

1. Purpose of the Lab

Understand definitions of various Amazon Web Services (AWS) and their use in cloud computing based web applications that are accessible over the Internet through an AWS account.

2. References to guide Lab work

- Chapter 1, *Distributed and Cloud Computing*, Hwang, Fox & Dongarra
- Chapter 1, *Programming Amazon EC2*, Vliet and Paganelli
- AWS Free Usage for Education:
 - o Overview of AWS, http://media.amazonwebservices.com/AWS_Overview.pdf
 - o Services on the free usage tier, <http://aws.amazon.com/free/>
 - o Make the most of your free monthly usage, <http://docs.aws.amazon.com/gettingstarted/latest/awsgsg-freetier/TestDriveFreeTier-monthly.html>
- AWS Documentation: <http://aws.amazon.com/documentation/>
- AWS Reference Architectures: <http://aws.amazon.com/architecture/>
- General AWS Reading: T. Morgan, “A Rare Peek Into The Massive Scale of AWS”, Nov. 2014 - <http://www.enterprisetech.com/2014/11/14/rare-peek-massive-scale-aws/>
- AWS educational resources (AWS credit, training, learning resources) <https://aws.amazon.com/education/awseducate/>

3. Lab Steps and output collection guidelines



Figure 1: Lab Steps Overview

The Figure 1 shows the required steps to be followed in order to successfully create an account credited with funds for this course. You will need to understand pricing conditions and services documentation related with ‘AWS free usage tier’, understand AWS Architecture, create your ‘AWS account’ and request for \$100 credit. Then, you will launch your first AWS EC2 (Elastic Compute Cloud) instance. The final step will show you the ways to connect to your instance through local Linux/Mac or Windows computer.

3.1 Amazon Web Services

Take your time in order to understand the conditions of free usage that involve free account availability, restrictions in terms of instance types, pay-as-you-go service rates, operating systems that are under the free usage condition, and free usage accumulation, detailed information can be found on <http://aws.amazon.com/free/>.

AWS Free Tier (12 Month Introductory Period):

These free tier offers are only available to new AWS customers, and are available for 12 months following your AWS sign-up date. When your 12 month free usage term expires or if your application use exceeds the tiers, you simply pay standard, pay-as-you-go service rates (see each service page for full pricing details). Restrictions apply; see [offer terms](#) for more details.

Elastic Compute Cloud (EC2)

- 750 hours of [Amazon EC2](#) Linux t2.micro instance usage (1 GiB of memory and 32-bit and 64-bit platform support) – enough hours to run continuously each month*
- 750 hours of [Amazon EC2](#) Microsoft Windows Server† t2.micro instance usage (1 GiB of memory and 32-bit and 64-bit platform support) – enough hours to run continuously each month*
- 750 hours of an [Elastic Load Balancer](#) plus 15 GB data processing*
- 30 GB of [Amazon Elastic Block Storage](#) in any combination of General Purpose (SSD) or Magnetic, plus 2 million I/Os (with EBS Magnetic) and 1 GB of snapshot storage*
- 500 MB-month of [Amazon EC2 Container Registry](#) storage for new customers*

Amazon Simple Storage Service (S3)

- 5 GB of [Amazon S3](#) standard storage, 20,000 Get Requests, and 2,000 Put Requests*

Data Transfer

- 15 GB of bandwidth out aggregated across all AWS services*

Amazon Data Pipeline

- 3 low frequency preconditions running on AWS per month*
- 5 low frequency activities running on AWS per month*

Amazon ElastiCache

- 750 hours of [Amazon ElastiCache](#) cache.t2micro Node usage – enough hours to run continuously each month.*

Amazon CloudFront

- 50 GB Data Transfer Out, 2,000,000 HTTP and HTTPS Requests of [Amazon CloudFront](#)*

Amazon AppStream

- 20 free hours per month*

Go through the <http://aws.amazon.com/documentation/> to find detailed information of each service that AWS provides. Pay special attention to the service groups: Getting started with AWS, Compute, Storage & Content Delivery and Database.

3.2. AWS Architecture Center

You will need to understand overall <http://aws.amazon.com/architecture/> to help you build your application architecture customized according to your requirements, and for maximizing the AWS services usage. Web application hosting related customization example is shown below in Figure 1.

