

RStudio on AWS

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RStudio in the Cloud

At the end of this tutorial, we will be able to install RStudio on an Amazon Web Services(AWS) EC2 Instance and use it via any web browser. This tutorial uses Amazon Web Services (AWS), but it could just as easily use Microsot, Google, or any other provider.

The only prerequisite is an AWS account, which you can sign up for if you haven't already. A credit card is required to sign up, but you will only be charged for computing time you use, and Amazon offers an excellent free tier that is suitable for small jobs.

We will be using Louis Aslett's pre-configured AMI's to speed up our configuration and installation of required software.

Introduction to AWS

Amazon Web Services (AWS) provides on-demand computing resources and services in the cloud, with pay-as-you-go pricing. Using AWS resources instead of your own is like purchasing electricity from a power company instead of running your own generator, and it provides many of the same benefits: capacity exactly matches your need, you pay only for what you use, economies of scale result in lower costs.

AWS Elastic Compute Cloud (EC2) Service

While AWS is a platform which a plethora of cloud computing services, this tutorial's focus will be on one service called Elastic Compute Cloud or EC2. You can learn more about the service [here](#). EC2 gives users the ability to quickly deploy virtual computers (called instances) in the cloud. The specifications (number of cores, RAM, and storage) of an instance can be tailored to the size and complexity of the task.

Why Use Cloud Computing for datascience?

1. **Access from Anywhere** : Having a computer in the cloud with RStudio configured, allows you to access your datascience platform with a customizable and predictable setup from anywhere in the world, on any computer in a platform independent fashion. All you need is a web browser with a working internet connection on the local computer to access your work.
2. **Scalable Computing Power** : It is not always practical to upgrade the computing power, memory, disk space on a personal computer frequently to suit the computing power required to solve the problem at hand. Cloud computers afforded by services like EC2 make tremendous computing power available to you at your finger tips, that you can turn up and turn down depending on your requirement in seconds. In most cases all you pay for is the computing power you use, for the time you use it.

Getting Started

To get started you first need to sign up for an account on AWS. Your credit card details will be required to do so, but don't fret, we would be using a **T2 Micro Instance** which is free if you qualify for the free tier. Even if you don't the charges for this machine are minimal.

Configuring your machine

Once you sign up, we typically would need to select EC2 service and configure our instance via the AWS Console Dashboard. The detailed tutorial to do so for a generic EC2 instance is available here if you are interested.

However for our purpose, in order to keep it simple for beginners, we would be using pre-configured AMI (Amazon Machine Image) very generously made available by Louis Aslett. This method reduces the time required to get up and running to just a few minutes. As an added advantage, the configured machine also makes Python, Julia and R Jupyter notebook interfaces available in addition to RStudio and Shiny server. There is also a script to connect you *DropBox* account to this machine, so you have portability for your files across different machines.

So to begin

STEP1 : Select AMI

Navigate to Louis Aslett's AMI page and click on RStudio 0.99.903 R 3.3.1 Julia 0.4.6 AMI for your region, which happens to be the latest AMI as of this writing.

AMI Release History

Check back for updates as I will be periodically removing old AMIs because I can't afford indefinite storage for them. For historical purposes, the AMI release history is recorded here (scroll right to see all):

Release		EU West (Ireland)	EU Central (Frankfurt)	US East (Virginia)	US West (N. Calif.)	US West (Oregon)	S. America (São Paulo)	Asia Pacific (Singapore)	Asia Pacific (Tokyo)	Asia Pacific (Seoul)	Asia Pacific (Sydney)
RStudio 0.99.903 R 3.3.1 Julia 0.4.6 Available	64-bit HVM	ami-b1b0c3c2	ami-ca46b6a5	ami-8fe18f98	ami-c0b8f5a0	ami-6a52840a	ami-55079639	ami-ce9c47ad	ami-1f79b17e	ami-41f4212f	ami-b9093fda
RStudio 0.99.896 R 3.3.0 Julia 0.4.5 Available	64-bit HVM	ami-ca149fb9	ami-6ec92401	ami-0acd2067	ami-ada2dbcd	ami-c78875a7	ami-af26afc3	ami-3f9a4c5c	ami-90dd39f1	ami-6e68a000	ami-72def211
RStudio 0.99.491 R 3.2.3 Available	64-bit HVM	ami-e95df59a	ami-52edf33e	ami-7f9dc615	ami-d1e792b1	ami-1d7f657c	ami-50f1703c	ami-b277bad1	ami-2549744b	N/A*	ami-a54a6fc6

Figure 1: AMI List

Link for the US East (Virginia) region

STEP 2: Choose type of Machine

Once you click on a suitable AMI above, the browser should redirect you to an AWS page where you need to se-

console.aws.amazon.com/ec2/v2/home?region=us-east-1#LaunchInstanceWizard:ami=ami-...

