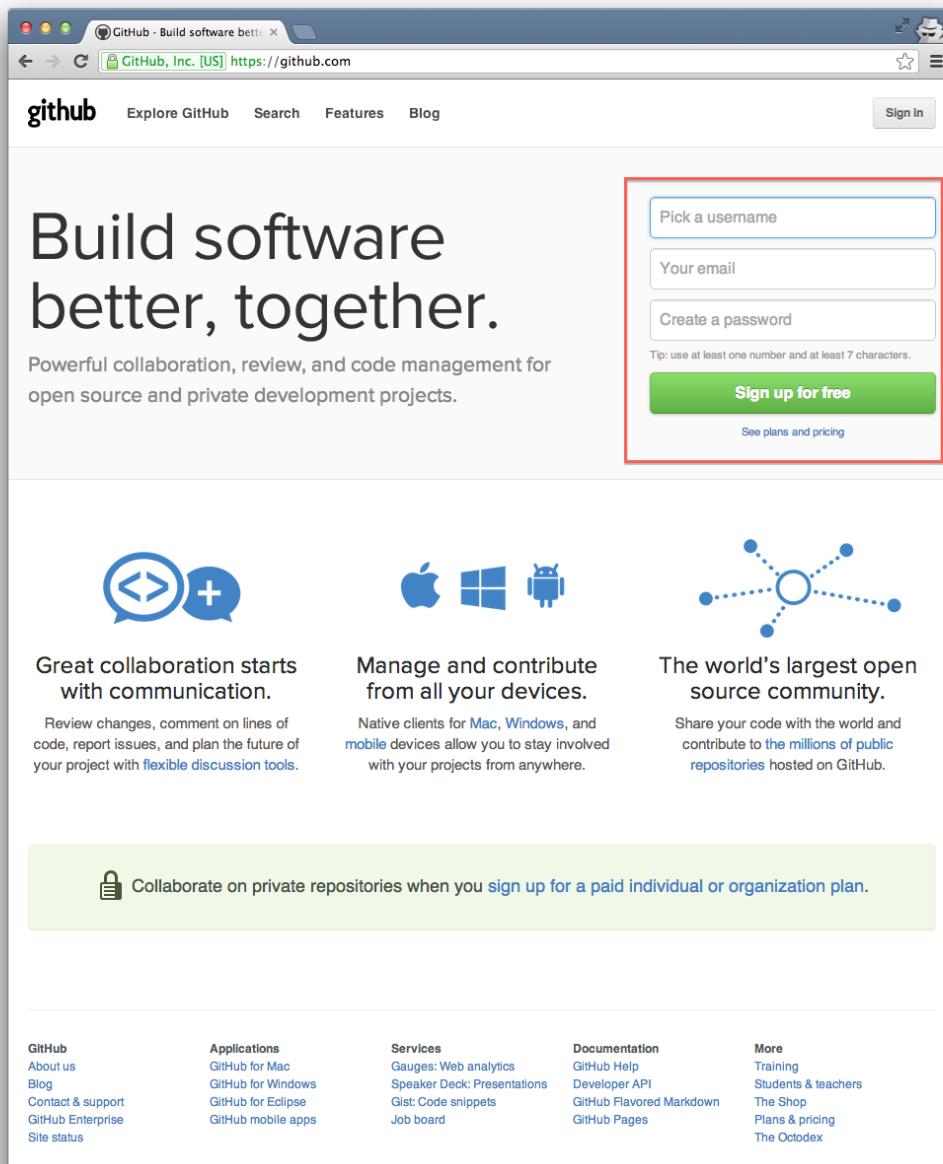


**Figure 40:** Once everything is set up, your page should look like this.

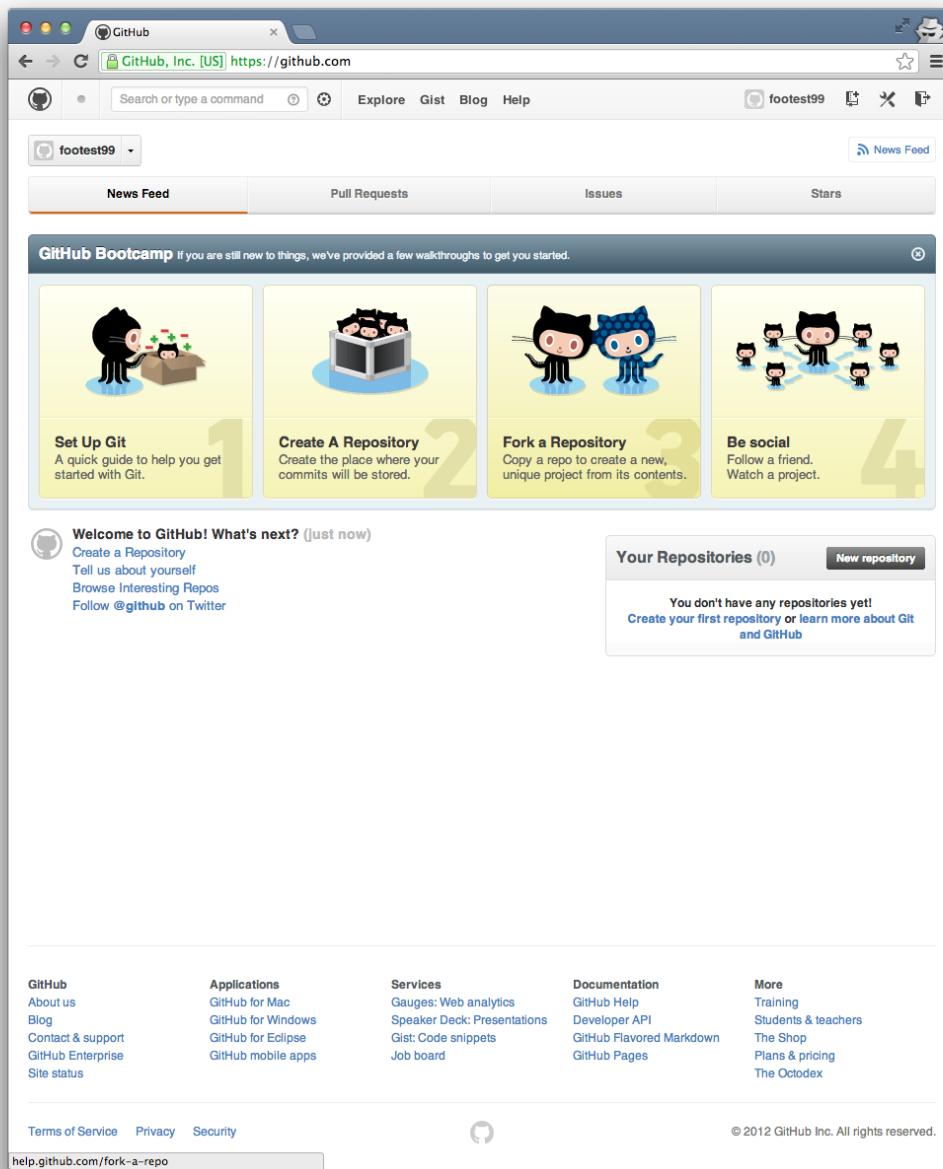
The Gravatar site has been buggy in the past and you may need to repeat some of the steps (particularly the cropping step and the “add a new image” step at the very end) a few times. Do this by logging out of Gravatar, clearing cookies in Chrome, logging back in and resuming where you left off.

- Github Signup

Github is one of the most important developments in software over the past five years. The site began in 2008 as a simple frontend for the open-source `git` distributed version control tool, which we will cover in much more detail later in the course. In this sense it was similar to code repositories like SourceForge, Google Code, or Bitbucket. But Github has transcended the category to become an institution in its own right. Features that it pioneered (like web-based pull requests and `README.md` files) are now crucial tools for any group software engineering work. Moreover, github.com is now the world’s largest and most dynamic repository of open-source code, and a strong Github account has become more important than your CV or formal education for the most cutting-edge technology companies. Let’s get started by navigating to <http://www.github.com>.



**Figure 41:** Sign up in the top right and confirm your account via email.



**Figure 42:** After signing in, you will see this page.

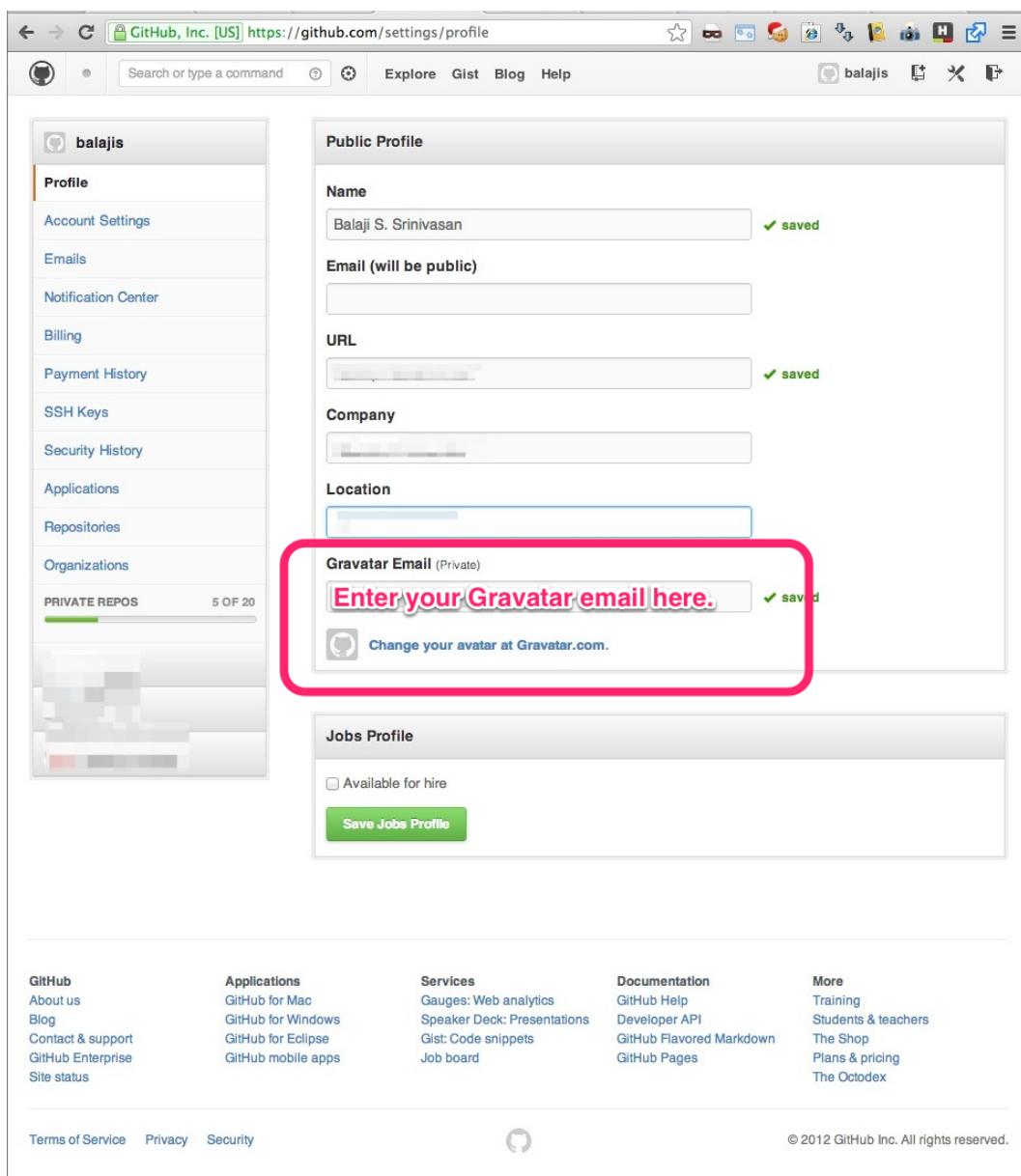


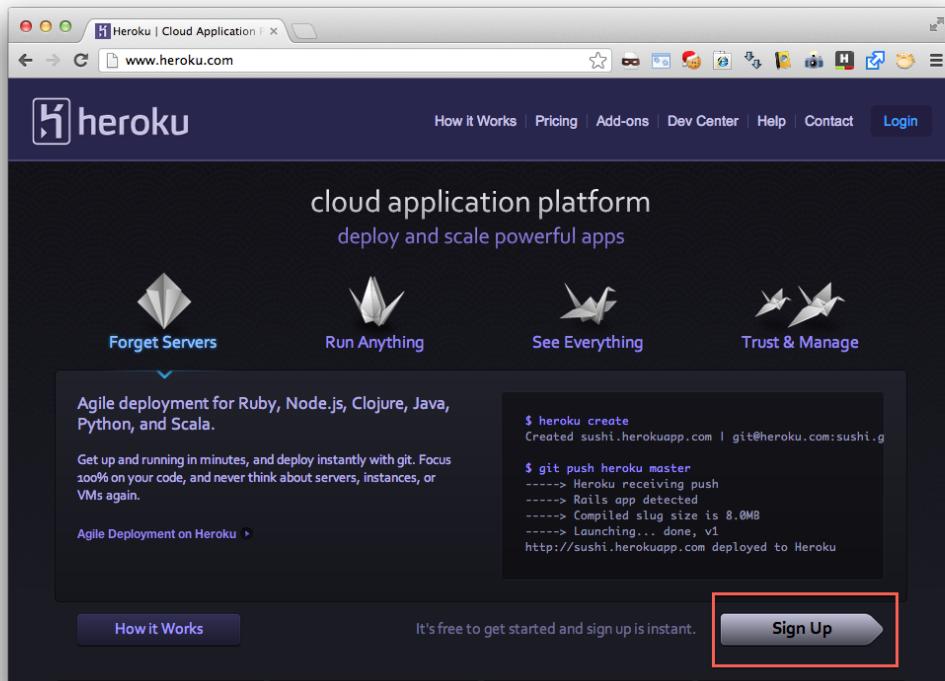
Figure 43: Navigate to `github.com/settings/profile` to enter your Gravatar email

You now have a Github account, which you will use for hosting your sourcecode for this class and likely for future projects. Take a look at your [profile page](#) in particular.