Select your AWS Support Plan

All customers receive free support. Choosing a paid support plan will allow you to receive one-on-one technical assistance from experienced engineers and access many other support features. [Click here to compare all Support plans.](#)

- ☒ **Basic (Free)**
Contact Customer Service for account and billing questions, receive help for resources that don't pass system health checks, and access the AWS Community Forums.
- ☐ **Developer (\$49/month)**
Get started on AWS – ask technical questions and get a response to your web case within 12 hours during local business hours.
- ☐ **Business (Starting at \$100/month - Pricing example ☺) - Recommended**
24/7/365 real-time assistance by phone and chat, a 1 hour response to web cases, and help with 3rd party software. Access Trusted Advisor to increase performance, fault tolerance, security, and potentially save money. (What's this ☺)
- ☐ **Enterprise (Starting at \$15,000/month - Pricing example ☺)**
15 minute response to web cases, an assigned technical account manager (TAM) who is an expert in your use case, and white-glove case handling that notifies your TAM and the service engineering team of a critical issue.

[Continue](#)

- Once you create your account you will see all AWS services available for you.

The screenshot shows the AWS Management Console interface. At the top, there's a navigation bar with 'AWS', 'Services', and 'Edit' dropdowns, along with user information 'Saptarshi Debroy', 'N. Virginia', and 'Support'. Below the navigation bar, the 'Quick Starts' section features six cards: 'Build a web app', 'Launch a virtual machine', 'Back up your files', 'Build a backend for your mobile app', 'Host a static website', and 'Analyze big data'. The 'AWS Services' section is organized into a grid of categories: COMPUTE (EC2, ECS, Elastic Beanstalk, Lambda), STORAGE & CONTENT DELIVERY (S3, CloudFront, Elastic File System, Glacier, Snowball, Storage Gateway), DATABASE (RDS, DynamoDB, ElastiCache, Redshift, DMS), NETWORKING (VPC, Direct Connect, Route 53), DEVELOPER TOOLS (CodeCommit, CodeDeploy, CodePipeline), MANAGEMENT TOOLS (CloudWatch, CloudFormation, CloudTrail, Config, OpsWorks, Service Catalog, Trusted Advisor), SECURITY & IDENTITY (IAM, Directory Service, Inspector, WAF, Certificate Manager), ANALYTICS (EMR, Data Pipeline, Elasticsearch Service, Kinesis, Machine Learning), INTERNET OF THINGS (AWS IoT), GAME DEVELOPMENT (GameLift), MOBILE SERVICES (Mobile Hub, Cognito, Device Farm, Mobile Analytics, SNS), APPLICATION SERVICES (API Gateway, AppStream, CloudSearch, Elastic Transcoder, SES, SQS, SWF), and ENTERPRISE APPLICATIONS (WorkSpaces, WorkDocs, WorkMail). On the right side, there are four informational panels: 'GETTING STARTED' with links to documentation and training, 'AWS CONSOLE MOBILE APP' with download links for App Store and Google Play, 'AWS MARKETPLACE' for finding and buying software, and 'FEEDBACK' for user input. At the bottom right, the 'Service Health' dashboard shows a green checkmark indicating 'All services are operating normally' as of July 11, 2016.

3.4. Add AWS Education Credit for \$100 to your Account.

- In <https://aws.amazon.com/education/awseducate/apply/> Apply for AWS credit using the 'Apply for AWS Educate for students' link.



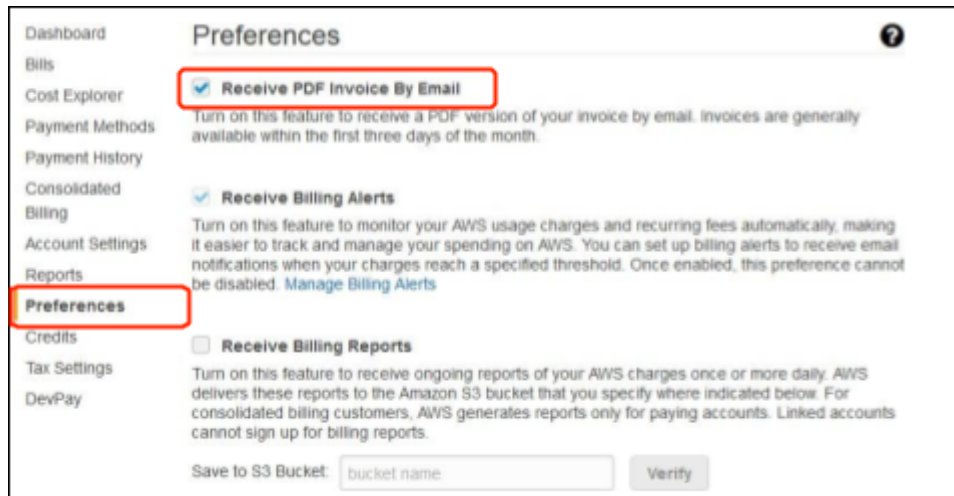
- Once you received an email from AWS with the Promo Code, activated it by enter it on 'Credits' tag as shown below.

