

Using Cloud Compute Services for Radiance Simulations

Andy McNeil

Disclaimers

- This presentation is offered with no warranty, use at your own risk.
- Andy is a hobbyist at best. Consult a network security expert for much better advice regarding security than what you're about to receive.
- There is likely a better way to do everything I'm going to show you.



There is no cloud.
It's just someone else's computer.

Why use someone else's computer?

- Computing resources scale with needs
 - Add and drop instances as your workload changes
 - No need to coordinate with coworkers for running jobs
- Zero up front cost | Hello Freelancers!
- Track costs by project and bill computing expense to client
- Use Linux-only Radiance features without having to get a linux / mac computer

Andy's experience in 2015-2016

☞ Lighting Team



Andrew McNeil – June 14, 2016 at 01:20 PM

As a contractor to Arup I (mostly) provide my own computing resources. For Radiance simulations I use the Amazon Elastic Compute Cloud (EC2). I've just been reviewing my usage statistics over the last 11 months, and thought I'd share with the lighting community.

With the EC2 you choose the specs of your instance when you request it. They have instances with specs ranging from 1 to 40 CPUs. I tended to use instances ranging from 32-40 cpus (depending on market pricing).

My usage statistics over the Past 11 months:

Total Cost: \$888

Total CPU hours: 69,028

Cost per CPU hour: \$0.013

On average over the 11 months I had 8.5 CPUs for \$900, which is competitive with purchasing a high end desktop computer (assuming a 3-4 year life). But the real benefit is scalability. You see I didn't have an 8 CPU computer, I had practically unlimited computing resources at my disposal when I needed them. For example, right now I have 4 x 40 CPU instances running (160 CPUs total!) and it is only costing me \$1.40 an hour at spot market pricing.

- 11 months
- \$900
- 69,028 CPU hours
(equivalent to 8.5 constantly running CPUs)
- 160+ CPUs running for short periods
- Zero CPUs most of the time


Who's Computer?

- AWS (Amazon)
- Azure (Microsoft)
- Google Cloud
- IBM Cloud
- **Cloud & Heat** - Distributed mini data centers that also provide heat to buildings
- And lots more...

Considerations - just a lazy list

- Access
- Storage
- Instance Configurations
- Computing Costs
- Spot / Low-Priority / Preemptible offering
- Your employer's preference (and your client's preference)

I chose 

- It was 2015 - AWS was the leader in cloud services
- Now things are pretty even between biggest cloud providers
(but I still use AWS 'cause I'm an old dog) 

Getting Started with AWS in Twenty-one Easy Steps!

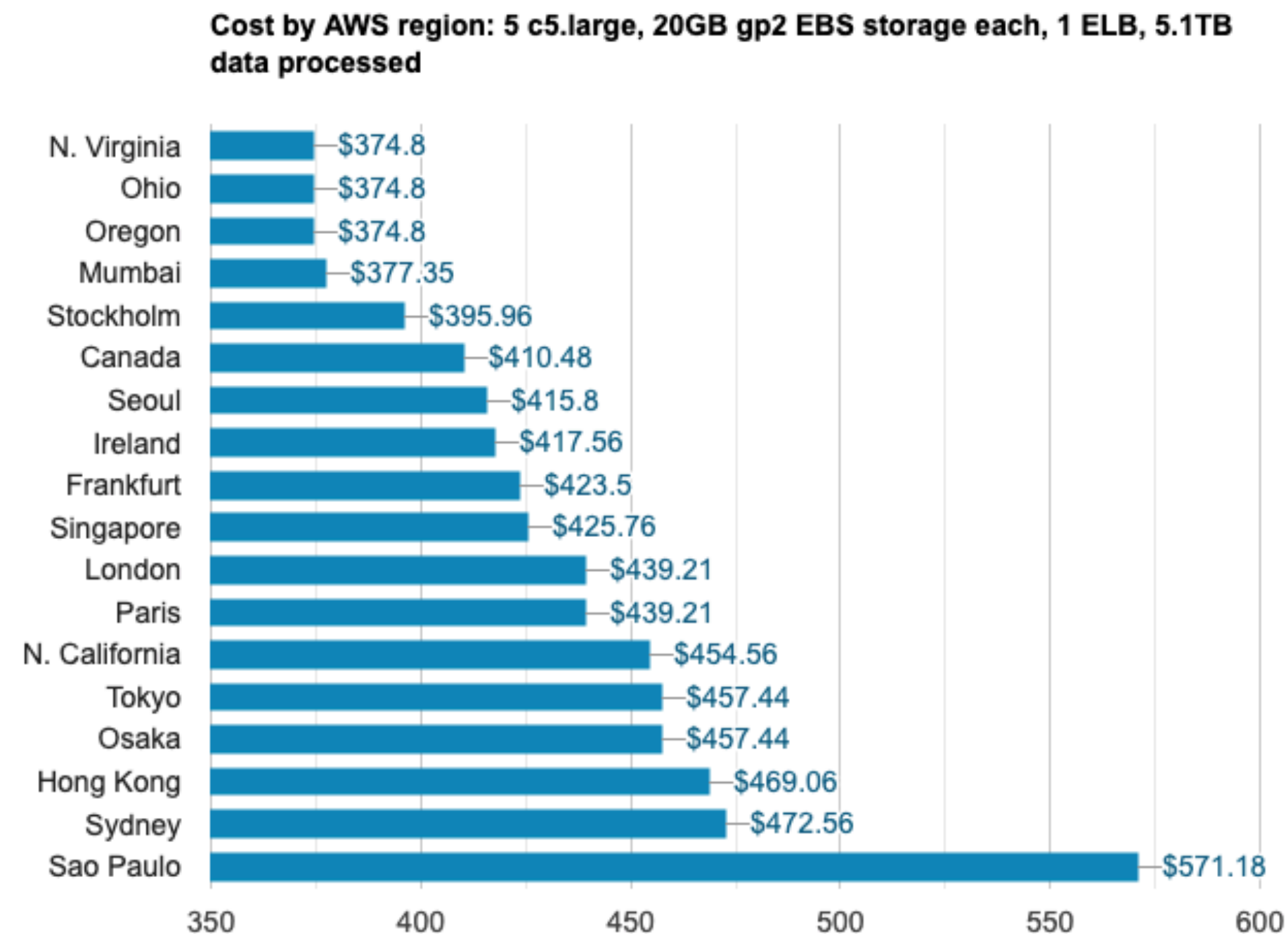
1. Create an AWS account
2. Choose a Region
3. Generate a key pair
4. Set up a security group
5. Choose spot or reserved instance
6. Select an instance type
7. Select a machine image
8. Launch instance
9. Connect to your instance
10. Install software
11. Save a machine image
12. Create persistent file storage
13. Mount persistent file storage
14. Upload Radiance model files
15. Start simulation
16. Set an alarm to terminate instance when simulation finishes
17. Launch an instance to retrieve results from file storage
18. Download results
19. Terminate instance
20. Get your cloud expenses and invoice your client
21. Bask in the glory of a job well done



AWS Regions

US East (Ohio)
US East (N. Virginia)
US West (N. California)
US West (Oregon)
Asia Pacific (Hong Kong)
Asia Pacific (Mumbai)
Asia Pacific (Osaka-Local)
Asia Pacific (Seoul)
Asia Pacific (Singapore)
Asia Pacific (Sydney)
Asia Pacific (Tokyo)
Canada (Central)
China (Beijing)
China (Ningxia)
EU (Frankfurt)
EU (Ireland)
EU (London)
EU (Paris)
EU (Stockholm)
Middle East (Bahrain)
South America (Sao Paulo)

- Choose a region based on proximity and cost.
 - N. California is the most expensive of the US regions, and typically the last to get new features.

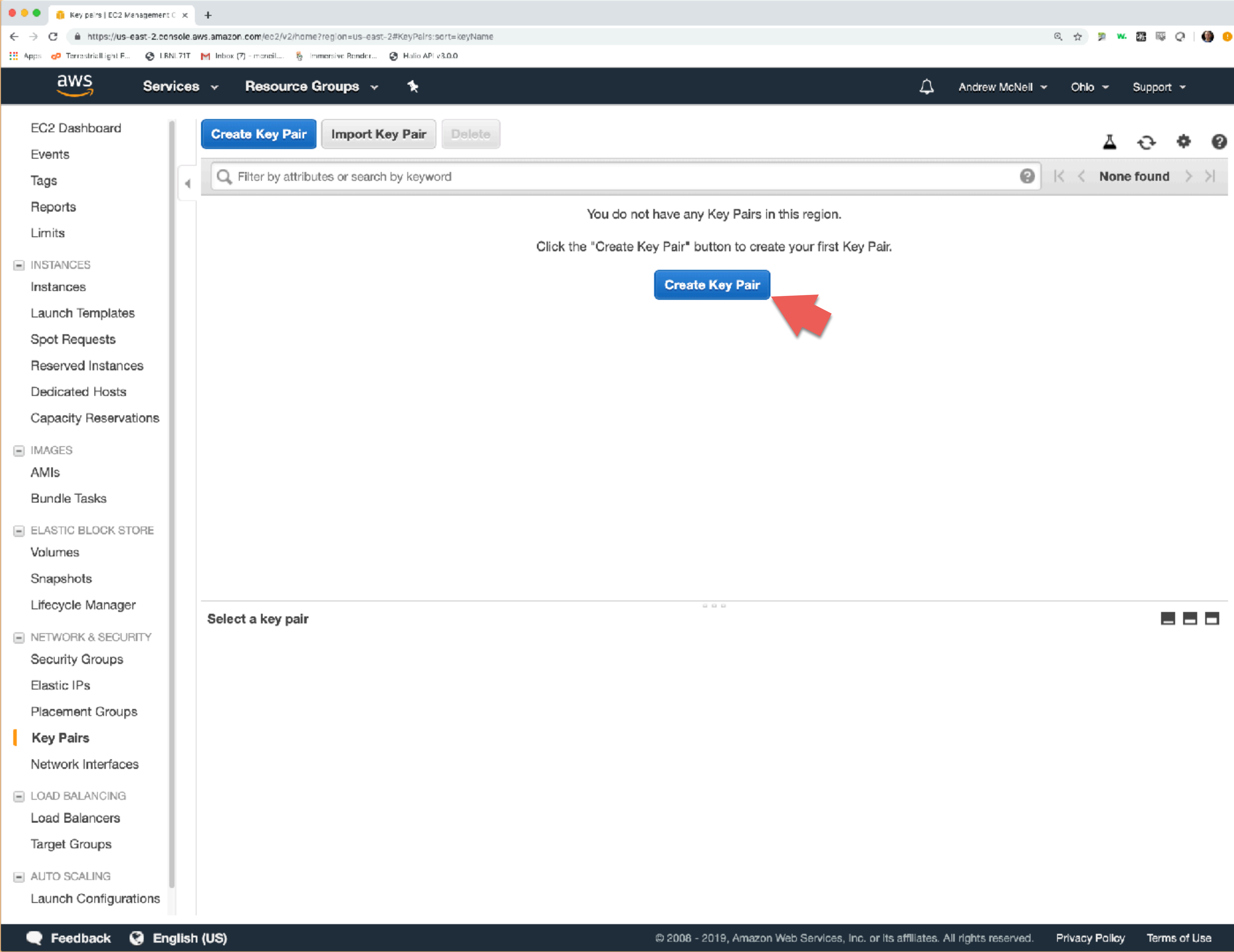


<https://www.concurrencylabs.com/blog/choose-your-aws-region-wisely/>

Key Pairs



- Key pairs are used to securely access your AWS resources.
- Each key pair has a public and private component.
 - AWS keeps the public part
 - You get the private part.
- The private key is downloaded to your computer when it is created
 - There is no way to get the private key again
 - If you lose the private key file you'll have to generate a new key pair and delete the old one



Key pairs | EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#KeyPairs:sort=keyName

EC2 Dashboard
Events
Tags
Reports
Limits

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- Instances
- Launch Templates
- Spot Requests
- Reserved Instances
- Dedicated Hosts
- Capacity Reservations

IMAGES

- AMIs
- Bundle Tasks

ELASTIC BLOCK STORE

- Volumes
- Snapshots
- Lifecycle Manager

NETWORK & SECURITY

- Security Groups
- Elastic IPs
- Placement Groups
- Key Pairs**
- Network Interfaces

LOAD BALANCING

- Load Balancers
- Target Groups

AUTO SCALING

- Launch Configurations

Create Key Pair Import Key Pair Delete

Filter by attributes or search by keyword

You do not have any Key Pairs in this region.

Click the "Create Key Pair" button to create your first Key Pair.

Create Key Pair

Select a key pair

Feedback English (US)

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To start, you have no key pairs in your account.

Click:
“Generate Key Pair”

Key pairs | EC2 Management C x

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#KeyPairs:sort=keyName

Services Resource Groups

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Create Key Pair Import Key Pair Delete

Filter by attributes or search by keyword

You do not have any Key Pairs in this region.
Click the "Create Key Pair" button to create your first Key Pair.

Create Key Pair

Create Key Pair

Key pair name: aws_ohio

Cancel Create

Select a key pair

Feedback English (US)

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Enter a name for your key pair and click create.

Key pairs | EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#KeyPairs:sort=keyName

aws Services Resource Groups

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Create Key Pair Import Key Pair Delete

Filter by attributes or search by keyword

Key pair name	Fingerprint
aws_ohio	da:bd:fa:2c:9f:ca:95:ae:09:60:29:46:1b:32:fe:88:3b:8b:e9:3e

Key Pair: aws_ohio

Key pair name	aws_ohio
Fingerprint	da:bd:fa:2c:9f:ca:95:ae:09:60:29:46:1b:32:fe:88:3b:8b:e9:3e

Feedback English (US)

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aws_ohio.pem



andy_ohio.pem is downloaded to my computer when I click “create”

Move your private key file somewhere secure and memorable. *I like to use a hidden folder for key files on my mac.*

Security Groups



- Sets access rules
 - restrict to IP address or only within security group
- Set accessible ports
 - SSH - port 22
 - NFS - port 2049
 - HTTP - port 80, HTTPS port 443
- When you launch an instance, a temporary security group is created, however it's simplest to use one that's already created.
- Useful for connecting EFS with ECS instances (we'll get to this later)

Security groups | EC2 Manager

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#SecurityGroups:sort=groupId

Apps | TerrestrialLight E... | LBNL/11 | Inbox (7) - mchell... | Immersive Render... | Hello API v3.0.0

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Auto Scaling Groups

Create Security Group

Actions

Filter by tags and attributes | Search by keyword

Name

Group ID

Group Name

VPC ID

Owner

Description

sg-6c47cc04

default

vpc-fe0a3097

885639356958

default VPC security group

Security Group: sg-6c47cc04

Description

Inbound

Outbound

Tags

Edit

Type

Protocol

Port Range

Source

Description

All traffic

All

All

sg-6c47cc04 (default)

Feedback

English (US)

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Your account contains a default security group that allows inbound connections from other instances in the security group and nowhere else.

Click ‘Create Security Group’ to make a new security group.

Security groups | EC2 Manager

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#SecurityGroups:sort=groupId

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Filter by tags and attributes or search by keyword

Name	Group ID	Group Name	VPC ID	Owner	Description
	sg-6c47cc04	default	vpc-fe0a3097	885639356958	default VPC security group

Create Security Group

Security group name

Basic

Description

SSH & NFS

VPC

vpc-fe0a3097 (default)

Security group rules:

Inbound

Outbound

Type	Protocol	Port Range	Source	Description	
SSH	TCP	22	Anywhere	0.0.0.0/0, ::/0	e.g. SSH for Admin I
NFS	TCP	2049	Anywhere	0.0.0.0/0, ::/0	e.g. SSH for Admin I

Add Rule

Cancel

Create

Feedback

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We'll create a security group with the following inbound access:

ssh from anywhere
(so you can connect to the instance from your computer)

nfs from anywhere
(we'll restrict nfs to this security group in the next step)

Security groups | EC2 Manager

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#SecurityGroups:sort=groupId

Apps

terrestrialLight E...

LBNL/11

Inbox (7) - mchell...

Immersive Render...

Hallo API v3.0.0

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Actions

Filter by tags and attributes or search by keyword

	Name	Group ID	Group Name	VPC ID	Owner	Description
<input checked="" type="checkbox"/>		sg-07c3608c40753cd0d	Basic	vpc-fe0a3097	885639356958	SSH & NFS
<input type="checkbox"/>		sg-6c47cc04	default	vpc-fe0a3097	885639356958	default VPC security group

Security Group: sg-07c3608c40753cd0d

Description

Inbound

Outbound

Tags

Edit

Type	Protocol	Port Range	Source	Description
SSH	TCP	22	0.0.0.0/0	
SSH	TCP	22	::/0	
NFS	TCP	2049	0.0.0.0/0	
NFS	TCP	2049	::/0	

Now we have two security groups.



Edit the inbound rules for the new security group by adding the ID of the security group in the source field for NFS.

This will restrict inbound NFS to only services in this security group.

Security groups | EC2 Manager

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#SecurityGroups:sort=groupId

Apps | TerrestrialLight E... | LBNL/11 | Inbox (7) - mchell... | Immersive Render... | Hello API v3.0.0

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NETWORK & SEC | Security Groups | Elastic IPs | Placement Groups | Key Pairs | Network Interfaces

LOAD BALANCING | Load Balancers | Target Groups

AUTO SCALING | Launch Configurations | Auto Scaling Groups

Create Security Group | Actions

Filter by tags and attributes or search by keyword

	Name	Group ID	Group Name	VPC ID	Owner	Description
<input checked="" type="checkbox"/>		sg-07c3608c40753cd0d	Basic	vpc-fe0a3097	885639356958	SSH & NFS
<input type="checkbox"/>		sg-6c47cc04	default	vpc-fe0a3097	885639356958	default VPC security group

Edit inbound rules

Type	Protocol	Port Range	Source	Description	
SSH	TCP	22	Custom 0.0.0.0/0	e.g. SSH for Admin Desktop	✕
SSH	TCP	22	Custom ::/0	e.g. SSH for Admin Desktop	✕
NFS	TCP	2049	Custom sg-07c3608c40753cd0d	e.g. SSH for Admin Desktop	✕

Add Rule

NOTE: Any edits made on existing rules will result in the edited rule being deleted and a new rule created with the new details. This will cause traffic that depends on that rule to be dropped for a very brief period of time until the new rule can be created.