EC2 Management Console

Services Resource Groups

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

Step 2: Choose an Instance Type

Amazon EC2 provides a wide selection of instance types optimized to fit different use cases. Instances are virtual servers that can run applications. They have varying combinations of CPU, memory, storage, and network capacity, and give you the flexibility to choose the appropriate mix of resources for your applications. [Learn more](#) about instance types and how they can meet your computing needs.

Filter by: All instance types Current generation Show/Hide Columns

Currently selected: t2.micro (Variable ECUs, 1 vCPUs, 2.5 GHz, Intel Xeon Family, 1 GiB memory, EBS only)

	Family	Type	vCPUs	Memory (GiB)	Instance Storage (GB)	EBS-Optimized Available	Network Performance	IF Support
<input type="checkbox"/>	General purpose	t2.nano	1	0.5	EBS only	-	Low to Moderate	Y
<input checked="" type="checkbox"/>	General purpose	t2.micro Free tier eligible	1	1	EBS only	-	Low to Moderate	Y
<input type="checkbox"/>	General purpose	t2.small	1	2	EBS only	-	Low to Moderate	Y
<input type="checkbox"/>	General purpose	t2.medium	2	4	EBS only	-	Low to Moderate	Y
<input type="checkbox"/>	General purpose	t2.large	2	8	EBS only	-	Low to Moderate	Y
<input type="checkbox"/>	General purpose	t2.xlarge	4	16	EBS only	-	Moderate	Y
<input type="checkbox"/>	General purpose	t2.2xlarge	8	32	EBS only	-	Moderate	Y
<input type="checkbox"/>	General purpose	m4.large	2	8	EBS only	Yes	Moderate	Y
<input type="checkbox"/>	General purpose	m4.xlarge	4	16	EBS only	Yes	High	Y
<input type="checkbox"/>	General purpose	m4.2xlarge	8	32	EBS only	Yes	High	Y

Cancel Previous Review and Launch Next: Configure Instance Details

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lect the instance type.

Select the General purpose t2.micro instance which is free tier eligible as shown.

Click Next: Configure Instance Details

STEP 3 : Configure Instance Details

On the Configure Instance Details page, review the default settings. The defaults are fine here.

console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstanceWizard:ami=ami-6i...

EC2 Management Console

Services Resource Groups

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

Step 3: Configure Instance Details

Configure the instance to suit your requirements. You can launch multiple instances from the same AMI, request Spot instances to take advantage of the lower pricing, assign an access management role to the instance, and more.

Number of instances 1 Launch into Auto Scaling Group

Purchasing option ☐ Request Spot instances

Network vpc-8db0a8eb (default) Create new VPC

Subnet No preference (default subnet in any Availability Zone) Create new subnet

Auto-assign Public IP Use subnet setting (Enable)

IAM role None Create new IAM role

Shutdown behavior Stop

Enable termination protection ☐ Protect against accidental termination

Monitoring ☐ Enable CloudWatch detailed monitoring
Additional charges apply.

Tenancy Shared - Run a shared hardware instance
Additional charges will apply for dedicated tenancy.

Advanced Details

Cancel Previous Review and Launch Next: Add Storage

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Click Next: Add Storage

STEP 4: Add Disk Storage

On the Add Storage page, you'll be asked to specify the amount of storage you want. The defaults are fine here as well. The storage here has been optimized at 10GB to reduce the running costs of this machine even after the

console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstanceWizard:ami=ami-6

EC2 Management Console

Services

Resource Groups

1. Choose AMI

2. Choose Instance Type

3. Configure Instance

4. Add Storage

5. Add Tags

6. Configure Security Group

7. Review

Step 4: Add Storage

Your instance will be launched with the following storage device settings. You can attach additional EBS volumes and instance store volumes to your instance, or edit the settings of the root volume. You can also attach additional EBS volumes after launching an instance, but not instance store volumes. [Learn more](#) about storage options in Amazon EC2.

Volume Type ⓘ	Device ⓘ	Snapshot ⓘ	Size (GiB) ⓘ	Volume Type ⓘ	IOPS ⓘ	Throughput (MB/s) ⓘ	Delete on Termination ⓘ	Encrypted ⓘ
Root	/dev/sda1	snap-75197be8	10	General Purpose SSD (GP2)	100 / 3000	N/A	<input checked="" type="checkbox"/>	Not Encrypted

Add New Volume

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.