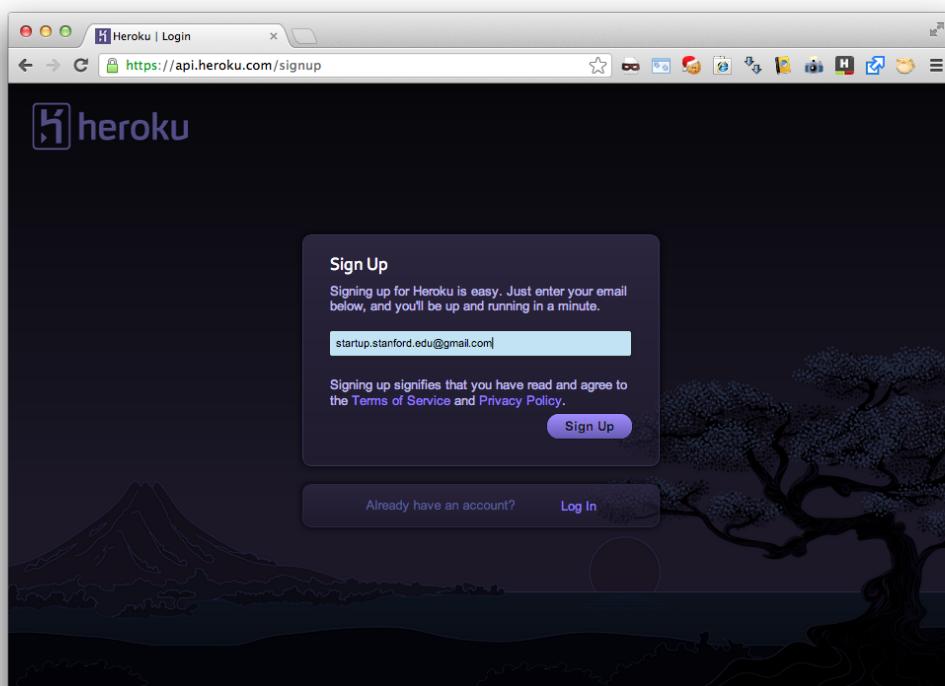
Importantly, if you [fork](#) a repository, you can optionally submit a so-called *pull request* to the owner of the upstream repository to merge in your contributions. As an analogy, this is like making a copy of a book (forking), writing up a new chapter (editing), and then sending that chapter back to the original author to integrate into the main book should he deem it worthy (issuing a pull request, i.e. a request to pull your code back into the main book). We'll cover these concepts in more depth later in the class.

- [Heroku Signup](#)

The last account we want to get configured is on Heroku, which began as a layer on top of Amazon Web Services. While AWS focuses more on low-level hardware manipulations, Heroku makes it easy to deploy a web/mobile application (see [here for more](#)). Begin by going to <http://www.heroku.com>.



**Figure 44:** The Heroku homepage. Click “Sign Up” in the bottom right.



**Figure 45:** Enter your email.

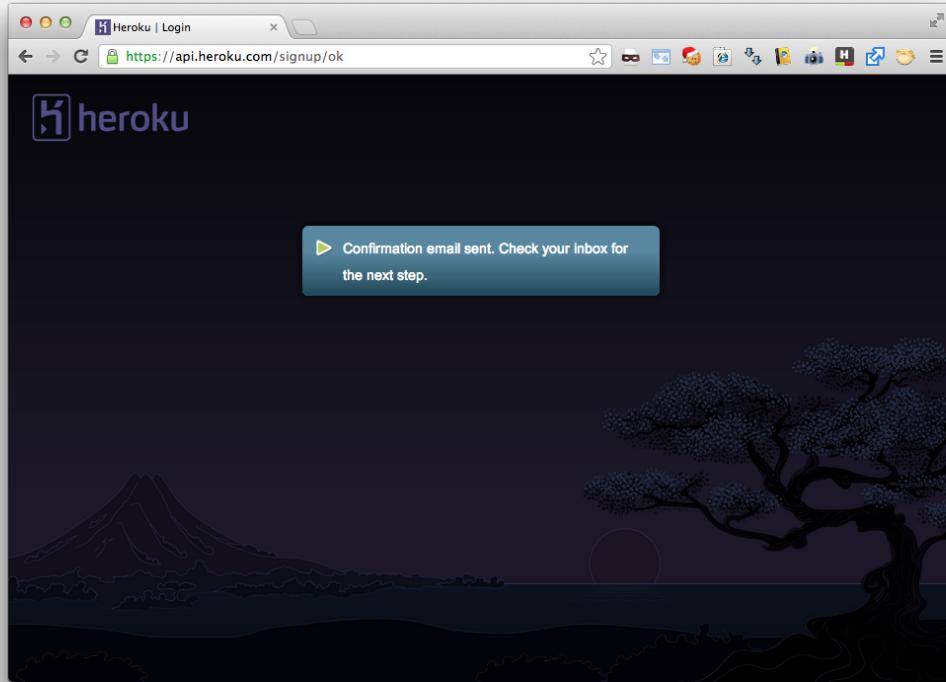


Figure 46: You should see a confirm page.

Confirm your account on Heroku Inbox x

---

 Heroku <bot@heroku.com> 4:05 PM (0 minutes ago) star back forward

to me ▾

Thanks for signing up with Heroku! You must follow this link to activate your account:

<https://api.heroku.com/signup/accept2/1>

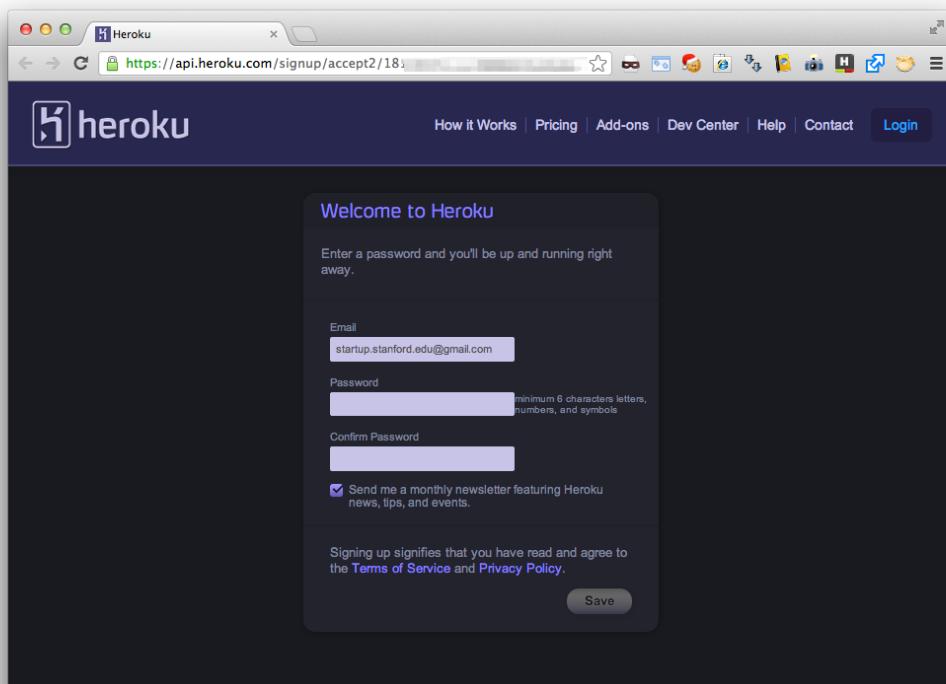
Have fun, and don't hesitate to contact us with your feedback.

- The Heroku Team  
<http://heroku.com/>

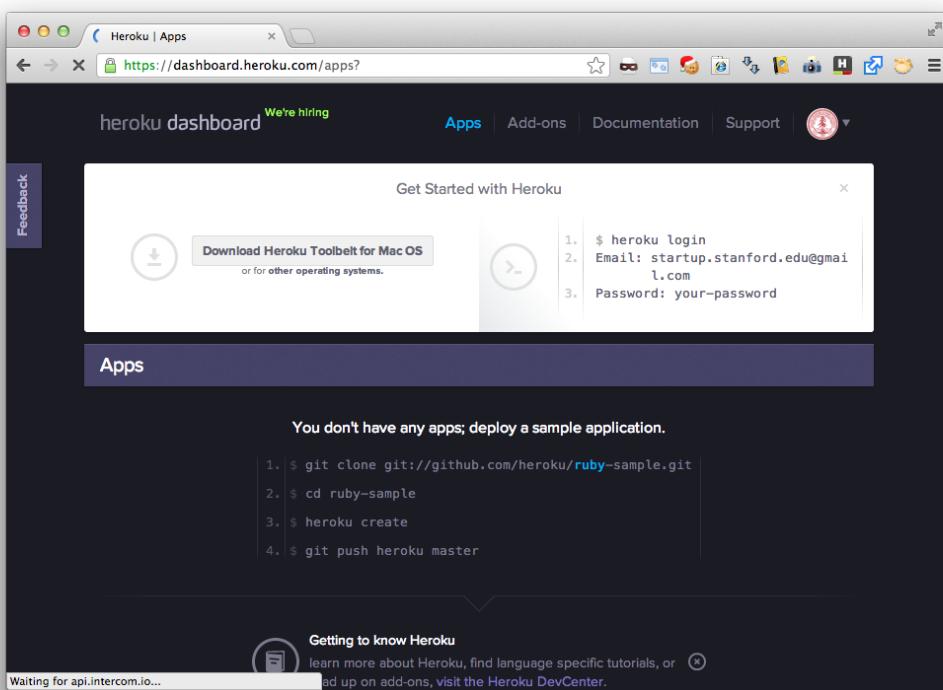
Heroku is the cloud platform for rapid deployment and scaling of web applications.  
Get up and running in minutes, then deploy instantly via Git.

To learn more about Heroku and all its features, check out the Dev Center:  
<http://devcenter.heroku.com/articles/quickstart>

Figure 47: Check your email and click the confirm link.



**Figure 48:** Now set up your password.



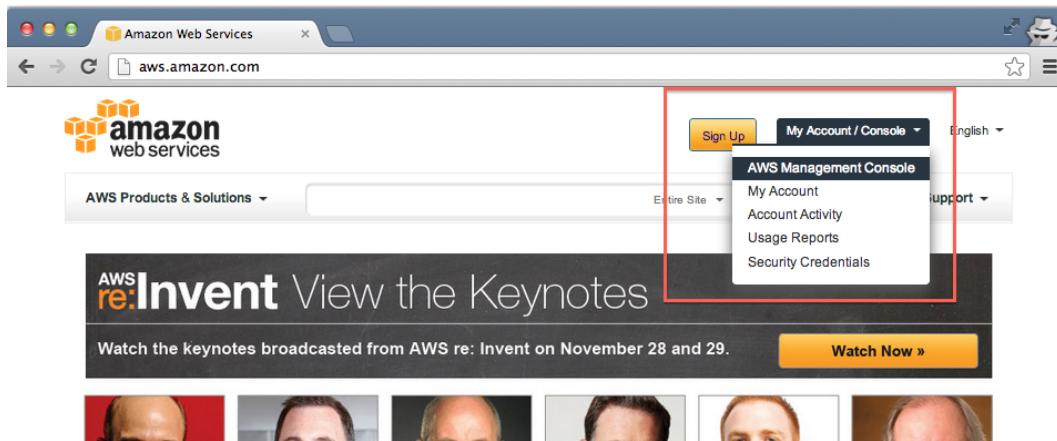
**Figure 49:** You now have a Heroku account. Ignore the instructions for now, we'll return to them later.

All right. At this point you should have your AWS, Gravatar, Github, and Heroku accounts all set up. Our next step will be to get an AWS instance running in the cloud as a development environment.

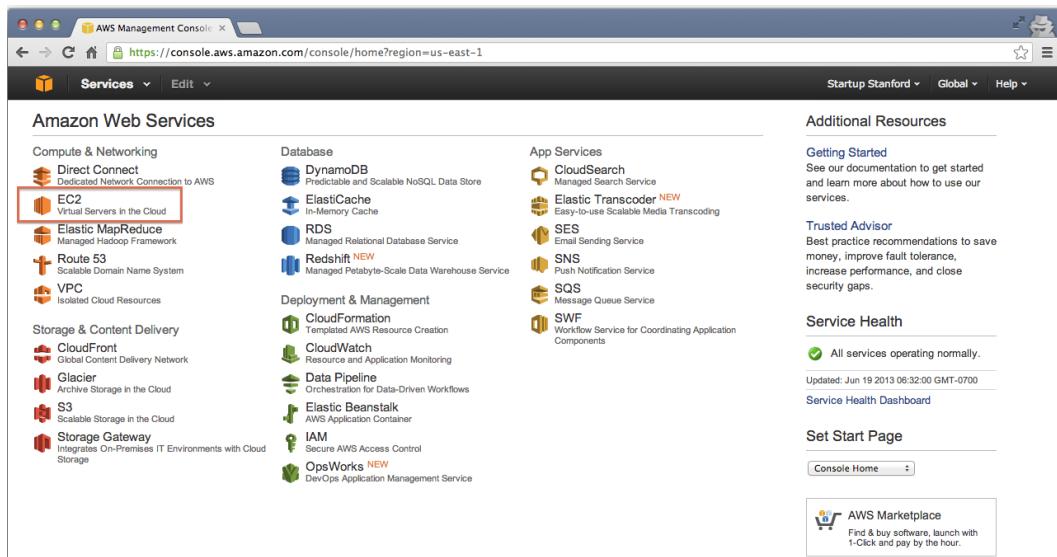
## Connect to a Cloud Computer

### Launch your EC2 Instance

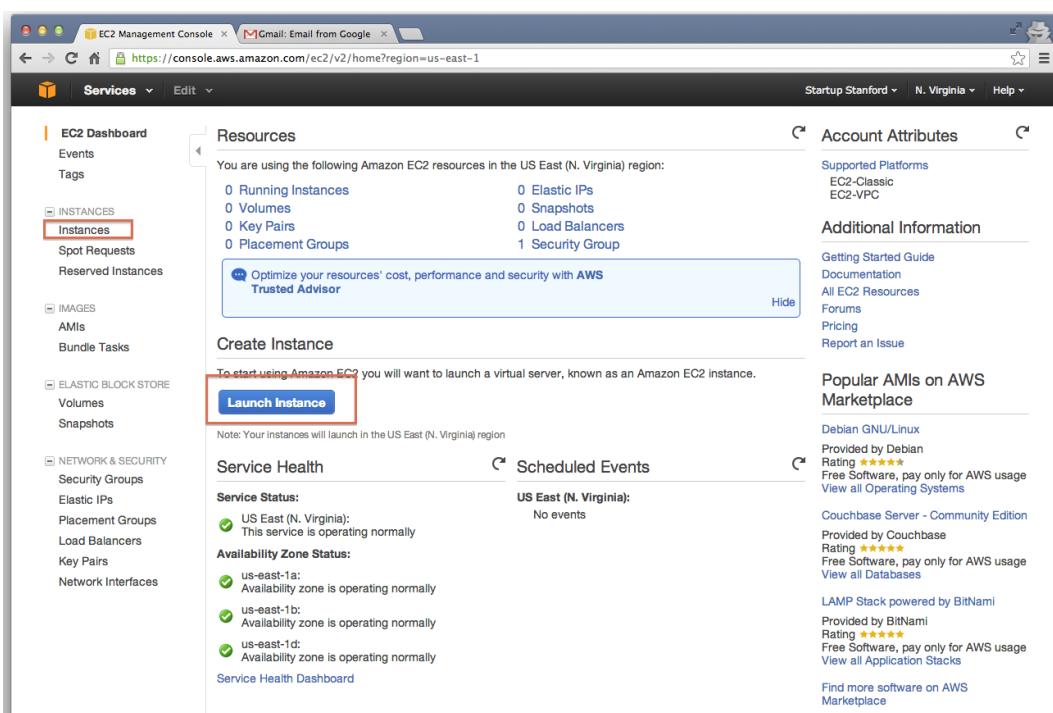
You are now going to launch and connect to an AWS cloud computer; you may find [Amazon's own instructions](#) useful as a supplement. We are going to initialize Amazon's smallest kind of cloud computer (a [t1.micro](#) instance) running [Ubuntu 12.04.2 LTS](#) (a popular Linux distribution) in its [us-east-1](#) region. Begin by returning to <http://aws.amazon.com> and log into the dashboard as shown.