Cancel Save

Type	Protocol	Port Range	Source	Description
SSH	TCP	22	0.0.0.0/0	
SSH	TCP	22	::/0	
NFS	TCP	2049	0.0.0.0/0	
NFS	TCP	2049	::/0	

Feedback | English (US)

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Security groups | EC2 Manager

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#SecurityGroups:sort=groupid

Apps | TerrestrialLight E... | LBNL/11 | Inbox (7) - mchell... | Immersive Render... | Hello API v3.0.0

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Filter by tags and attributes or search by keyword

	Name	Group ID	Group Name	VPC ID	Owner	Description
<input checked="" type="checkbox"/>		sg-07c3608c40753cd0d	Basic	vpc-fe0a3097	885639356958	SSH & NFS
<input type="checkbox"/>		sg-6c47cc04	default	vpc-fe0a3097	885639356958	default VPC security group

Security Group: sg-07c3608c40753cd0d

Description

Inbound

Outbound

Tags

Edit

Type	Protocol	Port Range	Source	Description
SSH	TCP	22	0.0.0.0/0	
SSH	TCP	22	:::0	
NFS	TCP	2049	sg-07c3608c40753cd0d (Basic)	



Now we have a custom security group.

Instance Types



- Dozens of machine instances available organized into categories:
 - General Purpose
 - M - balanced compute, memory, and storage
 - T - burstable
 - A - ARM
 - Compute Optimized
 - C: Lower cost per compute cycle
 - Storage Optimized
 - I: large SSD local storage
 - D: Very large HDD local storage (up to 48 TB)
 - H: Large HDD local storage (up to 16TB) and balanced compute and memory
 - Memory Optimized
 - R: more RAM per CPU
 - X: optimized for in memory database applications - lowest cost per GiB of RAM
 - Z: more RAM per CPU with highest CPU clock speed (4.0 GHz)
 - Accelerated Computing (GPU FGPA)
 - P: General Purpose GPU
 - G: Graphics intensive GPU
 - F: FGPAs

Information about instance types



- Amazon's info:
<https://aws.amazon.com/ec2/instance-types/>
- This 3rd-party website is sortable, filterable and includes prices:
<https://www.ec2instances.info>

Three ways to purchase an instance



- On-demand - regular
- Reserved - pay by the year
- Spot - pseudo auction

On-Demand Instance



- You start and stop the instance.
- You are billed per hour at fixed rate, only for the time you use.
- Nothing can stop the instance except you.

Reserved Instance



- Discounts on long term reservations. The instance is yours for the duration of the term wether you use it or not.
- 38% discount for a 1-year reservation paid monthly
- 72% discount for a 3-year reservation paid in advance
- You probably don't want to use reserved instances

SPOT Instance



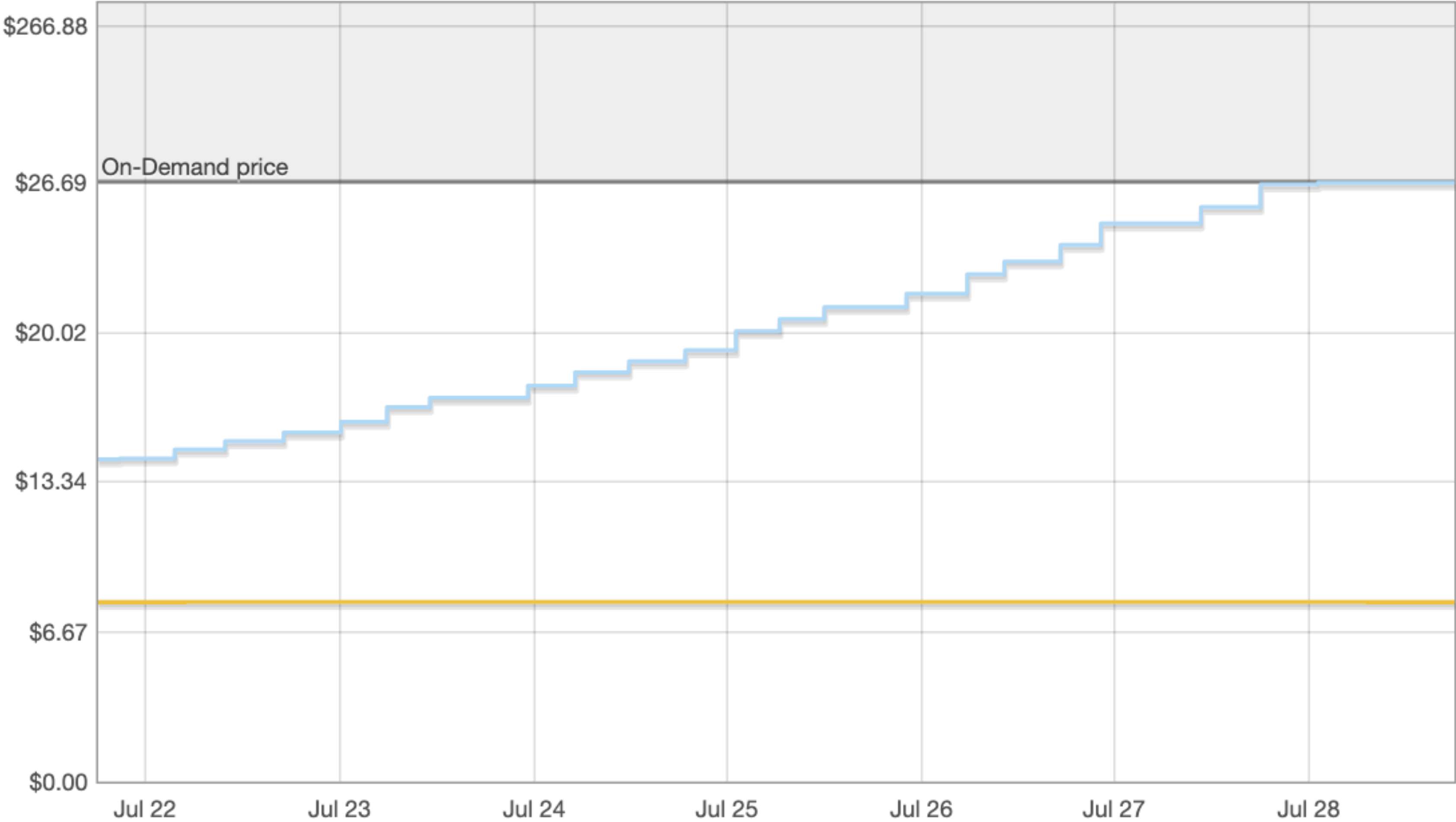
- You can get discounted rates on spare capacity (up to 90% discount).
- You bid the most you're willing to pay per hour.
- You pay the market clearing rate each hour (not your bid rate).
- If the market clearing rate exceeds your bid amount your instance is terminated without warning.

Spot Instance Pricing History

x



Product: Linux/UNIX Instance type: x1e.32xlarge Date range: 1 week



Date
7/28/2019
3:45:04 PM UTC-0700

On-Demand price
\$26.6880

Availability Zone	Price
us-east-2a	\$8.0064
us-east-2b	\$26.6880

Close



My spot bidding strategy:
Bid a few cents more than the on-demand price.



EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Home:

Apps Terrastrillight F... LBNL 71T Inbox (7) - mailil... Immersive Render... Halo API v3.0.0

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Resources

You are using the following Amazon EC2 resources in the US East (Ohio) region:

0 Running Instances

0 Elastic IPs

0 Dedicated Hosts

0 Snapshots

0 Volumes

0 Load Balancers

1 Key Pairs

2 Security Groups

0 Placement Groups

Learn more about the latest in AWS Compute from AWS re:Invent by viewing the [EC2 Videos](#).

Create Instance

To start using Amazon EC2 you will want to launch a virtual server, known as an Amazon EC2 instance.

Launch Instance

Note: Your instances will launch in the US East (Ohio) region

Service Health

Service Status:

US East (Ohio):

Availability Zone Status:

us-east-2a:

us-east-2b:

us-east-2c:

Service Health Dashboard

Scheduled Events

US East (Ohio):

No events

Account Attributes

Supported Platforms

VPC

Default VPC

vpc-fe0a3097

Resource ID length management

Console experiments

Settings

Additional Information

Getting Started Guide

Documentation

All EC2 Resources

Forums

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Contact Us

AWS Marketplace

Find free software trial products in the AWS Marketplace from the [EC2 Launch Wizard](#).

Or try these popular AMIs:

Barracuda CloudGen Firewall for AWS - PAYG

By Barracuda Networks, Inc.

Rating

Starting from \$0.60/hr or from \$4,599/yr (12% savings) for software + AWS usage fees

View all Infrastructure Software

Matillion ETL for Amazon Redshift

By Matillion

Rating

Starting from \$1.37/hr or from \$9,950/yr (17% savings) for software + AWS usage

Feedback

English (US)

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Let's launch an instance!

Launch Instance Wizard | EC2 | x

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#LaunchInstanceWizard:

Apps TerrastricLight F... LBNL 71T Inbox (7) - mailil... Immersive Render... Halo API v3.0.0

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Support

1. Choose AMI

2. Choose Instance Type

3. Configure Instance

4. Add Storage

5. Add Tags

6. Configure Security Group

7. Review

Cancel and Exit

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.

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

Quick Start

My AMIs

AWS Marketplace

Community AMIs

☐ Free tier only

Amazon Linux

Free tier eligible

Amazon Linux 2 AMI (HVM), SSD Volume Type - ami-0d8f6eb4f641ef691 (64-bit x86) / ami-0f378490dca16e3f4 (64-bit Arm)

Amazon Linux 2 comes with five years support. It provides Linux kernel 4.14 tuned for optimal performance on Amazon EC2, systemd 219, GCC 7.3, Glibc 2.26, Binutils 2.29.1, and the latest software packages through extras.

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

Amazon Linux

Free tier eligible

Amazon Linux AMI 2018.03.0 (HVM), SSD Volume Type - ami-02f706d959cedf892

The Amazon Linux AMI is an EBS-backed, AWS-supported image. The default image includes AWS command line tools, Python, Ruby, Perl, and Java. The repositories include Docker, PHP, MySQL, PostgreSQL, and other packages.

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

Red Hat

Free tier eligible

Red Hat Enterprise Linux 8 (HVM), SSD Volume Type - ami-0520e698dd500b1d1 (64-bit x86) / ami-0099847d600887c9f (64-bit Arm)

Red Hat Enterprise Linux version 8 (HVM), EBS General Purpose (SSD) Volume Type

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

SUSE Linux

Free tier eligible

SUSE Linux Enterprise Server 15 SP1 (HVM), SSD Volume Type - ami-0e0bae59dc35fe89a (64-bit x86) / ami-0b49a8f443e46ff20 (64-bit Arm)

SUSE Linux Enterprise Server 15 Service Pack 1 (HVM), EBS General Purpose (SSD) Volume Type. Public Cloud, Advanced Systems Management, Web and Scripting, and Legacy modules enabled.

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

Ubuntu

Ubuntu Server 18.04 LTS (HVM), SSD Volume Type - ami-05c1fa8df71875112 (64-bit x86) / ami-0606a0d9f566249d3 (64-bit Arm)

Select

64-bit (x86)

64-bit (Arm)

Select

64-bit (x86)

Select

64-bit (x86)

64-bit (Arm)

Select

64-bit (x86)

64-bit (Arm)

Select

Feedback

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I’ve always used Amazon Linux. I don’t have a good reason.

Launch Instance Wizard | EC2

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#LaunchInstanceWizard:

Apps

Terraform

1.6.1.71T

Inbox (7)

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Halio API v3.0.0

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Support

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 networking 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	IPv6 Support
<input type="checkbox"/>	General purpose	t2.nano	1	0.5	EBS only	-	Low to Moderate	Yes
<input checked="" type="checkbox"/>	General purpose	t2.micro Free tier eligible	1	1	EBS only	-	Low to Moderate	Yes
<input type="checkbox"/>	General purpose	t2.small	1	2	EBS only	-	Low to Moderate	Yes
<input type="checkbox"/>	General purpose	t2.medium	2	4	EBS only	-	Low to Moderate	Yes
<input type="checkbox"/>	General purpose	t2.large	2	8	EBS only	-	Low to Moderate	Yes
<input type="checkbox"/>	General purpose	t2.xlarge	4	16	EBS only	-	Moderate	Yes
<input type="checkbox"/>	General purpose	t2.2xlarge	8	32	EBS only	-	Moderate	Yes
<input type="checkbox"/>	General purpose	t3a.nano	2	0.5	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	t3a.micro	2	1	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	t3a.small	2	2	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	t3a.medium	2	4	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	t3a.large	2	8	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	t3a.xlarge	4	16	EBS only	Yes	Up to 5 Gigabit	Yes

Cancel

Previous

Review and Launch

Next: Configure Instance Details

Then you select the type of instance.

Make sure you only use the free tier eligible instance if you don't want to pay.

Launch Instance Wizard | EC2 | x

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#LaunchInstanceWizard:

Apps TerrastricLight F... LBNL 71T Inbox (7) - mail... Immersive Render... Halo API v3.0.0

aws

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Andrew McNell

Ohio

Support

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-fe0a3097 (default)

Create new VPC

Subnet

No preference (default subnet in any Availability Zon

Create new subnet

Auto-assign Public IP

Use subnet setting (Enable)

Placement group

☐ Add instance to placement group

Capacity Reservation

Open

Create new Capacity Reservation

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.

Elastic Inference

☐ Add an Elastic Inference accelerator

Additional charges apply.

T2/T3 Unlimited

☐ Enable

Additional charges may apply

Advanced Details

Cancel

Previous

Review and Launch

Next: Add Storage

Feedback

English (US)

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Nothing to do here yet.

But we'll do some things here later.

Launch Instance Wizard | EC2 | x

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#LaunchInstanceWizard:

Apps TerrastricLight F... LBNL 71T Inbox (7) - mailil... Immersive Render... Halo API v3.0.0

aws

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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 ⓘ	Encryption ⓘ
Root	/dev/xvda	snap-077085afe6b3ee68d	8	General Purpose SSD (gp2) ▾	100 / 3000	N/A	<input checked="" type="checkbox"/>	Not Encrypte ▾

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 Tags

Feedback

English (US)

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This is where you add EBS storage, if you decide to use that.

Launch Instance Wizard | EC2 | x

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#LaunchInstanceWizard:

Apps Terrastrillight F... LBNL 71T Inbox (7) - mailil... Immersive Render... Halo API v3.0.0

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Andrew McNell Ohio Support

1. Choose AMI

2. Choose Instance Type

3. Configure Instance

4. Add Storage

5. Add Tags

6. Configure Security Group

7. Review

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	
project	radiance workshop	<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

Feedback

English (US)

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If you want to track costs by project, add a tag here.

Also, you need to activate the tag in the cost management page (we'll do that towards the end)



Launch Instance Wizard | EC2

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#LaunchInstanceWizard:

AppsTerrestrialLight E...LBNL/11Inbox (7) - mcnell...Immersive Render...Halo API v3.0.0

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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. 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
<input checked="" type="checkbox"/> sg-07c3608c40753cd0d	Basic	SSH & NFS	Copy to new
<input type="checkbox"/> sg-6c47cc04	default	default VPC security group	Copy to new

Inbound rules for sg-07c3608c40753cd0d (Selected security groups: sg-07c3608c40753cd0d)

Type	Protocol	Port Range	Source	Description
SSH	TCP	22	0.0.0.0/0	
SSH	TCP	22	::/0	
NFS	TCP	2049	sg-07c3608c40753cd0d (Basic)	

Cancel

Previous

Review and Launch

We'll use the security group we created.

Launch Instance Wizard | EC2

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#LaunchInstanceWizard:

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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, Basic, 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

Edit AMI

Free tier eligible

Amazon Linux 2 AMI (HVM), SSD Volume Type - ami-0d8f6eb4f641ef691
Amazon Linux 2 comes with five years support. It provides Linux kernel 4.14 tuned for optimal performance on Amazon EC2, systemd 219, GCC 7.3, Glibc 2.26, Binutils 2.29.1, and the latest software packages through extras.
Root Device Type: ebs Virtualization type: hvm

▼

Instance Type

Edit 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

Edit security groups

Security Group ID	Name	Description
sg-07c3608c40753cd0d	Basic	SSH & NFS

All selected security groups inbound rules

Type ⓘ	Protocol ⓘ	Port Range ⓘ	Source ⓘ	Description ⓘ
SSH	TCP	22	0.0.0.0/0	
SSH	TCP	22	::/0	
NFS	TCP	2049	sg-07c3608c40753cd0d (Basic)	

Cancel

Previous

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Yes, the security group is open to the world, but they can't get in without your private key.