The screenshot shows the AWS Credits page. On the left is a navigation menu with options like Dashboard, Bills, Cost Explorer, Budgets, Reports, Cost Allocation Tags, Payment Methods, Payment History, Consolidated Billing, Preferences, Credits (highlighted with a red box), Tax Settings, and DevPay. The main content area is titled "Credits" and includes a form to redeem a promo code. The form has a "Promo Code" input field, a "Security Check" section with a CAPTCHA image showing the characters "ELB87GB" and a "Refresh Image" link, and a "Please type the characters as shown above" input field. A "Redeem" button is below the form. Below the form, there is a table of redeemed credits. The table has columns for "Expiration Date", "Credit Name", "Credits Used", "Credits Remaining", and "Applicable Products". One credit is listed with an expiration date of 2016-12-31, a name of ENG_FY2016_Q1_AWS_100USD, 0.00 credits used, and 100.00 credits remaining. A red box highlights the "Total Amount of Credits Remaining: \$100.00" at the bottom of the table.

Expiration Date	Credit Name	Credits Used	Credits Remaining	Applicable Products
2016-12-31	ENG_FY2016_Q1_AWS_100USD	\$0.00	\$100.00	See complete list

Total Amount of Credits Remaining: \$100.00

- You will be able to see your detailed usage and Credits Balance by accessing 'Bills' option in the left menu.
- Another useful option is to enable 'Receive PDF Invoice my Email' as well 'Receive Billing Alerts' to keep track of the usage.



3.5 Launching your first AWS Instance

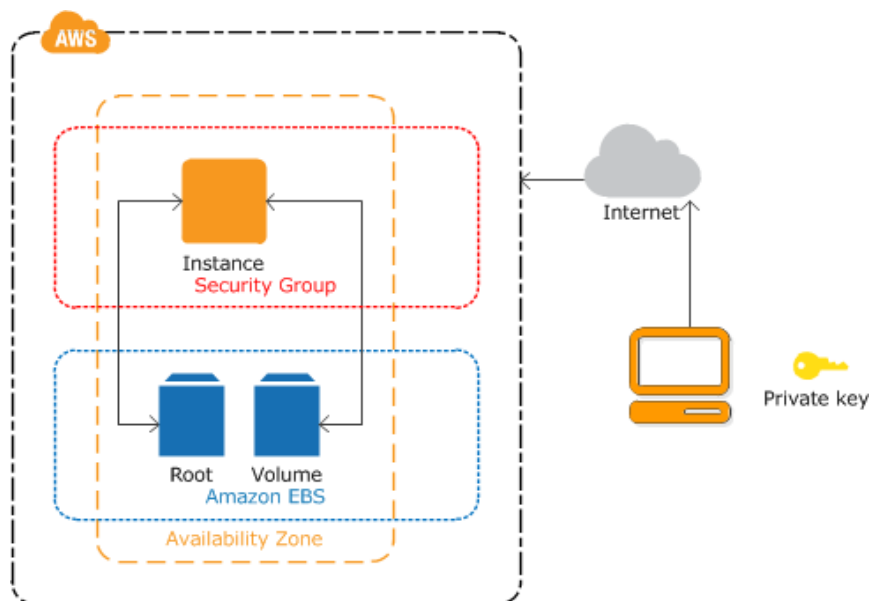
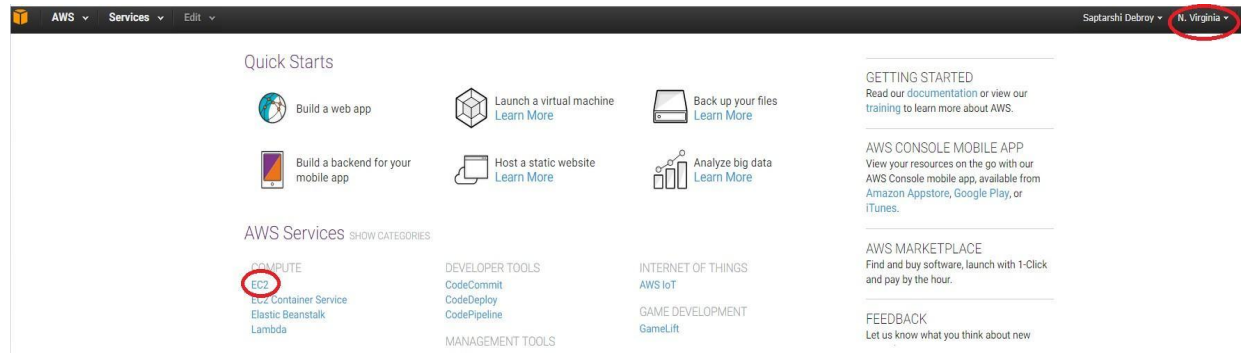