Cancel

Previous

Review and Launch

Next: Add T

Feedback

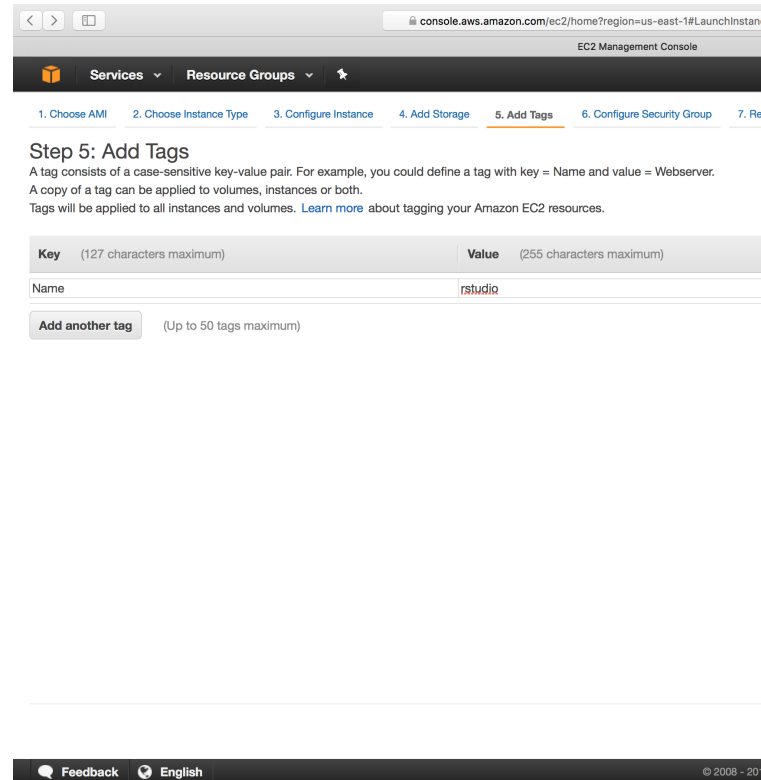
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free tier period ends.

Click Next: Add Tags

STEP 5: Name your Machine



On this page you can give your instance a name (e.g. rstudio).

Click Next: Configure Security Group

STEP6: Make your Machine accessible

On this page you tell the AWS how you want your instance to interact with the outside world. - Select **Create a new security group** as shown below. - Give your **Security Group** a name and description. This can be reused later across machine if you like - SSH on port number 22 should already be enabled by default on this page. Just change the Source drop down from **Custom** to **Anywhere**. **SSH allows us to securely log into this cloud machine via a terminal if needed (we won't be doing so in this tutorial)** - You can use the **Add Rule** button to add a new rule - Select **HTTP** from the **Type** dropdown list this time - Change the Source from **Custom** to **Anywhere** to allow access to this machine via the browser from any machine

console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstanceWizard:ami=ami-8...

EC2 Management Console

Services Resource Groups

1. Choose AMI 2. Choose Instance Type 3. Configure Instance 4. Add Storage 5. Add Tags 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. To 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 an existing security group.

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

Security group name: SSH_HTTP

Description: SSH and HTTP for RStudio Server

Type	Protocol	Port Range
SSH	TCP	22
HTTP	TCP	80

Add Rule

Warning

Rules with source of 0.0.0.0/0 allow all IP addresses to access your instance. We recommend setting security group rules to allow access from known IP addresses.

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The settings once done should look as shown below.

Click **Review** and **Launch**

STEP 7: Launch your Machine

If a warning is presented as shown below. Ignore it for now as the discussion of Network Security is beyond the

console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstanceWizard:ami=ami-8...

EC2 Management Console

Services Resource Groups

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

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.

⚠ Improve your instances' security. Your security group, SSH_HTTP, is open to the world.