Launch Instance Wizard | EC2

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#LaunchInstanceWizard:

AppsTerrestrialLight E...LBNL/11Inbox (7) - mchell...Immersive Render...Hello API v3.0.0

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ServicesResource Groups

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1. Choose AMI2. Choose Instance Type3. Configure Instance4. Add Storage5. Add Tags6. Configure Security Group7. 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, Basic, 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](#)

AMIDetails

Amazon Linux 2 AMI (HVM), SSD

Free tier eligible

Amazon Linux 2 comes with five years s
software packages through extras.
Root Device Type: ebsVirtualization type: hv

Instance Type

Instance Type	ECUs	vCP
t2.micro	Variable	1

Security Groups

Security Group ID

sg-07c3608c40753cd0d

All selected security groups inbound rules

Type ⓘ	Protocol ⓘ	Port Range ⓘ	Source ⓘ	Description ⓘ
SSH	TCP	22	0.0.0.0/0	
SSH	TCP	22	::/0	
NFS	TCP	2049	sg-07c3608c40753cd0d (Basic)	

Edit AMI

Edit instance type

Edit security groups

CancelPreviousLaunch

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

aws_ohio

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

CancelLaunch Instances

Pick the key you want to use, and then acknowledge that you have the key file.

Instances | EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Instances:sort=instanceId

Apps | TerrestrialLight E... | LBNL/11 | Inbox (7) - mchell... | Immersive Render... | Hello API v3.0.0

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Connect

Actions

Filter by tags and attributes or search by keyword

	Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public
		i-0558a0059aa9097...	t2.micro	us-east-2b	pending	Initializing	None	ec2-18-222-35-37.us-e...	18.222.35.3

Instance: i-0558a0059aa90975a

Public DNS: ec2-18-222-35-37.us-east-2.compute.amazonaws.com

Description

Status Checks

Monitoring

Tags

Instance ID	i-0558a0059aa90975a	Public DNS (IPv4)	ec2-18-222-35-37.us-east-2.compute.amazonaws.com
Instance state	pending	IPv4 Public IP	18.222.35.37
Instance type	t2.micro	IPv6 IPs	-
Elastic IPs		Private DNS	ip-172-31-16-190.us-east-2.compute.internal
Availability zone	us-east-2b	Private IPs	172.31.16.190
Security groups	Basic: view inbound rules . view outbound rules	Secondary private IPs	
Scheduled events	-	VPC ID	vpc-fe0a3097
AMI ID	amzn2-ami-hvm-2.0.20190618-x86_64-gp2 (ami-0d8f6eb4f641ef691)	Subnet ID	subnet-955219ee
Platform	-	Network interfaces	eth0
IAM role	-	Source/dest. check	True
Key pair name	aws_ohio	T2/T3 Unlimited	Disabled
Owner	885639356958	EBS-optimized	False
Launch time	August 11, 2019 at 11:13:03 AM UTC-7 (less than one hour)	Root device type	ebs
Termination protection	False	Root device	/dev/xvda
Lifecycle	normal	Block devices	/dev/xvda

Feedback

English (US)

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There it is, you did it!

You are clouding!

Connecting to your instance



- Mac & Linux: use ssh
- Windows: use putty or your favorite ssh client

The screenshot shows the AWS Management Console interface. On the left is a navigation menu with categories like INSTANCES, IMAGES, ELASTIC BLOCK STORE, NETWORK & SECURITY, LOAD BALANCING, and AUTO SCALING. The main area displays a list of EC2 instances. One instance is highlighted, and its details are shown below. A red box highlights the IPv4 Public IP address 18.222.35.37 in the instance list. A callout box points to the detailed view of the instance, where the IPv4 Public IP is also highlighted with a red box.

Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public
	i-0558a0059aa90975a	t2.micro	us-east-2b	running	2/2 checks ...	None	ec2-18-222-35-37.us-east-2.compute.amazonaws.com	18.222.35.37

Instance: i-0558a0059aa90975a		Public DNS: ec2-18-222-35-37.us-east-2.compute.amazonaws.com	
Description			
Instance ID	i-0558a0059aa90975a	Public DNS (IPv4)	ec2-18-222-35-37.us-east-2.compute.amazonaws.com
Instance state	running	IPv4 Public IP	18.222.35.37
Instance type	t2.micro	IPv6 IPs	-
Elastic IPs	-	Private DNS	ip-172-31-16-190.us-east-2.compute.internal
Availability zone	us-east-2b	Private IPs	172.31.16.190
Security groups	Basic, view inbound rules, view outbound rules	Secondary private IPs	-
Scheduled events	No scheduled events	VPC ID	vpc-fe0a3097
AMI ID	amzn2-ami-hvm-2.0.20190618-x86_64-gp2 (ami-0d8f6eb4f641ef691)	Subnet ID	subnet-955219ee
Platform	-	Network interfaces	eth0
IAM role	-	Source/dest. check	True
Key pair name	aws_ohio	T2/T3 Unlimited	Disabled
Owner	885639356958	EBS-optimized	False
Launch time	August 11, 2019 at 11:13:03 AM UTC-7 (less than one hour)	Root device type	ebs
Termination protection	False	Root device	/dev/xvda
Lifecycle	normal	Block devices	/dev/xvda

Connecting on Mac / Linux



```
andy — -bash — 80x24
Last login: Sun Aug 11 11:39:28 on ttys008
amcn:~ andy$ ssh -i aws_ohio.pem ec2-user@18.222.35.37
```

ssh command from mac

-i to use your private key file

ec2-user is the username for
amazon linux

use the public IP for your instance

Connecting on Mac / Linux



```
andy — ssh -i aws_ohio.pem ec2-user@18.222.35.37 — 80x24
Last login: Sun Aug 11 11:39:28 on ttys008
[amcn:~ andy$ ssh -i aws_ohio.pem ec2-user@18.222.35.37
The authenticity of host '18.222.35.37 (18.222.35.37)' can't be established.
ECDSA key fingerprint is SHA256:pxosq3oYz00IHPIERekfuZUE0kLG/KnlG4AbWRXevuM.
Are you sure you want to continue connecting (yes/no)?
```

yes you want to continue
connecting.

Connecting on Mac / Linux



```
andy — -bash — 80x24
Last login: Sun Aug 11 11:39:28 on ttys008
[amcn:~ andy$ ssh -i aws_ohio.pem ec2-user@18.222.35.37
The authenticity of host '18.222.35.37 (18.222.35.37)' can't be established.
ECDSA key fingerprint is SHA256:pxosq3oYz00IHPIERekfuZUE0kLG/KnlG4AbWRXevuM.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '18.222.35.37' (ECDSA) to the list of known hosts.
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@                WARNING: UNPROTECTED PRIVATE KEY FILE!          @
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
Permissions 0644 for 'aws_ohio.pem' are too open.
It is required that your private key files are NOT accessible by others.
This private key will be ignored.
Load key "aws_ohio.pem": bad permissions
ec2-user@18.222.35.37: Permission denied (publickey,gssapi-keyex,gssapi-with-mic
).
[amcn:~ andy$
```

whoops!

you need tighter permissions for
your private key.

Connecting on Mac / Linux



```
andy — -bash — 80x24
Last login: Sun Aug 11 11:39:28 on ttys008
[amcn:~ andy$ ssh -i aws_ohio.pem ec2-user@18.222.35.37
The authenticity of host '18.222.35.37 (18.222.35.37)' can't be established.
ECDSA key fingerprint is SHA256:pxosq3oYz00IHPIERekfuZUE0kLG/KnLG4AbWRXevuM.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '18.222.35.37' (ECDSA) to the list of known hosts.
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@                WARNING: UNPROTECTED PRIVATE KEY FILE!          @
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
Permissions 0644 for 'aws_ohio.pem' are too open.
It is required that your private key files are NOT accessible by others.
This private key will be ignored.
Load key "aws_ohio.pem": bad permissions
ec2-user@18.222.35.37: Permission denied (publickey,gssapi-keyex,gssapi-with-mic
).
[amcn:~ andy$ chmod 600 aws_ohio.pem
```

chmod 600 to prevent access
from any other user.

Connecting on Mac / Linux



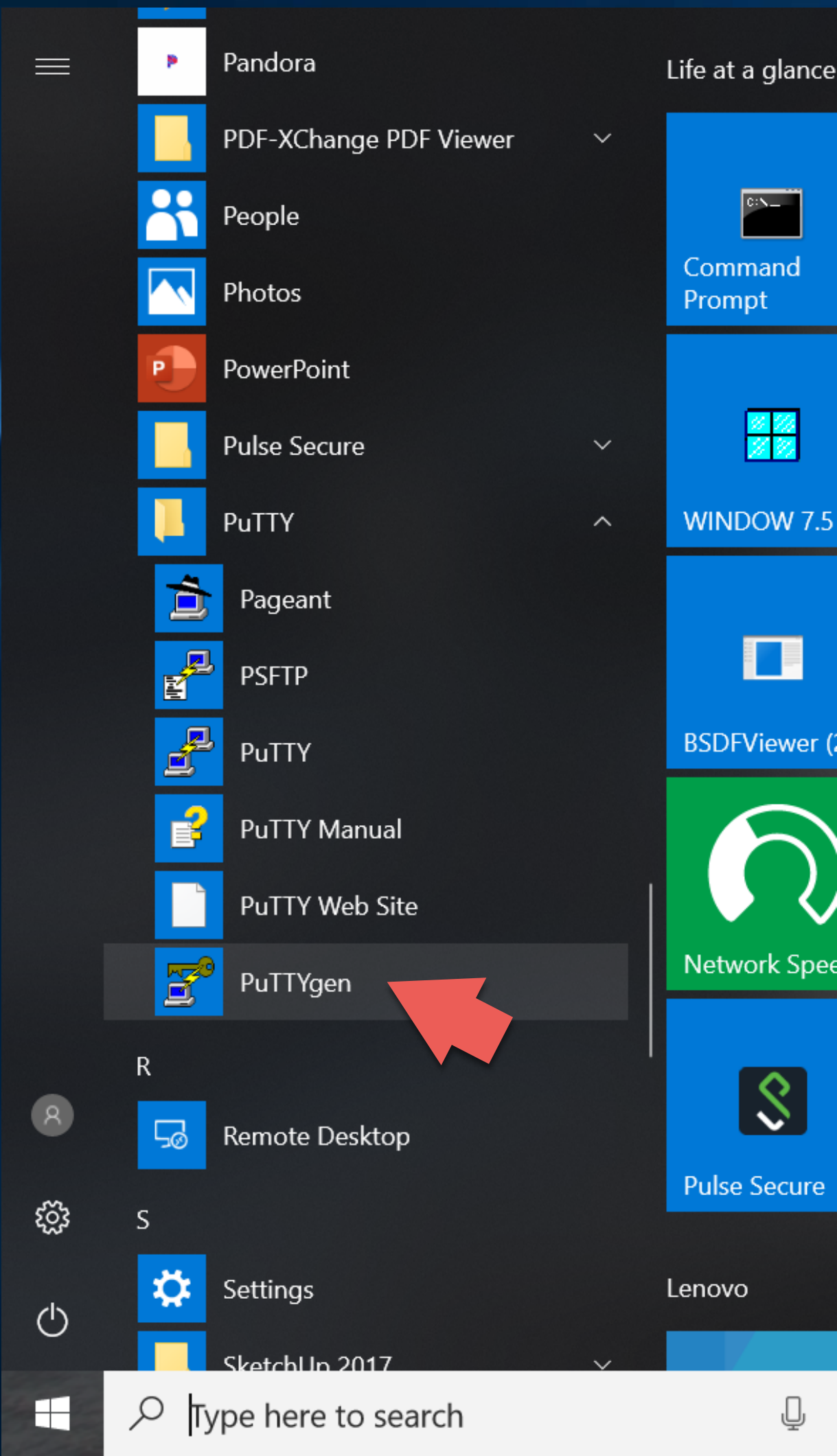
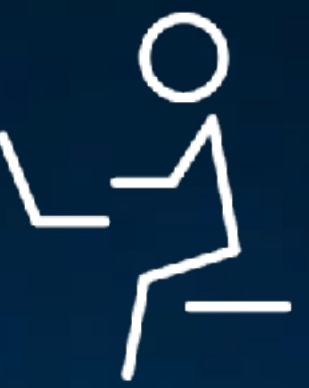
```
andy — ec2-user@ip-172-31-16-190:~ — ssh -i aws_ohio.pem ec2-user@18.222.35.37 — 80x24
ECDSA key fingerprint is SHA256:pxosq3oYz00IHPIERekfuZUE0kLG/KnlG4AbWRXevuM.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '18.222.35.37' (ECDSA) to the list of known hosts.
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@                WARNING: UNPROTECTED PRIVATE KEY FILE!                @
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
Permissions 0644 for 'aws_ohio.pem' are too open.
It is required that your private key files are NOT accessible by others.
This private key will be ignored.
Load key "aws_ohio.pem": bad permissions
ec2-user@18.222.35.37: Permission denied (publickey,gssapi-keyex,gssapi-with-mic
).
[amcn:~ andy$ chmod 600 aws_ohio.pem
[amcn:~ andy$ ssh -i aws_ohio.pem ec2-user@18.222.35.37
Last login: Sun Aug 11 18:37:28 2019 from c-67-169-62-4.hsd1.ca.comcast.net

  _| _|_ )
  _| ( _ /  Amazon Linux 2 AMI
  _|\_|_|

https://aws.amazon.com/amazon-linux-2/
4 package(s) needed for security, out of 12 available
Run "sudo yum update" to apply all updates.
[ec2-user@ip-172-31-16-190 ~]$
```

then ssh again and viola!

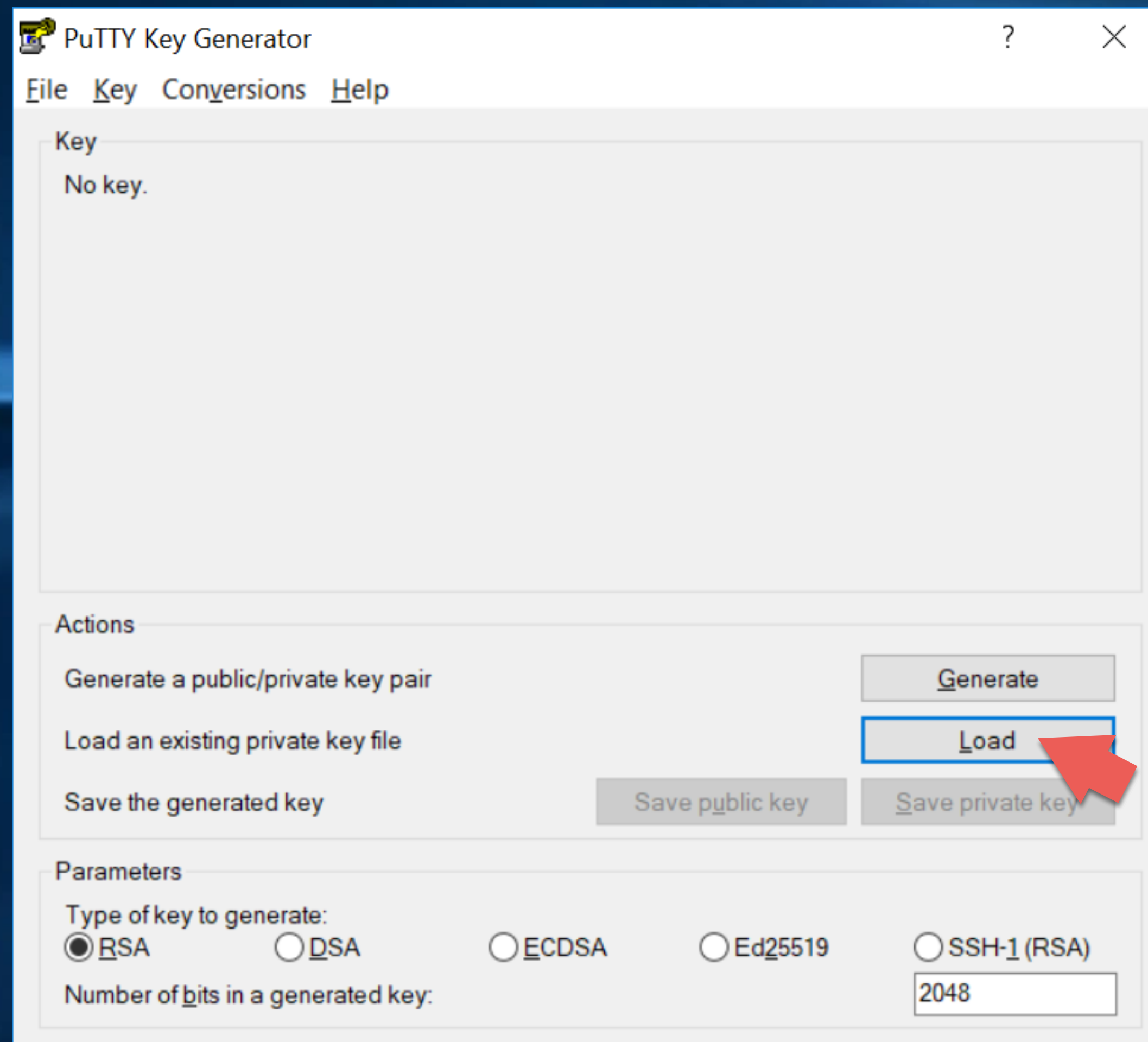
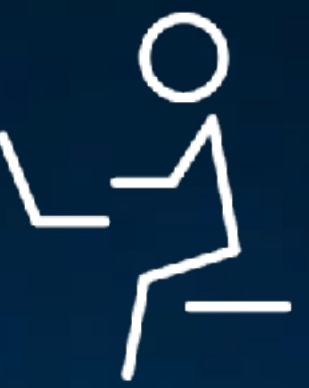
Connecting on Windows



First you need to convert your private key file to a PuTTY private key file.

Open PuTTYgen

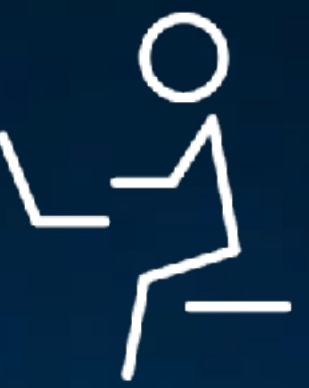
Connecting on Windows



Click “Load”

Browse to and select your pem file from amazon.

