



Cold
Spring
Harbor
Laboratory

Introduction to cloud computing

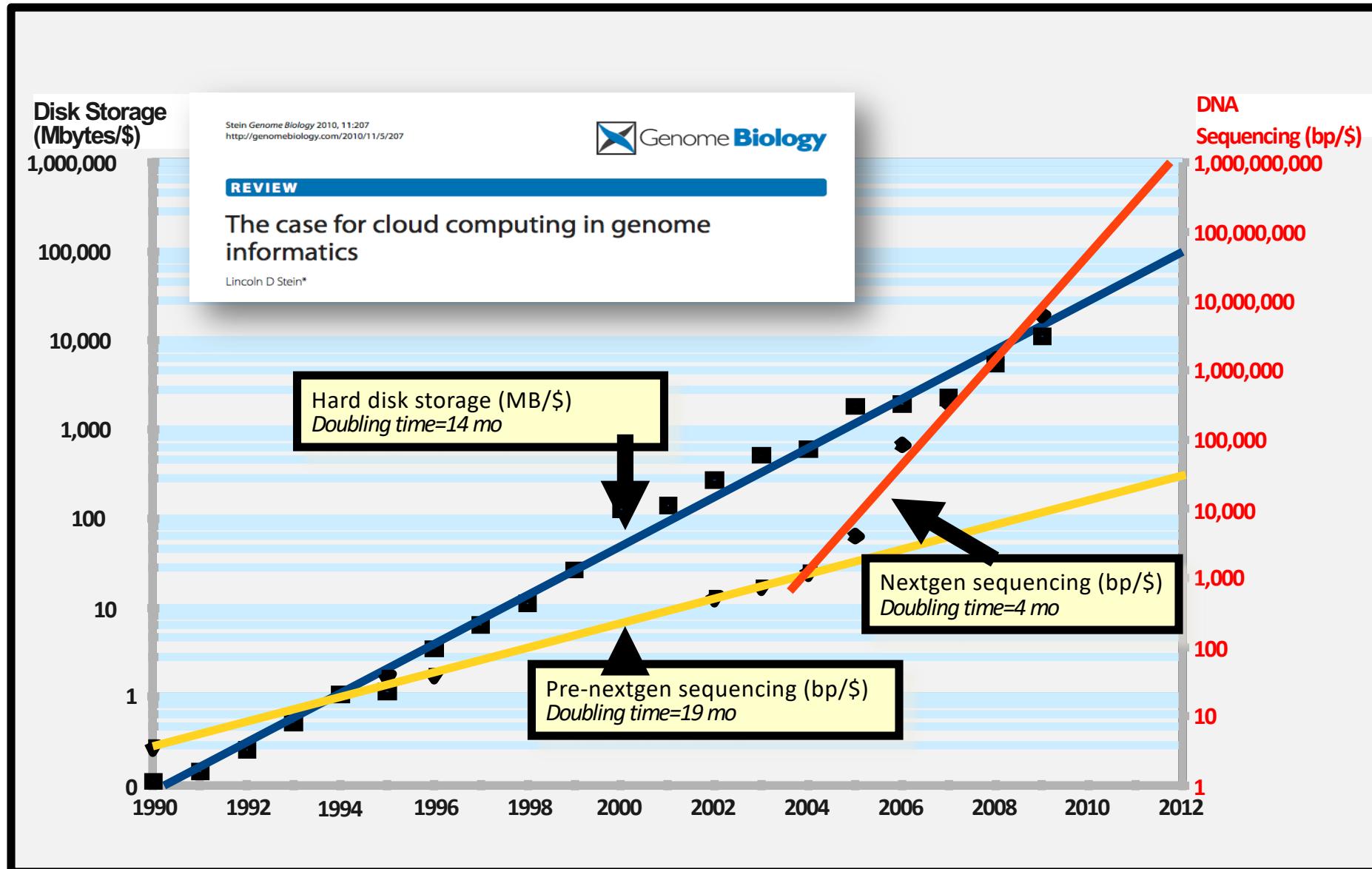
John Chamberlin, Kelsy Cotto, Felicia Gomez, Obi Griffith, Malachi Griffith,
Simone Longo, Allegra Petti, Aaron Quinlan, Megan Richters, Huiming Xia
Advanced Sequencing Technologies & Bioinformatics Analysis November 16-20, 2020



Learning Objectives

- Introduction to cloud computing concepts
- Introduction to cloud computing providers
- Use the Amazon EC2 console to create an instance for each student
 - Will be used for many hands-on tutorials throughout the course
- How to log into your cloud instance

Disk Capacity vs Sequencing Capacity, 1990-2012



About DNA and computers

- We hit the \$1000 genome* in ~2016
 - Need to think about the \$100 genome
- The doubling time of sequencing has been ~5-6 months.
- The doubling time of storage and network bandwidth is ~12 months.
- The doubling time of CPU speed is ~18 months.
- The cost of sequencing a base pair will eventually equal the cost of storing a base pair

What is the general biomedical scientist to do?

- Lots of data
- Poor IT infrastructure in many labs
- Where do they go?
- Get bigger hardware?
- Write more grants?

Cloud computing providers

- Amazon AWS
 - <https://aws.amazon.com/>
- Google cloud
 - <https://cloud.google.com/>
- Microsoft Azure
 - <https://azure.microsoft.com/en-us/>
- More...

Amazon Web Services (AWS)

- Infinite storage (scalable): S3 (simple storage service)
- Compute per hour: EC2 (elastic cloud computing)
- Ready when you are High Performance Computing
- Multiple football fields of HPC throughout the world



Some of the challenges of cloud computing:

- Not cheap
- Getting files to and from there
- Standardization can be a challenge if you don't control hardware
- PHI: personal health information & security concerns
 - In the USA: HIPAA act, PSQIA act, HITECH act, Patriot act, CLIA and CAP programs, etc.
 - <http://www.biostars.org/p/70204/>

Some of the advantages of cloud computing:

- We received a grant from Amazon, so supported by ‘AWS in Education grant award’.
- There are better ways of transferring large files, and now AWS makes it free to upload files.
- A number of datasets exist on AWS (e.g. 1000 genome data).
- Many useful bioinformatics AMI’s (Amazon Machine Images) exist on AWS: e.g. cloudbiolinux & CloudMan (Galaxy) – now one for this course!
- Many flavors of cloud available, not just AWS

Key AWS concepts and terminology

- **AWS** - Amazon Web Services. A collection of cloud computing services provided by Amazon.
- **EC2** - Elastic Compute. An AWS service that allows you to configure and rent computers to meet your compute needs on an as needed basis.
- **EBS** - Elastic Block Storage. A data storage solution that allows you to rent disk storage and associate that storage with your compute resources. EBS volumes are generally backed by SSD devices.

Key AWS concepts and terminology

- **S3** - Simple storage service. Cheaper than EBS and allows for storage of larger amounts of data with some drawbacks compared to EBS. S3 volumes store data as objects that are accessed by an API or command line interface or other application designed to work with S3. EBS volumes on the other hand can be mounted as if they were a local disk drive associated with the Instance.
- **SSD** - Solid state drive. A particular type of storage hardware that is generally faster and more expensive than traditional hard drives.

What is difference between the 'Start', 'Stop', 'Reboot', and 'Terminate' (Instance States)?

- Start – turn on an EC2 instance that you have previously created
- Stop – turn off an EC2 instance that you have previously created
- Reboot – restart an EC2 instance
- Terminate – permanently stop and destroy an EC2 instance. Any associated EBS volumes may also be destroyed at this time depending on configuration

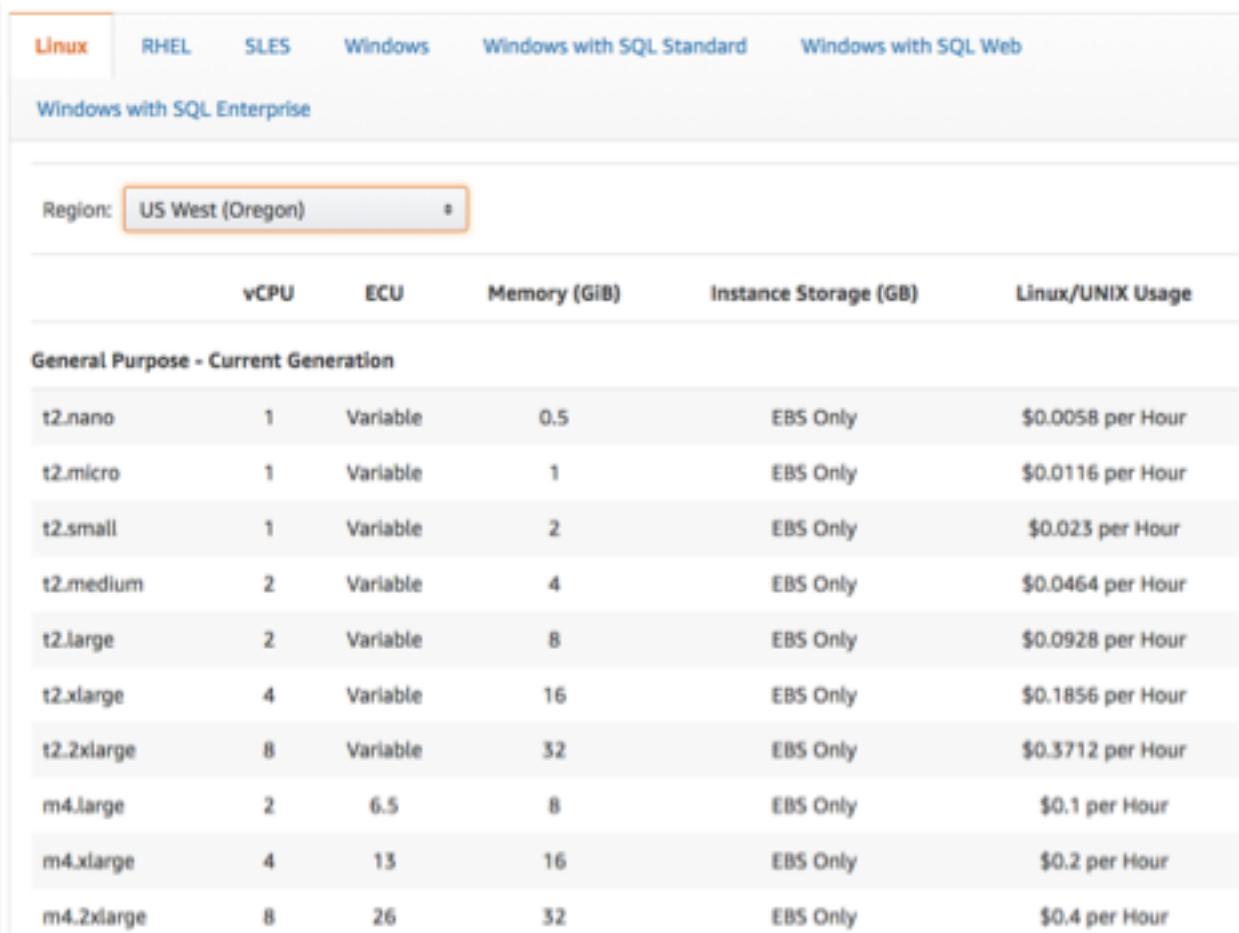
What is an AMI/snapshot?