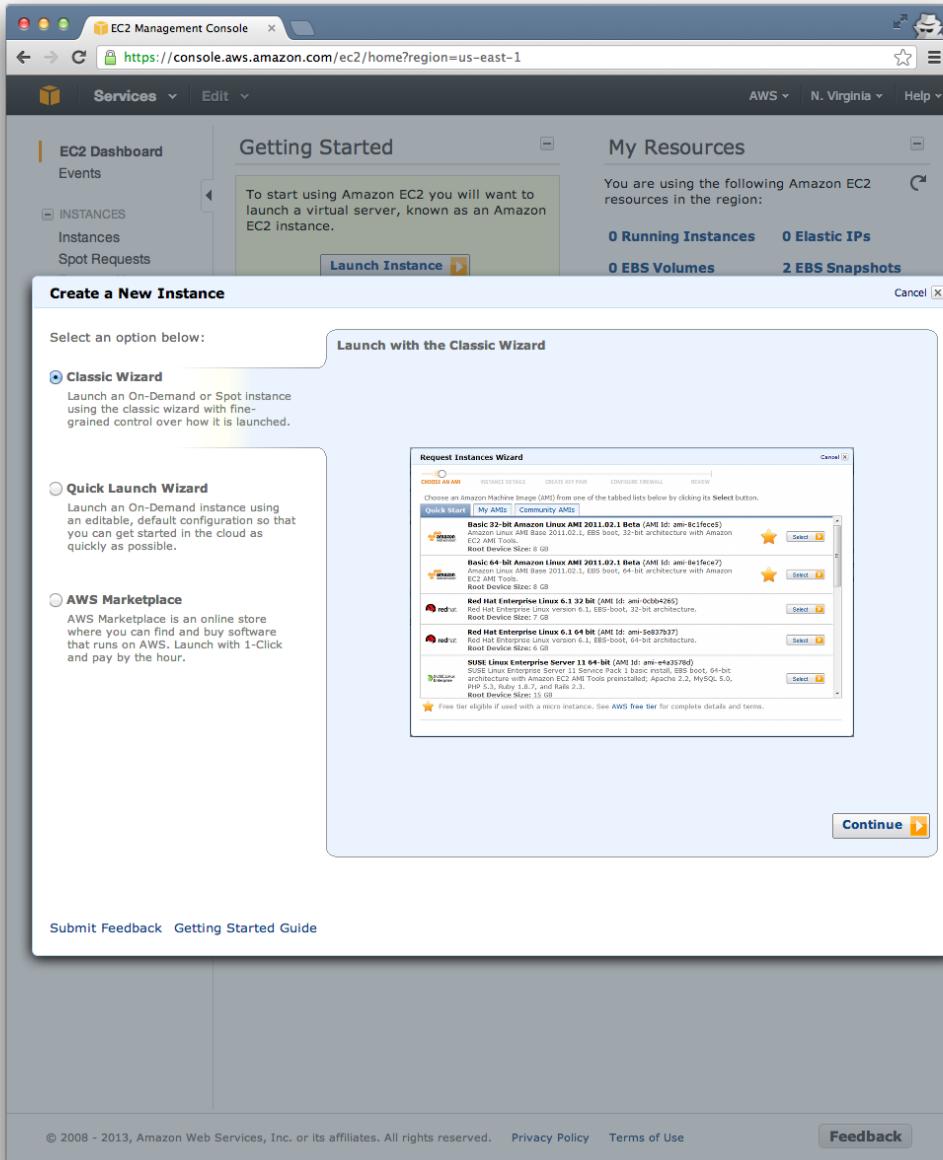
**Figure 50:** Log into your Management Console.



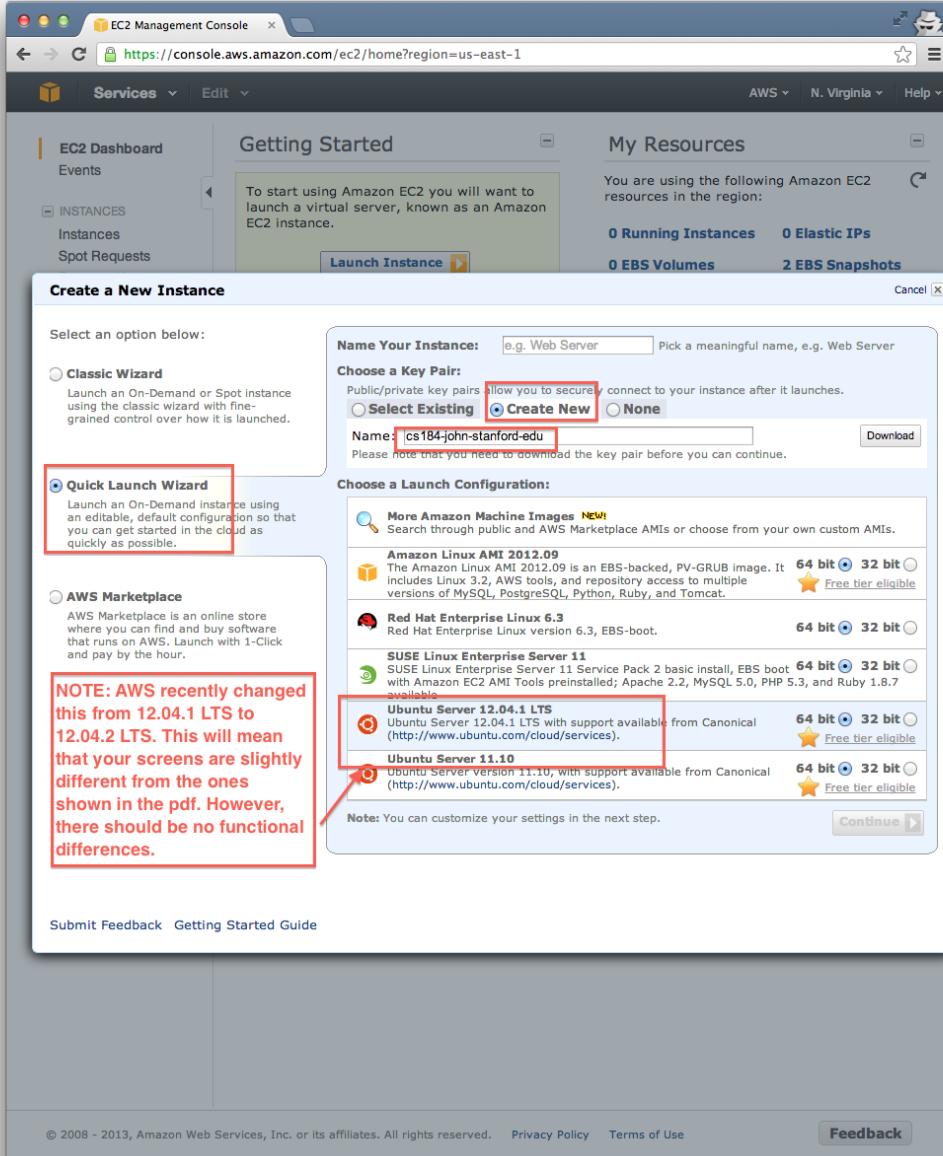
**Figure 51:** Click "EC2" on the AWS Dashboard.



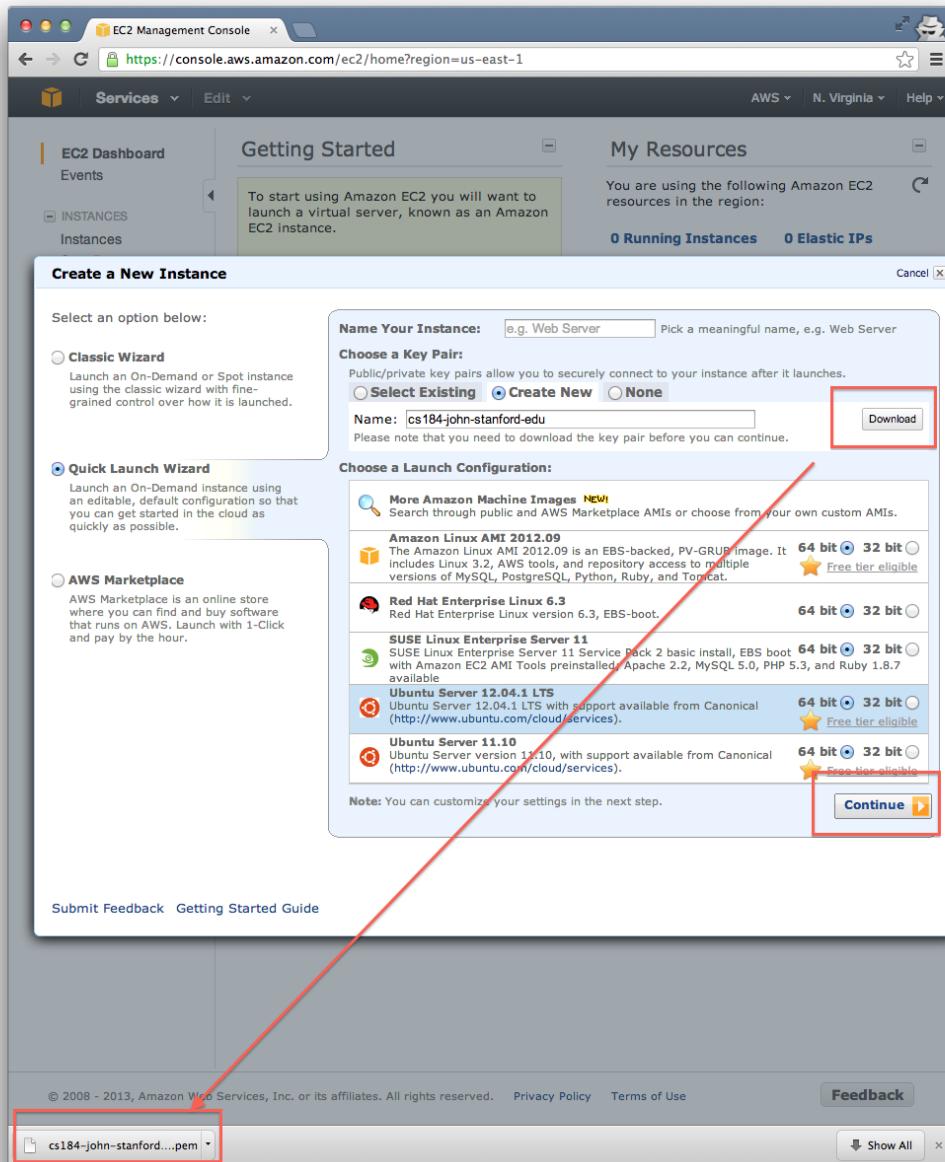
**Figure 52:** Click “Launch Instances”. Also note the “Instances” link (boxed) on the left hand side; you will need this in a bit.



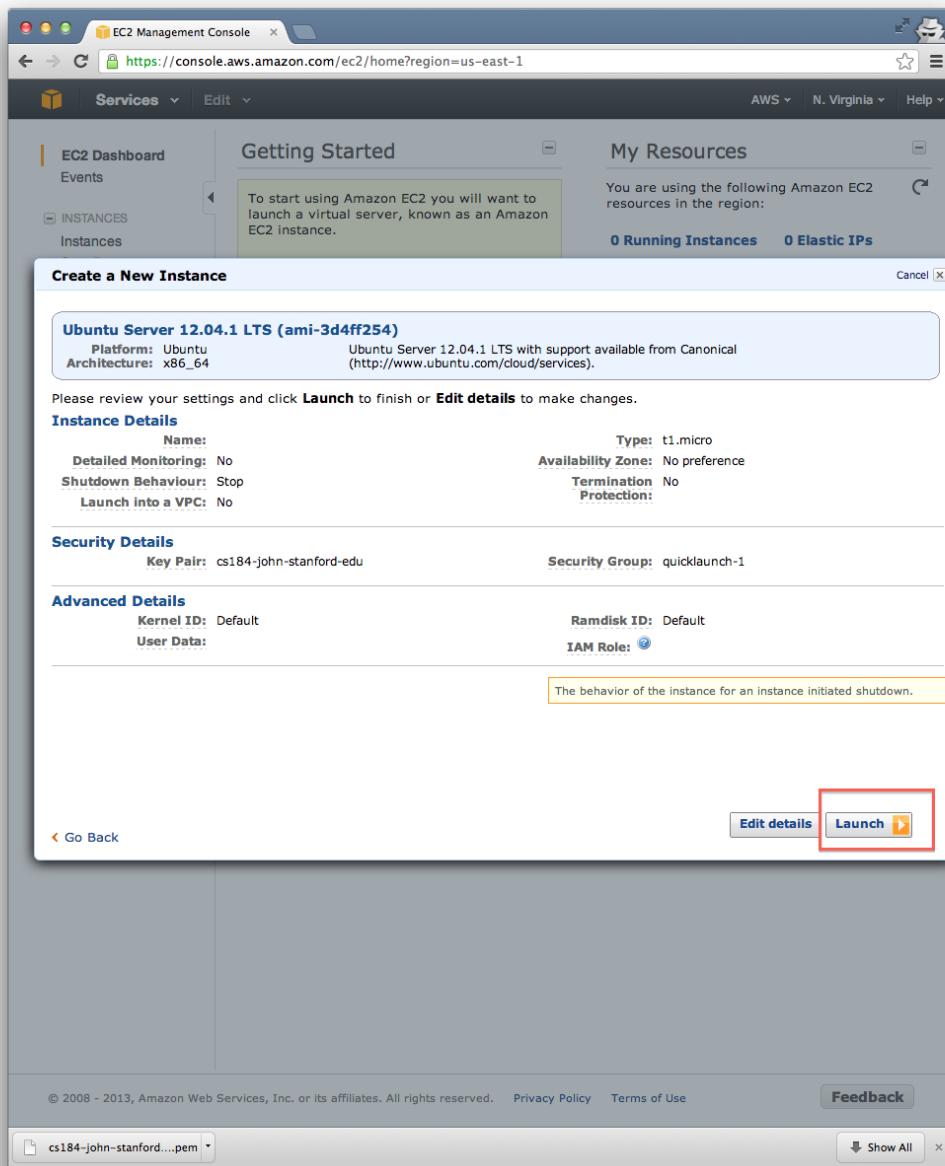
**Figure 53:** You should see the Create a New Instance Wizard.