Connecting on Windows



PuTTY Key Generator

File Key Conversions Help

Key

Public key for pasting into OpenSSH authorized_keys file:

```
ssh-rsa
AAAAB3NzaC1yc2EAAAADAQABAAQCKXBbxVuc9/UAHOjinUAVmsy2WTi2uOpOoqN
3We0fZ8XuM7ZM9eSalFp0M2ypawltLvSCT
+my7qysnfKulkCtPKTggQwLjBRRq1lu05Wt71MHPTux0uOCjyQE1YyS
+E7h/2frNaichsWL4xQw7FWbkhJ6Mk1nTfRzq5nm3E4kT+F4FX788cD/
```

Key fingerprint: ssh-rsa 2048 76:19:5e:1c:83:ae:2d:19:cf:ea:ec:c2:56:86:52:01

Key comment: imported-openssh-key

Key passphrase:

Confirm passphrase:

Actions

Generate a public/private key pair

Load an existing private key file

Save the generated key

Parameters

Type of key to generate:

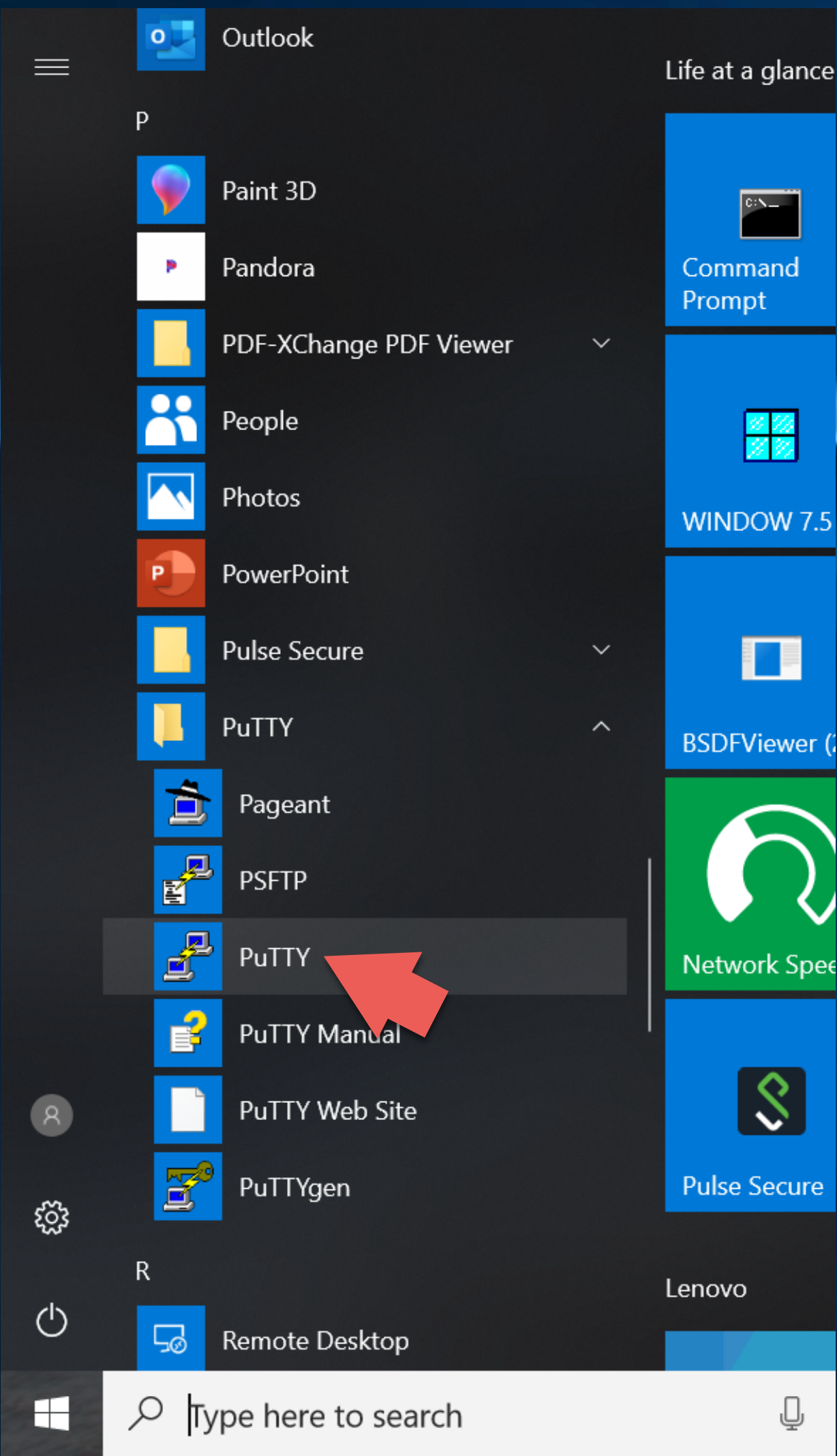
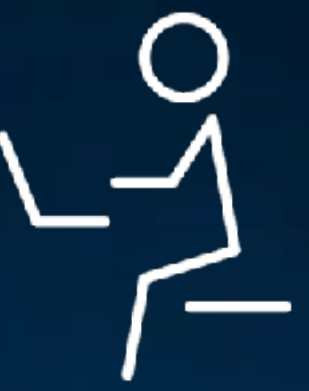
☒ RSA ☐ DSA ☐ ECDSA ☐ Ed25519 ☐ SSH-1 (RSA)

Number of bits in a generated key: 2048

Click "Save private key"

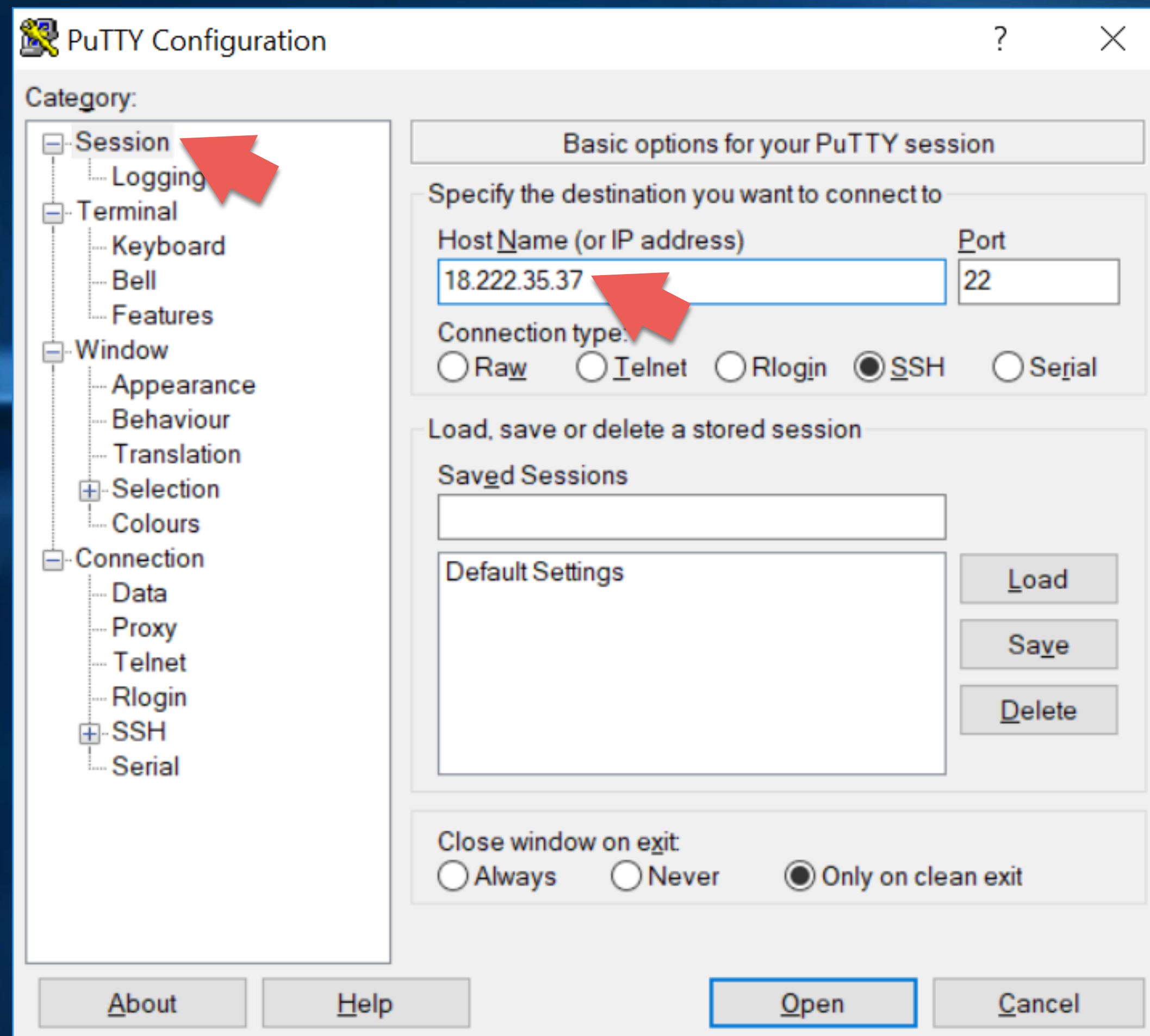
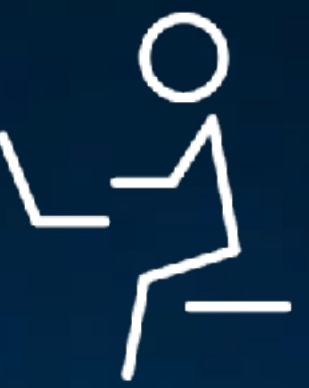


Connecting on Windows



Next Launch PuTTY

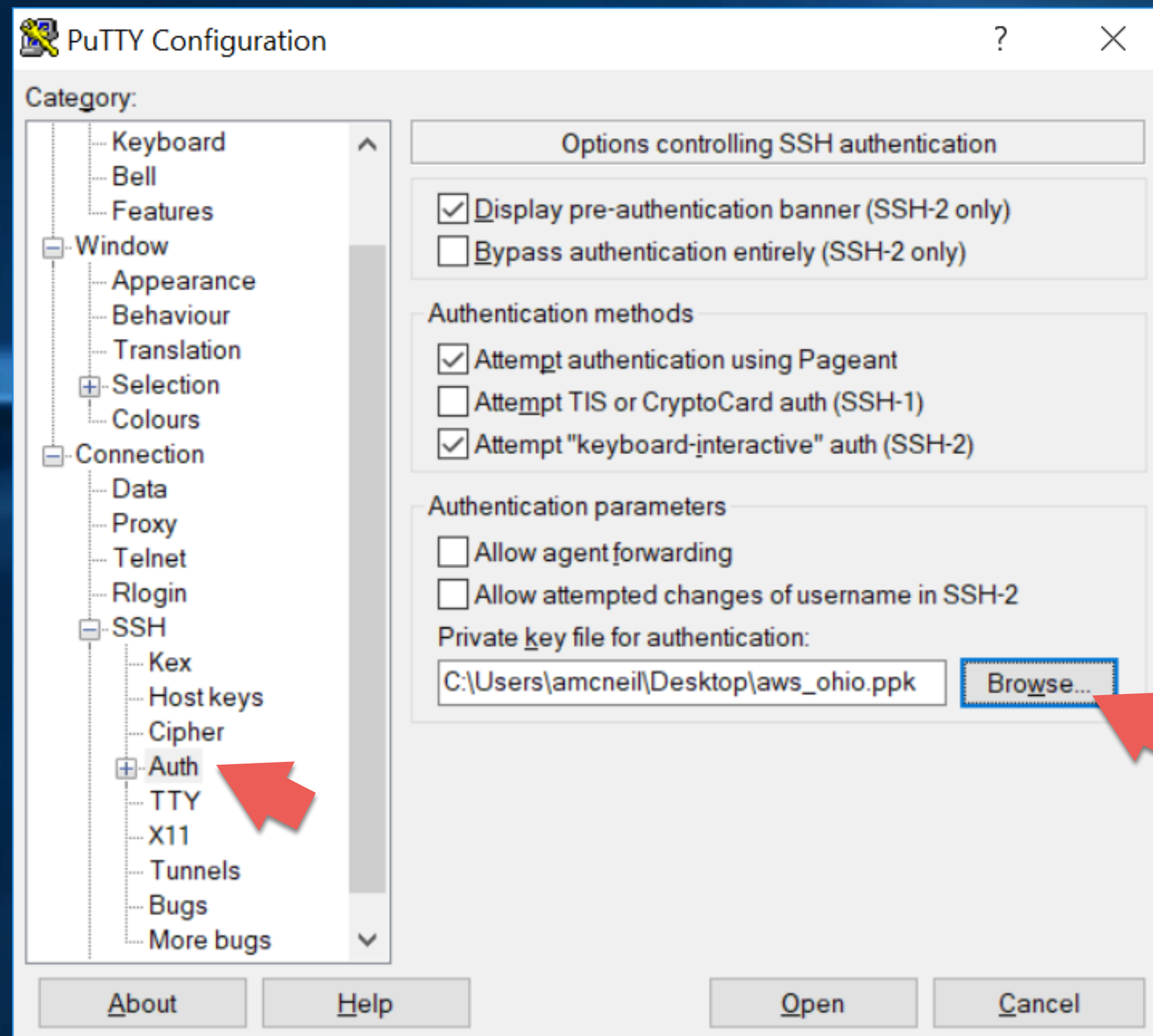
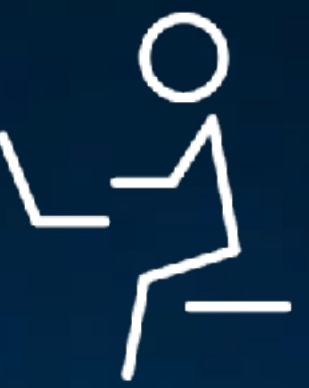
Connecting on Windows



Select Session, if not already selected

Enter the public IP address of your instance

Connecting on Windows

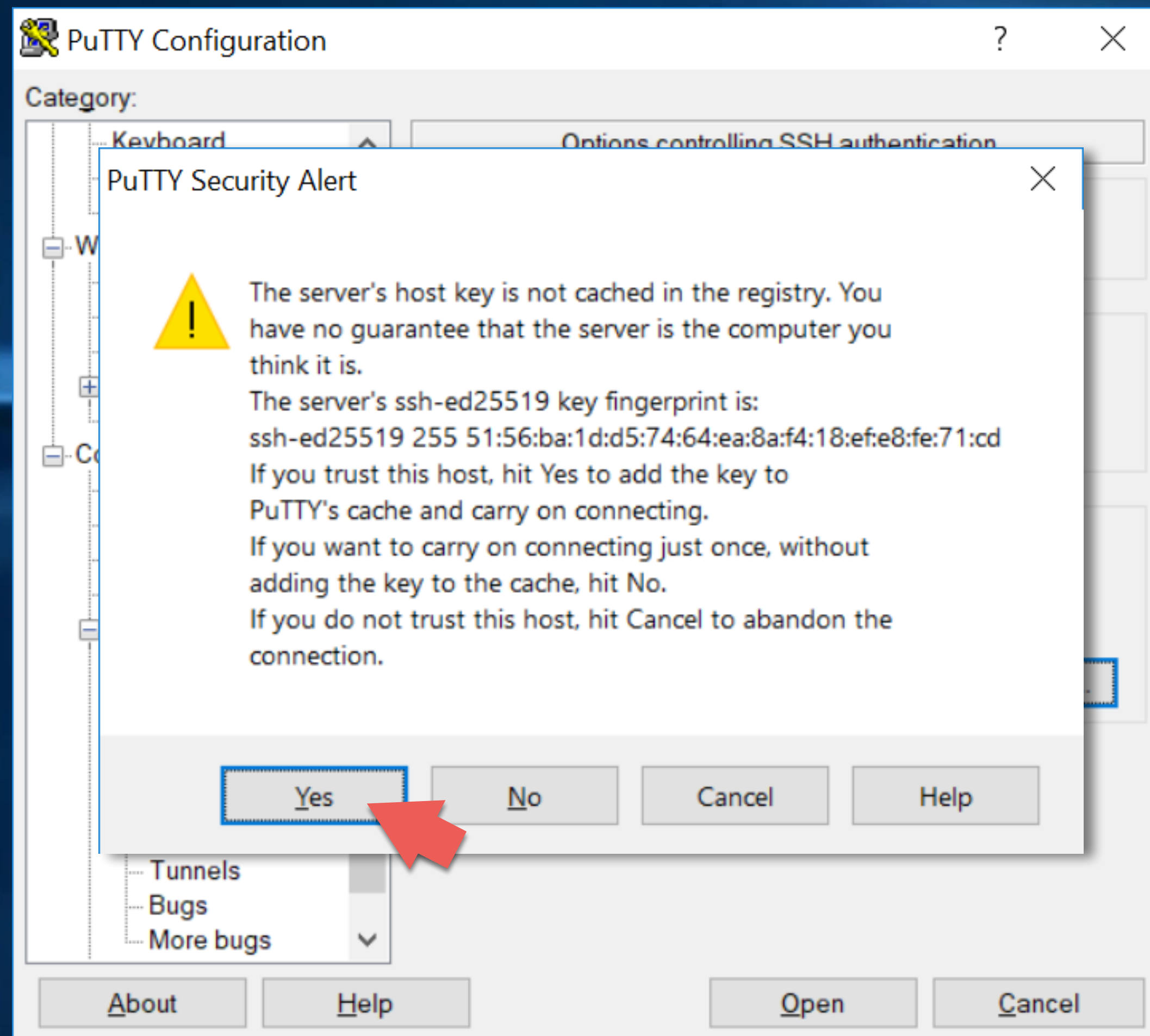
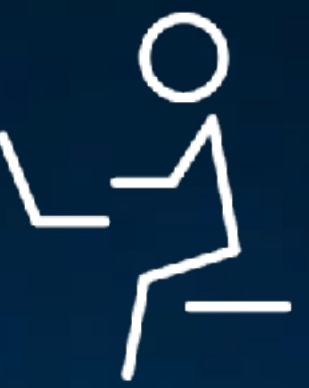


Select “Connection”
-> “SSH”
-> “Auth”

Click Browse, and select the
private key ppk file.