- AMI (Amazon Machine Image) – a template that specifies how to launch EC2 instances
 - Root volume with operating system (OS), pre-installed applications, etc
 - Launch permissions determine who can use the AMI
 - Specification of (data) volumes to attach when launched
- You can create an AMI for any instance you have created/configured
- AMI can be made public for sharing (region-specific)
- Creating an AMI involves creating a snapshot of the root and any attached volumes. You will be charged to store this snapshot.

I can not log into my EC2 instance, what might have gone wrong?

- Is your instance running?
- Are you providing the correct path to your key file?
- Is it the correct key file?
- Have you set the permissions for your key file correctly?
- Did you specify a valid user for your AMI (e.g., ubuntu)?
- Did you specify the correct IP address?
- Does the Security Group for the instance allow access for your connection protocol (e.g., SSH) and location?

How much does it cost to use AWS EC2 resources?



The screenshot shows the AWS CloudWatch Metrics Insights search interface. At the top, there are tabs for different operating systems: Linux (selected), RHEL, SLES, Windows, Windows with SQL Standard, and Windows with SQL Web. Below the tabs, a dropdown menu shows the region as "US West (Oregon)". The main area displays a table of AWS Lambda metrics. The columns are: vCPU, ECU, Memory (GiB), Instance Storage (GB), and Linux/UNIX Usage. The table lists various Lambda functions with their respective specifications and usage costs.

	vCPU	ECU	Memory (GiB)	Instance Storage (GB)	Linux/UNIX Usage
General Purpose - Current Generation					
t2.nano	1	Variable	0.5	EBS Only	\$0.0058 per Hour
t2.micro	1	Variable	1	EBS Only	\$0.0116 per Hour
t2.small	1	Variable	2	EBS Only	\$0.023 per Hour
t2.medium	2	Variable	4	EBS Only	\$0.0464 per Hour
t2.large	2	Variable	8	EBS Only	\$0.0928 per Hour
t2.xlarge	4	Variable	16	EBS Only	\$0.1856 per Hour
t2.2xlarge	8	Variable	32	EBS Only	\$0.3712 per Hour
m4.large	2	6.5	8	EBS Only	\$0.1 per Hour
m4.xlarge	4	13	16	EBS Only	\$0.2 per Hour
m4.2xlarge	8	26	32	EBS Only	\$0.4 per Hour

Data transfer (GB): In: free or \$0.01; Out: free, \$0.01 or \$0.02

EBS storage (GB/Month): \$0.10

S3 storage (GB/Month): \$0.023 standard, \$0.0125 infrequent access, or
\$0.004 glacier

Why am I still getting a monthly bill?

- Generally you get an accounting of usage and cost on a 30 day cycle
 - Pricing is per instance-hour (now instance-second!) consumed for each instance type.
 - Also charges for storage, transfers, etc
- Be aware of regions!
- Even when an instance is stopped, storage for root or other EBS volumes persist
- Creating AMIs/snapshots requires storage
- Explore the billing and cost management tools of AWS to track your spending, set warnings, etc

Amazon AWS documentation

https://rnabio.org/module-00-setup/0000/06/01/Intro_to_AWS/

<http://aws.amazon.com/console/>

In this workshop:

- Some tools (data) are
 - on your computer
 - on the web
 - on the cloud.
- You will become efficient at traversing these various spaces, and finding resources you need, and using what is best for you.
- There are different ways of using the cloud:
 1. Command line (like your own very powerful Unix box)
 2. With a web-browser (e.g. Galaxy): not in this workshop

Things we have set up:

- Loaded data files to a web server
- We brought up an Ubuntu (Linux) instance, and loaded a whole bunch of software for NGS analysis.
- We will clone this and create separate instances for everybody in the class.
- We've simplified the security: you basically all have the same login and file access, and opened ports. In your own world you would be more secure.

Logging into Amazon AWS

Go to course wiki, “Log into AWS” page



Log into AWS

[« Introduction to AWS](#)

[Course](#)

[Unix »](#)

Using cloud computing to complete this course involves two major components: (1) Launching an instance on the cloud (essentially renting a virtual computer by the hour and turning it on) and (2) logging into that instance).

Covered in this section: logging into AWS EC2 console, starting an instance from the course AMI, configuring it in the console (select instance AMI, instance type, instance details, storage volumes, tags, security group, and key pairs).



https://rnabio.org/module-00-setup/0000/07/01/Log_into_AWS/

Login to AWS console



<https://cshlworkshops.signin.aws.amazon.com/console>

Select "EC2" service

AWS Management Console

AWS services

Find Services

You can enter names, keywords or acronym

EC2

Recently visited services

- EC2
- Billing
- IAM

All services

Build a solution

Get started with simple wizards and automated workflows.

Stay con resource

Download the AWS Console Mobile App to your iOS or Android mobile device. [Learn more](#)

Explore AWS

Amazon SageMaker Autopilot

Get hands-on with AutoML. [Learn more](#)

AWS Storage Gateway

Get on-premises low latency access to virtually unlimited cloud storage with this hybrid cloud storage service. [Learn more](#)

Make sure you are in Virginia region

Search for EC2

A red arrow points to the search bar containing "EC2". A red arrow also points to the "N. Virginia" region selector in the top right corner.

Launch a new Instance

The screenshot shows the AWS EC2 Dashboard. On the left sidebar, under the 'Instances' section, the 'Launch Templates' option is selected. In the main content area, there is a 'Launch instance' button at the bottom of a section that says 'To get started, launch an Amazon EC2 instance, which is a virtual server in the cloud.' A large red arrow points to this 'Launch instance' button. The dashboard also displays resource statistics and account attributes.

Resources

You are using the following Amazon EC2 resources in the US East (N. Virginia) Region:

Instances (running)	2	Dedicated Hosts	0
Elastic IPs	0	Instances (all states)	2
Key pairs	5	Load balancers	0
Placement groups	0	Security groups	4
Snapshots	4	Volumes	3

Launch instance

To get started, launch an Amazon EC2 instance, which is a virtual server in the cloud.

Launch instance

Note: Your instances will launch in the US East (N. Virginia) Region

Account attributes

Supported platforms

- VPC

Default VPC

vpc-ad2c8fd7

Settings

EBS encryption

Zones

Default credit specification

Console experiments

Additional information

Getting started guide

Documentation

All EC2 resources

Forums

Choose an AMI – Find the CSHL SEQTEC 2020 AMI in the My AMIs

Screenshot of the AWS 'Choose an AMI' wizard Step 1: Choose an Amazon Machine Image (AMI).

An AMI is a template that contains the software configuration (operating system, application server, and applications) required to launch your instance. You can select an AMI provided by AWS, our user community, or the AWS Marketplace; or you can select one of your own AMIs.

Step 1: Choose an Amazon Machine Image (AMI)

Cancel and Exit

Search for an AMI by entering a search term e.g. "Windows"

Search by Systems Manager parameter

Quick Start

My AMIs **←**

AWS Marketplace

Community AMIs

Ownership

Owned by me

Shared with me

Architecture

32-bit (x86)

64-bit (x86)

cshl-seqtec-2019 - ami-018b3bf40f9926ac5

Root device type: ebs Virtualization type: hvm Owner: 577256725291 ENA Enabled: Yes

Select

64-bit (x86)