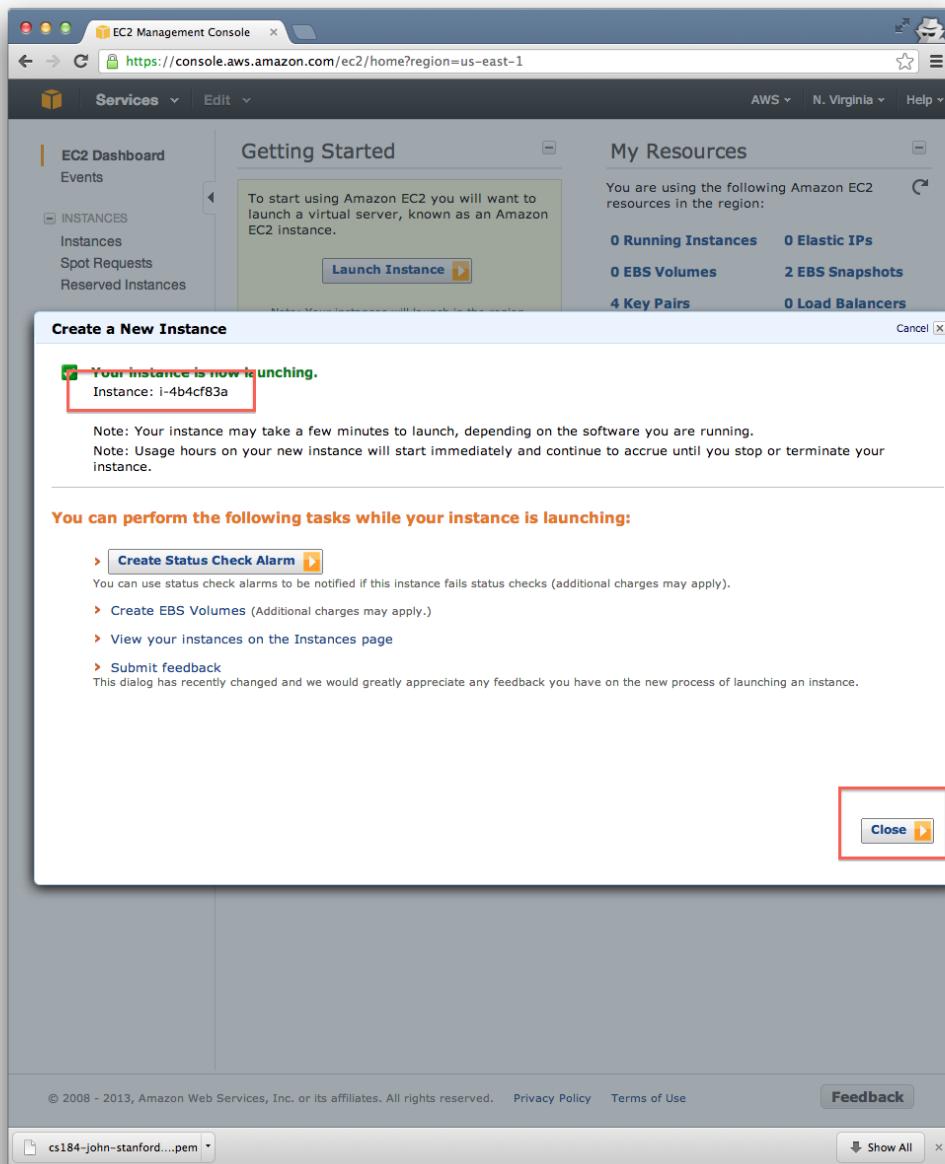
**Figure 54:** Select the *Quick Launch Wizard*, click the “Create New” radio button, enter a memorable keyname (e.g. `cs184-john-stanford-edu`), and select *Ubuntu Server 12.04.2 LTS* for the “Launch Configuration”. Note that the remaining screenshots depict 12.04.1 LTS, while your screen will show 12.04.2 LTS; this won’t change anything that you do, however.



**Figure 55:** Click Download and notice the .pem file which you just created. Then click Continue.



**Figure 56:** Launch the new instance.



**Figure 57:** Your instance (in this case `i-4b4cf83a`) is now launching. Now go to the [Instances Dashboard](#).

The screenshot shows the AWS EC2 Instances Dashboard. On the left, there's a sidebar with options like EC2 Dashboard, Events, Instances (which is selected), Spot Requests, Reserved Instances, Images, AMIs, Bundle Tasks, Elastic Block Store, Volumes, Snapshots, and Network & Security. The main area has tabs for Launch Instance and Actions. A search bar at the top says 'Viewing: All Instances' and 'All Instance Types'. Below that is a table with columns: Name, Instance, AMI ID, Root Device, Type, State, and Status Checks. There are two rows: one for instance 'empty' (terminated) and one for instance 'empty' (running, initializing...). A red box highlights the second row, and a red arrow points from the text 'When done initializing, you can connect to the EC2 instance.' to the 'Status Checks' column of the second row.

Name	Instance	AMI ID	Root Device	Type	State	Status Checks
empty	i-7dcfd602	ami-3d4ff254	ebs	t1.micro	terminated	
empty	i-4b4cf83a	ami-3d4ff254	ebs	t1.micro	running	initializing...

When done initializing, you can connect to the EC2 instance.

**Figure 58:** At the [Instances Dashboard](#), your instance (shown is *i-4b4cf83a* again) should be initializing. (Ignore the older terminated instance in this screenshot).

You should now have a local .pem file downloaded and the instance (in the above example i-4b4cf83a) should be in the process of initializing. You can monitor the status at this [dashboard link](#) (Figure 59). Now you want to connect to the instance, which in this case has hostname `ec2-50-19-140-229.compute-1.amazonaws.com` (yours will be different). For didactic purposes let's take a look at Amazon's instructions; we are going to modify these instructions slightly.

You can drag this pane upwards

Name	Instance	AMI ID	Root Device	Type	State	Status Checks
<input checked="" type="checkbox"/> empty	i-4b4cf83a	ami-3d4ff254	ebs	t1.micro	running	<span style="color: green;">✓</span> 2/2 checks passed

**1 EC2 Instance selected.**

**EC2 Instance: i-4b4cf83a** ●  
ec2-50-19-140-229.compute-1.amazonaws.com

Description Status Checks Monitoring Tags

**AMI:** ubuntu/images/ebs/ubuntu-precise-12.04-amd64-server-20121001 (ami-3d4ff254)

**Zone:** us-east-1d

**Type:** t1.micro

**Scheduled Events:** No scheduled events

**VPC ID:** -

**Source/Dest. Check:** -

**Placement Group:** -

**RAM Disk ID:** -

**Key Pair Name:** cs184-john-stanford-edu

**Monitoring:** basic

**Elastic IP:** -

**Alarm Status:** none

**Security Groups:** quicklaunch-1, view rules

**State:** running

**Owner:** 896552222739

**Subnet ID:** -

**Virtualization:** paravirtual

**Reservation:** r-ca7b48b2

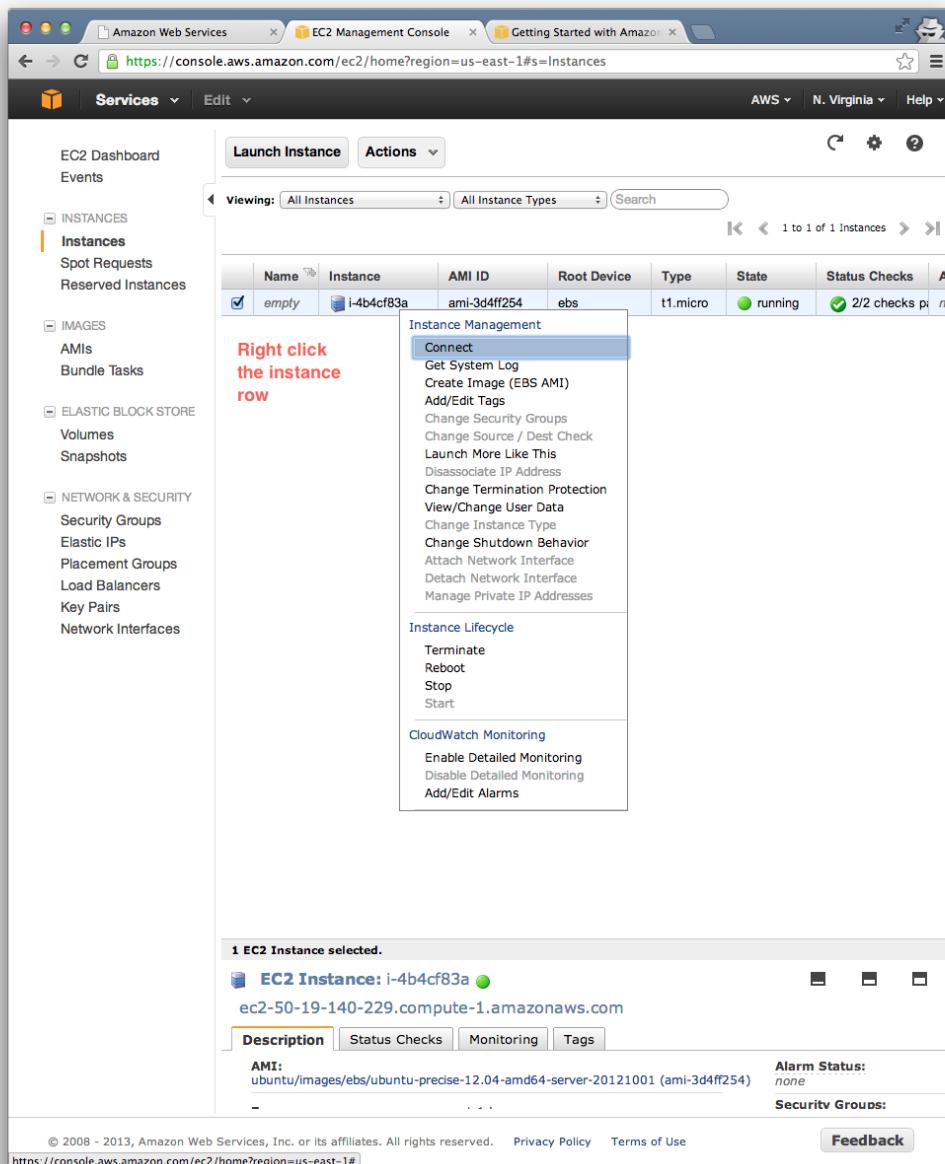
**Platform:** -

**Kernel ID:** aki-825ea7eb

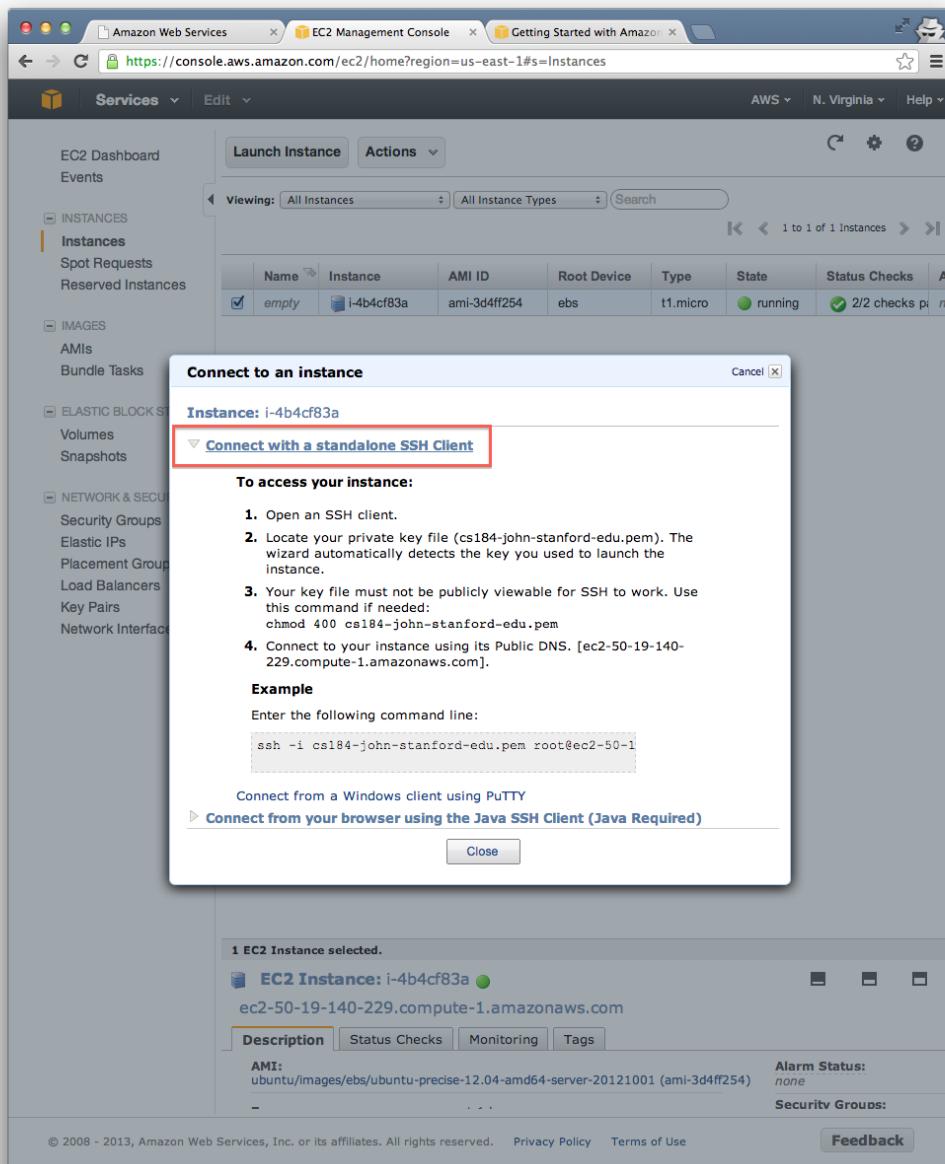
**AMI Launch Index:** 0

**Root Device:** sda1

**Figure 59:** The *Instances Dashboard* will have a green check under “Status Checks” when the instance is live. Note that it is at this point that the hostname `ec2-50-19-140-229.compute-1.amazonaws.com` is assigned.