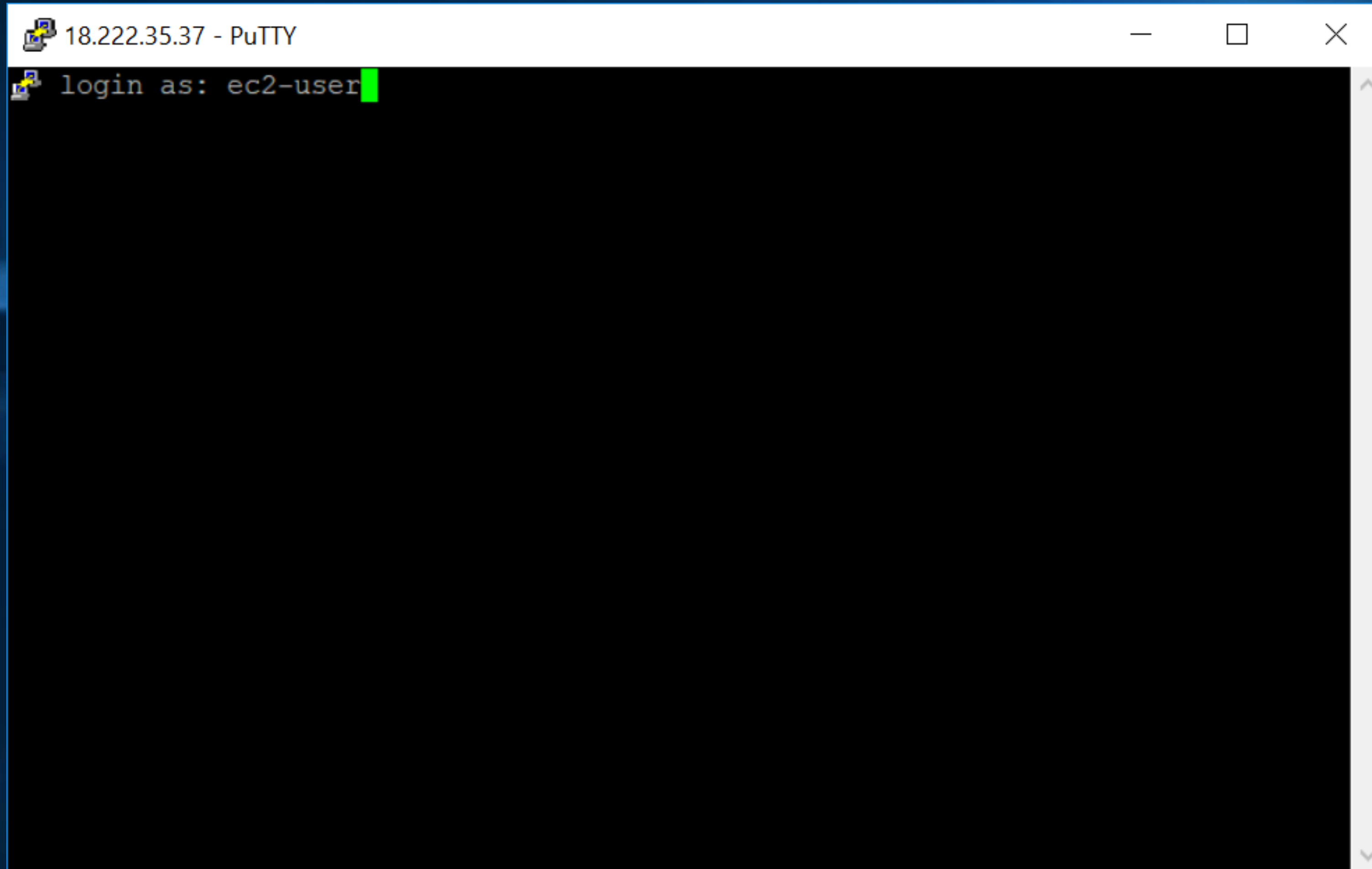
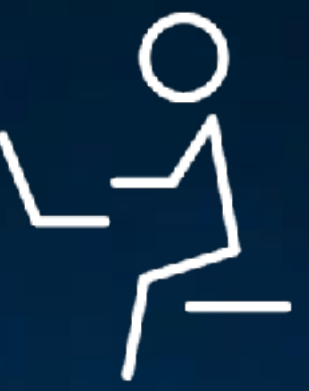
Then click “Open”

Connecting on Windows



Yes, you want to carry on connecting.

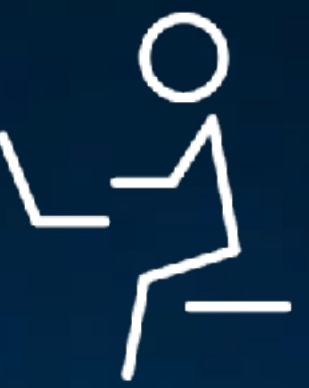
Connecting on Windows



The image shows a PuTTY terminal window titled "18.222.35.37 - PuTTY". The terminal displays the prompt "login as: ec2-user" with a green cursor at the end of the text. The terminal background is black, and the text is white.

at the “login as:” prompt enter
ec2-user

Connecting on Windows



```
ec2-user@ip-172-31-16-190:~  
login as: ec2-user  
Authenticating with public key "imported-openssh-key"  
Last login: Sun Aug 11 19:36:48 2019 from c-67-169-62-4.hsd1.ca.comcast.net  
  
  _ |  _ | _ )  
 _ | ( _ | /  Amazon Linux 2 AMI  
 _ | \ _ | _ |  
  
https://aws.amazon.com/amazon-linux-2/  
[ec2-user@ip-172-31-16-190 ~]$
```

And you're in!

Look at that screen. Your family is going to think you're a nefarious hacker.

Regardless of OS, It's the same from here...



- Bourne-Again Shell (bash)
- package manager: yum

```
andy ec2-user@ip-172-31-16-190:~$ ssh -i ~/aws_ohio.pem ec2-user@18.222.35.37
Last login: Sun Aug 11 20:40:50 2019 from c-67-169-62-4.hsd1.ca.comcast.net

 _|_ ( _|_ /
_|_|_|_|_| Amazon Linux 2 AMI

https://aws.amazon.com/amazon-linux-2/
[ec2-user@ip-172-31-16-190 ~]$
```

```
ec2-user@ip-172-31-16-190:~$
login as: ec2-user
Authenticating with public key "imported-openssh-key"
Last login: Sun Aug 11 19:36:48 2019 from c-67-169-62-4.hsd1.ca.comcast.net

 _|_ ( _|_ /
_|_|_|_|_| Amazon Linux 2 AMI

https://aws.amazon.com/amazon-linux-2/
[ec2-user@ip-172-31-16-190 ~]$
```

Installing Software

- Amazon Linux uses yum package manager
 - First run yum update to get security and other updates
 - Then install packages needed to compile Radiance

```
sudo yum -y update
```

```
sudo yum -y install tcsh gcc gcc-c++ libX11-devel
```

Commands for installing RADIANCE

```
# create a directory for Radiance
```

```
mkdir Radiance
```

```
cd Radiance
```

```
# download Radiance HEAD from radiance-online.org
```

```
wget --no-check-certificate http://www.radiance-online.org/software/snapshots/radiance-HEAD.tgz
```

```
wget --no-check-certificate http://www.radiance-online.org/download-install/radiance-source-code/latest-release/radR52supp.tar.gz
```

```
# unpack tarballs
```

```
tar -xf radiance-HEAD.tgz
```

```
tar -xf radR52supp.tar.gz
```

```
# compile and install radiance
```

```
cd ray
```

```
sudo ./makeall install
```

```
# set raypath and copy cal files to raypath
```

```
echo RAYPATH=./usr/local/lib/ray/ > .bash_profile
```

```
echo export RAYPATH > .bash_profile
```

```
sudo cp src/cal/cal/* /usr/local/lib/ray/.
```

```
# check installation
```

```
rtrace -version
```


Run Mark Stock's Benchmark

```
# Install git
```

```
sudo yum -y install git
```

```
# clone benchmark repo
```

```
git clone https://github.com/markstock/Radiance-Benchmark4.git
```

```
# run the benchmark
```

```
export NCPU=16; make smp
```


File Storage Options

	price per GB	
Simple Storage Service (S3)	\$0.02	<ul style="list-style-type: none">• object storage in flat environment• good for archiving tarballs of old projects, but not for active storage
Elastic Block Store (EBS)	\$0.10	<ul style="list-style-type: none">• Can be attached to a single EC2 instance• Easy to attach when launching instance• Limited to one availability zone (most regions have three zones)• Size is fixed and set when provisioned (you pay for empty GB)
Elastic File System (EFS)	\$0.30	<ul style="list-style-type: none">• Can be simultaneously attached to many EC2 instances• Must be mounted like a network drive (at the command line or with a startup script)• Spans availability zones (but limited to region)• Size is elastic, you only pay for GB used by your data

Andy recommends EFS

Instances | EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Instances:sort=instanceId

AppsTerrestrialLight E...LBNL/11Inbox (7) - mchell...Immersive Render...Hello API v3.0.0

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Services

Resource Groups

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History

EC2

Console Home

EFS

S3

AWS Cost Explorer

Billing

Find a service by name or feature (for example, EC2, S3 or VM, storage).

GroupA-Z

Compute

EC2

Lightsail

ECR

ECS

EKS

Lambda

Batch

Elastic Beanstalk

Serverless Application Repository

Storage

S3

EFS

FSx

S3 Glacier

Storage Gateway

AWS Backup

Database

RDS

DynamoDB

ElastiCache

Neptune

Amazon Redshift

Amazon QLDB

Amazon DocumentDB

Migration & Transfer

AWS Migration Hub

Application Discovery Service

Robotics

AWS RoboMaker

Blockchain

Amazon Managed Blockchain

Satellite

Ground Station

Management & Governance

AWS Organizations

CloudWatch

AWS Auto Scaling

CloudFormation

CloudTrail

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OpsWorks

Service Catalog

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Trusted Advisor

Managed Services

Control Tower

AWS License Manager

AWS Well-Architected Tool

Personal Health Dashboard

AWS Chatbot

Media Services

Elastic Transcoder

Kinesis Video Streams

Analytics

Athena

EMR

CloudSearch

Elasticsearch Service

Kinesis

QuickSight

Data Pipeline

AWS Glue

AWS Lake Formation

MSK

Security, Identity, & Compliance

IAM

Resource Access Manager

Cognito

Secrets Manager

GuardDuty

Inspector

Amazon Macie

AWS Single Sign-On

Certificate Manager

Key Management Service

CloudHSM

Directory Service

WAF & Shield

Artifact

Security Hub

Mobile

AWS Amplify

Mobile Hub

Business Applications

Alexa for Business

Amazon Chime

WorkMail

End User Computing

WorkSpaces

AppStream 2.0

WorkDocs

WorkLink

Internet Of Things

IoT Core

Amazon FreeRTOS

IoT 1-Click

IoT Analytics

IoT Device Defender

IoT Device Management

IoT Events

IoT Greengrass

IoT SiteWise

IoT Things Graph

Game Development

Amazon GameLift

close

FeedbackEnglish / US

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elastic file system manager

https://us-east-2.console.aws.amazon.com/efs/home?region=us-east-2#/first-run

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Amazon Elastic File System (EFS)

Amazon EFS provides file storage for use with your EC2 instances.

Create file system

Getting started guide

Create

Create an Amazon EFS file system to store your files in the Amazon cloud. A file system grows and shrinks automatically with the files you put in, and you pay only for what you use.

Access

Write files to and read files from your Amazon EFS file system by using the NFSv4 protocol. Any number of EC2 instances can work with your file system at the same time, and your instances can be in multiple Availability Zones in a region.

Manage

You can easily administer your file system using the Amazon EFS console, CLI, and SDK.

Elastic File System documentation & support

Getting started guide | Documentation | Support | Forums

FeedbackEnglish (US)

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Create file system

- Step 1: Configure file system access
- Step 2: Configure optional settings
- Step 3: Review and create

Configure file system access

An Amazon EFS file system is accessed by EC2 instances running inside one of your VPCs. Instances connect to a file system by using a network interface called a mount target. Each mount target has an IP address, which we assign automatically or you can specify.

VPC vpc-f0a3097 (default) ⓘ

Create mount targets

Instances connect to a file system by using mount targets you create. We recommend creating a mount target in each of your VPC's Availability Zones so that EC2 instances across your VPC can access the file system.

	Availability Zone	Subnet	IP address	Security groups
<input checked="" type="checkbox"/>	us-east-2a	subnet-4b494322 (default)	Automatic	<div>sg-07c3608c40753cd0d - Basic</div> <div>sg-6c47cc04 - default</div>
<input checked="" type="checkbox"/>	us-east-2b	subnet-955219ee (default)	Automatic	<div>sg-07c3608c40753cd0d - Basic</div> <div>sg-6c47cc04 - default</div>
<input checked="" type="checkbox"/>	us-east-2c	subnet-b99b0cf4 (default)	Automatic	<div>sg-07c3608c40753cd0d - Basic</div> <div>sg-6c47cc04 - default</div>

elastic File System Manager

https://us-east-2.console.aws.amazon.com/efs/home?region=us-east-2#/wizard/2

AppsTerrestrialLight E...LBNL/11Inbox (7) - mchell...Immersive Render...Hello API v3.0.0

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Create file system

Step 1: Configure file system access

Step 2: Configure optional settings

Step 3: Review and create

Configure optional settings

Add tags

You can add tags to describe your file system. A tag consists of a case-sensitive key-value pair. (For example, you can define a tag with key-value pair with key = Corporate Department and value = Sales and Marketing.) At a minimum, we recommend a tag with key = Name.

Key	Value	Remove
Name	Add New Value	
Add New Key		

Enable lifecycle management

Automatically save up to 85% on your EFS bill as your access patterns change by enabling Lifecycle Management for your file system. Based on the policy you choose, any files in your file system that are not accessed for a period of time will automatically move to the EFS Infrequent Access (EFS IA) storage class. EFS IA provides price/performance that's cost-optimized for files not accessed every day.

Lifecycle policy14 days since last access

Choose throughput mode

We recommend Bursting throughput mode for most file systems. Use Provisioned throughput mode for applications that require more throughput than allowed by Bursting throughput.

Bursting

Provisioned

Choose performance mode

We recommend General Purpose performance mode for most file systems. Max I/O performance mode is optimized for applications where tens, hundreds, or thousands of EC2 instances are accessing the file system — it scales to higher levels of aggregate throughput and operations per second with a tradeoff of slightly

Lifecycle policy automatically moves files not recently accessed to lower cost storage

The next time its accessed there will be latency of up to 100ms. but then it’s put back into the faster more expensive storage.

File systems

AWS DataSync

AWS Backup

File systems

Success!

You have created a file system. You can mount your file system from an EC2 instance with an NFSv4.1 client installed. You can also mount your file system from an on-premises server over an AWS Direct Connect or AWS VPN connection. Click [here](#) for EC2 mount instructions, and [here](#) for on-premises mount instructions.

Create file system

Actions

	Name	File system ID	Metered size	Number of mount targets	Creation date
		fs-8e7921f7	6.0 KiB	3	08/11/2019, 18:51:37 UTC

Other details

Owner ID

885639356958

File system state

Available

Performance mode

General Purpose

Throughput mode

Bursting

Encrypted

No

Lifecycle policy

14 days since last access

Tags

No tags added

Manage tags

File system access

Manage file system access

DNS name

fs-8e7921f7.efs.us-east-2.amazonaws.com

Amazon EC2 mount instructions (from local VPC)

Amazon EC2 mount instructions (across VPC peering connection)

On-premises mount instructions

Mount targets

VPC	Availability Zone	Subnet	IP address	Mount target ID	Network interface ID	Security groups	Mount target state
	us-east-2c	subnet-b99b0cf4 (default)	172.31.46.223	fsmt-90a32ce9	eni-0c81bc56240e39e4a		Creating
vpc-fe0a3097	us-east-2h	subnet-955219ee	172.31.23.217	fsmt-	eni-		Creating

Your file system id is used for mounting to instances.

There are mount instructions on the EFS page if you ever forget. You don't need to download this pdf again just for mounting instructions.

Mounting Elastic File Storage

Install tools

```
sudo yum install -y amazon-efs-utils
```

create mount point

```
mkdir efs
```

mount

```
sudo mount -t efs fs-8e7921f7:/ efs
```

change owner and group if it's your first time mounting the file system

```
sudo chown ec2-user efs
```

```
sudo chgrp ec2-user efs
```

Saving a custom machine image

- It'd be nice to not have to do all this setup every time, right?
- Machine Images - You can save the state of the machine
- Configuration script - Allows you to run updates and mount EFS drives when the instance is started

Machine Images

- Remember this step when launching an instance? — — — — — >

The screenshot displays the AWS Management Console's 'Launch Instance wizard' at the 'Choose AMI' step. The breadcrumb trail at the top indicates the sequence: 1. Choose AMI, 2. Choose Instance Type, 3. Configure Instance, 4. Add Storage, 5. Add Tags, 6. Configure Security Group, and 7. Review. The main heading is 'Step 1: Choose an Amazon Machine Image (AMI)', followed by a descriptive paragraph about AMIs. A search bar prompts the user to 'Search for an AMI by entering a search term e.g. "Windows"'. On the left, a 'Quick Start' sidebar offers filters for 'My AMIs', 'AWS Marketplace', 'Community AMIs', and a 'Free tier only' checkbox. The main content area lists five AMIs, each with a logo, name, description, and a 'Select' button. The AMIs are: Amazon Linux 2 AMI (HVM), SSD Volume Type; Amazon Linux AMI 2018.03.0 (HVM), SSD Volume Type; Red Hat Enterprise Linux 8 (HVM), SSD Volume Type; SUSE Linux Enterprise Server 15 SP1 (HVM), SSD Volume Type; and Ubuntu Server 18.04 LTS (HVM), SSD Volume Type. Each entry also specifies the root device type (ebs), virtualization type (hvm), and whether ENA is enabled (Yes). The bottom of the console shows a 'Feedback' link, the language set to 'English (US)', and the copyright notice '© 2008 - 2019, Amazon Web Services, Inc. or its affiliates. All rights reserved.' along with links to 'Privacy Policy' and 'Terms of Use'.