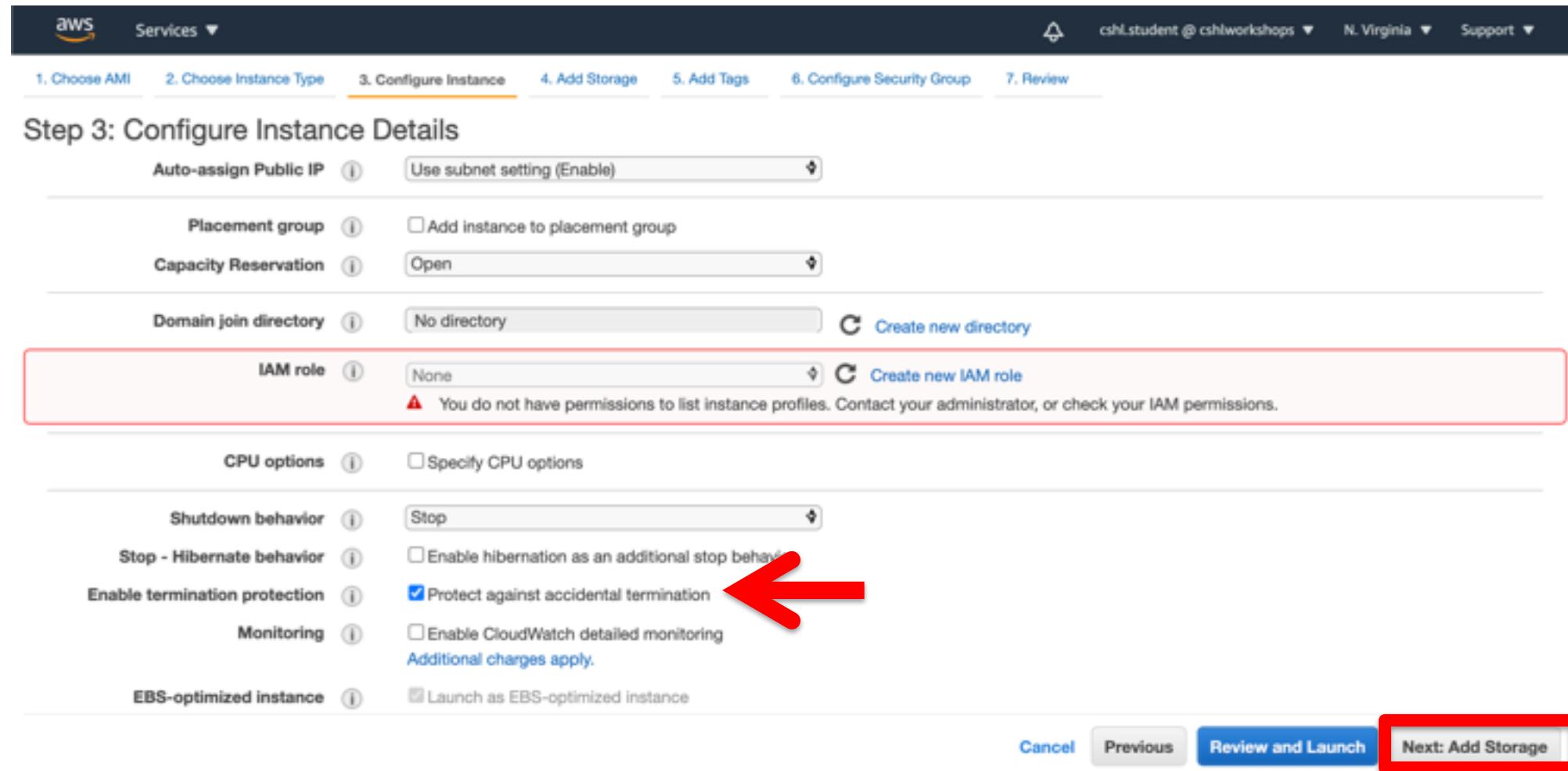
cshl-seqtech-2020 - ami-0cdaba7e6f983f943

Root device type: ebs Virtualization type: hvm Owner: 577256725291 ENA Enabled: Yes

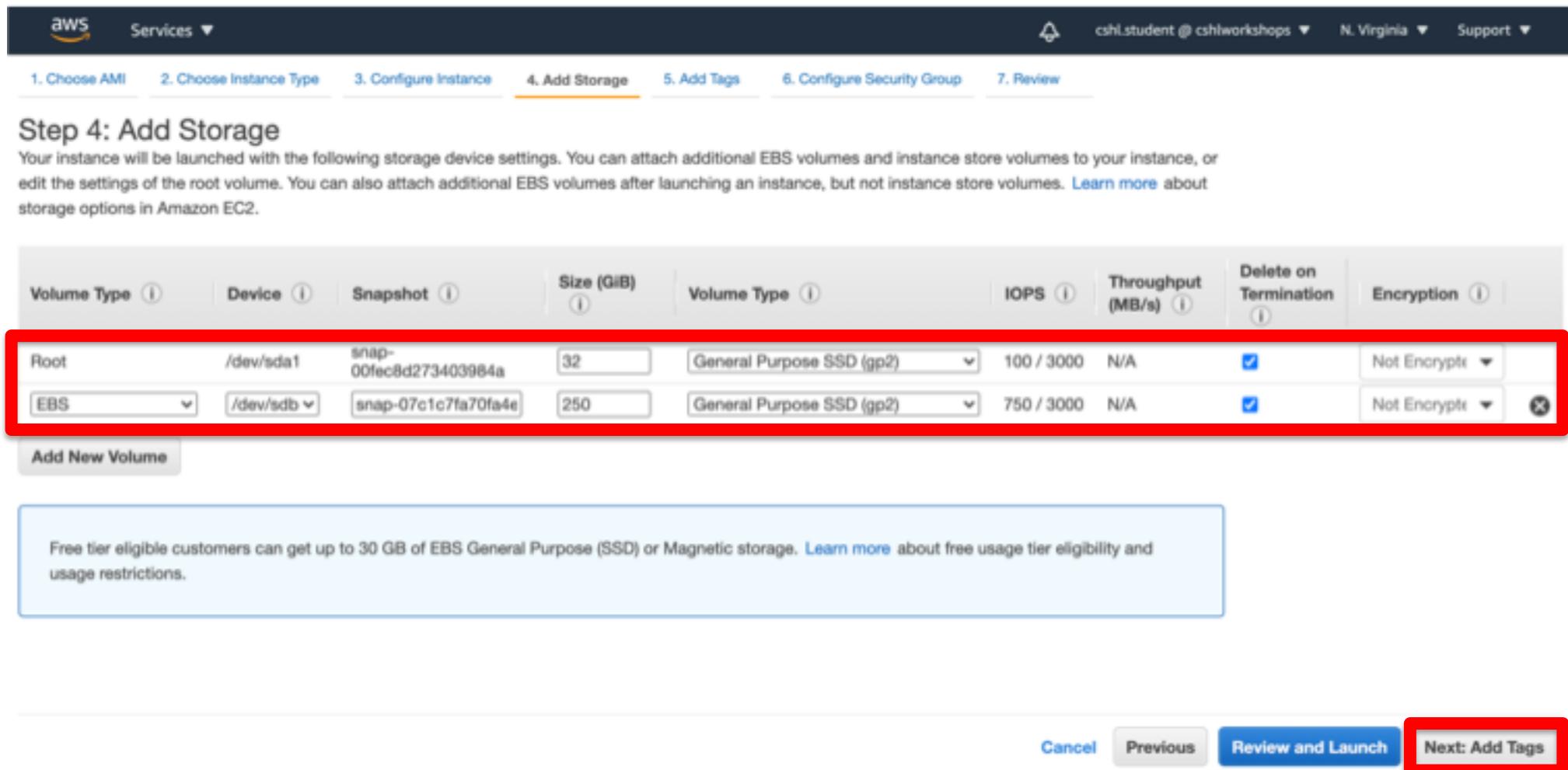
Select

64-bit (x86) **←**

Select "Protect against accidental termination", then "Next: Add Storage".



You should see "snap-xxxxxxx" (32GB) and "snap-yyyyyyy" (250GB) as the two storage volumes selected. Then, "Next: Tag Instance"



The screenshot shows the AWS EC2 instance creation wizard at Step 4: Add Storage. The '4. Add Storage' tab is active. Two EBS volumes are listed:

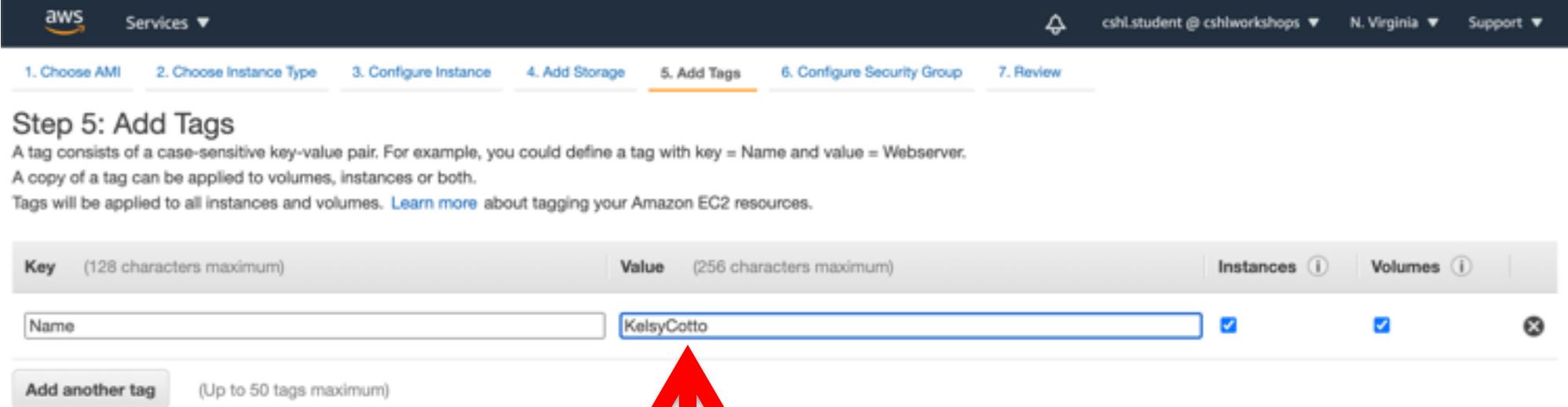
Volume Type	Device	Snapshot	Size (GiB)	Volume Type	IOPS	Throughput (MB/s)	Delete on Termination	Encryption
Root	/dev/sda1	snap-00fec8d273403984a	32	General Purpose SSD (gp2)	100 / 3000	N/A	<input checked="" type="checkbox"/>	Not Encrypted
EBS	/dev/sdb	snap-07c1c7fa70fa4e	250	General Purpose SSD (gp2)	750 / 3000	N/A	<input checked="" type="checkbox"/>	Not Encrypted

A red box highlights the second volume row. Below the table is a note about free tier usage:

Free tier eligible customers can get up to 30 GB of EBS General Purpose (SSD) or Magnetic storage. Learn more about free usage tier eligibility and usage restrictions.