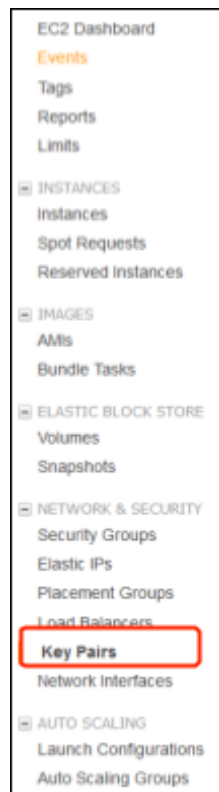
Figure 3: Overview of an AWS Instance

Figure 3 shows the instance architecture to be configured in this Lab. Using your AWS account, you will launch a virtual instance created in a new 'Volume' from an Amazon EBS-backed instance snapshot (called 'Root'), in order to access your reserved infrastructure resources over the Internet; you will need to create key pairs and secure it through a security group; all the infrastructure will be created in a specific zone.

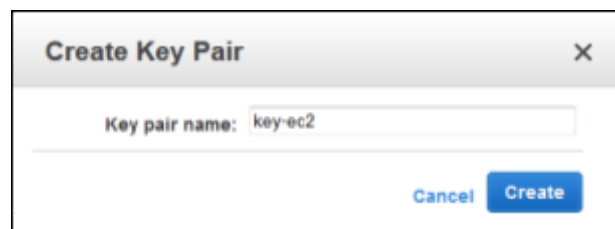
3.5.1 Click 'Console Home', make sure to select the US East (N. Virginia) region in the top-right part of your screen and select AWS EC2 service (Elastic Compute Cloud).



3.5.2 In left menu select “Key Pairs”.

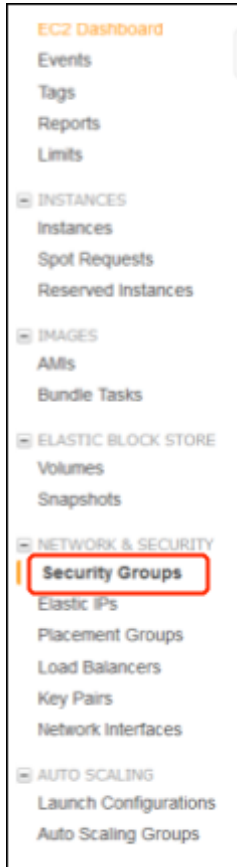


- Create a KeyPair called 'key-ec2' and **store it in a safe location**, you will need this key to connect to the instances.



If you are a Linux/MAC user, remember to set the priority for the key pair: `chmod 700 <path-to-the-keypairs>`.

- 3.5.3 Select “Security Groups” from the left menu, name a Security Group ‘SG_EC2’, add description and a SSH rule with ‘anywhere’ option selected in source field.



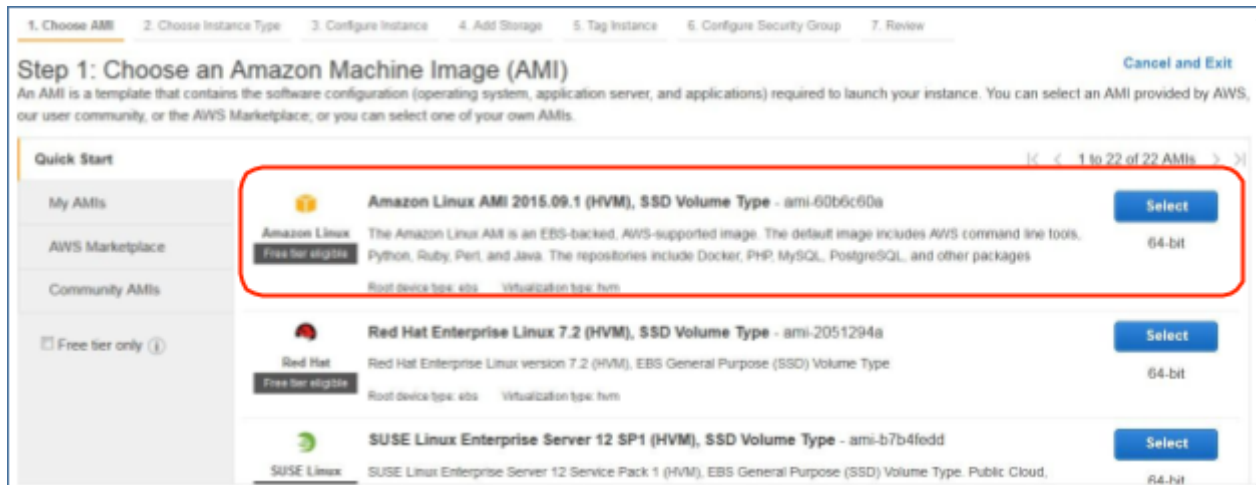
- Example of Security Group creation.