Launch Instance wizard | EC2 | x

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#LaunchInstanceWizard:

aws Services Resource Groups

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

Cancel and Exit

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.

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

Quick Start

My AMIs

AWS Marketplace

Community AMIs

☐ Free tier only ⓘ

Amazon Linux 2 AMI (HVM), SSD Volume Type - ami-0d8f6eb4f641ef691 (64-bit x86) / ami-0f378490dca16e3f4 (64-bit Arm) Select

Amazon Linux Free tier eligible

Amazon Linux 2 comes with five years support. It provides Linux kernel 4.14 tuned for optimal performance on Amazon EC2, systemd 219, GCC 7.3, Glibc 2.26, Binutils 2.29.1, and the latest software packages through extras.

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

64-bit (x86) 64-bit (Arm)

Amazon Linux AMI 2018.03.0 (HVM), SSD Volume Type - ami-02f706d959cedf892 Select

Amazon Linux Free tier eligible

The Amazon Linux AMI is an EBS-backed, AWS-supported image. The default image includes AWS command line tools, Python, Ruby, Perl, and Java. The repositories include Docker, PHP, MySQL, PostgreSQL, and other packages.

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

64-bit (x86)

Red Hat Enterprise Linux 8 (HVM), SSD Volume Type - ami-0520e698dd500b1d1 (64-bit x86) / ami-0099847d600887c9f (64-bit Arm) Select

Red Hat Free tier eligible

Red Hat Enterprise Linux version 8 (HVM), EBS General Purpose (SSD) Volume Type

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

64-bit (x86) 64-bit (Arm)

SUSE Linux Enterprise Server 15 SP1 (HVM), SSD Volume Type - ami-0e0bae59dc35fe89a (64-bit x86) / ami-0b49a8f443e46ff20 (64-bit Arm) Select

SUSE Linux Free tier eligible

SUSE Linux Enterprise Server 15 Service Pack 1 (HVM), EBS General Purpose (SSD) Volume Type. Public Cloud, Advanced Systems Management, Web and Scripting, and Legacy modules enabled.

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

64-bit (x86) 64-bit (Arm)

Ubuntu Server 18.04 LTS (HVM), SSD Volume Type - ami-05c1fa8df71875112 (64-bit x86) / ami-0606a0d9f566249d3 (64-bit Arm) Select

Free tier eligible

Ubuntu Server 18.04 LTS (HVM), EBS General Purpose (SSD) Volume Type. Support available from Canonical (http://www.ubuntu.com/cloud/services).

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

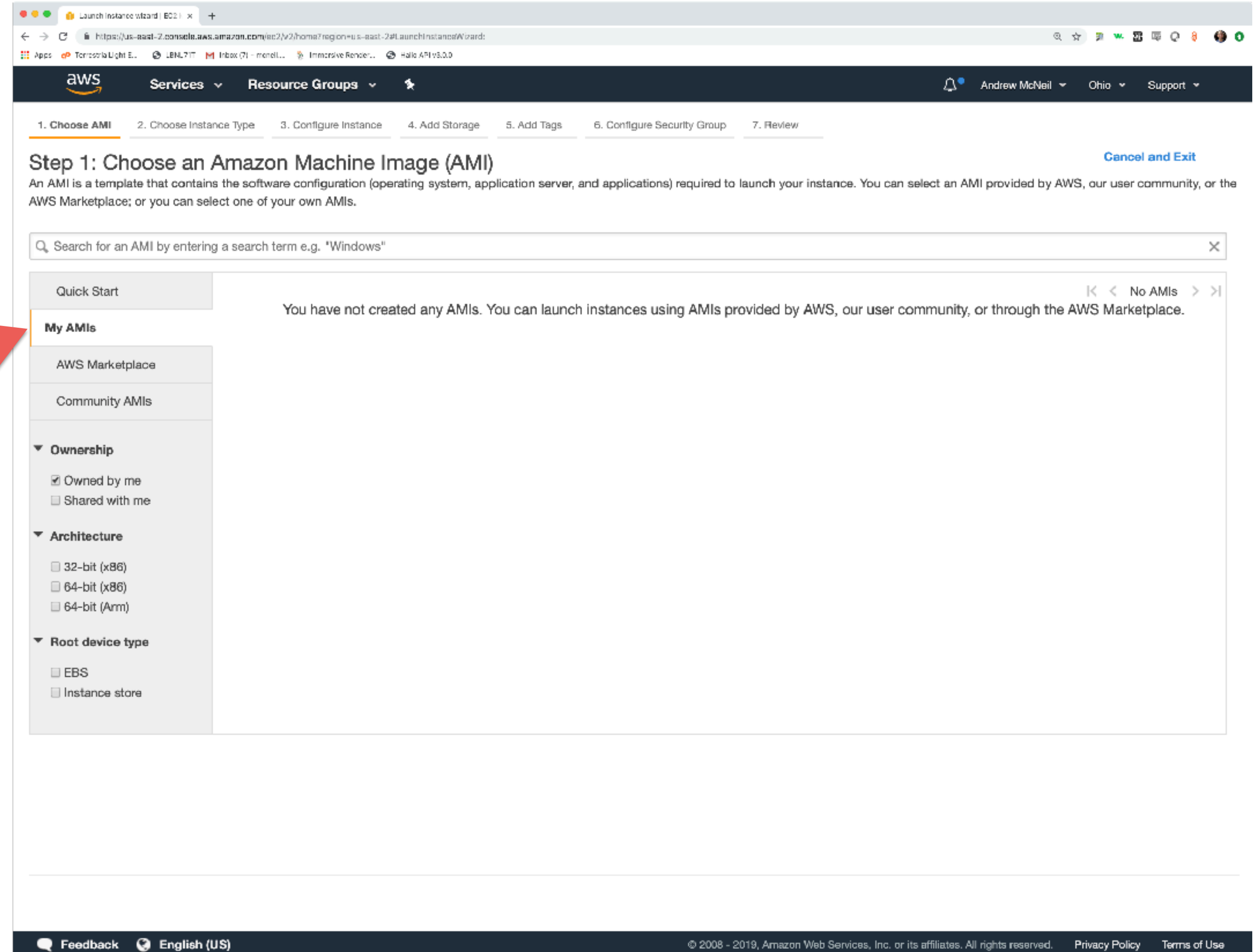
64-bit (x86) 64-bit (Arm)

Feedback English (US)

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Machine Images

- Let's create a machine image!



Instances | EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Instances:sort=instanceId

ServicesResource Groups

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EC2 DashboardEventsTagsReportsLimitsINSTANCESInstancesLaunch TemplatesSpot RequestsReserved InstancesDedicated HostsCapacity ReservationsIMAGESAMIsBundle TasksELASTIC BLOCK STOREVolumesSnapshotsLifecycle ManagerNETWORK & SECURITYSecurity GroupsElastic IPsPlacement GroupsKey PairsNetwork InterfacesLOAD BALANCINGLoad BalancersTarget GroupsAUTO SCALINGLaunch ConfigurationsAuto Scaling Groups

Launch InstanceConnectActions

Filter by tags and attributes or search

	Name	Instance ID	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public
<input checked="" type="checkbox"/>		i-0558a0059aa90975a	us-east-2b	running	2/2 checks ...	None	ec2-18-222-35-37.us-east-2.compute.amazonaws.com	18.222.35.37

Instance: i-0558a0059aa90975aPublic DNS: ec2-18-222-35-37.us-east-2.compute.amazonaws.com

DescriptionStatus ChecksMonitoringTags

Instance ID	i-0558a0059aa90975a	Public DNS (IPv4)	ec2-18-222-35-37.us-east-2.compute.amazonaws.com
Instance state	running	IPv4 Public IP	18.222.35.37
Instance type	t2.micro	IPv6 IPs	-
Elastic IPs		Private DNS	ip-172-31-16-190.us-east-2.compute.internal
Availability zone	us-east-2b	Private IPs	172.31.16.190
Security groups	Basic: view inbound rules. view outbound rules	Secondary private IPs	
Scheduled events	No scheduled events	VPC ID	vpc-fe0a3097
AMI ID	amzn2-ami-hvm-2.0.20190618-x86_64-gp2 (ami-0d8f6eb4f641ef691)	Subnet ID	subnet-955219ee
Platform	-	Network interfaces	eth0
IAM role	-	Source/dest. check	True
Key pair name	aws_ohio	T2/T3 Unlimited	Disabled
Owner	885639356958	EBS-optimized	False
Launch time	August 11, 2019 at 11:13:03 AM UTC-7 (less than one hour)	Root device type	ebs
Termination protection	False	Root device	/dev/xvda
Lifecycle	normal	Block devices	/dev/xvda

Select the instance from which you want to generate a machine image.

Make sure it's not busy, it will be rebooted to make the image!

Instances | EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Instances:sort=instanceId

Apps | TerrestrialLight E... | LBNL/11 | Inbox (7) - mchell... | Immersive Render... | Hello API v3.0.0

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Elastic IPs

Placement Groups

Key Pairs

Network Interfaces

LOAD BALANCING

Load Balancers

Target Groups

AUTO SCALING

Launch Configurations

Auto Scaling Groups

Launch Instance | Connect | Actions

Filter by tags and attributes or search by keyword

Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public
	i-0558a0059aa9097...	t2.micro	us-east-2b	running	2/2 checks ...	None	ec2-18-222-35-37.us-o...	18.222.35.3

Create Image

Instance ID i-0558a0059aa90975a

Image name Radiance

Image description HEAD 2019-08-11

No reboot

Instance Volumes

Volume Type	Device	Snapshot	Size (GiB)	Volume Type	IOPS	Throughput (MB/s)	Delete on Termination	Encrypted
Root	/dev/xvda	snap-077085afe6b3ee68d	8	General Purpose SSD (gp2)	100 / 3000	N/A	<input checked="" type="checkbox"/>	Not Encrypted

Add New Volume

Total size of EBS Volumes: 8 GiB
When you create an EBS image, an EBS snapshot will also be created for each of the above volumes.

Cancel

Create Image

Platform -

IAM role -

Key pair name aws_ohio

Owner 885639356958

Launch time August 11, 2019 at 11:13:03 AM UTC-7 (less than one hour)

Termination protection False

Lifecycle normal

Network interfaces eth0

Source/dest. check True

T2/T3 Unlimited Disabled

EBS-optimized False

Root device type ebs

Root device /dev/xvda

Block devices /dev/xvda

Feedback

English (US)

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Instances | EC2 Management Console

← → ↻ https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Instances:sort=instanceId

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Connect

Actions ▾

Filter by tags and attributes or search by keyword

	Name ▾	Instance ID ▴	Instance Type ▾	Availability Zone ▾	Instance State ▾	Status Checks ▾	Alarm Status	Public DNS (IPv4) ▾	IPv4 Public
<input type="checkbox"/>		i-0558a0059aa9097...	t2.micro	us-east-2b	running	2/2 checks ...	None	ec2-18-222-35-37.us-e...	18.222.35.3

Create Image

✔ Create Image request received.

[View pending image ami-01ad2f81030f30f31](#)

Any snapshots backing your new EBS image can be managed on the [snapshots screen](#) after successful image creation.

Close

Availability zone

us-east-2b

Security groups

Basic: [view inbound rules](#), [view outbound rules](#)

Scheduled events

No scheduled events

AMI ID

amzn2-ami-hvm-2.0.20190618-x86_64-gp2
([ami-0d8f6eb4f641ef691](#))

Platform

-

IAM role

-

Key pair name

aws_ohio

Owner

885639356958

Launch time

August 11, 2019 at 11:13:03 AM UTC-7
(more than one hour)

Termination protection

False

Lifecycle

normal

Private DNS

ip-172-31-16-190.us-east-2.compute.internal

Private IPs

172.31.16.190

Secondary private IPs

VPC ID

vpc-fe0a3097

Subnet ID

subnet-955219ee

[ec2-user@ip-172-31-16-190 ~]\$ sudo cnown ec2-user ers

[ec2-user@ip-172-31-16-190 ~]\$ sudo chgrp ec2-user efs

[ec2-user@ip-172-31-16-190 ~]\$ Connection to 18.222.35.37 closed by remote host.

Connection to 18.222.35.37 closed.

amcn:~ andy\$

Feedback

English (US)

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Select the instance from which you want to generate a machine image.

Make sure it's not busy, it will be rebooted to make the image!

AMIs | EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#images:sort=name

aws

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Andrew McNeil

Ohio

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Owned by me

Filter by tags and attributes or search by keyword

1 to 1 of 1

	Name	AMI Name	AMI ID	Source	Owner	Visibility	Status	Creation Date	Platform
		Radiance	ami-01ad2f81030f30f31	885639356958/...	885639356958	Private	available	August 11, 2019 at 12:11:09 ...	Other Lin

Image: ami-01ad2f81030f30f31

DetailsPermissionsTags

AMI ID

ami-01ad2f81030f30f31

AMI Name

Radiance

Owner

885639356958

Source

885639356958/Radiance

Status

available

State Reason

-

Creation date

August 11, 2019 at 12:11:09 PM UTC-7

Platform

Other Linux

Architecture

x86_64

Image Type

machine

Virtualization type

hvm

Description

HEAD 2019-08-11

Root Device Name

/dev/xvda

Root Device Type

ebs

Edit

Feedback

English (US)

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There's our new image!

Configuration / Startup script

- There are some things you'll want to run every time you start an instance, for example:
 - `sudo yum -y update`
(for security)
 - `sudo mount -t efs myfilesystem:/ efs`
- Configuration scripts can be provided as a text file when launching an instance.
- Or you could put this in a `@reboot` cron job on the machine image.

Example Configuration Script

aws_startup.bsh:

```
#!/bin/bash

yum -y update
mount -t efs fs-8e7921f7:/ /home/ec2-user/efs
```

When provided as a configuration script, it is run with root privileges, so you don't need sudo.

Launch Instance Wizard | EC2

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#LaunchInstanceWizard:ami=ami-01ad2f81030f30f31

AppsTerrestrialLight E...LBNL/11Inbox (7) - mchell...Immersive Render...Hello API v3.0.0

aws

Services

Resource Groups

Andrew McNeil

Ohio

Support

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

<input type="checkbox"/>	General purpose	t3.nano	2	0.5	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	t3.micro	2	1	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	t3.small	2	2	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	t3.medium	2	4	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	t3.large	2	8	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	t3.xlarge	4	16	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	t3.2xlarge	8	32	EBS only	Yes	Up to 5 Gigabit	Yes
<input type="checkbox"/>	General purpose	m5ad.large	2	8	1 x 75 (SSD)	Yes	Up to 10 Gigabit	Yes
<input type="checkbox"/>	General purpose	m5ad.xlarge	4	16	1 x 150 (SSD)	Yes	Up to 10 Gigabit	Yes
<input type="checkbox"/>	General purpose	m5ad.2xlarge	8	32	1 x 300 (SSD)	Yes	Up to 10 Gigabit	Yes
<input checked="" type="checkbox"/>	General purpose	m5ad.4xlarge	16	64	2 x 300 (SSD)	Yes	Up to 10 Gigabit	Yes
<input type="checkbox"/>	General purpose	m5ad.12xlarge	48	192	2 x 900 (SSD)	Yes	10 Gigabit	Yes
<input type="checkbox"/>	General purpose	m5ad.24xlarge	96	384	4 x 900 (SSD)	Yes	20 Gigabit	Yes
<input type="checkbox"/>	General purpose	m5a.large	2	8	EBS only	Yes	Up to 10 Gigabit	Yes
<input type="checkbox"/>	General purpose	m5a.xlarge	4	16	EBS only	Yes	Up to 10 Gigabit	Yes
<input type="checkbox"/>	General purpose	m5a.2xlarge	8	32	EBS only	Yes	Up to 10 Gigabit	Yes
<input type="checkbox"/>	General purpose	m5a.4xlarge	16	64	EBS only	Yes	Up to 10 Gigabit	Yes
<input type="checkbox"/>	General purpose	m5a.8xlarge	32	128	EBS only	Yes	Up to 10 Gigabit	Yes
<input type="checkbox"/>	General purpose	m5a.12xlarge	48	192	EBS only	Yes	10 Gigabit	Yes

Cancel

Previous

Review and Launch

Next: Configure Instance Details

Feedback

English (US)

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I'm going to launch a 16 CPU instance this time.

NOT FREE TIER!

Launch instance wizard | EC2

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#LaunchInstanceWizard:ami=ami-01ad2f81030f30f31

AppsTerrestrialLight E...LBNL/11Inbox (7) - mchell...Immersive Render...Hello API v3.0.0

aws

ServicesResource Groups

Andrew McNeilOhioSupport

1. Choose AMI2. Choose Instance Type3. Configure Instance4. Add Storage5. Add Tags6. Configure Security Group7. 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 instances1Launch into Auto Scaling Group

Purchasing option

Current price

Availability Zone	Current price
us-east-2a	\$0.1596
us-east-2b	\$0.1596
us-east-2c	\$0.6295

Maximum price

\$1

Persistent request

Persistent request

Launch group

(Optional)

Request valid from

Any timeEdit

Request valid to

Any timeEdit

Network

vpc-fe0a3097 (default)Create new VPC

Subnet

No preference (default subnet in any Availability ZonCreate new subnet

Auto-assign Public IP

Use subnet setting (Enable)

Placement group

Add instance to placement group

Capacity Reservation

OpenCreate new Capacity Reservation

IAM role

NoneCreate new IAM role

CPU options

Specify CPU options

Monitoring

Enable CloudWatch detailed monitoringAdditional charges apply.