At the bottom right, the 'Next: Add Tags' button is highlighted with a red box.

Create a tag like “Name=KelsyCotto” [use your own name]. Then hit “Next: Configure Security Group”.



The screenshot shows the AWS EC2 instance creation wizard at Step 5: Add Tags. The 'Value' field is highlighted with a red arrow pointing to it. The value 'KelsyCotto' is typed into the field. Below the table, there is a note: 'Important: Don't forget to name your instance! (FirstnameLastname)'. At the bottom right, the 'Next: Configure Security Group' button is highlighted with a red box.

Step 5: Add Tags

A tag consists of a case-sensitive key-value pair. For example, you could define a tag with key = Name and value = Webserver.

A copy of a tag can be applied to volumes, instances or both.

Tags will be applied to all instances and volumes. [Learn more](#) about tagging your Amazon EC2 resources.

Key	(128 characters maximum)	Value	(256 characters maximum)	Instances	Volumes	
Name		KelsyCotto		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="button" value="X"/>

Add another tag (Up to 50 tags maximum)

Cancel Previous Review and Launch Next: Configure Security Group

Review the details of your instance, note the warnings, then hit Launch

Step 7: Review Instance Launch

Please review your instance launch details. You can go back to edit changes for each section. Click Launch to assign a key pair to your instance and complete the launch process.

AMI Details

cshl-seqtech-2020 - ami-0cdab7e6f983ff943
Root Device Type: ebs Virtualization type: hvm

Instance Type

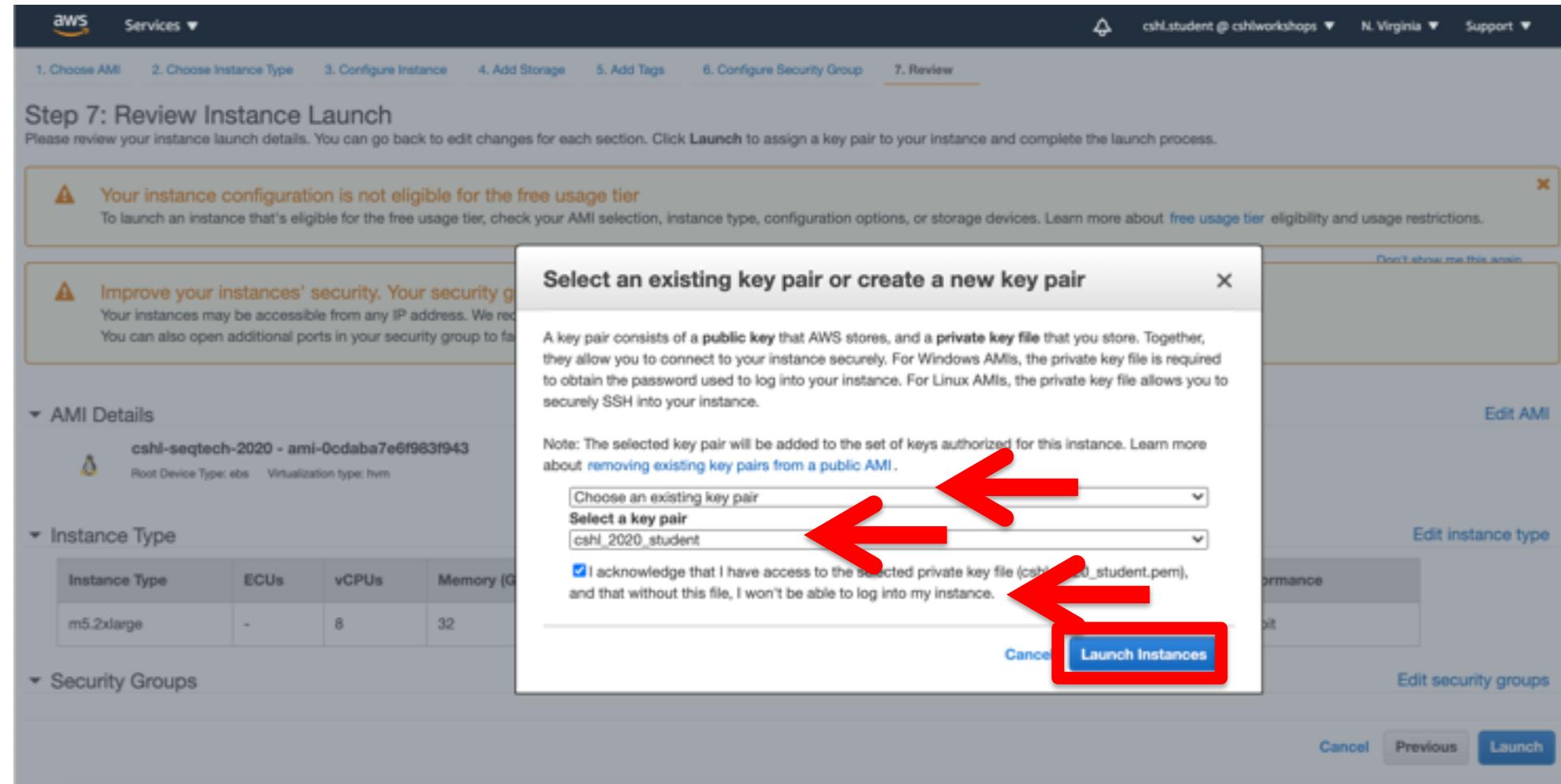
Instance Type	ECUs	vCPUs	Memory (GiB)	Instance Storage (GiB)	EBS-Optimized Available	Network Performance
m5.2xlarge	-	8	32	EBS only	Yes	Up to 10 Gigabit

Security Groups

Security Group ID	Name	Description
sg-0087dc3a8b6e37a2d	SSH and HTTP	created 2019-11-08T09:43:29.293-05:00

Cancel Previous **Launch**

Choose an existing key pair: "cshl_2019_student" and then Launch.



View Instances to see your new instance spinning up!

The screenshot shows the AWS Launch Status page. At the top, there's a navigation bar with the AWS logo, 'Services', 'Resource Groups', and a star icon. On the right, it shows the user 'cshi.student @ cshiworkshops', 'N. Virginia', and 'Support'. Below the navigation, the title 'Launch Status' is displayed. A green box contains a checkmark icon and the text 'Your instances are now launching'. It also mentions 'The following instance launches have been initiated: i-08e73e43f17783273' and a 'View launch log' link. A blue box contains an info icon and the text 'Get notified of estimated charges'. It includes a link to 'Create billing alerts' and a note about getting email notifications for estimated charges exceeding a defined amount. The main content area has a heading 'How to connect to your instances'. It explains that instances are launching and may take a few minutes to reach the running state. It suggests clicking 'View Instances' to monitor status and provides links to the 'Amazon EC2: User Guide' and 'Amazon EC2: Discussion Forum'. There's also a section for creating status check alarms and attaching EBS volumes, both with notes about additional charges. A red box highlights the 'View Instances' button at the bottom right.

Launch Status

Your instances are now launching

The following instance launches have been initiated: [i-08e73e43f17783273](#) [View launch log](#)

Get notified of estimated charges

Create billing alerts to get an email notification when estimated charges on your AWS bill exceed an amount you define (for example, if you exceed the free usage tier).

How to connect to your instances

Your instances are launching, and it may take a few minutes until they are in the running state, when they will be ready for you to use. Usage hours on your new instances will start immediately and continue to accrue until you stop or terminate your instances.

Click [View Instances](#) to monitor your instances' status. Once your instances are in the running state, you can connect to them from the Instances screen. [Find out](#) how to connect to your instances.

Here are some helpful resources to get you started

- [How to connect to your Linux instance](#)
- [Learn about AWS Free Usage Tier](#)
- [Amazon EC2: User Guide](#)
- [Amazon EC2: Discussion Forum](#)

While your instances are launching you can also

Create status check alarms to be notified when these instances fail status checks. (Additional charges may apply)

Create and attach additional EBS volumes (Additional charges may apply)

Manage security groups

[View Instances](#)

Find YOUR instance, select it, and then hit connect for instructions on how to connect (It may take some time for your instance to be ready)