Your instances may be accessible from any IP address. We recommend that you update your security group rules to allow access from known IP addresses only. You can also open additional ports in your security group to facilitate access to the application or service you're running, e.g., HTTP (80) for web servers. [Edit security groups](#)

▼ AMI Details

RStudio-0.99.903_R-3.3.1_Julia-0.4.6_ubuntu-16.04-LTS-64bit - ami-8fe18f98

Ready to run RStudio + (experimental) Julia server for statistical computation (www.louisaslett.com). Connect to instance public DNS in web browser (standard port 80), username rstudio and password rstudio

Root Device Type: ebs Virtualization type: hvm

▼ Instance Type

Instance Type	ECUs	vCPUs	Memory (GiB)	Instance Storage (GB)	EBS-Optimized Available	Network Performance
t2.micro	Variable	1	1	EBS only	-	Low to Moderate

▼ Security Groups

Security group name: SSH_HTTP

Description: SSH and HTTP for RStudio Server

Type	Protocol	Port Range	Source
SSH	TCP	22	0.0.0.0/0

Cancel Previous Launch

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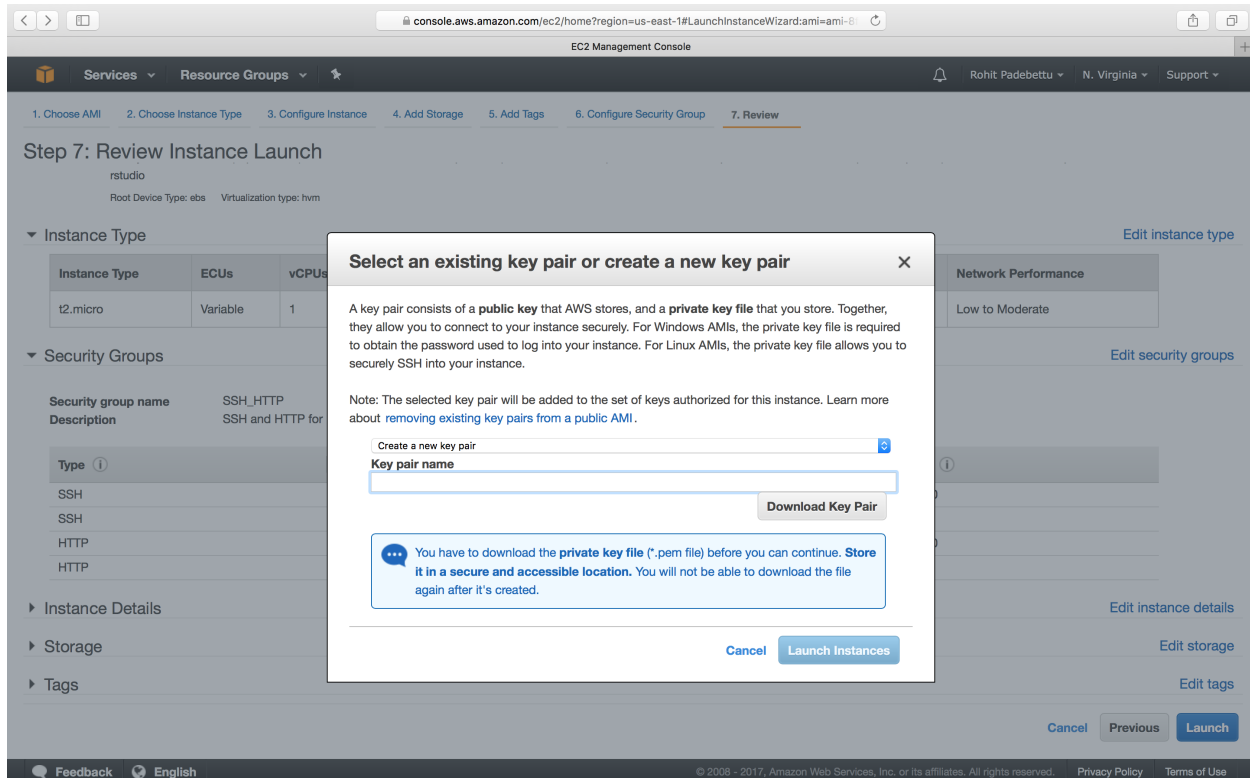
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scope of this tutorial.

Click Launch

Download Key Pair

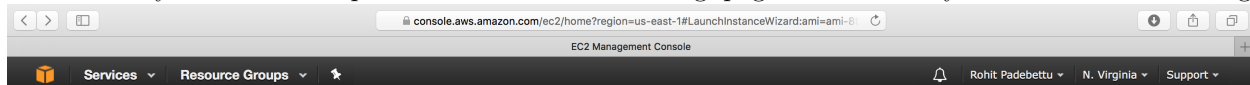
You will now be presented with a pop-up window asking you to create a Key Pair. A Key Pair is a secure way of accessing the cloud machine. It is like an encrypted username/password combination which only you and AWS know about. Give your Key Pair a name you like and click the **Download Key Pair** button. You should store this file safely on your personal local machine in a safe place. You will not be able to download this file again (Although you can create a new Key Pair if required). This file is required to access the cloud machine through SSH and other means if required.