**Figure 60:** Right clicking on your instance and select ‘Connect’ from the dropdown.



**Figure 61:** Click ‘Connect with a standalone SSH client’ and read the instructions. In the next section, we are going to have to use slightly different commands.

## Mac: Connect to EC2 instance via Terminal.app

To connect to your EC2 instance via a Mac, type a modified version of the following commands into Terminal.app (see also Figure 62):

```
1 # Commands for Terminal.app on Mac OS X
2 $ cd ~/downloads
3 $ chmod 400 cs184-john-stanford-edu.pem
4 $ ssh -i cs184-john-stanford-edu.pem \
5     ubuntu@ec2-50-19-140-229.compute-1.amazonaws.com
```

Here, we use the standard convention that lines prefixed with # are comments and with \$ are meant to be typed in literally. When a backslash \ appears at the end of a line, that is a command which extends over multiple lines. Note also that you will need to change the .pem file (cs184-john-stanford-edu.pem) and hostname (ec2-50-19-140-229.compute-1.amazonaws.com) to match your own, and that we are logging in as `ubuntu` rather than `root`. Note in particular the use of the `chmod` command to change the permissions of your file. In the event you are using a multiuser system, like a shared computer in an academic environment, this would keep other users from logging in as you.

The screenshot shows a Terminal window on a Mac. The terminal session starts with:

```
[balajis@junit:~]$ cd downloads
[balajis@junit:~/downloads]$ chmod 400 cs184-john-stanford-edu.pem
[balajis@junit:~/downloads]$ ssh -i cs184-john-stanford-edu.pem ubuntu@ec2-50-19-140-229.compute-1.amazonaws.com
```

An arrow points from the text "Note that we specify the username." to the word "ubuntu" in the command line above. The terminal then displays the Ubuntu welcome message:

```
Welcome to Ubuntu 12.04.1 LTS (GNU/Linux 3.2.0-31-virtual x86_64)

 * Documentation: https://help.ubuntu.com/

 System information as of Mon Jan  7 19:02:16 UTC 2013

 System load:  0.0          Processes:      57
 Usage of /:   11.5% of 7.87GB  Users logged in:  0
 Memory usage: 30%           IP address for eth0: 10.211.171.76
 Swap usage:   0%
```

It then provides system management links and package update information:

```
Graph this data and manage this system at https://landscape.canonical.com/
65 packages can be updated.
31 updates are security updates.

Get cloud support with Ubuntu Advantage Cloud Guest
http://www.ubuntu.com/business/services/cloud
ubuntu@domU-12-31-39-0A-A8-BE:~$
```

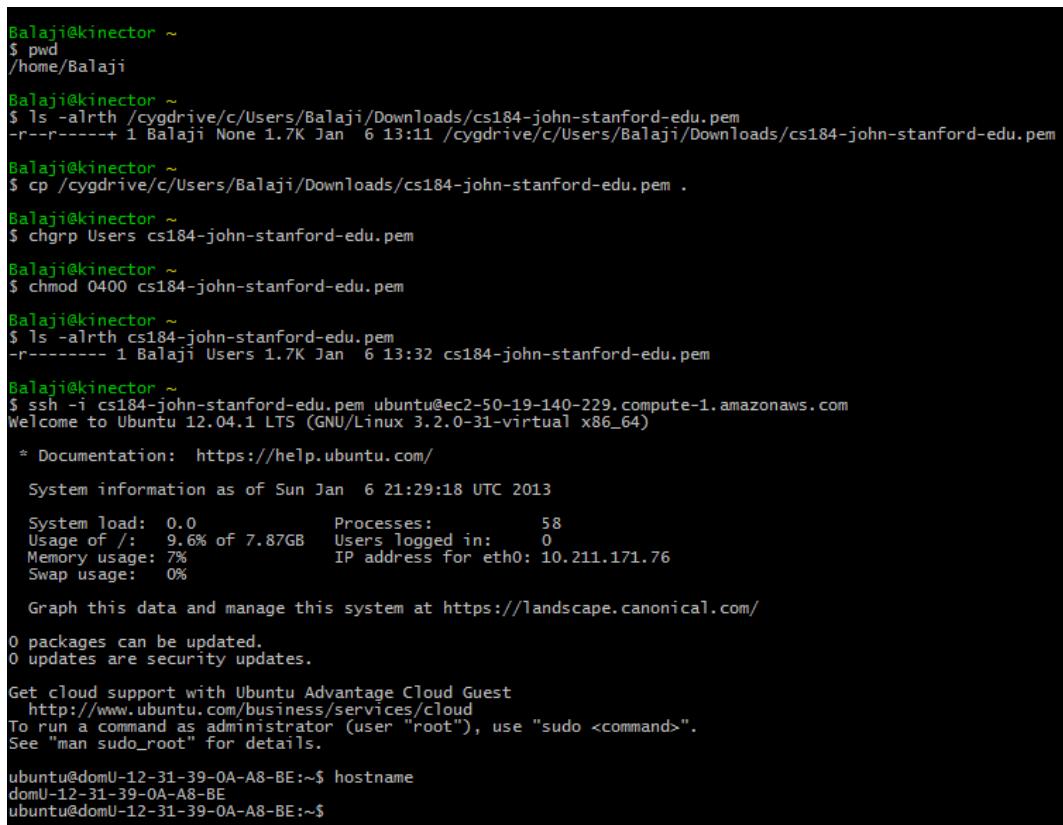
**Figure 62:** Connecting to your EC2 instance via Terminal.app on a Mac.

## Windows: Connect to EC2 instance via Cygwin

To connect to EC2 via Cygwin on Windows, you need to handle two key idiosyncrasies. First, the Windows directory structure sits off the to the side from where Cygwin lives, so you need to address files in /cygdrive/c or /cygdrive/d to access files on the C:\ and D:\ drives, such as the .pem file you just downloaded. Second, Cygwin has a [permissions bug](#) which requires an extra command to fix. You will thus need to execute the following commands, replacing JohnSmith, cs184-john-stanford-edu.pem and ec2-50-19-140-229.compute-1.amazonaws.com with your own variables.

```
1 # Commands for Cygwin on Windows
2 $ cd ~
3 $ cp /cygdrive/c/Users/JohnSmith/Downloads/cs184-john-stanford-edu.pem .
4 $ chgrp Users cs184-john-stanford-edu
5 $ chmod 400 cs184-john-stanford-edu.pem
6 $ ssh -i cs184-john-stanford-edu.pem \
7     ubuntu@ec2-50-19-140-229.compute-1.amazonaws.com
```

Here is how all this looks when you launch Cygwin:



```
Balaji@kinector ~
$ pwd
/home/Balaji

Balaji@kinector ~
$ ls -alrth /cygdrive/c/Users/Balaji/Downloads/cs184-john-stanford-edu.pem
-r--r-----+ 1 Balaji None 1.7K Jan  6 13:11 /cygdrive/c/Users/Balaji/Downloads/cs184-john-stanford-edu.pem

Balaji@kinector ~
$ cp /cygdrive/c/Users/Balaji/Downloads/cs184-john-stanford-edu.pem .

Balaji@kinector ~
$ chgrp Users cs184-john-stanford-edu.pem

Balaji@kinector ~
$ chmod 0400 cs184-john-stanford-edu.pem

Balaji@kinector ~
$ ls -alrth cs184-john-stanford-edu.pem
-r----- 1 Balaji Users 1.7K Jan  6 13:32 cs184-john-stanford-edu.pem

Balaji@kinector ~
$ ssh -i cs184-john-stanford-edu.pem ubuntu@ec2-50-19-140-229.compute-1.amazonaws.com
Welcome to Ubuntu 12.04.1 LTS (GNU/Linux 3.2.0-31-virtual x86_64)

 * Documentation:  https://help.ubuntu.com/
 * System information as of Sun Jan  6 21:29:18 UTC 2013
   System load:  0.0      Processes:          58
   Usage of /:  9.6% of 7.87GB  Users logged in:    0
   Memory usage: 7%           IP address for eth0: 10.211.171.76
   Swap usage:  0%
   Graph this data and manage this system at https://landscape.canonical.com/
 0 packages can be updated.
 0 updates are security updates.

Get cloud support with Ubuntu Advantage Cloud Guest
  http://www.ubuntu.com/business/services/cloud
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

ubuntu@domU-12-31-39-0A-A8-BE:~$ hostname
domU-12-31-39-0A-A8-BE
ubuntu@domU-12-31-39-0A-A8-BE:~$
```

Figure 63: Connecting to your EC2 instance via Cygwin for Windows.

```

Balaji@kinector ~
$ pwd
/home/Balaji

Balaji@kinector ~
$ ls -alrth ./cygdrive/c/Users/Balaji/Downloads/cs184-john-stanford-edu.pem
-r--r---- 1 Balaji None 1.7K Jan  6 13:11 ./cygdrive/c/Users/Balaji/Downloads/cs184-john-stanford-edu.pem

Balaji@kinector ~
$ cp ./cygdrive/c/Users/Balaji/Downloads/cs184-john-stanford-edu.pem .

Balaji@kinector ~
$ chgrp Users cs184-john-stanford-edu.pem
[Red box highlights 'None' in the previous command's output]

Balaji@kinector ~
$ chmod 0400 cs184-john-stanford-edu.pem

Balaji@kinector ~
$ ls -alrth cs184-john-stanford-edu.pem
-r----- 1 Balaji Users 1.7K Jan  6 13:32 cs184-john-stanford-edu.pem

Balaji@kinector ~
$ ssh -i cs184-john-stanford-edu.pem ubuntu@ec2-50-19-140-229.compute-1.amazonaws.com
Welcome to Ubuntu 12.04.1 LTS (GNU/Linux 3.2.0-31-virtual x86_64)

 * Documentation:  https://help.ubuntu.com/
 
 System information as of Sun Jan  6 21:29:18 UTC 2013

 System load:  0.0      Processes:           58
 Usage of /:   9.6% of 7.87GB   Users logged in:    0
 Memory usage: 7%                  IP address for eth0: 10.211.171.76
 Swap usage:   0%
 
 Graph this data and manage this system at https://landscape.canonical.com/
 
 0 packages can be updated.
 0 updates are security updates.

 Get cloud support with Ubuntu Advantage Cloud Guest
 http://www.ubuntu.com/business/services/cloud
 To run a command as administrator (user "root"), use "sudo <command>".
 See "man sudo_root" for details.

ubuntu@domU-12-31-39-0A-A8-BE:~$ hostname
domU-12-31-39-0A-A8-BE
ubuntu@domU-12-31-39-0A-A8-BE:~$
```

**Figure 64:** The `chgrp` command changed the group membership of the `cs184-john-stanford-edu.pem` file from `None` to `Users`, as shown. (More on [Unix permissions](#).)

```

Balaji@kinector ~
$ pwd
/home/Balaji

Balaji@kinector ~
$ ls -alrth /cygdrive/c/Users/Balaji/Downloads/cs184-john-stanford-edu.pem
-r--r-----+ 1 Balaji None 1.7K Jan  6 13:11 /cygdrive/c/Users/Balaji/Downloads/cs184-john-stanford-edu.pem

Balaji@kinector ~
$ cp /cygdrive/c/Users/Balaji/Downloads/cs184-john-stanford-edu.pem .

Balaji@kinector ~
$ chgrp Users cs184-john-stanford-edu.pem

Balaji@kinector ~
$ chmod 0400 cs184-john-stanford-edu.pem

Balaji@kinector ~
$ ls -alrth cs184-john-stanford-edu.pem
-r----- 1 Balaji Users 1.7K Jan  6 13:32 cs184-john-stanford-edu.pem

Balaji@kinector ~
$ ssh -i cs184-john-stanford-edu.pem ubuntu@ec2-50-19-140-229.compute-1.amazonaws.com
Welcome to Ubuntu 12.04.1 LTS (GNU/Linux 3.2.0-31-virtual x86_64)

 * Documentation: https://help.ubuntu.com/
 
 System information as of Sun Jan  6 21:29:18 UTC 2013

 System load:  0.0      Processes:           58
 Usage of /:   9.6% of 7.87GB   Users logged in:     0
 Memory usage: 7%           IP address for eth0: 10.211.171.76
 Swap usage:   0%
 
 Graph this data and manage this system at https://landscape.canonical.com/
 
 0 packages can be updated.
 0 updates are security updates.

Get cloud support with Ubuntu Advantage Cloud Guest
 http://www.ubuntu.com/business/services/cloud
 To run a command as administrator (user "root"), use "sudo <command>".
 See "man sudo_root" for details.

ubuntu@domU-12-31-39-0A-A8-BE:~$ hostname
domU-12-31-39-0A-A8-BE
ubuntu@domU-12-31-39-0A-A8-BE:~$
```

**Figure 65:** The `chmod` command changed the read/write permissions of the `cs184-john-stanford-edu.pem` file such that only you can read it. (More on [Unix permissions](#).)

```

Balaji@kinector ~
$ chgrp None cs184-john-stanford-edu.pem

Balaji@kinector ~
$ ssh -i cs184-john-stanford-edu.pem ubuntu@ec2-50-19-140-229.compute-1.amazonaws.com
@@@@@@@@@@@ WARNING: UNPROTECTED PRIVATE KEY FILE! @@@@
Permissions 0440 for 'cs184-john-stanford-edu.pem' are too open.
It is required that your private key files are NOT accessible by others.
This private key will be ignored.
bad permissions: ignore key: cs184-john-stanford-edu.pem
Permission denied (publickey).

Balaji@kinector ~
$ ls -alrth cs184-john-stanford-edu.pem
-r--r----- 1 Balaji None 1.7K Jan  6 13:32 cs184-john-stanford-edu.pem

Balaji@kinector ~
$ |
```

**Figure 66:** Here's what happens if your permissions are wrong: a public key error caused by incorrect permissions on the `.pem` file. Make sure you executed `chmod` and `chgrp`.