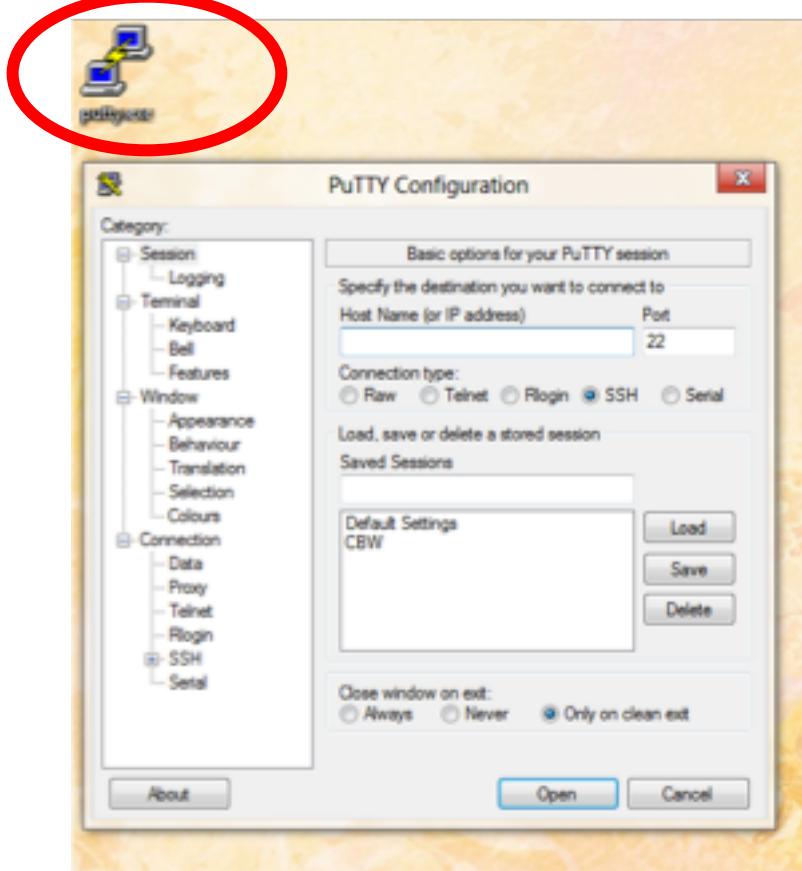
The screenshot shows the AWS EC2 Instances page. On the left, there's a sidebar with links like New EC2 Experience, EC2 Dashboard, Events, Tags, Limits, Instances (selected), Instance Types, Launch Templates, Spot Requests, Savings Plans, Reserved Instances, Dedicated Hosts, Scheduled Instances, Capacity Reservations, Images (AMIs), and Elastic Block Store (Volumes, Snapshots, Lifecycle Manager). The main content area has a title 'Instances (1/3) Info' and a 'Filter instances' search bar. A red arrow points to the 'KelsyCotto' instance in the list, which is highlighted with a blue selection bar. Another red arrow points to the 'Public IPv4 address' field, which contains '100.24.122.188 | open address'. The top navigation bar includes 'Services', 'csh.student@cshworkshops', 'N. Virginia', and 'Support'. Buttons for 'Connect' (highlighted with a red box), 'Actions', and 'Launch instances' are also visible.

Take note of your Public DNS/IP and the instructions on changing permissions for the key file (Note, we will login as ubuntu NOT root)

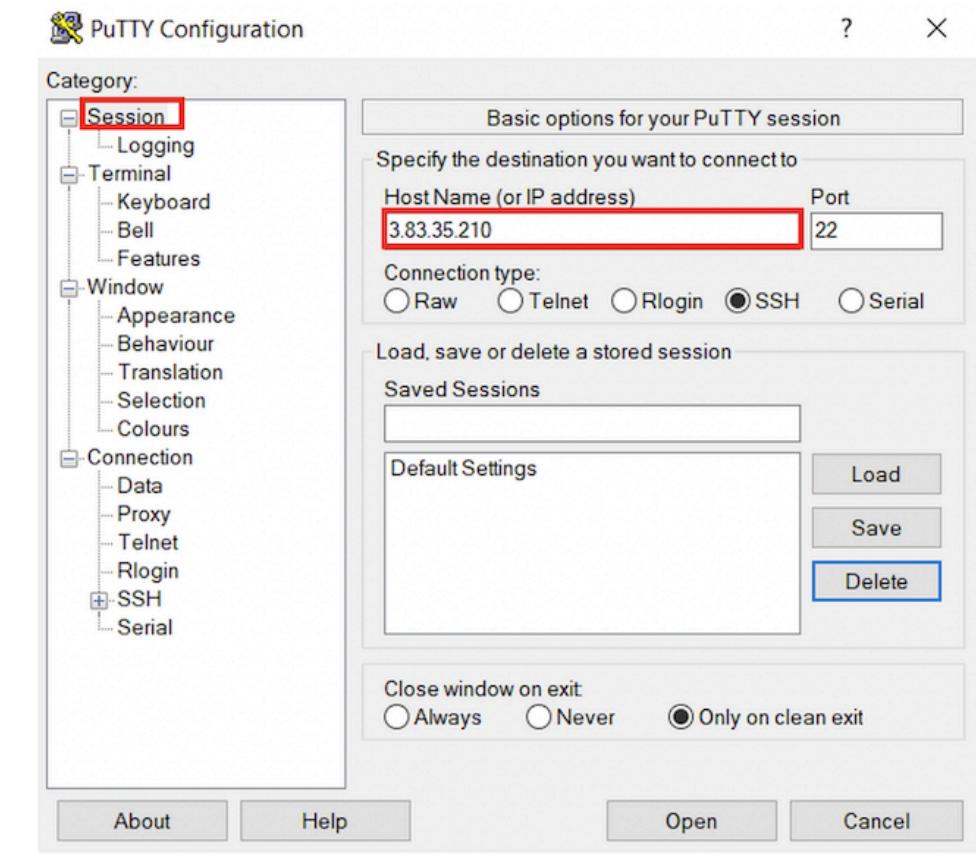
The screenshot shows the AWS EC2 'Connect to instance' interface. At the top, there's a navigation bar with the AWS logo, 'Services ▾', a notification bell, the email 'cshl.student@cshlworkshops ▾', the region 'N. Virginia ▾', and 'Support ▾'. Below the navigation, the path 'EC2 > Instances > i-0b012943b3ce51aee > Connect to instance' is visible. The main content area has a title 'Connect to instance' with a blue 'Info' link. It says 'Connect to your instance i-0b012943b3ce51aee (KelsyCotto) using any of these options'. There are three tabs: 'EC2 Instance Connect', 'Session Manager', and 'SSH client', with 'SSH client' being the active one and highlighted with a red arrow. Below the tabs, the 'Instance ID' is listed as 'i-0b012943b3ce51aee (KelsyCotto)'. A numbered list of steps follows: 1. Open an SSH client. 2. Locate your private key file. The key used to launch this instance is 'cshl_2020_student.pem'. 3. Run this command, if necessary, to ensure your key is not publicly viewable. A checkbox is shown next to the command 'chmod 400 cshl_2020_student.pem'. 4. Connect to your instance using its Public DNS: A checkbox is shown next to the URL 'ec2-3-237-46-215.compute-1.amazonaws.com'. An 'Example:' section shows the command 'ssh -i "cshl_2020_student.pem" root@ec2-3-237-46-215.compute-1.amazonaws.com'. At the bottom right of the content area is a 'Cancel' button.

Logging into your instance (Windows)

Open PuTTY

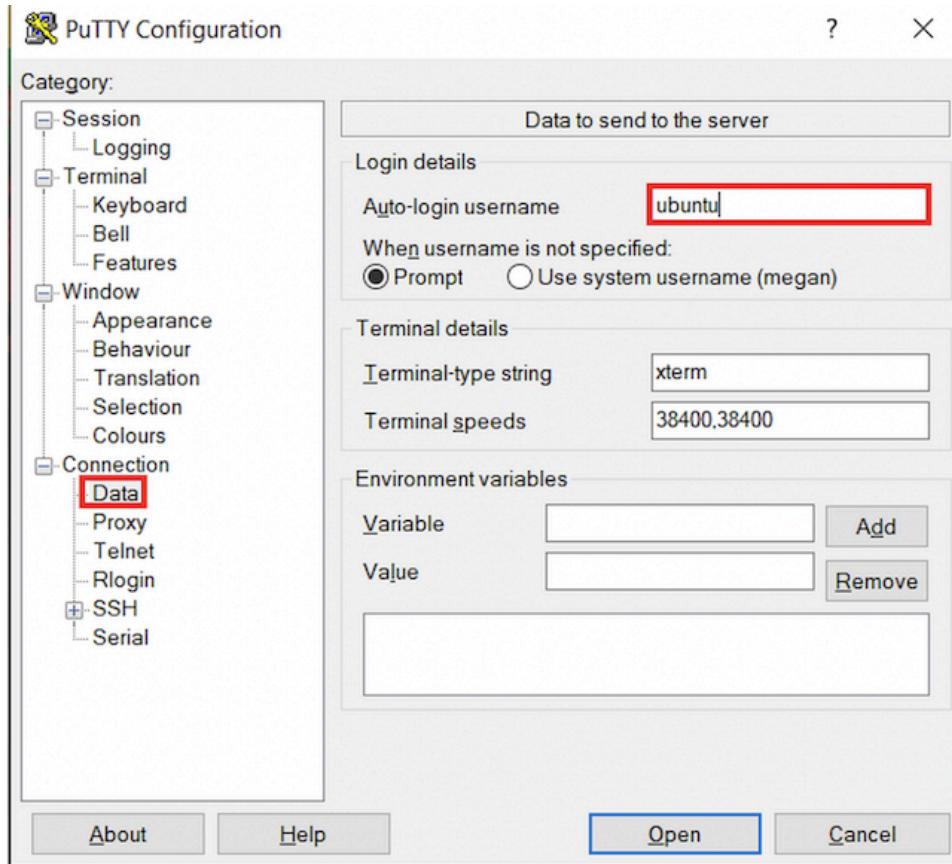


Enter the Host Name (IP address)