The image shows the 'Create Security Group' dialog box. The 'Security group name' is 'SG_EC2', the 'Description' is 'SSH', and the 'VPC' is 'vpc-2a28444f (172.31.0.0/16) *'. A red rectangle highlights the 'SSH' rule in the 'Security group rules' section, which has a source of 'Anywhere'.

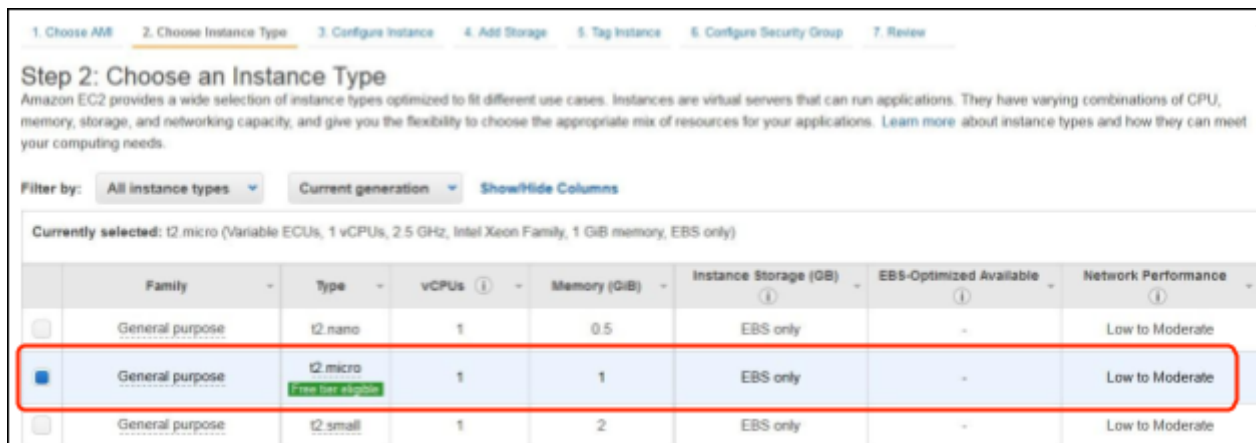
Type	Protocol	Port Range	Source
SSH	TCP	22	Anywhere

3.5.4 Launch your Instance

- In left menu, launch a new instance in the 'Instances' option Click on the 'Launch Instance' button and select the first Image of 'Amazon Linux' on the list



- Select the t2.micro instance that is 'Free'.



- Keep default values in the next configuration windows and continue until you get to the 'Tag Instance' option. Add 'Key' and 'Value' as shown in figure below and click on 'Next: Configure Security Group'.

1. Choose AMI 2. Choose Instance Type 3. Configure Instance 4. Add Storage 5. Tag Instance 6. Configure Security Group

Step 5: Tag Instance

A tag consists of a case-sensitive key-value pair. For example, you could define a tag with key = Name and value = Webserver. [Learn more](#) about tagging your Amazon EC2 resources.

Key (127 characters maximum)	Value (255 characters maximum)
Server Name	Web Server

[Create Tag](#) (Up to 10 tags maximum)

- Select the 'Security Group' created previously and click on 'Review and Launch'.

1. Choose AMI 2. Choose Instance Type 3. Configure Instance 4. Add Storage 5. Tag Instance 6. Configure Security Group 7. Review

Step 6: Configure Security Group

A security group is a set of firewall rules that control the traffic for your instance. On this page, you can add rules to allow specific traffic to reach your instance. For example, if you want to set up a web server and allow internet traffic to reach your instance, add rules that allow unrestricted access to the HTTP and HTTPS ports. You can create a new security group or select from an existing one below. [Learn more](#) about Amazon EC2 security groups.