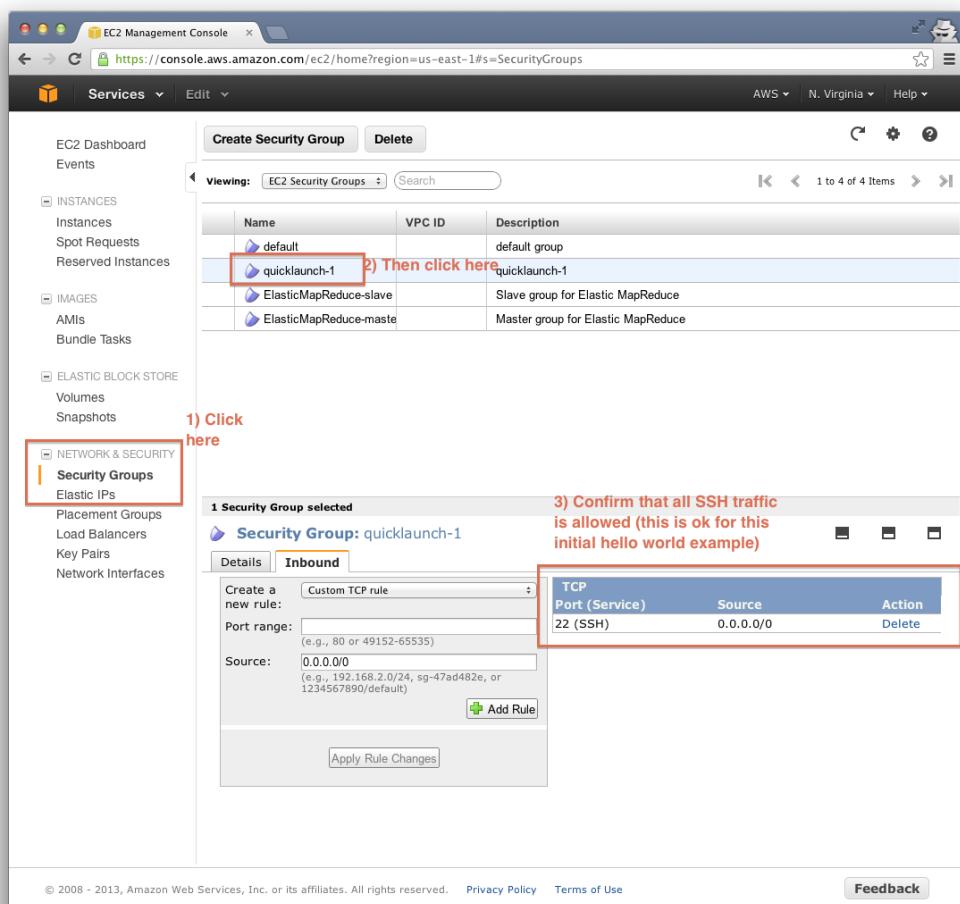
Unix permissions are a bit of a [deep topic](#), so you can just think of the above as an incantation for now that makes the files private to you. Note that if your permissions are incorrect (i.e. if you have not executed the `chmod 0400` and `chgrp Users` commands) you will get an error about public keys as shown above.

## Security Groups

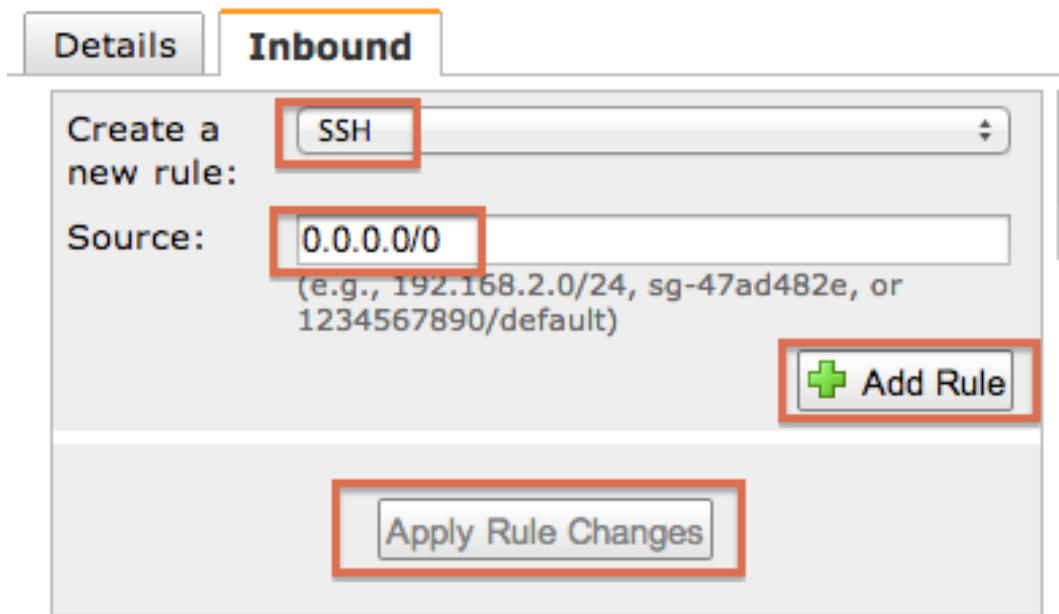
If you still have problems with the above commands, you might need to change your security groups to permit traffic on the SSH port.

The screenshot shows the AWS EC2 Management Console. On the left, there's a sidebar with links for EC2 Dashboard, Events, Instances (which is selected), Spot Requests, Reserved Instances, Images, AMIs, Bundle Tasks, Elastic Block Store, Volumes, Snapshots, Network & Security, Security Groups (which is also selected), Elastic IPs, Placement Groups, Load Balancers, Key Pairs, and Network Interfaces. The main pane shows a table of instances with one row selected: 'empty' (Instance ID: i-4b4cf83a, AMI ID: ami-3d4ff254, Root Device: ebs, Type: t1.micro, State: running). Below the table, a modal window is open for the selected instance. The modal has tabs for Description, Status Checks, Monitoring, and Tags. The 'Description' tab is active. It shows the instance details: AMI: ubuntu/images/ebs/ubuntu-precise-12.04-amd64-server-20121001 (ami-3d4ff254), Zone: us-east-1d, Type: t1.micro. To the right of these details, a note says 'Security Groups determine what can connect to your running instance.' A red arrow points from the 'Instances' link in the sidebar to this note. Another red arrow points to the 'Security Groups' field in the instance details, which is highlighted with a red box. The 'Security Groups' field contains 'quicklaunch-1. view rules'. The modal also lists other instance metadata like Owner, Subnet ID, Virtualization, Reservation, Platform, Kernel ID, AMI Launch Index, Root Device, and Tenancy.

**Figure 67:** Select your instance and look at the pane on the lower right to see which security group you're running.



**Figure 68:** This is what things should look like if you click *Security Groups* (left hand side), your own security group at the top (which may or may not be titled *quicklaunch-1*), and then look in the bottom right corner.



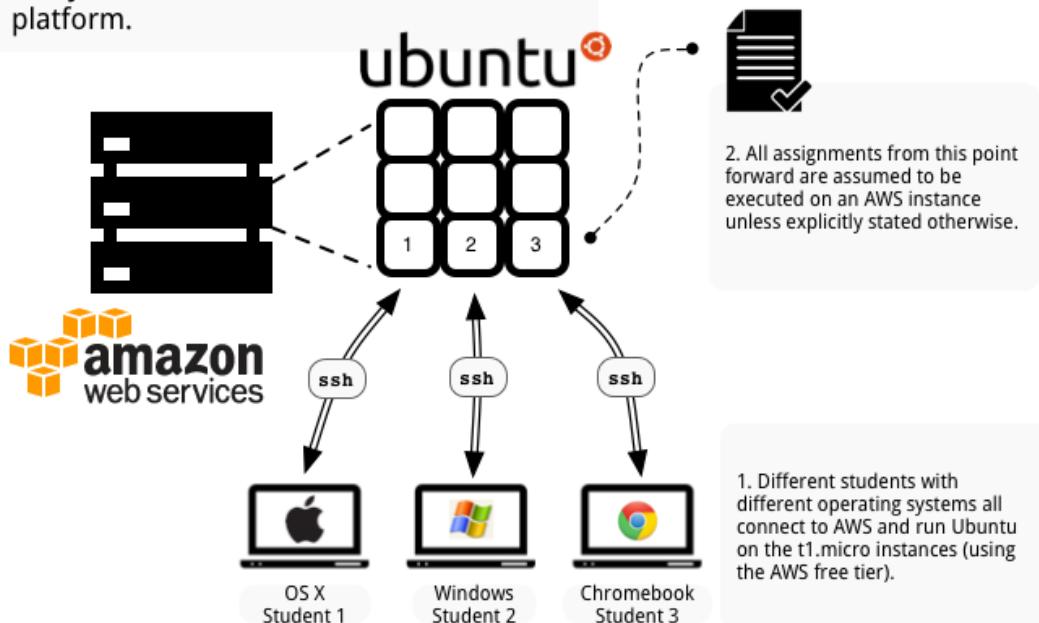
**Figure 69:** If necessary, use the form to open up SSH on port 22 with allowed IPs 0.0.0.0/0 (i.e. any IP), just as shown. You wouldn't do this in production, but it's fine for now.

## Standard Operating System: Ubuntu 12.04.2 LTS on a t1.micro AWS instance

From this point forward, for the duration of the class unless otherwise specified, we assume that all commands are executed on your remote AWS cloud instance, specifically on Ubuntu 12.04.2 LTS on a t1.micro AWS instance (Figure 70). The idea here is to even out the dissimilarities between different computer setups and get an even (and reproducible) playing field for all students.

### AWS Ubuntu 12.04.2 LTS Our common platform

No matter whether you have a Mac, Windows, or Linux machine, all further instructions will be given relative to the Amazon AMI running Ubuntu. Now everyone in the class has a common platform.



**Figure 70:** Note that AWS smooths out OS and configuration inhomogeneity. All assignments and commands from this point forward will be assumed to be run on a EC2 t1.micro instance running Ubuntu 12.04.2 LTS unless otherwise specified.

Going forward, note that conventionally the @ symbol is used to indicate where a command is being executed, to distinguish between remote vs. local machines. If you ever get confused, you can issue the command `hostname` to learn which machine you're on, as shown:

OK. You know that cloud thing everyone is talking about? You just did it. You rented a computer in the cloud and executed a few commands!

```

[balajis@jiunit:~/downloads]$hostname
jiunit
[balajis@jiunit:~/downloads]$echo "this command is executed on my local machine"
this command is executed on my local machine
[balajis@jiunit:~/downloads]$ssh -i cs184-john-stanford-edu.pem ubuntu@ec2-54-234-41-176.compute-1.amazonaws.com
Welcome to Ubuntu 12.04.2 LTS (GNU/Linux 3.2.0-40-virtual x86_64)

* Documentation: https://help.ubuntu.com/

System information as of Wed Jun 19 13:20:30 UTC 2013

System load: 0.03      Processes:          61
Usage of /: 11.0% of 7.87GB  Users logged in:   1
Memory usage: 8%           IP address for eth0: 10.112.37.132
Swap usage:  0%
Graph this data and manage this system at https://landscape.canonical.com/

Get cloud support with Ubuntu Advantage Cloud Guest:
http://www.ubuntu.com/business/services/cloud

Use Juju to deploy your cloud instances and workloads:
https://juju.ubuntu.com/#cloud-precise

0 packages can be updated.
0 updates are security updates.

Last login: Wed Jun 19 13:20:05 2013 from 108-218-105-2.lightspeed.sntcca.sbcglobal.net
To run a command as administrator (user "root"), use "sudo <commands>".
See "man sudo_root" for details.

ubuntu@ip-10-112-37-132:~$ hostname
ip-10-112-37-132
ubuntu@ip-10-112-37-132:~$ echo "this command is executed on an AWS virtual machine"
this command is executed on an AWS virtual machine
ubuntu@ip-10-112-37-132:~$ exit
logout
Connection to ec2-54-234-41-176.compute-1.amazonaws.com closed.

[balajis@jiunit:~/downloads]$hostname
jiunit
[balajis@jiunit:~/downloads]$echo "i logged out. this command is executed on my local machine again."
i logged out. this command is executed on my local machine again.
[balajis@jiunit:~/downloads]$
```

**Figure 71:** Red are commands executed locally by your laptop. Blue are commands which are executed remotely by the AWS instance.

## Deploy your code

### Test out your Heroku account

We're now going to execute a series of commands that will deploy your first node.js app to heroku.

- First, you will SSH into your EC2 instance.
- Next, you'll install git and the heroku toolbelt.
- Next, login to heroku at the command line and set up SSH keys.
- Then, pull down a sample app, configure it as a heroku app, and push it live.
- Finally, view the app's URL in your browser.

That was in English. Here are the command lines to accomplish this:

```
1 # Execute these commands on your EC2 instance.
2 # Note that -q0- is not -q0-. 0 is the English letter, 0 is the number zero.
3
4 # 1) Install heroku and git
5 $ sudo apt-get install -y git-core
6 $ wget -q0- https://toolbelt.heroku.com/install-ubuntu.sh | sh
7 $ which git
8 $ which heroku
9 # 2) Login and set up your SSH keys
10 $ heroku login
11 $ ssh-keygen -t rsa
12 $ heroku keys:add
13 # 3) Clone a sample repo and push to heroku
14 $ git clone https://github.com/heroku/node-js-sample.git
15 $ cd node-js-sample
16 $ heroku create
17 $ git push heroku master
```

Now let's go through the screenshots of how it looks when executing those commands. Again, begin by connecting to your EC2 instance.