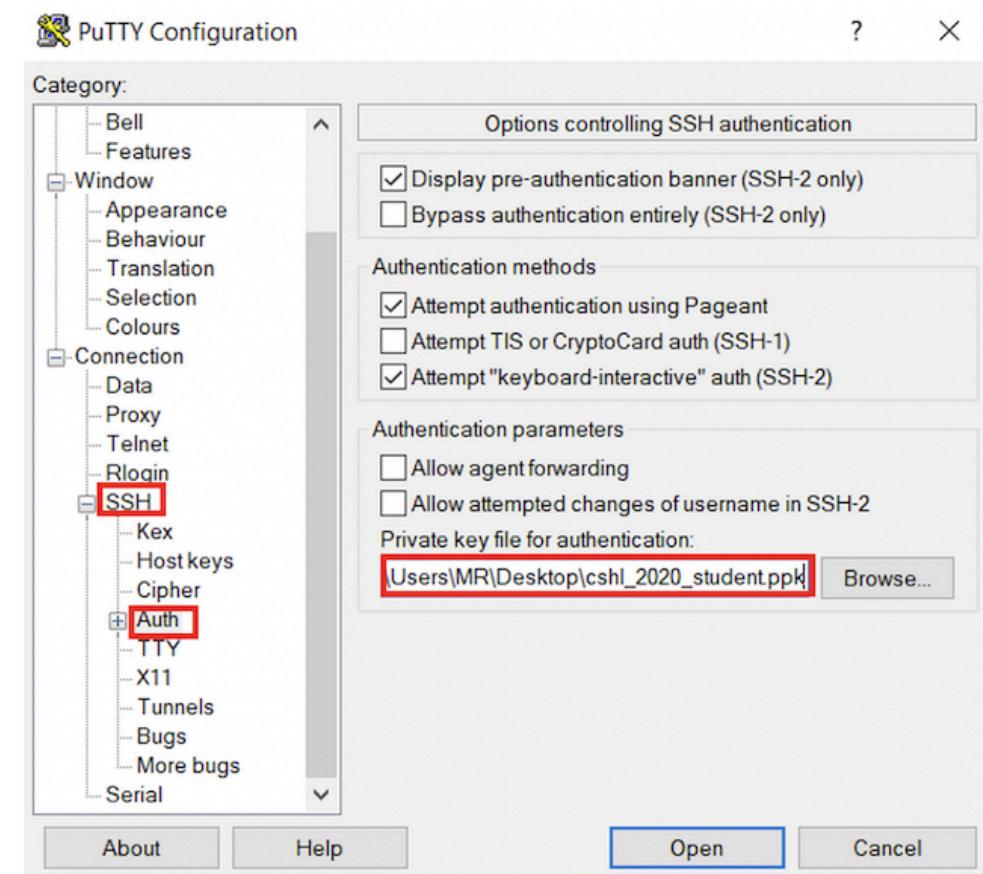


Logging into your instance (Windows)

Choose Connection -> Data
Enter the username 'ubuntu'



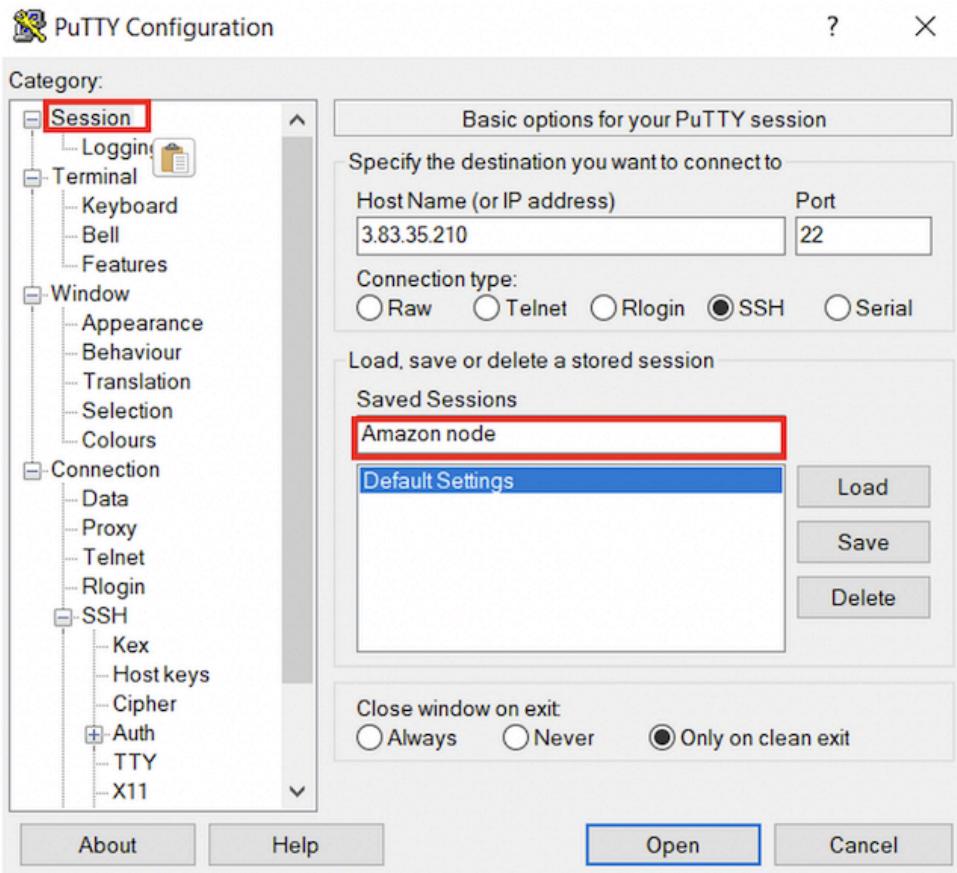
Choose SSH -> Auth
Browse to Private key (ppk) file



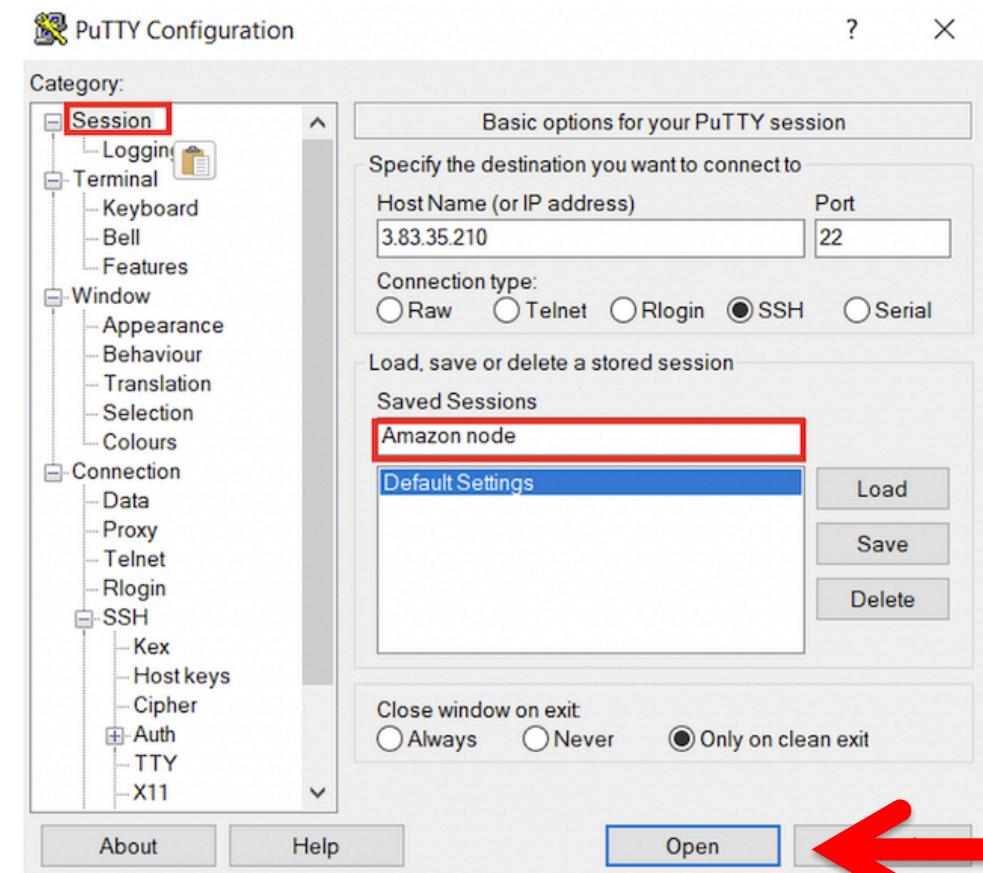
Logging into your instance (Windows)

Choose Session

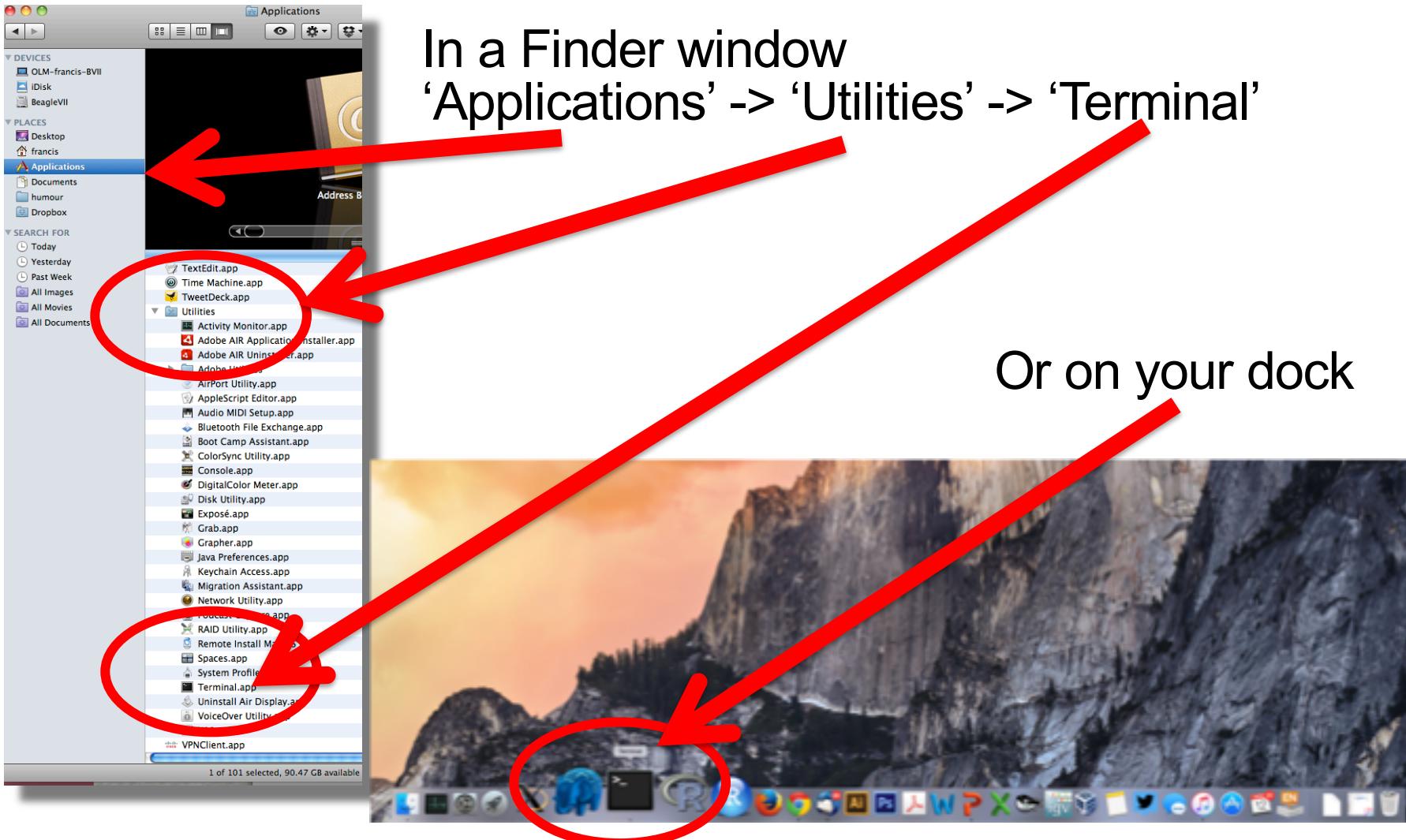
Save your session as "Amazon Node"