CancelPreviousReview and LaunchNext: Add Storage

FeedbackEnglish (US)

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And let's do a spot request too.

Launch Instance wizard | EC2

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#LaunchInstanceWizard:ami=ami-01ad2f81030f30f31

AppsTerrestrialLight E...LBNL/11Inbox (7) - mcheil...Immersive Render...Hello API v3.0.0

awsServicesResource GroupsAndrew McNeilOhioSupport

1. Choose AMI2. Choose Instance Type3. Configure Instance4. Add Storage5. Add Tags6. Configure Security Group7. Review

Step 3: Configure Instance Details

	us-east-2b	\$0.1596
	us-east-2c	\$0.6295

Maximum price

\$1

Persistent request

☐ Persistent request

Launch group

(Optional)

Request valid from

Any time [Edit](#)

Request valid to

Any time [Edit](#)

Network

vpc-fe0a3097 (default)

Create new VPC

Subnet

No preference (default subnet in any Availability Zone)

Create new subnet

Auto-assign Public IP

Use subnet setting (Enable)

Placement group

☐ Add instance to placement group

Capacity Reservation

Open

Create new Capacity Reservation

IAM role

None

Create new IAM role

CPU options

☐ Specify CPU options

Monitoring

☐ Enable CloudWatch detailed monitoring
[Additional charges apply.](#)

EBS-optimized instance

☒ Launch as EBS-optimized instance

Elastic Inference

☐ Add an Elastic Inference accelerator
[Additional charges apply.](#)

Advanced Details

User data

☐ As text ☒ As file ☐ Input is already base64 encoded

Choose File

aws_startup.bsh

Cancel

Previous

Review and Launch

Next: Add Storage

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We can add our configuration script as a file under advanced details.

Launch instance wizard | EC2

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#LaunchInstanceWizard:ami=ami-01ad2f81030f30f31

AppsTerrestrialLight E...LBNL/11Inbox (7) - mchell...Immersive Render...Hello API v3.0.0

aws

ServicesResource Groups

Andrew McNeilOhioSupport

1. Choose AMI2. Choose Instance Type3. Configure Instance4. Add Storage5. Add Tags6. Configure Security Group7. Review

Step 5: Tag Spot Request

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.

Note that these tags will be applied to this Spot instance request and not to any instances launched to fulfill this request.

Key(128 characters maximum)	Value(256 characters maximum)
project	radiance workshop

Add another tag

(Up to 50 tags maximum)

Cancel

Previous

Review and Launch

Next: Configure Security Group

Feedback

English (US)

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Tagging the spot request does not tag the instance. You need to tag the instance when it launches.

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. 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
<input checked="" type="checkbox"/> sg-07c3608c40753cd0d	Basic	SSH & NFS	Copy to new
<input type="checkbox"/> sg-6c47cc04	default	default VPC security group	Copy to new



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 only.

Inbound rules for sg-07c3608c40753cd0d (Selected security groups: sg-07c3608c40753cd0d)

Type ⓘ	Protocol ⓘ	Port Range ⓘ	Source ⓘ	Description ⓘ
SSH	TCP	22	0.0.0.0/0	
SSH	TCP	22	::/0	
NFS	TCP	2049	sg-07c3608c40753cd0d (Basic)	

Cancel

Previous

Review and Launch

Instances | EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Instances:sort=instanceId

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Launch Instance | Connect | Actions

Filter by tags and attributes or search by keyword

	Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public
		i-0558a0059aa9097...	t2.micro	us-east-2b	running	2/2 checks ...	None	ec2-18-222-35-37.us-e...	18.222.35.3
		i-09f1b883f8de003e6	m5ad.4xlarge	us-east-2a	running	Initializing	None	ec2-18-217-166-239.us...	18.217.166.

Instance: i-09f1b883f8de003e6

Public DNS: ec2-18-217-166-239.us-east-2.compute.amazonaws.com

Description

Status Checks

Monitoring

Tags

Instance ID	i-09f1b883f8de003e6	Public DNS (IPv4)	ec2-18-217-166-239.us-east-2.compute.amazonaws.com
Instance state	running	IPv4 Public IP	18.217.166.239
Instance type	m5ad.4xlarge	IPv6 IPs	-
Elastic IPs		Private DNS	ip-172-31-8-156.us-east-2.compute.internal
Availability zone	us-east-2a	Private IPs	172.31.8.156
Security groups	Basic: view inbound rules. view outbound rules	Secondary private IPs	
Scheduled events	No scheduled events	VPC ID	vpc-fe0a3097
AMI ID	Radiance (ami-01ad2f81030f30f31)	Subnet ID	subnet-4b494322
Platform	-	Network interfaces	eth0
IAM role	-	Source/dest. check	True
Key pair name	aws_ohio	T2/T3 Unlimited	-
Owner	885639356958	EBS-optimized	True
Launch time	August 11, 2019 at 12:32:45 PM UTC-7 (less than one hour)	Root device type	ebs
Termination protection	False	Root device	/dev/xvda
Lifecycle	spot	Block devices	/dev/xvda
Monitoring	basic	Elastic Graphics ID	-

Feedback

English (US)

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Now that the spot request is fulfilled, you should remember to tag the resulting instance.

Instances | EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Instances:sort=instanceId

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Launch InstanceConnectActions

Filter by tags and attributes or search by keyword1 to 2 of 2

	Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public
<input type="checkbox"/>		i-0558a0059aa9097...	t2.micro	us-east-2b	running	2/2 checks ...	None	ec2-18-222-35-37.us-e...	18.222.35.3
<input checked="" type="checkbox"/>		i-09f1b883f8de003e6	m5ad.4xlarge	us-east-2a	running	Initializing	None	ec2-18-217-166-239.us...	18.217.166.

Instance: i-09f1b883f8de003e6Public DNS: ec2-18-217-166-239.us-east-2.compute.amazonaws.com

DescriptionStatus ChecksMonitoringTags

Add/Edit Tags

Key	Value
This resource currently has no tags	

Now you should remember to tag your spot fulfilled instance.

Instances | EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Instances:sort=instanceId

Apps

terrestrialLight E...

LBNL/11

Inbox (7) - mchell...

Immersive Render...

HALO API v3.0.0

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Connect

Actions

Filter by tags and attributes or search by keyword

1 to 2 of 2

	Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public
<input type="checkbox"/>		i-0558a0059aa9097...	t2.micro	us-east-2b	running	2/2 checks ...	None	ec2-18-222-35-37.us-e...	18.222.35.3
<input checked="" type="checkbox"/>		i-09f1b883f8de003e6	m5ad.4xlarge	us-east-2a	running	Initializing	None	ec2-18-217-166-239.us...	18.217.166.

Instance: i-09f1b883f8de003e6

Description

Status Checks

Add/Edit Tags

Key

Add/Edit Tags

Apply tags to your resources to help organize and identify them.

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	Value
project	radiance workshop

Create Tag

Cancel

Save

This resource currently has no tags

Feedback

English (US)

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Now you should remember to tag your spot fulfilled instance.

Instances | EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Instances:sort=instanceId

Apps | TerrestrialLight E... | LBNL/11 | Inbox (7) - mchell... | Immersive Render... | Hello API v3.0.0

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Launch Instance

Connect

Actions

Filter by tags and attributes or search by keyword

1 to 2 of 2

	Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public
<input type="checkbox"/>		i-0558a0059aa9097...	t2.micro	us-east-2b	running	2/2 checks ...	None	ec2-18-222-35-37.us-e...	18.222.35.3
<input checked="" type="checkbox"/>		i-09f1b883f8de003e6	m5ad.4xlarge	us-east-2a	running	Initializing	None	ec2-18-217-166-239.us...	18.217.166.

Instance: i-09f1b883f8de003e6

Public DNS: ec2-18-217-166-239.us-east-2.compute.amazonaws.com

Description

Status Checks

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Tags

Add/Edit Tags

Key	Value
project	radiance workshop

Show Column

Feedback

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Now you should remember to tag your spot fulfilled instance.

Upload model files - Mac / Linux



- scp (secure copy)
- Copies files over ssh (similar syntax to ssh)

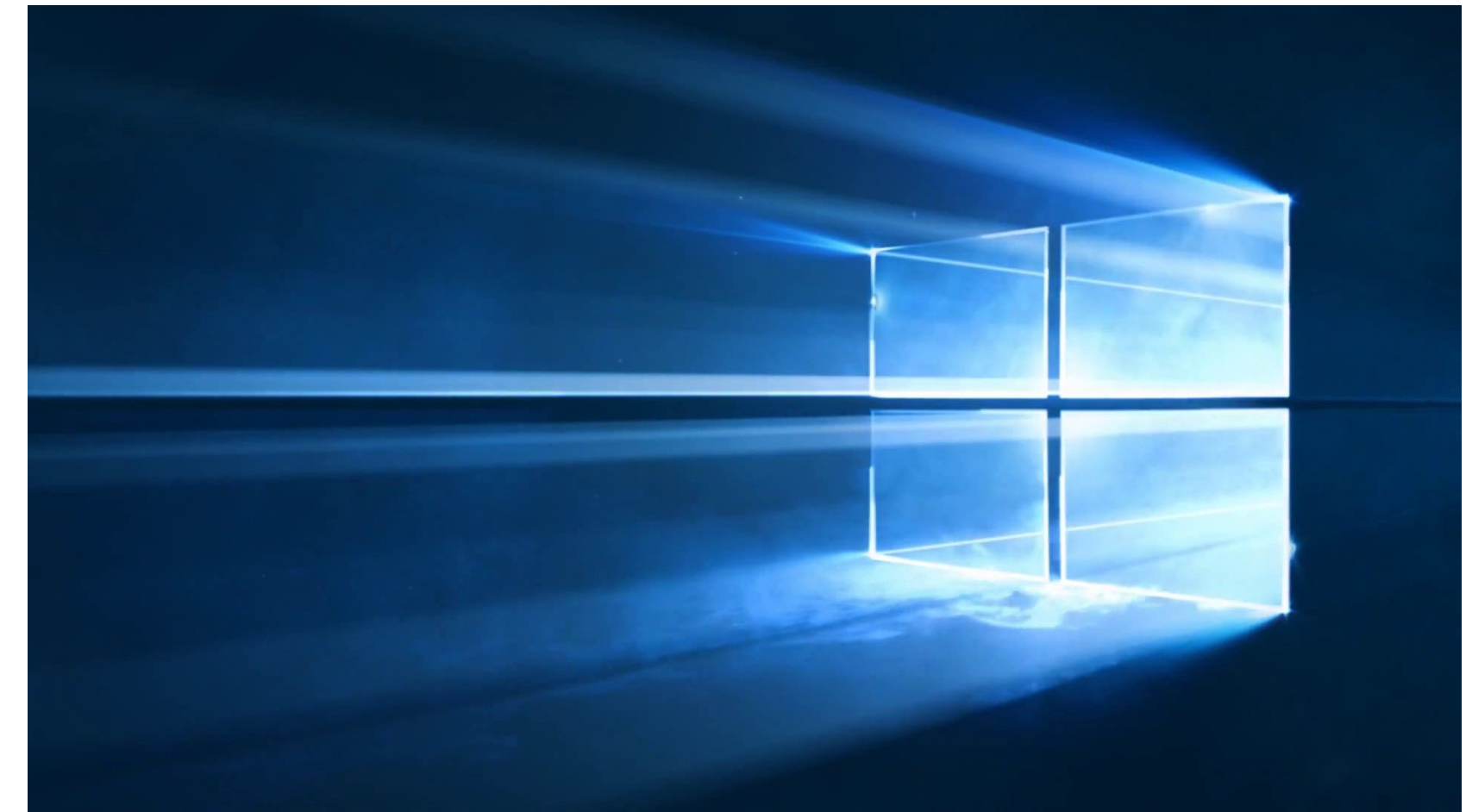
```
scp -i aws_ohio.pem -r my_model/ ec2-user@18.222.35.37:~/efs/
```

copy this to here

-i key.pem : private key

-r : recursive (copies directories and contents)

Upload model files - Windows



- pscp (PuTTY secure copy)
- Copies files over ssh

```
pscp -i aws_ohio.ppk -r my_model/ ec2-user@18.222.35.37:
```

copy this to here

-i key.ppk : private key

-r : recursive (copies directories and contents)

Uploading David's example files

#These commands are run locally.

upload zip files

```
scp -i ~/aws_ohio.pem 01_genBSDF.zip ec2-user@18.222.35.37:~/efs/.
```

```
scp -i ~/aws_ohio.pem example_noResults.zip ec2-user@18.222.35.37:~/efs/.
```

Start Simulation!!!!

- nohup (very important)
 - keeps a process running until it finishes, even if you log out
 - sends stdout to a file, nohup.out by default
 - to stop a process running with nohup, use ps to get the process id and kill to end it.

Running David's BSDF example

```
# unpack zip files
```

```
unzip 01_genBSDF.zip
```

```
unzip example_noResults.zip
```

```
# change permission to make scripts executable
```

```
# this can be avoided if script has 'bash myscript.sh' instead of './myscript.sh'
```

```
cd example_noResults
```

```
chmod +x *.sh scripts/*.sh
```

```
# copy cal file to current directory so script can find it
```

```
cp ../01_genBSDF/window7_2side.cal .
```

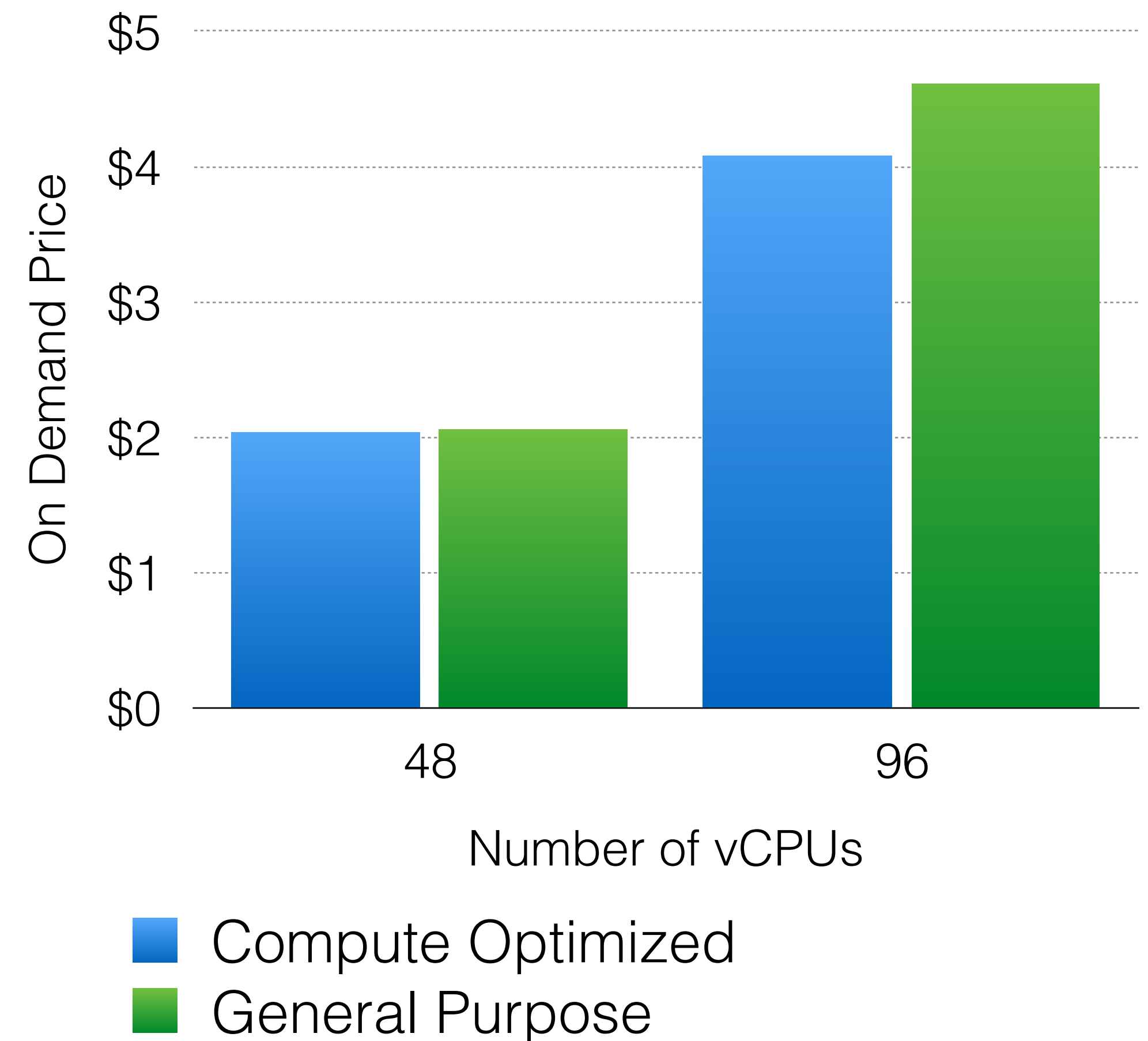
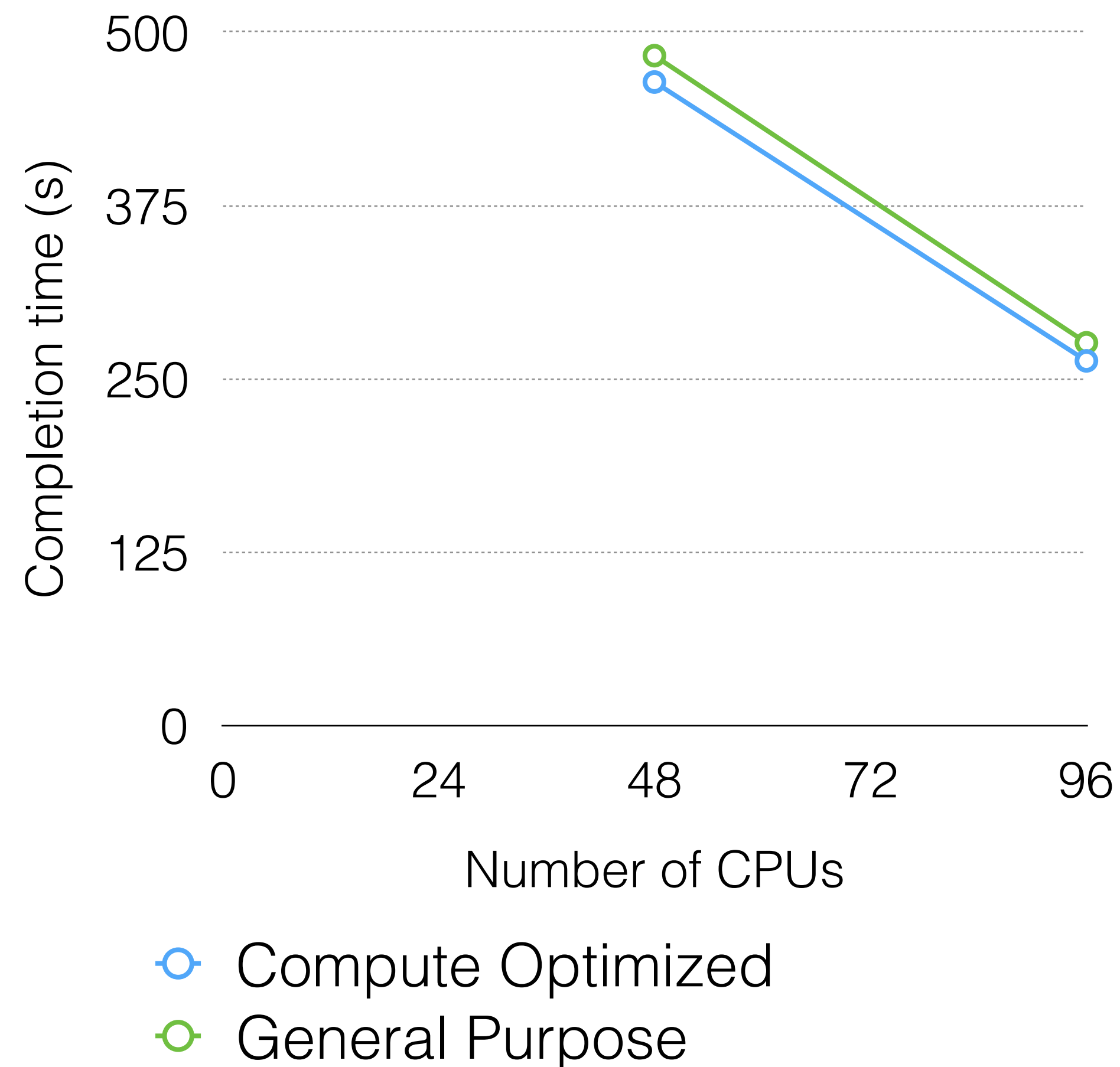
```
# run command
```

```
nohup time bash oo_all.sh &
```