Assign a security group: ☐ Create a new security group ☒ Select an existing security group

Security Group ID	Name	Description	Actions
sg-84dd79eb	default	default VPC security group	Copy to new
<input checked="" type="checkbox"/> sg-0dcc0c69	SG_EC2	SSH	Copy to new

- Once you click 'launch' you will be prompted to choose the key pair 'key-ec2' created previously.

Select an existing key pair or create a new key pair

A key pair consists of a **public key** that AWS stores, and a **private key file** that you store. Together, they allow you to connect to your instance securely. For Windows AMIs, the private key file is required to obtain the password used to log into your instance. For Linux AMIs, the private key file allows you to securely SSH into your instance.

Note: The selected key pair will be added to the set of keys authorized for this instance. [Learn more](#) about [removing existing key pairs from a public AMI](#).

Choose an existing key pair

Select a key pair
key-ec2

☒ I acknowledge that I have access to the selected private key file (key-ec2 pem), and that without this file, I won't be able to log into my instance.

[Cancel](#) [Launch Instances](#)

- In a short time your new instance will be deployed and ready to be used.

Instance ID: i-ead7db14 Public DNS: ec2-54-159-183-6.compute-1.amazonaws.com

Description Status Checks Monitoring Tags

Instance ID	i-ead7db14	Public DNS	ec2-54-159-183-6.compute-1.amazonaws.com
Instance state	running	Public IP	54.159.183.6
Instance type	t1.micro	Elastic IP	-
Private DNS	ip-10-28-32-78.ec2.internal	Availability zone	us-east-1a
Private IPs	10.28.32.78	Security groups	SG_EC2... view rules
Secondary private IPs	-	Scheduled events	No scheduled events
VPC ID	-	AMI ID	amzn-ami-pv-2014.09.1.x86_64-ebs (ami-246ed34c)

3.6 Adding volume

In left menu “Elastic Block Store”, select ‘Volumes’ and you will see the default volume where your instance is stored.

Create Volume Actions

Filter by tags and attributes or search by keyword

Name	Size	Volume Type	Snapshot	Created	Availability Zone	State
	8 GiB	gp2	snap-b4aacb13	January 6, 2015 4:5...	us-east-1c	in-use

Volumes: vol-2b9cc96f

Description Status Checks Monitoring Tags

Volume ID	vol-2b9cc96f	Alarm status	None
Size	8 GiB	Snapshot	snap-b4aacb13
Created	January 6, 2015 4:52:33 PM UTC-6	Availability Zone	us-east-1c

- Click in ‘Create Volume’ for creating a new **2GB** volume and Volume Type ‘General Purpose (SSD)’. Be sure that the ‘Availability Zone’ in the new volume is the same as the ‘Zone’ of the first volume (For this specific case us-east-1c)

Create Volume

Volume Type (i) General Purpose SSD (GP2)

Size (GiB) (i) 2 (Min: 1 GiB, Max: 16384 GiB)

IOPS (i) 6 / 3000 (Baseline of 3 IOPS per GiB)

Availability Zone (i) us-east-1c

Snapshot ID (i) Search (case-insensitive)

Encryption (i) ☐ Encrypt this volume

Cancel Create

- Once the new volume is 'available', right click on it and select 'Attach volume', select your created instance and attach it. Note the path will be established in the 'Device' option.

Attach Volume

Volume (i) vol-7b69dc3f in us-east-1c

Instance (i) i-e96d4005 in us-east-1c

Device (i) /dev/sdf
Linux Devices: /dev/sdf through /dev/sdp

Note: Newer Linux kernels may rename your devices to /dev/xvdf through /dev/xvdp internally, even when the device name entered here (and shown in the details) is /dev/sdf through /dev/sdp.

Cancel Attach

- You will end up with a new 2 GB SDD storage drive attached to your instance.
- It is good practice to name your volumes.

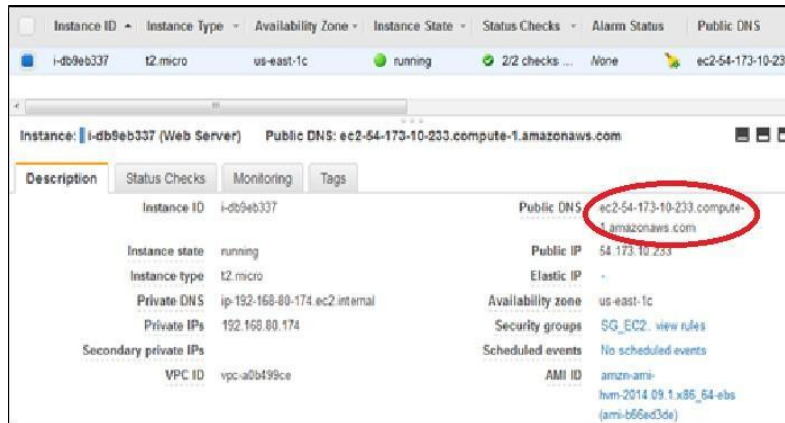
Create Volume Actions

Filter by tags and attributes or search by keyword

	Name	Size	Volume Type	Snapshot	Created
<input checked="" type="checkbox"/>	2GB	2 GiB	gp2		January 6, 2015 5:4...
<input type="checkbox"/>	8GB	8 GiB	gp2	snap-b4aacb13	January 6, 2015 4:5...