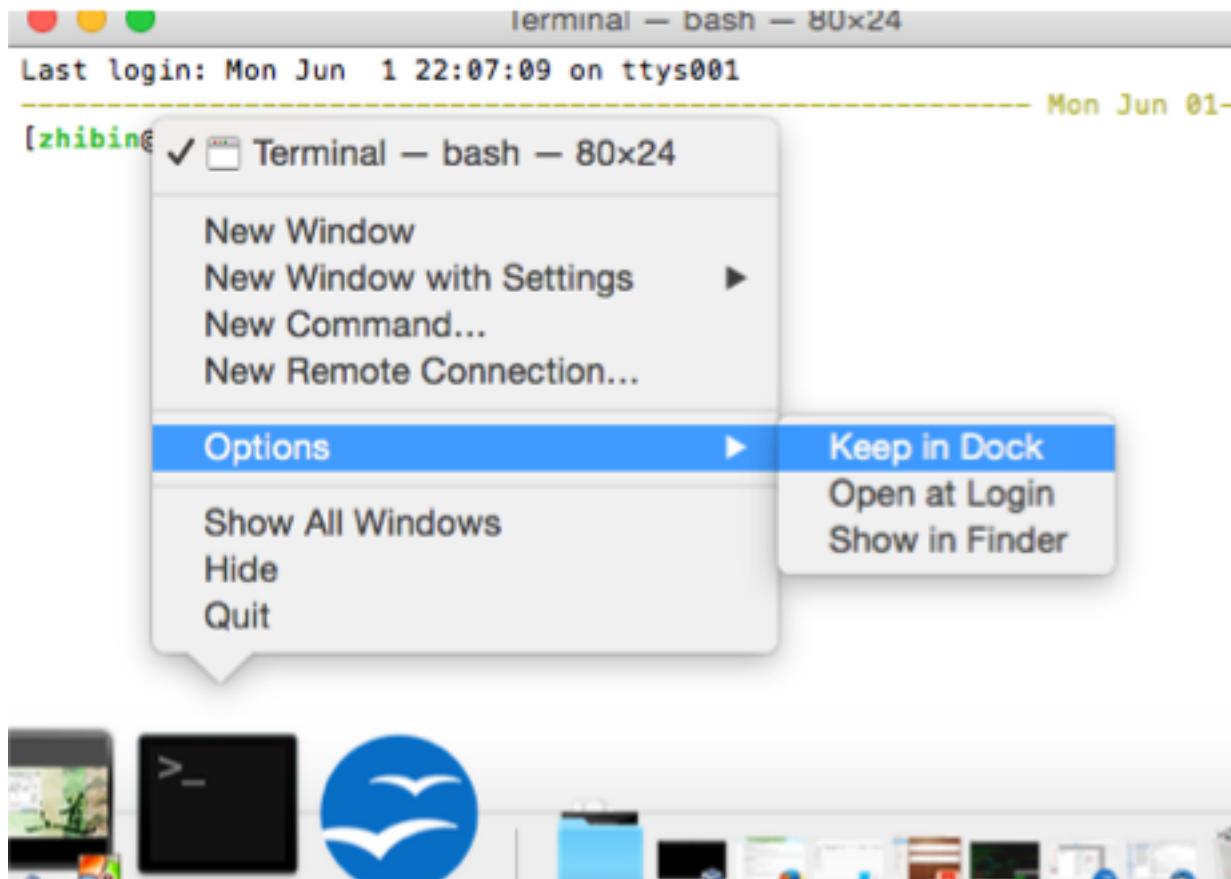
Double-click saved “Amazon Node” session OR
Select “Amazon Node” session and click Open



Logging into your instance (Mac)



Add the terminal App to your dock



Creating a working directory on your Mac called 'cshl'

```
obis-air:~ ogriffit$ pwd
/Users/ogriffit
obis-air:~ ogriffit$ ls
Applications   Desktop      Dropbox      Movies       Public      gittemp     temp
Attachments    Documents    Google Drive  Music        bin         igv
Box Sync       Downloads    Library      Pictures    git         ncbi
obis-air:~ ogriffit$ mkdir cshl
obis-air:~ ogriffit$ cd cshl
obis-air:cshl ogriffit$ ls -la
total 0
drwxr-xr-x  2 ogriffit  staff   68 Nov 13 22:18 .
drwxr-xr-x+ 58 ogriffit  staff  1972 Nov 13 22:18 ..
obis-air:cshl ogriffit$ █
```

mkdir cshl
cd cshl

Obtain the course SSH key file

- NOTE for Mac users. You will need to use a “.pem” file
- **NOTE for Windows Users.** You will need to use a “.ppk” file instead.
 - This is created from the “.pem” file.
 - <https://aws.amazon.com/premiumsupport/knowledge-center/convert-pem-file-into-ppk/>
- The SSH key file will be used to securely login to your student instance on the cloud

Save the pem/ppk file you received via email/slack to your new cshl folder

Changing file permissions of your ‘key’ file (Mac/Linux)

ls -l (long listing)

```
-rw-r--r--@ 1 kcotto staff 1696 Nov 9 09:19 cshl_2020_student.pem
```

 rwx : owner

 rwx : group

 rwx: world

 r read (4)

 w write (2)

 x execute (1)

Which ever way you add these 3 numbers, you know which integers were used (6 is always 4+2, 5 is 4+1, 4 is by itself, 0 is none of them etc ...)

So, when you have:

chmod 400 <file name>

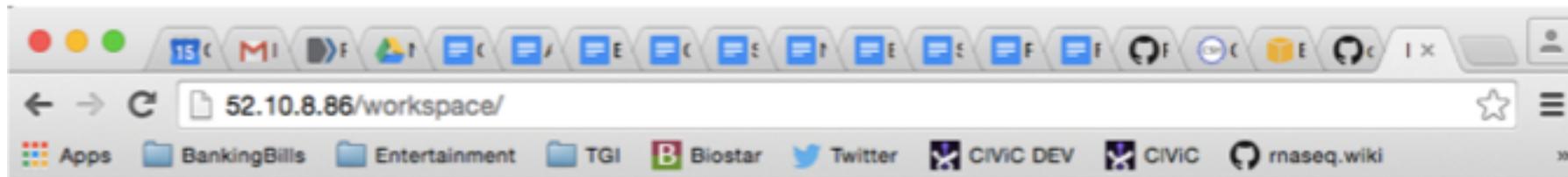
It is “r” for the the file owner **only**

Logging into your instance

Mac/Linux

```
cd ~/cshl  
chmod 400 cshl_2020_student.pem  
ssh -i cshl_2020_student.pem ubuntu@[YOUR PUBLIC IP]
```

Copying files from AWS to your computer (using a web browser)



Index of /workspace

Name	Last modified	Size	Description
<a>< Parent Directory		-	
<a> Homo_sapiens/	2015-11-13 06:45	-	
<a> README.txt	2014-06-17 23:53	5.3K	
<a> bam-demo/	2015-11-14 21:03	-	
<a> data/	2015-11-13 01:39	-	
<a> scratch/	2015-11-13 19:43	-	
<a> tools/	2015-11-13 01:54	-	

Apache/2.4.7 (Ubuntu) Server at 52.10.8.86 Port 80

[http://\[YOUR PUBLIC DNS OR IP\]/](http://[YOUR PUBLIC DNS OR IP]/)