This is it for configuration of your machine.

Click **Launch Instance** button once you have saved the key pair file

Once done you should be presented with the following page to indicate your instance is running.



Launch Status

Your instances are now launching
 The following instance launches have been initiated: [i-0c4d655ace6df8bd3](#) [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](#)
- [Amazon EC2: User Guide](#)
- [Learn about AWS Free Usage Tier](#)
- [Amazon EC2: Discussion Forum](#)

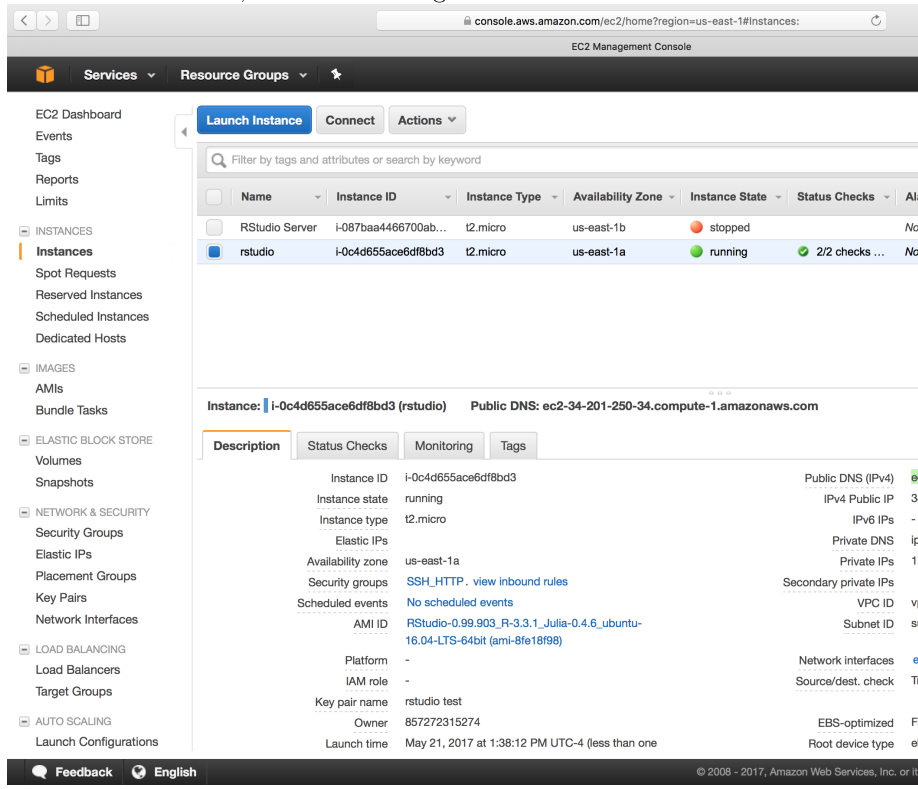
While your instances are launching you can also

- [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](#)

Verify Instance State on Dashboard: The last step is to review the instance whether if it is running on your EC2 dashboard. If you named your instance `rstudio` as suggested in **STEP 5**, then you should see a row named `rstudio` running. Click on it to view your instance details and to get the public address of the machine to enable you to access RStudio Server remotely.

Copy the **Public DNS(IPv4)** in the bottom pane on the left side. This will vary for each one of you and each time you restart your cloud machine. For my account and instance, the address assigned this time is **ec2-34-**



The screenshot shows the AWS Management Console for the EC2 instance named `rstudio`. The instance is in the `running` state. The instance details pane shows the following information:

Property	Value
Instance ID	i-0c4d655ace6df8bd3
Instance state	running
Instance type	t2.micro
Availability zone	us-east-1a
Security groups	SSH_HTTP, view inbound rules
Scheduled events	No scheduled events
AMI ID	RStudio-0.99.903_R-3.3.1_Julia-0.4.6_ubuntu-16.04-LTS-64bit (ami-8fe18f98)
Platform	-
IAM role	-
Key pair name	rstudio test
Owner	857272315274
Launch time	May 21, 2017 at 1:38:12 PM UTC-4 (less than one

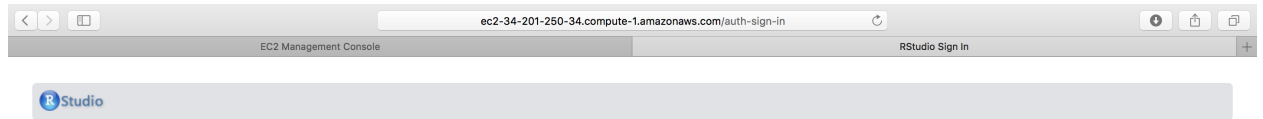
The Public DNS (IPv4) is **ec2-34-201-250-34.compute-1.amazonaws.com**.