3.7 Connection to the instance using SSH

First up, copy the public DNS.



3.7.1 For Linux and MAC OS

Open a terminal and type in:

```
ssh -i <path-to-your-key-pairs> <public DNS>
```

```
$ ssh -i key-ec2.pem ec2-user@ec2-54-173-10-233.compute-1.amazonaws.com
```

You will be logged in the amazon instance.

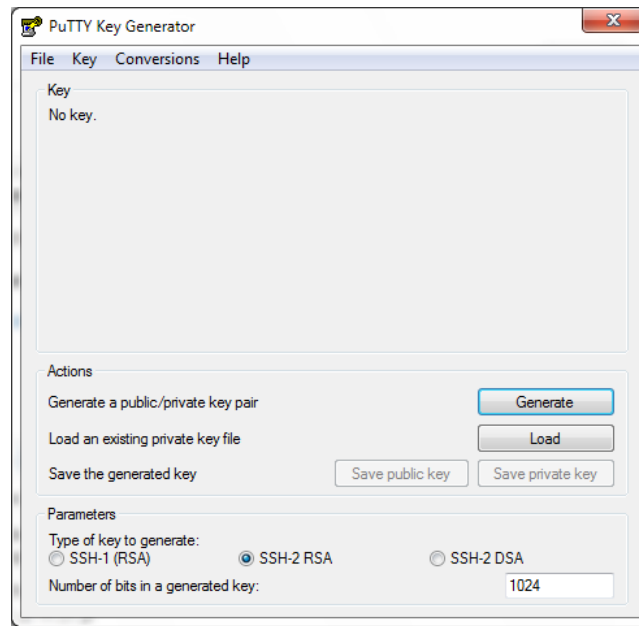
```

 _ | _ | _ )
 _ | ( /   Amazon Linux AMI
 _ | \ _ | _ |

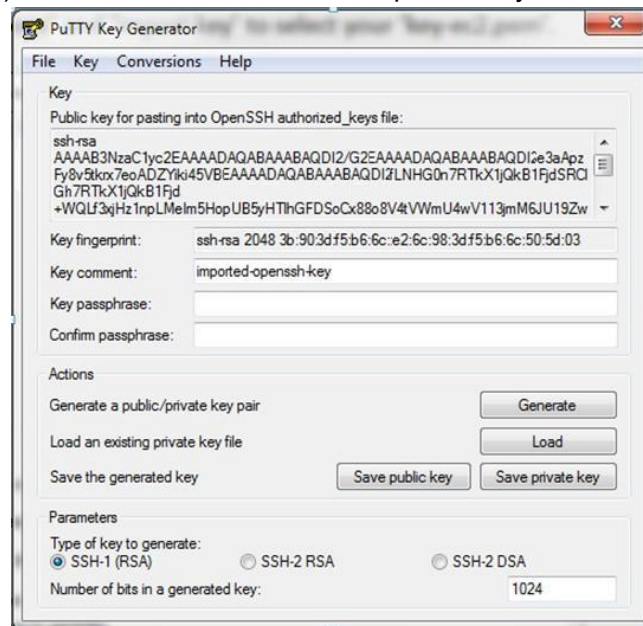
https://aws.amazon.com/amazon-linux-ami/2014.09-release-notes/
18 package(s) needed for security, out of 42 available
Run "sudo yum update" to apply all updates.
[ec2-user@ip-192-168-80-174 ~]$
```