The screenshot shows a terminal window on an Ubuntu 12.04.1 LTS system. The user has SSHed into their EC2 instance using a private key. The terminal output includes system information, package updates, and the execution of an apt-get command to install the 'git-core' package. A red box highlights the command 'sudo apt-get install git-core'. Another red box highlights the terminal prompt '[Y/n]? Y'.

```

[balajis@junit:~]$ls
[balajis@junit:~/downloads]$ssh -i cs184-john-stanford-edu.pem ubuntu@ec2-50-19-140-29.compute-1.amazonaws.com
Welcome to Ubuntu 12.04.1 LTS (GNU/Linux 3.2.0-31-virtual x86_64)

 * Documentation:  https://help.ubuntu.com/
 
 System information as of Mon Jan  7 00:24:25 UTC 2013

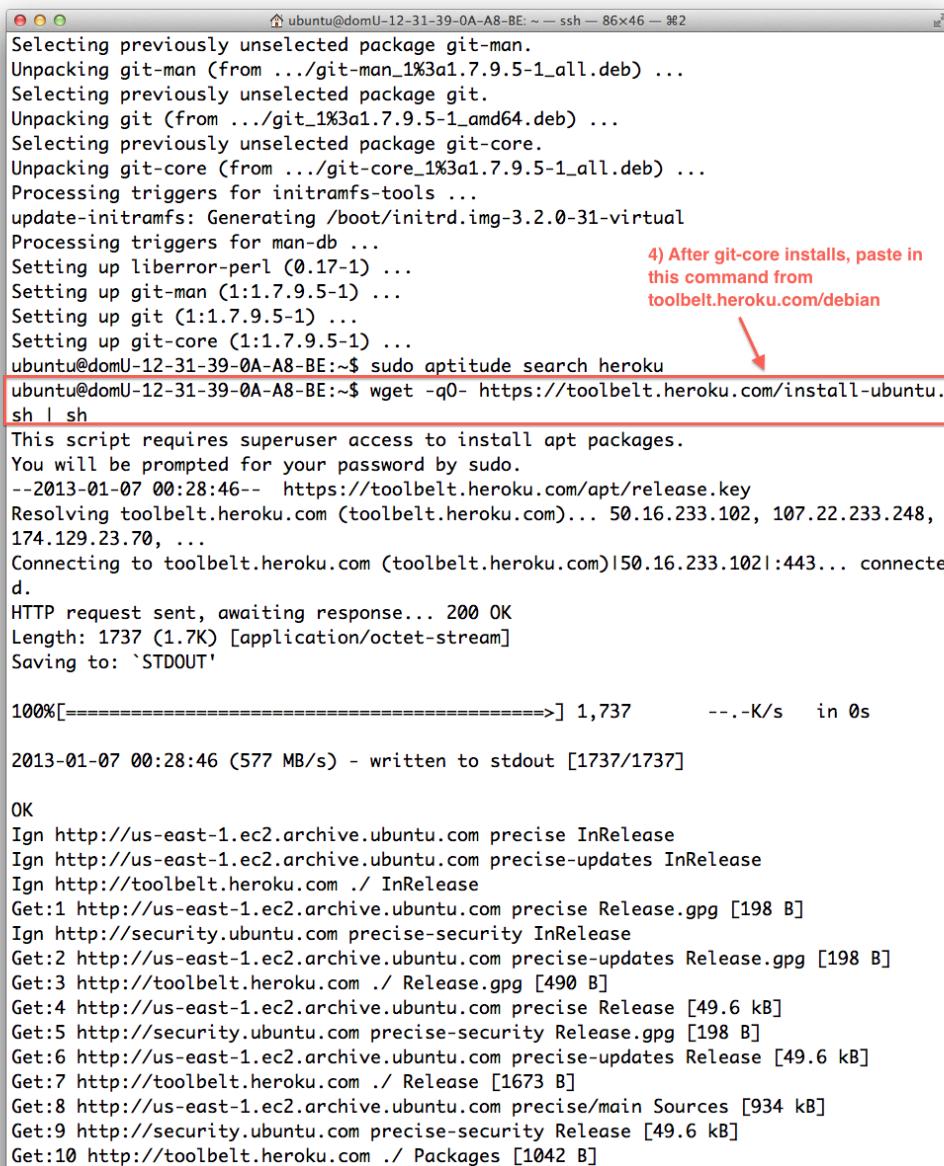
 System load:  0.0          Processes:      58
 Usage of /:   9.6% of 7.87GB  Users logged in:    0
 Memory usage: 7%           IP address for eth0: 10.211.171.76
 Swap usage:   0%
 
 Graph this data and manage this system at https://landscape.canonical.com/
 
 0 packages can be updated.
 0 updates are security updates.

 Get cloud support with Ubuntu Advantage Cloud Guest
 http://www.ubuntu.com/business/services/cloud
 To run a command as administrator (user "root"), use "sudo <command>".
 See "man sudo_root" for details.

ubuntu@domU-12-31-39-0A-A8-BE:~$ which git
ubuntu@domU-12-31-39-0A-A8-BE:~$ sudo aptitude search git-core
p  git-core                               - fast, scalable, distributed revision control
v  git-core:i386                            -
ubuntu@domU-12-31-39-0A-A8-BE:~$ sudo apt-get install git-core
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following extra packages will be installed:
  git git-man liberror-perl
Suggested packages:
  git-daemon-run git-daemon-sysvinit git-doc git-el git-arch git-cvs git-svn
  git-email git-gui gitk gitweb
The following NEW packages will be installed:
  git git-core git-man liberror-perl
0 upgraded, 4 newly installed, 0 to remove and 0 not upgraded.
Need to get 6742 kB of archives.
After this operation, 15.3 MB of additional disk space will be used.
Do you want to continue [Y/n]? Y  3) Say yes

```

**Figure 72:** SSH into your EC2 instance and install `git-core` as shown. If you do `sudo apt-get install -y git-core` you won't have to type the `Y`.



The screenshot shows a terminal window on an Ubuntu system. The terminal output is as follows:

```

ubuntu@domU-12-31-39-0A-A8-BE: ~ ssh 86x46 9%2
Selecting previously unselected package git-man.
Unpacking git-man (from .../git-man_1%3a1.7.9.5-1_all.deb) ...
Selecting previously unselected package git.
Unpacking git (from .../git_1%3a1.7.9.5-1_amd64.deb) ...
Selecting previously unselected package git-core.
Unpacking git-core (from .../git-core_1%3a1.7.9.5-1_all.deb) ...
Processing triggers for initramfs-tools ...
update-initramfs: Generating /boot/initrd.img-3.2.0-31-virtual
Processing triggers for man-db ...
Setting up liberror-perl (0.17-1) ...
Setting up git-man (1:1.7.9.5-1) ...
Setting up git (1:1.7.9.5-1) ...
Setting up git-core (1:1.7.9.5-1) ...
ubuntu@domU-12-31-39-0A-A8-BE:~$ sudo aptitude search heroku
ubuntu@domU-12-31-39-0A-A8-BE:~$ wget -qO- https://toolbelt.heroku.com/install-ubuntu.sh | sh
This script requires superuser access to install apt packages.
You will be prompted for your password by sudo.
--2013-01-07 00:28:46-- https://toolbelt.heroku.com/apt/release.key
Resolving toolbelt.heroku.com (toolbelt.heroku.com)... 50.16.233.102, 107.22.233.248,
174.129.23.70, ...
Connecting to toolbelt.heroku.com (toolbelt.heroku.com)|50.16.233.102|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 1737 (1.7K) [application/octet-stream]
Saving to: `STDOUT'

100%[=====] 1,737      --.-K/s   in 0s

2013-01-07 00:28:46 (577 MB/s) - written to stdout [1737/1737]

OK
Ign http://us-east-1.ec2.archive.ubuntu.com precise InRelease
Ign http://us-east-1.ec2.archive.ubuntu.com precise-updates InRelease
Ign http://toolbelt.heroku.com ./ InRelease
Get:1 http://us-east-1.ec2.archive.ubuntu.com precise Release.gpg [198 B]
Ign http://security.ubuntu.com precise-security InRelease
Get:2 http://us-east-1.ec2.archive.ubuntu.com precise-updates Release.gpg [198 B]
Get:3 http://toolbelt.heroku.com ./ Release.gpg [490 B]
Get:4 http://us-east-1.ec2.archive.ubuntu.com precise Release [49.6 kB]
Get:5 http://security.ubuntu.com precise-security Release.gpg [198 B]
Get:6 http://us-east-1.ec2.archive.ubuntu.com precise-updates Release [49.6 kB]
Get:7 http://toolbelt.heroku.com ./ Release [1673 B]
Get:8 http://us-east-1.ec2.archive.ubuntu.com precise/main Sources [934 kB]
Get:9 http://security.ubuntu.com precise-security Release [49.6 kB]
Get:10 http://toolbelt.heroku.com ./ Packages [1042 B]

```

A red box highlights the command `sh | sh`. A red arrow points from the text "4) After git-core installs, paste in this command from [toolbelt.heroku.com/debian](https://toolbelt.heroku.com/debian)" to the highlighted command.

**Figure 73:** Once the installation of `git-core` completes, paste in the command from [toolbelt.heroku.com/debian](https://toolbelt.heroku.com/debian) to install the `heroku` command line tools.

```

ubuntu@domU-12-31-39-0A-A8-BE:~$ which git
/usr/bin/git
ubuntu@domU-12-31-39-0A-A8-BE:~$ which heroku
/usr/bin/heroku
ubuntu@domU-12-31-39-0A-A8-BE:~$ which foreman
/usr/bin/foreman
ubuntu@domU-12-31-39-0A-A8-BE:~$ git --version
git version 1.7.9.5

```

5) You can confirm that *git* and *heroku* were installed properly by running the "which" command. It should produce the paths as shown.

**Figure 74:** Now confirm that *git* and *heroku* are installed and on your path. If they were not, then *which* would not print anything. If they are both installed, *which* will print the location of the programs, as shown they are both in */usr/bin*.

```

ubuntu@domU-12-31-39-0A-A8-BE:~/node-js-sample$ heroku login
Enter your Heroku credentials.
Email: balajis@stanford.edu
Password (typing will be hidden):
Authentication successful.

```

6) Log in at the command line with the same user/pass as [heroku.com](http://heroku.com)

**Figure 75:** Log in to *heroku* from the command line, using the same user/pass you set up at [heroku.com](http://heroku.com).

```

ubuntu@domU-12-31-39-0A-A8-BE:~$ ssh-keygen -t rsa
Generating public/private rsa key pair.
Enter file in which to save the key (/home/ubuntu/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/ubuntu/.ssh/id_rsa.
Your public key has been saved in /home/ubuntu/.ssh/id_rsa.pub.
The key fingerprint is:
5f:7b:87:19:0c:c8:23:aa:06:97:77:12:52:27:81:12 ubuntu@domU-12-31-39-0A-A8-BE
The key's randomart image is:
+--[ RSA 2048]--+
| E. .+.. |
| . . . o . . |
| . . . + . . |
| o o . . o |
| . o + S . o |
| o o o . . . + |
| o . . . + . |
| . . . . . |
+-----+
ubuntu@domU-12-31-39-0A-A8-BE:~$

```

7) Next we set up your SSH keys for talking to Heroku. Just type in this command and hit enter twice ("empty for no passphrase")

**Figure 76:** Here we are setting up your SSH keys for connecting to Heroku. Just hit enter twice when prompted for the passphrase.

```

ubuntu@domU-12-31-39-0A-A8-BE:~$ ssh-keygen -t rsa
Generating public/private rsa key pair.
Enter file in which to save the key (/home/ubuntu/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/ubuntu/.ssh/id_rsa.
Your public key has been saved in /home/ubuntu/.ssh/id_rsa.pub.
The key fingerprint is:
5f:7b:87:19:0c:c8:23:aa:06:97:77:12:52:27:81:12 ubuntu@domU-12-31-39-0A-A8-BE
The key's randomart image is:
+--[ RSA 2048]----+
| E. .+.. |
| . . o . . |
| . . . + . |
| o o . . o |
| . o + S . o |
| o o o . . + |
| o . . . + . |
| . . . . . |
+-----+
ubuntu@domU-12-31-39-0A-A8-BE:~$ heroku keys:add
Found existing public key: /home/ubuntu/.ssh/id_rsa.pub
Uploading SSH public key /home/ubuntu/.ssh/id_rsa.pub... done

```

8) After you've done the ssh-keygen step, now tell heroku about the new keys by typing in this command.

**Figure 77:** Now add the SSH keys you just generated to heroku (specifically you are sending the public key to heroku).

```

ubuntu@domU-12-31-39-0A-A8-BE:~$ git clone https://github.com/heroku/node-js-sample.git
Cloning into 'node-js-sample'...
remote: Counting objects: 277, done.
remote: Compressing objects: 100% (240/240), done.
remote: Total 277 (delta 9), reused 276 (delta 9)
Receiving objects: 100% (277/277), 191.16 KiB, done.
Resolving deltas: 100% (9/9), done.
ubuntu@domU-12-31-39-0A-A8-BE:~$ cd node-js-sample/
ubuntu@domU-12-31-39-0A-A8-BE:~/node-js-sample$ heroku create
Enter your Heroku credentials.
Email: balajis@stanford.edu
Password (typing will be hidden):
Creating guarded-lake-3837... done, stack is cedar
http://guarded-lake-3837.herokuapp.com/ | git@heroku.com:guarded-lake-3837.git
Git remote heroku added
ubuntu@domU-12-31-39-0A-A8-BE:~/node-js-sample$ 

```

8) Execute this command to pull down the sample nodejs app. Note the trailing t on the next line.

9) After the cloning completes, cd into the node-js-sample directory.

10) Enter this command to set up a heroku app with a random name (e.g. guarded-lake-3837 in this example) using the code in this git repository.