201-250-34.compute-1.amazonaws.com.

Launch RStudio via web browser

Now you have configured a cloud computer for yourself and started it. If everything worked as expected, your cloud computer is now running and available for access via a web browser.

Launch a web browser of your choice on your local computer. Paste in the Public DNS you copied in the last step into the address bar and hit enter. If you have followed the steps until here, you should see a screen which looks



Sign in to RStudio

Username:

rstudio

Password:

↑↓

☐ Stay signed in

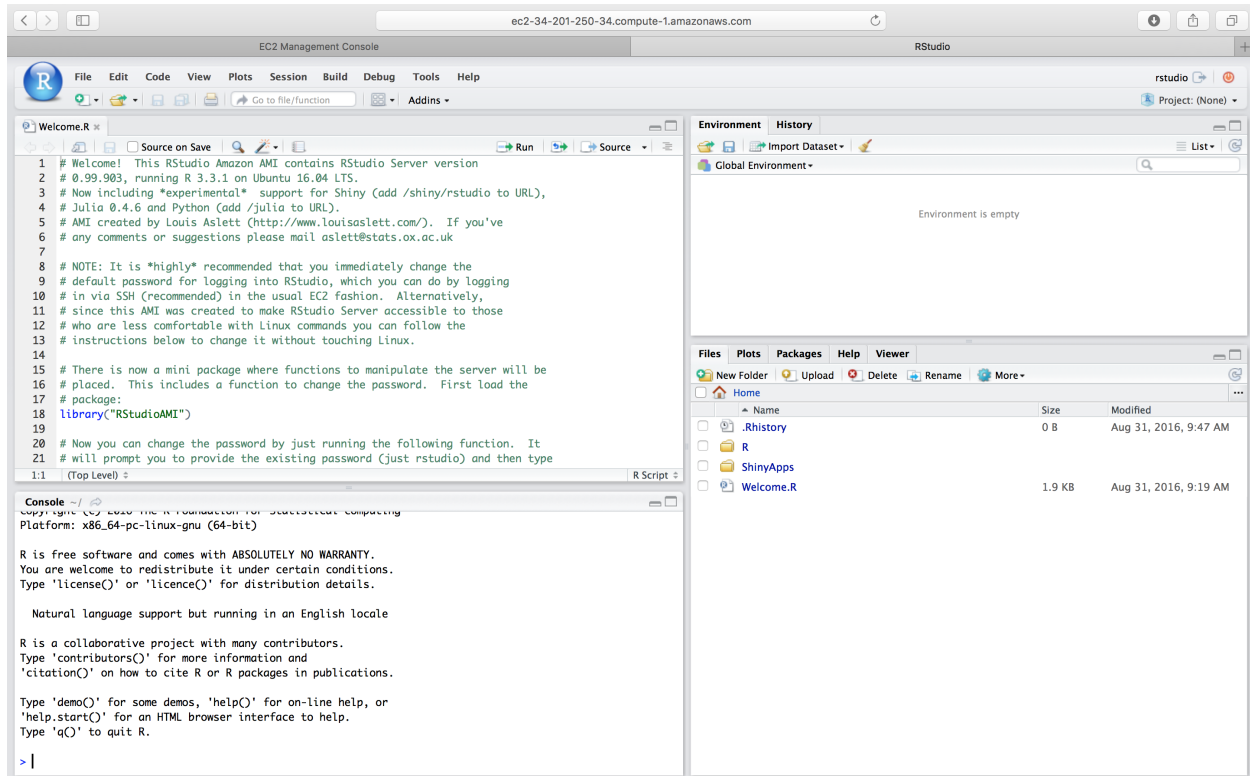
Sign In

like below.

Sign in to RStudio

```
`Username`: `rstudio` and `Password`: `rstudio`
```

Presto! You should see RStudio running in your browser. It works exactly like RStudio installed on your local machine. You can go ahead and customize the look and feel, install your favorite package, create projects and work on solving your next Data Science problem, right from any browser.



Additional Configuration

The RStudio version running in your browser was configured to open a very helpful and important `Welcome.R` script.