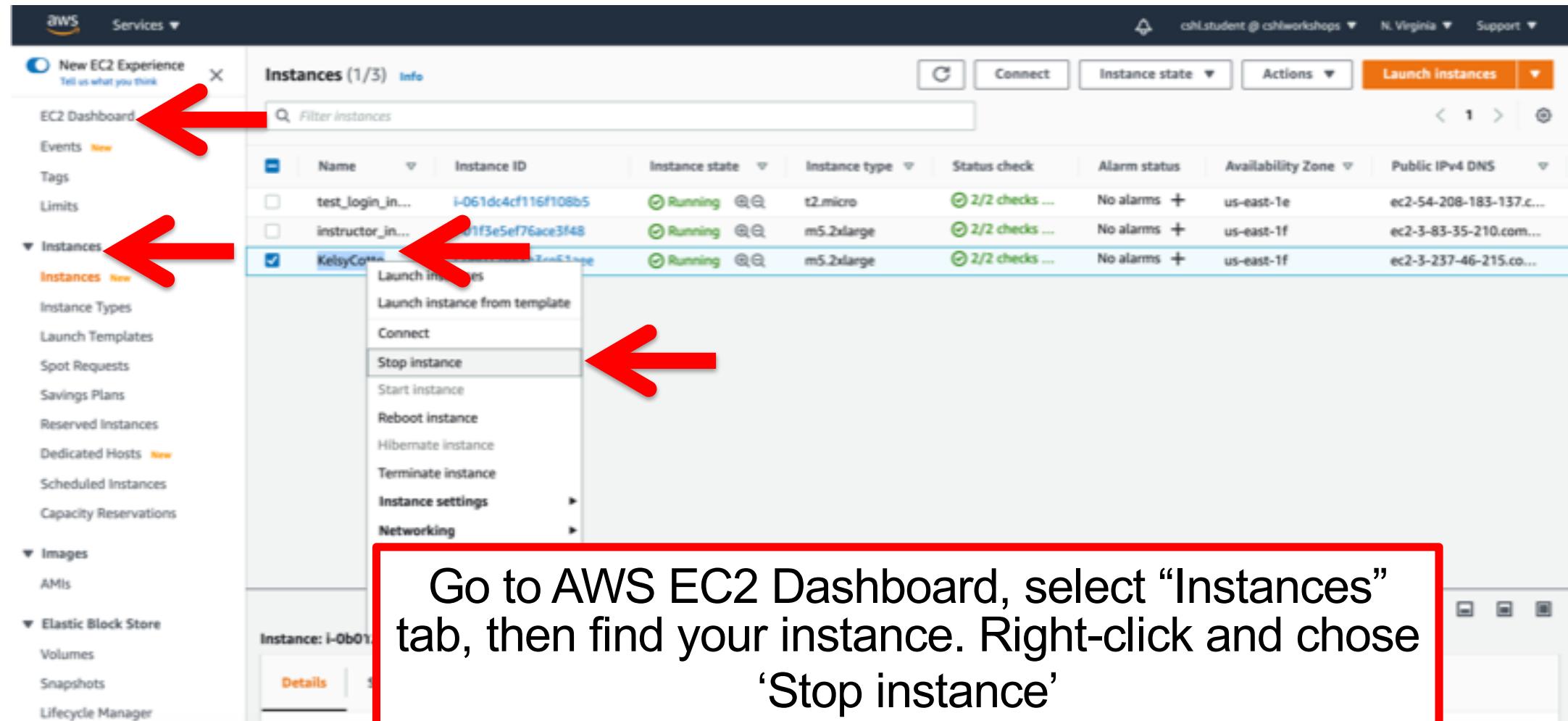
Logging out of your instance

Mac/Linux – simply type exit

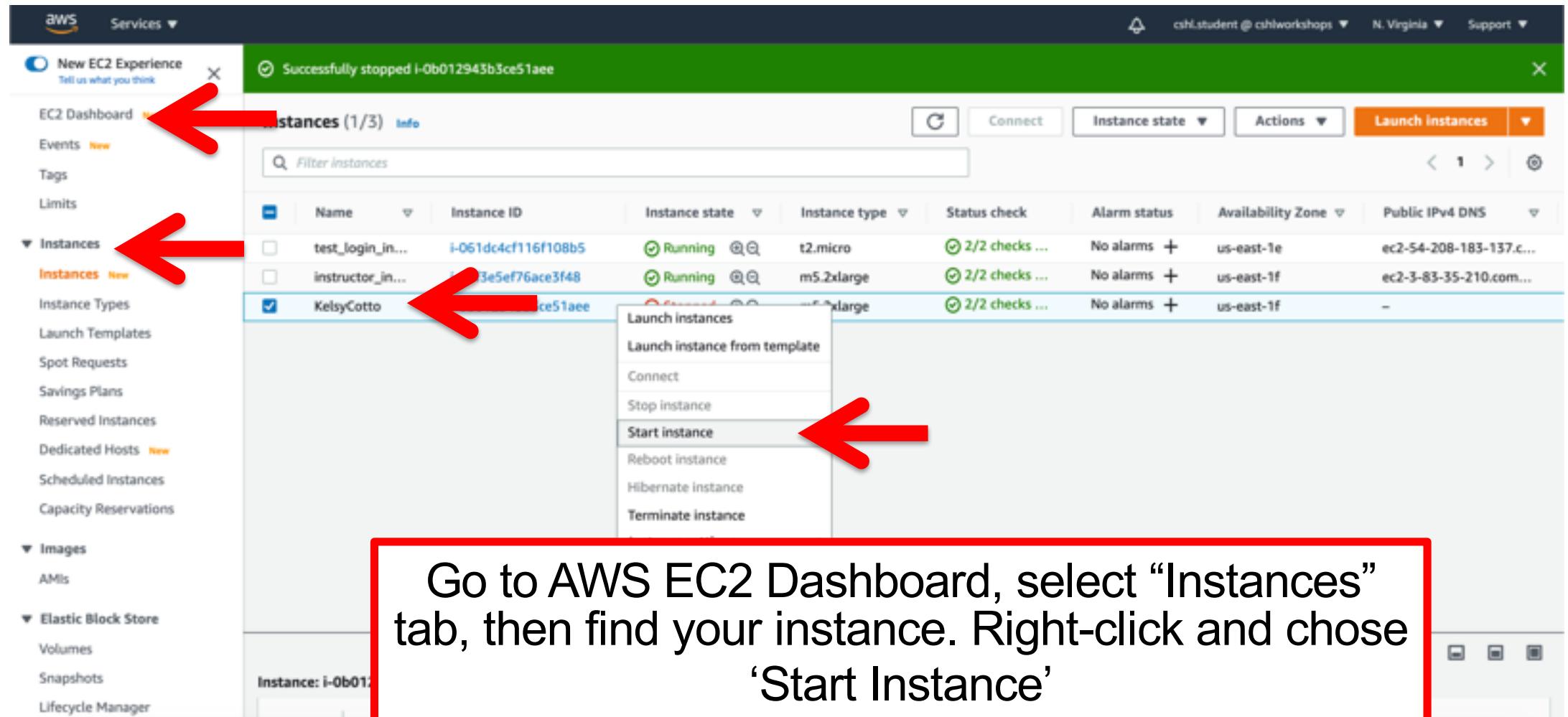
```
exit
```

Note, this disconnects the terminal session (ssh connection) to your cloud instance. But, your cloud instance is still running! See next slide for how to stop your instance.

When you are done for the day you can “Stop” your instance – Don’t Terminate!



Next morning, you can “Start” your instance again



When you restart your instance you will need to find your new Public DNS or IP address. Select your instance and “Connect” or look in Description tab. Then go back to instructions for “Logging into your instance”

The screenshot shows the AWS EC2 Instances page. On the left, there's a sidebar with various navigation links like EC2 Dashboard, Events, Tags, Limits, Instances, Images, and Elastic Block Store. The main area displays a table of instances. A red arrow points to the 'Connect' button in the top right of the table header. Below the table, a specific instance named 'KelsyCotto' is selected, and its details are shown in a larger pane. This pane has tabs for Details, Security, Networking, Storage, Status Checks, Monitoring, and Tags. The Details tab is selected. A second red arrow points to the 'Public IPv4 address' field, which contains '100.24.122.188 | open address'. The 'Public IPv4 DNS' field below it contains 'ec2-100-24-122-188.compute-1.amazonaws.com | open address'.

So, at this point:

- Your laptop/pc is ready for the workshop
- If it is not, you know where to get the information you need
- You know how to login to AWS
- The next step is to login to your linux machine on AWS and learn the basics of a linux command line

Break

Key AWS concepts and terminology

- **HDD** - Hard disk drive. A particular type of storage hardware that is generally cheaper and larger but slower than SSD. HDD drives are traditional hard drives that access data on a spinning magnetic disk.
- **Ephemeral storage** - Also known as Instance Store storage. Data storage associated with an EC2 instance that is local to the host computer. This storage does not persist when the instance is stopped or terminated. In other words, anything you store in this way will be lost if the system is stopped or terminated. Instance store volumes may be backed by SSD or HDD devices.

What is a Region?

- An AWS Region is set of compute resources that Amazon maintains (like the Data Center image shown before)
- Each Region corresponds to a physical warehouse of compute hardware (computers, storage, networking, etc.).
- At the time of writing there are 22 regions: (US East (N.Virginia), US East (Ohio), US West (Oregon), US West (N. California), GovCloud (US-West), GovCloud (US-East), Canada (Montreal), EU (Ireland), EU (Frankfurt), EU (London), EU (Paris), EU (Milan), EU (Stockholm), Middle East (Bahrain), Asia Pacific (Singapore), Asia Pacific (Sydney), Asia Pacific (Seoul), Asia Pacific (Tokyo), Asia Pacific (Mumbai), Asia Pacific (Hong Kong), Asia Pacific (Beijing), and South America (Sao Paulo).
- When you are logged into the AWS EC2 console, you are always operating in one of these regions.

What is a Region?

- Current region shown in the upper right corner of console
- It is important to pay attention to what region you are using for several reasons.
 - When you create an EC2 instance (EBS volume, etc) in one region you won't see it in another region.
 - The cost to use many AWS resources varies by region.
 - The region may influence network performance when you are accessing the instance, especially if you need to transfer large amounts of data in or out.
 - Billing is tracked separately for each region
 - Generally you should choose a region that is close to you or your users. But cost is also a consideration.