**Figure 78:** Type in the commands shown to pull down the sample nodejs codebase and create a corresponding heroku app for that codebase.

```

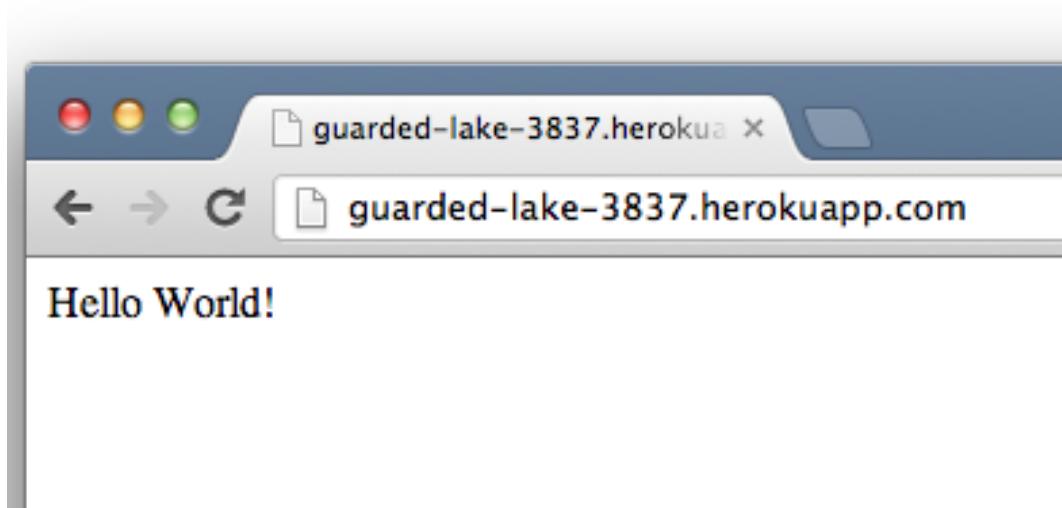
ubuntu@domU-12-31-39-0A-A8-BE:~$ cd node-js-sample/
ubuntu@domU-12-31-39-0A-A8-BE:~/node-js-sample$ git push heroku master
Counting objects: 277, done.
Compressing objects: 100% (240/240), done.
Writing objects: 100% (277/277), 191.16 KiB, done.
Total 277 (delta 9), reused 277 (delta 9)
----> Node.js app detected
----> Resolving engine versions
      Using Node.js version: 0.8.14
      Using npm version: 1.1.65
----> Fetching Node.js binaries
----> Vendorizing node into slug
----> Installing dependencies with npm
      npm WARN package.json node-example@0.0.1 No README.md file found!
      npm WARN package.json node-example@0.0.1 No README.md file found!
      npm WARN package.json connect@1.9.2 No README.md file found!
      express@2.5.11 /tmp/build_2znwj0puqx52w/node_modules/express
      connect@1.9.2 /tmp/build_2znwj0puqx52w/node_modules/express/node_modules/connect@1.9.2
      qs@0.4.2 /tmp/build_2znwj0puqx52w/node_modules/express/node_modules/qs
      mime@1.2.4 /tmp/build_2znwj0puqx52w/node_modules/express/node_modules/mime
      formidable@1.0.11 /tmp/build_2znwj0puqx52w/node_modules/express/node_modules/connect/node_modules/formidable
      mkdirp@0.3.0 /tmp/build_2znwj0puqx52w/node_modules/express/node_modules/mkdirp
      Dependencies installed
----> Building runtime environment
----> Discovering process types
      Procfile declares types -> web
----> Compiled slug size: 3.8MB
----> Launching... done, v4
      http://guarded-lake-3837.herokuapp.com deployed to Heroku

```

11) Finally, enter this command, also within the node-js-sample directory, to push the code to the app you just created.

12) Awesome. We now have a URL up and live. You will see a different app name - go and enter this into your browser now.

**Figure 79:** Last step: type in `git push heroku master` and then confirm that a URL is printed at the end (something like `http://guarded-lake-3837.herokuapp.com`, but yours will be different.)



**Figure 80:** Your first heroku nodejs app is now online! Your URL will be similar to `http://guarded-lake-3837.herokuapp.com`, but you will have your own custom version.

Congratulations! You just launched a cloud computer via AWS' EC2, cloned code from Github, and deployed a very simple website on Heroku. The last thing you want to do is terminate your EC2 instance so that it doesn't keep running.

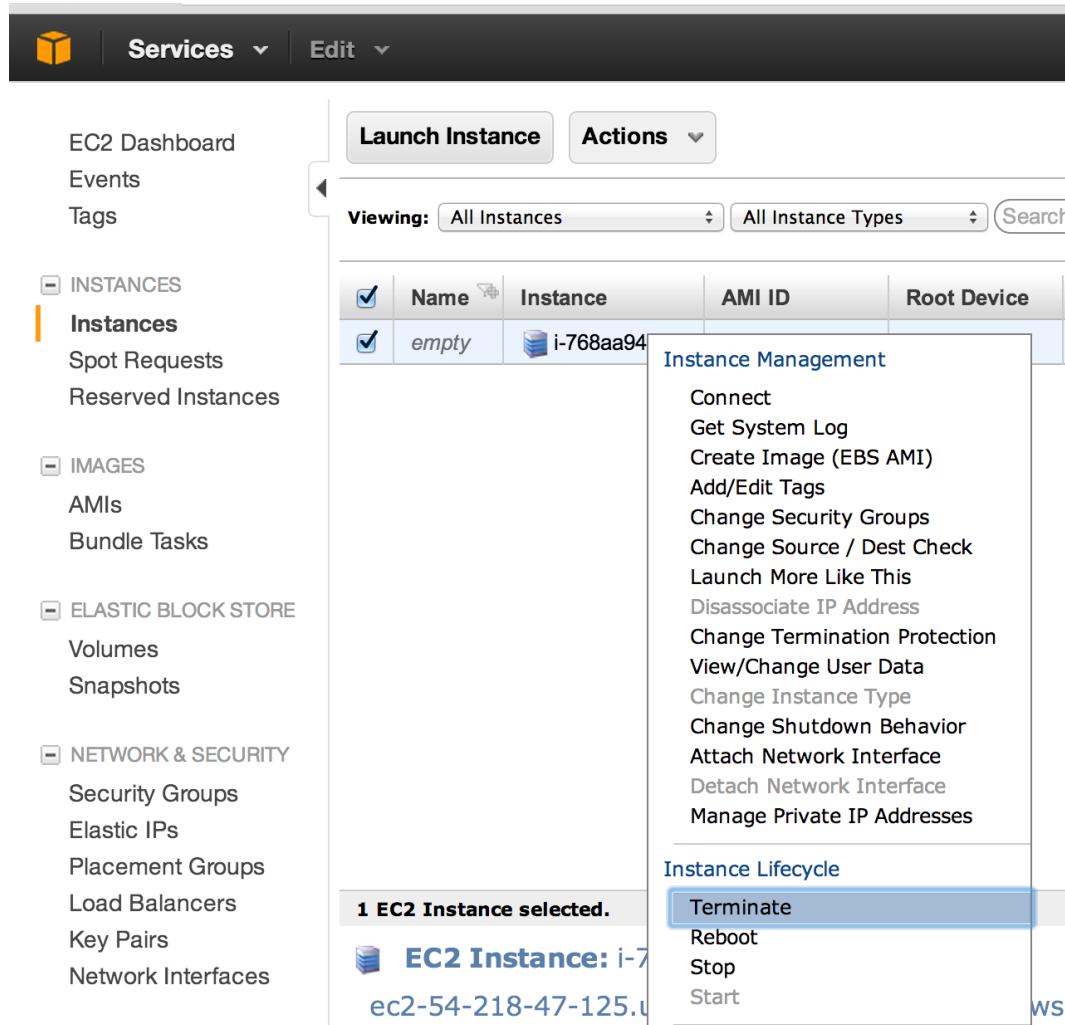


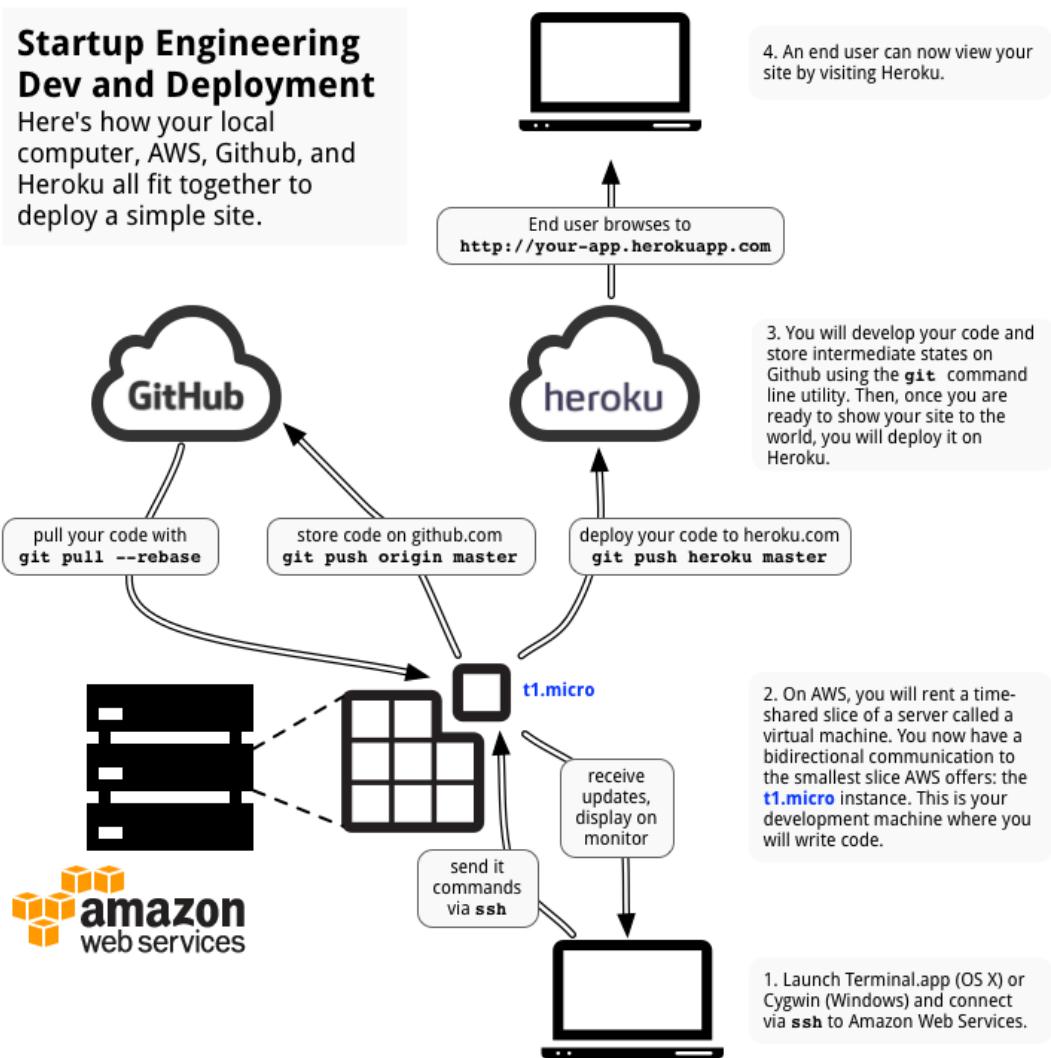
Figure 81: After you've gotten your Heroku app live, go to the [Instances Dashboard](#), right-click your instance, and select [Terminate](#).

Note: it is also possible to stop an instance. Stopping is different from terminating; while terminating completely kills and frees up all resources, stopping an EBS-backed instances pauses billing for the computing portion but still charges for the storage. We'll get into this later, but read [here](#) and [here](#) for more.

## Post-mortem

Now that you have your site up, take a look again at Figure 82. We did most of the things in there, except we only pulled code from [github.com](#) and didn't push any code. It's very important to keep in mind which computer you are currently controlling and executing commands on, whether that be your own laptop, an AWS machine, or a remote machine in the Heroku or Github clouds. Over time this will become second nature, and we'll show how to configure

your command line environment to give some hints.



**Figure 82:** Recall this figure again. You were controlling the **t1.micro** instance as you typed in those commands to pull down code from github and push it to heroku.

In the interests of speed, we did a number of things in this interactive start that we would not normally do. For example, we worked with `.pem` files in the directory where they landed, rather than moving them into `~/.ssh`. And in practice you would want to put code through three stages: a dev, staging, and production branch before pushing to the web. You probably also want to read the Heroku documentation on [node.js](#) and [SSH keys](#) to understand some of the steps at the end. We'll cover things like this in more detail as the course progresses.

## Terminology

Whew! We flew through quite a bit there. Here are a few terms which we introduced that you should become familiar with:

- **git**: A tool for storing and manipulating the history of a program edited by many different users. Also known as a distributed version control system (DVCS).
- *Github.com*: A social network for programmers built around **git**. There are other sites like this, such as BitBucket.com and Sourceforge.com
- **AWS**: Amazon Web Services, a set of cloud services for programmers.
- **Heroku**: A layer on top of AWS that greatly simplifies the process of developing and deploying a web application.
- **Gravatar**: A simple site which provides a globally recognizable image that you can use in various social contexts. For example, click [here](#) and look at the little images to the left of each **git** commit; those are being pulled from gravatar.com.
- **EC2**: Elastic Compute Cloud, a fleet of virtual machines that you can rent by the hour from Amazon.
- **Virtual machine**: In practice, you are usually not renting a single physical computer, but rather a virtualized piece of a multiprocessor computer. Breakthroughs in operating systems research have allowed us to take a single computer with (say) eight processors and make it seem like eight independent computers, capable of being completely wiped and rebooted without affecting the others.

A good analogy for virtualization is sort of like taking a house with eight rooms and converting it into eight independent apartments, each of which has its own key and climate control, and can be restored to default settings without affecting the others.

While these “virtual computers” have reasonable performance, they are less than that of the native hardware. In practice, virtualization is not magic; extremely high workloads on one of the other “tenants” in the VM system can affect your room, in the same way that a very loud next door neighbor can overwhelm the soundproofing. Still, most of the time you don’t need an eight room home or an eight processor computer; you need just one room for the night.

- **AMI**: Amazon Machine Image, an operating system + default software package which you can use to initialize any instance.
- **Availability Zone**: the physical location of the instance.
- **EC2 instance**: a particular instance, e.g. `i-2938408`.
- **IP address**: a dotted address representing a machine on the internet, e.g. `171.65.1.2`.
- **Hostname**: The name of a server, e.g. `ec2-1234.amazon.com`.
- **DNS**: The system which maps a hostname like `ec2-1234.amazon.com` to an IP address like `171.65.1.2`.

- *SSH*: Secure Shell, a means of connecting to a remote computer and execute commands.
- *Public Key*: When you hand out your public key, it is like handing out a set of special envelopes. Any who has your public key can put their message in one of these envelopes, seal it, and send it to you. But only you can open that message with your private key. Both of the “keys” in this case can be thought of as long hexadecimal numbers. Github asks for your public key to confirm your identity in future interactions; essentially for all future communications they send you a message that only you can open (with your private key). By decrypting this message and sending it back to them, they know that you must have the private key and so they authorize the operation.
- *RSA*: A kind of [encryption algorithm](#) that generates both public and private keys. Always run this locally on your machine; anyone who knows your private key can decrypt messages encrypted with the corresponding public key and thereby pose as you.