3.7.2 For Windows

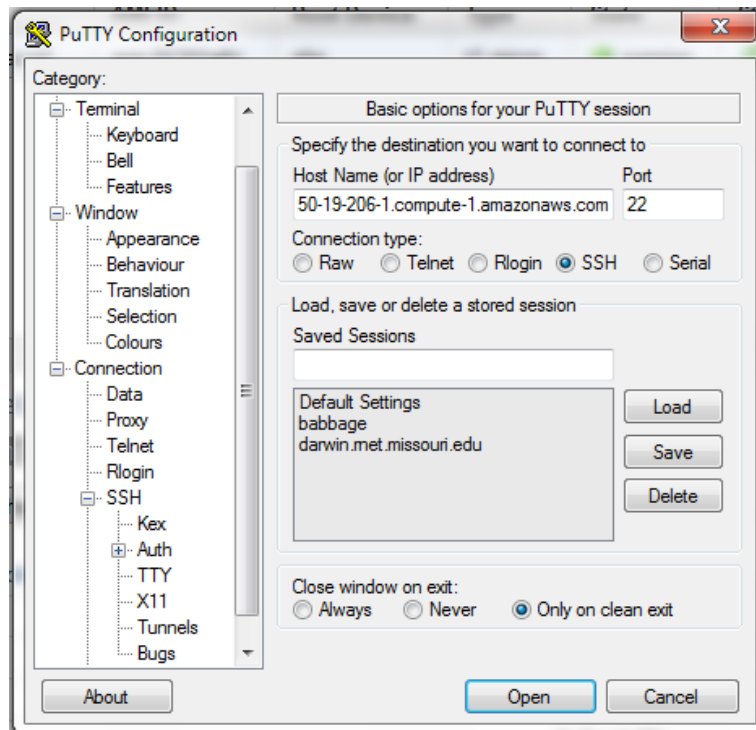
Download 'PuTTY Key Generator' to convert your key to PuTTY compatible format. Click in 'conversions' and 'import key' to select your 'key-ec2.pem'.



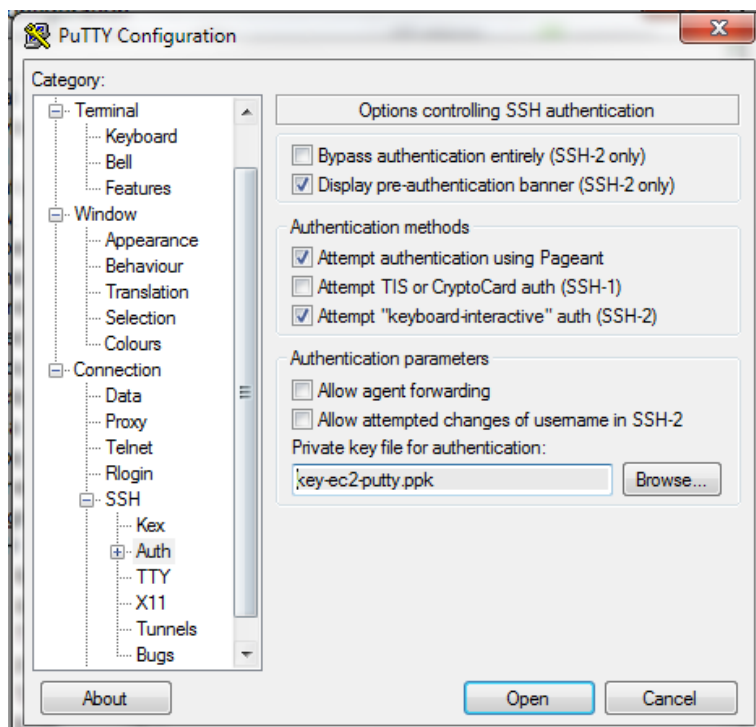
Select the 'SSH-1 (RSA)' check box and click on 'Save private key' for storing. Name it 'key-ec2-putty'



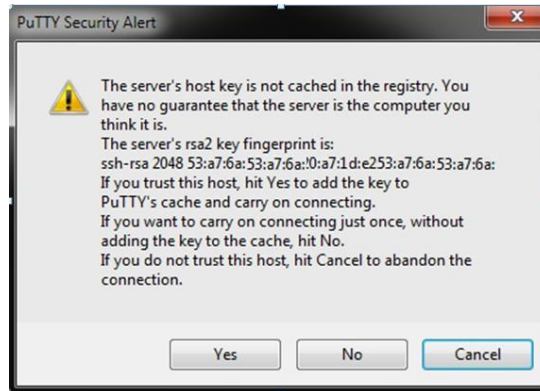
Now with PuTTY. Paste [public dns] in 'Host Name (or IP address)'



Browse the 'key-ec2-putty' in Connection/SSH/Auth then click Browse.



Select 'Yes' in the PuTTY alert. Then Login as 'ec2-user'



3.8 You should stop your instance after finishing the lab.

In your AWS EC2 service select 'Instances' under 'INSTANCES' option, select your running instance, click on 'Actions' button and 'Stop' option.