Read through it and follow the instructions there to reset your password to something only you would remember. The following command should allow you to do so

```
RStudioAMI::passwd()
```

Note: *If you don't do this, your machine is now accessible to anyone on the internet with a browser*

If interested, you could also use the instructions to link this machine to your **Dropbox** account, so that you have access to all the same files you have synced up to your Dropbox account. Dropbox is free for a limited storage space, so it is recommended you sign up for an account there and link it to this machine. You can use that folder to store the scripts and data files you produce while working in R. This allows you to retain your copy of the files even if you **terminate** or **delete** this cloud computer at some point later.

Stop or Terminate the Instance

Right clicking on the instance in the AWS Console EC2 Dashboard, will give you options to Stop the Instance or Terminate the Instance.

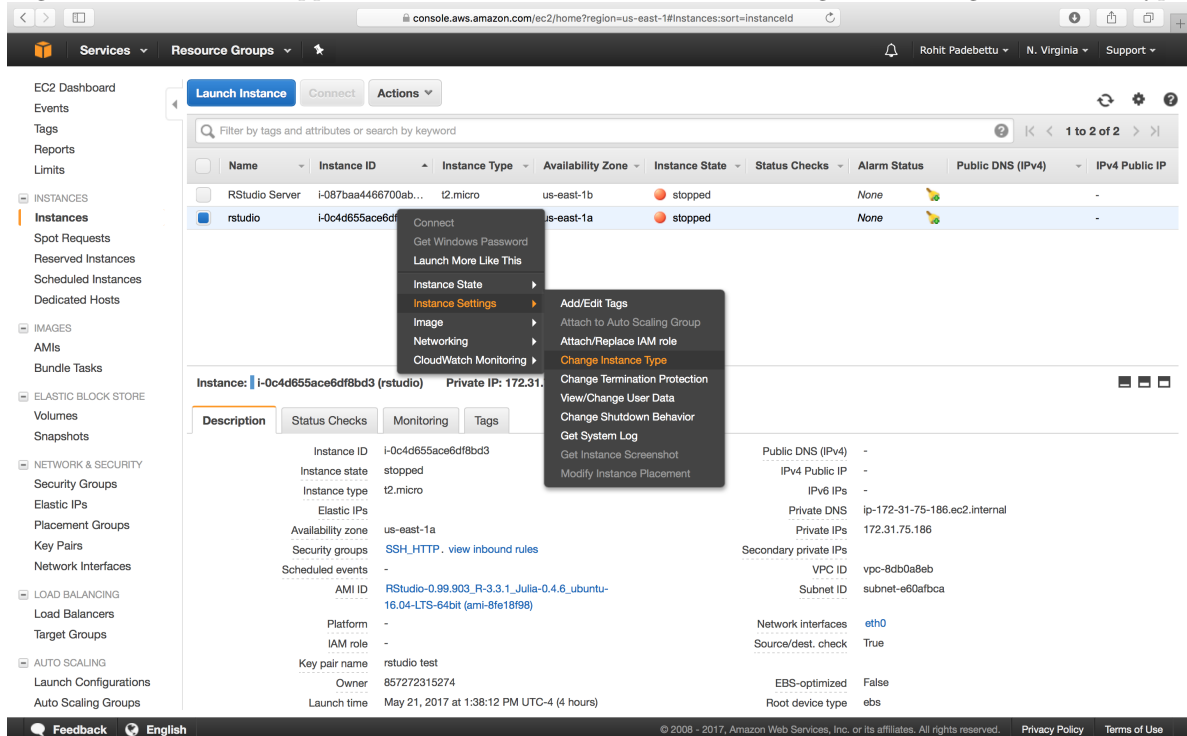
Stopping the instance is like shutting down the computer, while terminating the instance is like returning the computer back to Amazon.

Note: To keep the data and latest configuration on this cloud computer, remember you only need to STOP the computer after use and there is no need to TERMINATE it, unless you decide to TERMINATE for cost or reasons. Under free tier currently, running only this continuously for a year, shouldn't cost you anything

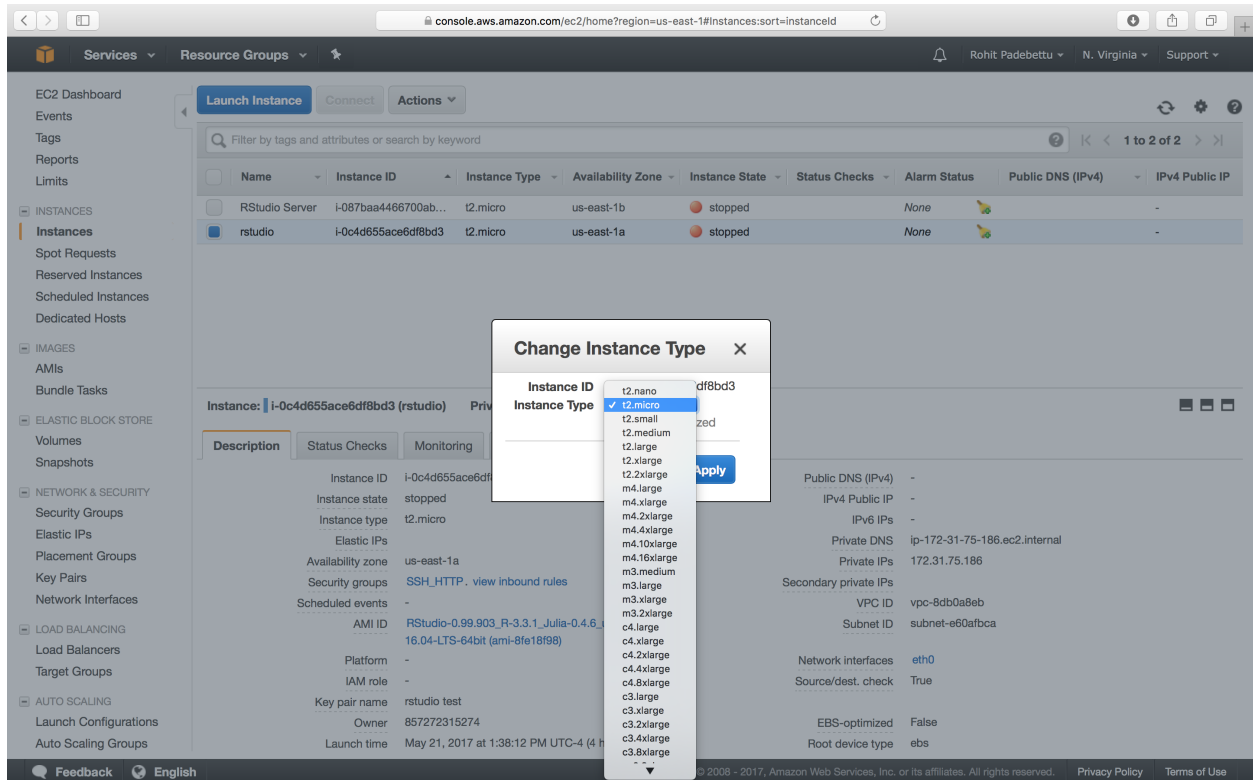
Increased Computing Power

To increase the computing power available to you, all you need to do is go back to the AWS Console. Navigate to the EC2 dashboard.

- Right click on the Stopped Instance and select Instance Settings -> Change Instance Type.



This should bring a pop-up window with a drop down menu that allows you to select the new instance type.



AWS Instance Pricing

As of this writing, the pricing for various instance types on Amazon are as follows. For example you can rent a m4.4x large cloud computer with 4 CPU cores and 16GB of memory (similar to my Mac Pro Laptop) for only

Region: US East (Ohio)

	vCPU	ECU	Memory (GiB)	Instance Storage (GB)	Linux/UNIX U
General Purpose - Current Generation					
t2.nano	1	Variable	0.5	EBS Only	\$0.0059 per H
t2.micro	1	Variable	1	EBS Only	\$0.012 per H
t2.small	1	Variable	2	EBS Only	\$0.023 per H
t2.medium	2	Variable	4	EBS Only	\$0.047 per H
t2.large	2	Variable	8	EBS Only	\$0.094 per H
t2.xlarge	4	Variable	16	EBS Only	\$0.188 per H
t2.2xlarge	8	Variable	32	EBS Only	\$0.376 per H
m4.large	2	6.5	8	EBS Only	\$0.1 per Ho
m4.xlarge	4	13	16	EBS Only	\$0.2 per Ho
m4.2xlarge	8	26	32	EBS Only	\$0.4 per Ho
m4.4xlarge	16	53.5	64	EBS Only	\$0.8 per Ho
m4.10xlarge	40	124.5	160	EBS Only	\$2 per Ho
m4.16xlarge	64	188	256	EBS Only	\$3.2 per Ho

about \$0.20 cents an hour.

Summary

This tutorial was intended to get you started quickly on Amazon AWS. Demonstrate how tremendous cloud computing power is available to us virtually On Demand these days at our finger tips. The tutorial was also intended to help you get started with RStudio and other Data Science software in the cloud.