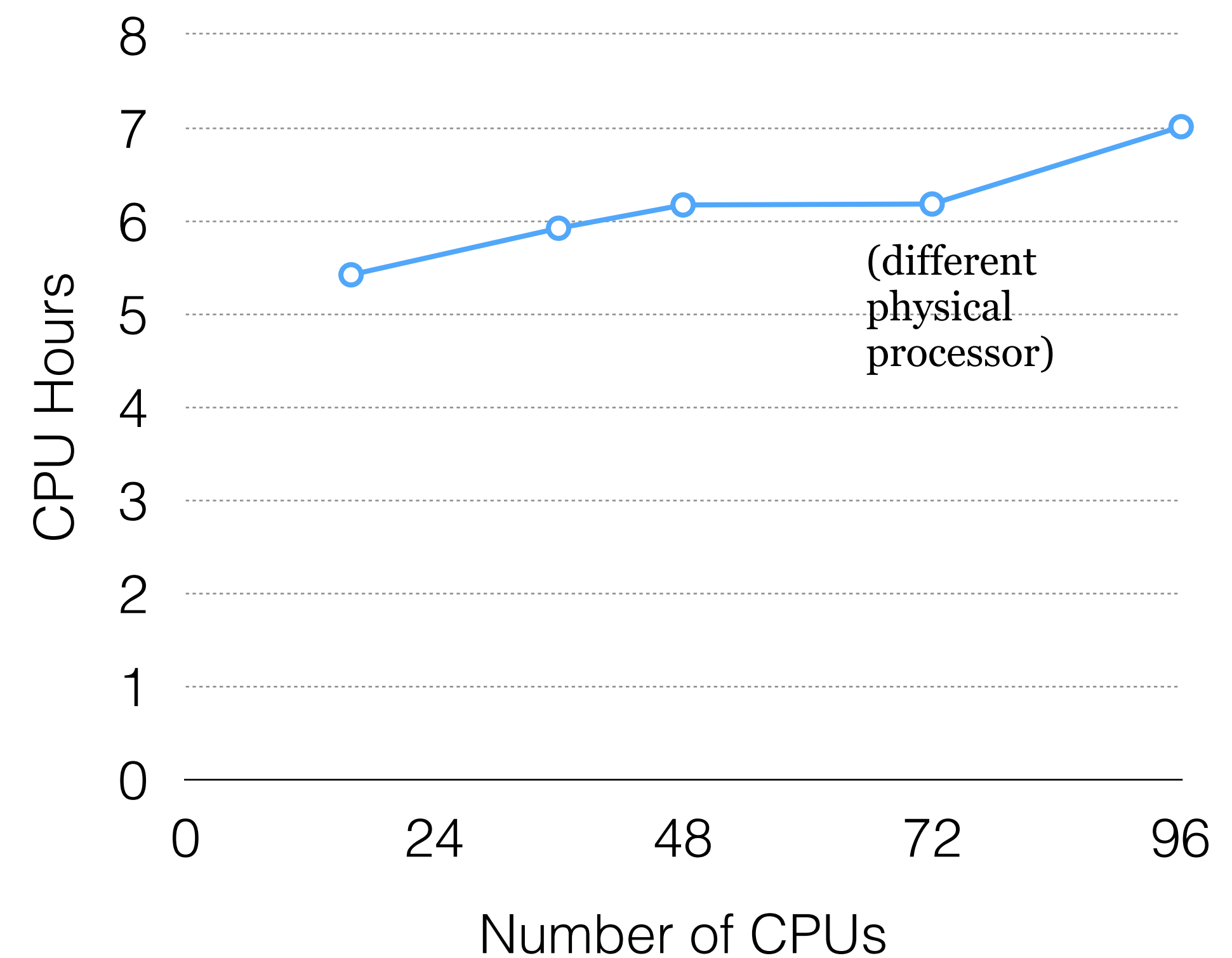
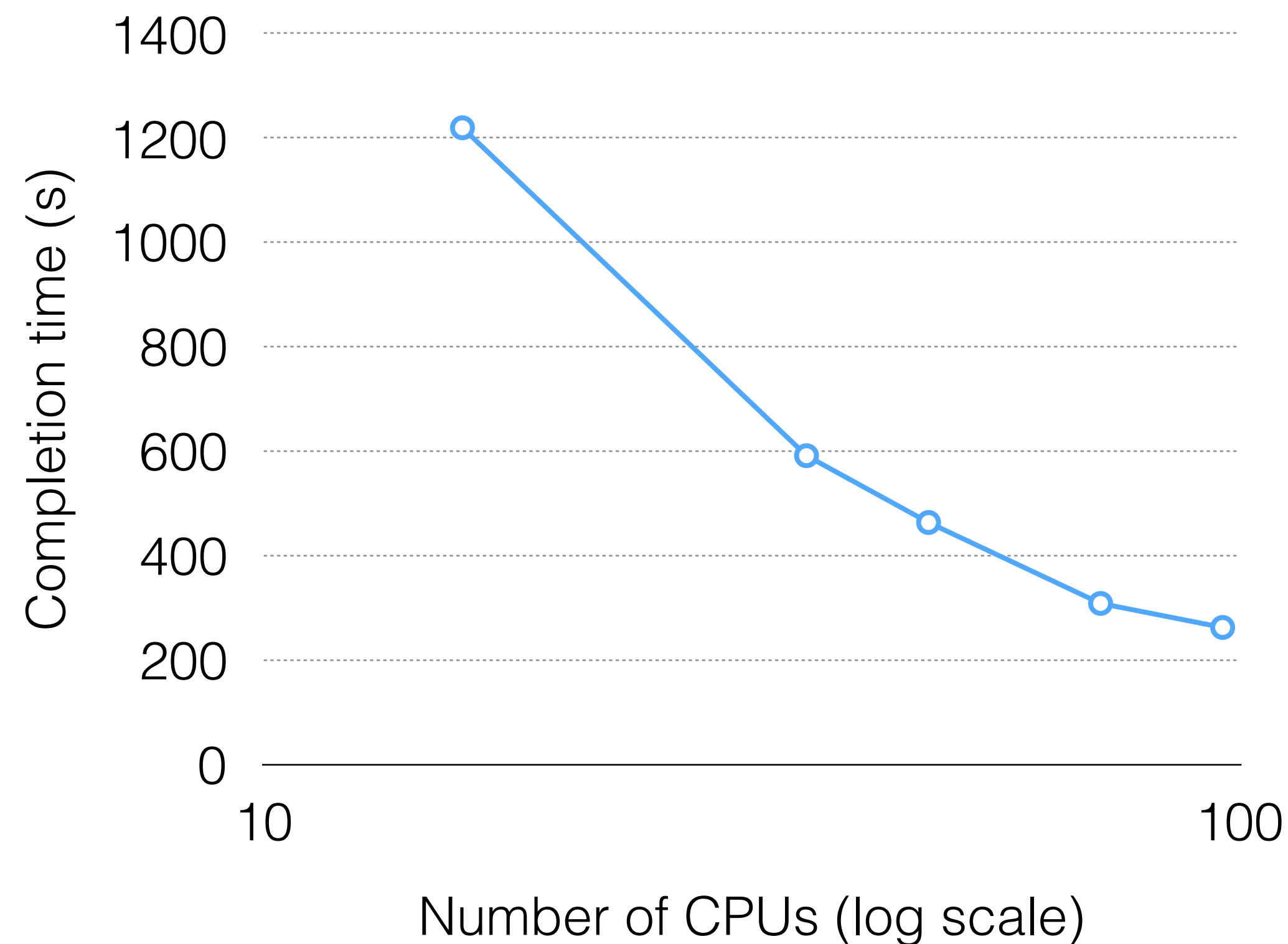
Benchmarks on David's example

Instance Type	vCPU	Physical Prodeessor	Clock Speed	Memory (GiB)	File Storage	Time (s)	On Demand		Spot (18 Aug, 15:00)	
							Rate/hr	Cost	Rate/hr	Cost
c5.24xlarge	96	2nd Gen Xeon Platinum 8175CL	3.0 GHz	192	EBS	263	\$4.08	\$0.298	\$0.91	\$0.066
c5.24xlarge	96	2nd Gen Xeon Platinum 8175CL	3.0 GHz	192	EFS	441	\$4.08	\$0.500	\$0.91	\$0.111
m5.24xlarge	96	Intel Xeon Platinum 8175	3.1 GHz	384	EBS	276	\$4.61	\$0.354	\$0.96	\$0.074
m5d.24xlarge	96	Intel Xeon Platinum 8175	3.1 GHz	384	SSD	278	\$5.42	\$0.419	\$0.96	\$0.074
m5d.24xlarge	96	Intel Xeon Platinum 8175	3.1 GHz	384	EFS	463	\$5.42	\$0.697	\$0.96	\$0.123
c5.18xlarge	72	Intel Xeon Platinum 8124M	3 GHz	144	EBS	309	\$3.06	\$0.263	\$0.80	\$0.069
c5.18xlarge	72	Intel Xeon Platinum 8124M	3 GHz	144	EBS	501	\$3.06	\$0.426	\$0.80	\$0.111
c5.12xlarge	48	2nd Gen Xeon Platinum 8175CL	3.0 GHz	96	EBS	464	\$2.04	\$0.263	\$0.46	\$0.059
c5.12xlarge	48	2nd Gen Xeon Platinum 8175CL	3.0 GHz	96	EFS	638	\$2.04	\$0.362	\$0.46	\$0.082
m5.12xlarge	48	Intel Xeon Platinum 8175	3.1 GHz	192	EBS	483	\$2.06	\$0.276	\$0.54	\$0.072
m5.12xlarge	48	Intel Xeon Platinum 8175	3.1 GHz	192	EFS	665	\$2.06	\$0.380	\$0.54	\$0.100
c5.9xlarge	36	Intel Xeon Platinum 8124M	3 GHz	72	EBS	592	\$1.53	\$0.252	\$0.39	\$0.064
c5.9xlarge	36	Intel Xeon Platinum 8124M	3 GHz	72	EFS	774	\$1.53	\$0.329	\$0.39	\$0.084
c5.4xlarge	16	Intel Xeon Platinum 8124M	3 GHz	32	EBS	1220	\$0.68	\$0.230	\$0.15	\$0.051
c5.4xlarge	16	Intel Xeon Platinum 8124M	3 GHz	32	EFS	1415	\$0.68	\$0.267	\$0.15	\$0.059

Compute optimized instances completed the script in less time and cost less.

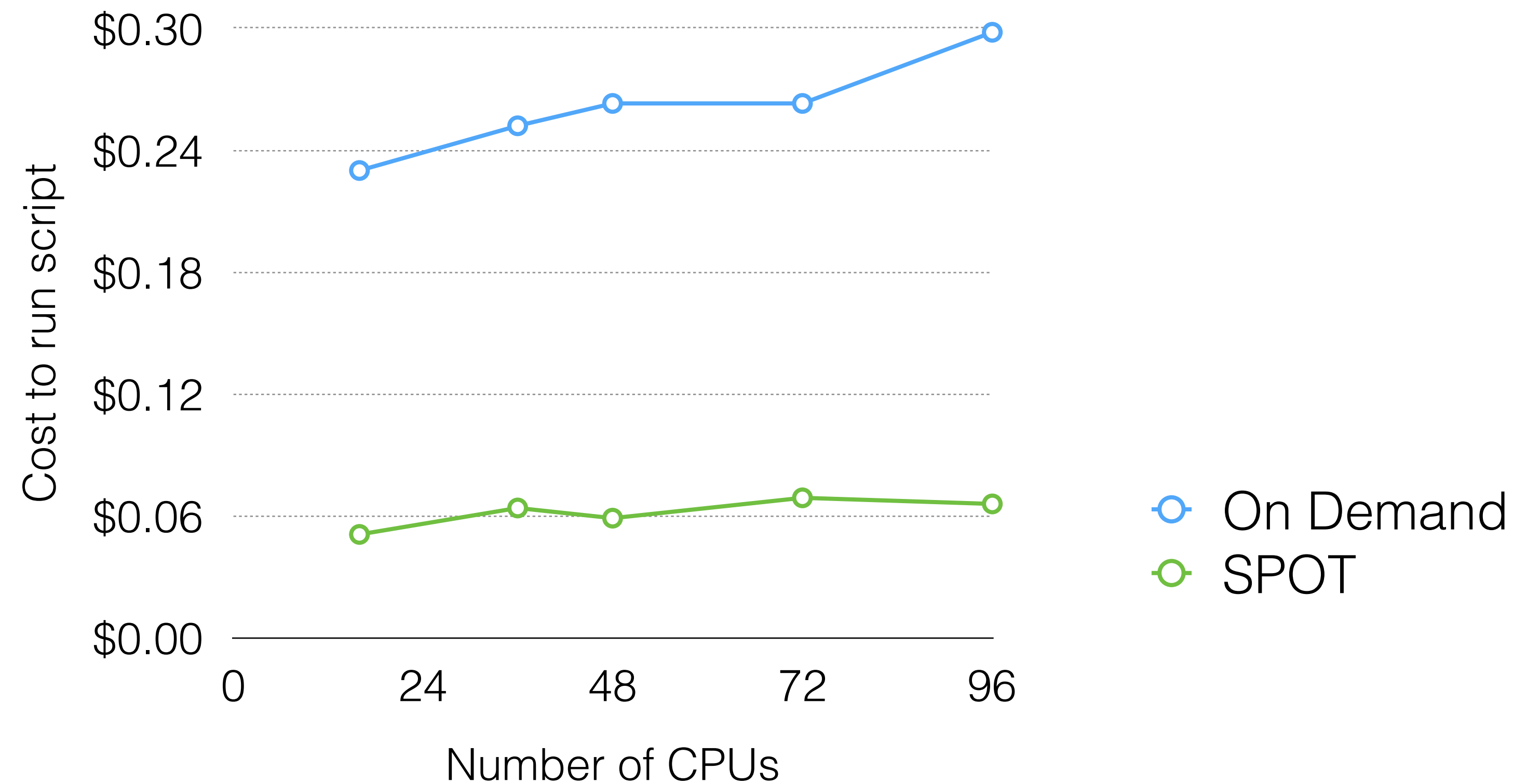


Increasing CPU count has diminishing returns, but for this simulation up to 96 CPUs are still effective.



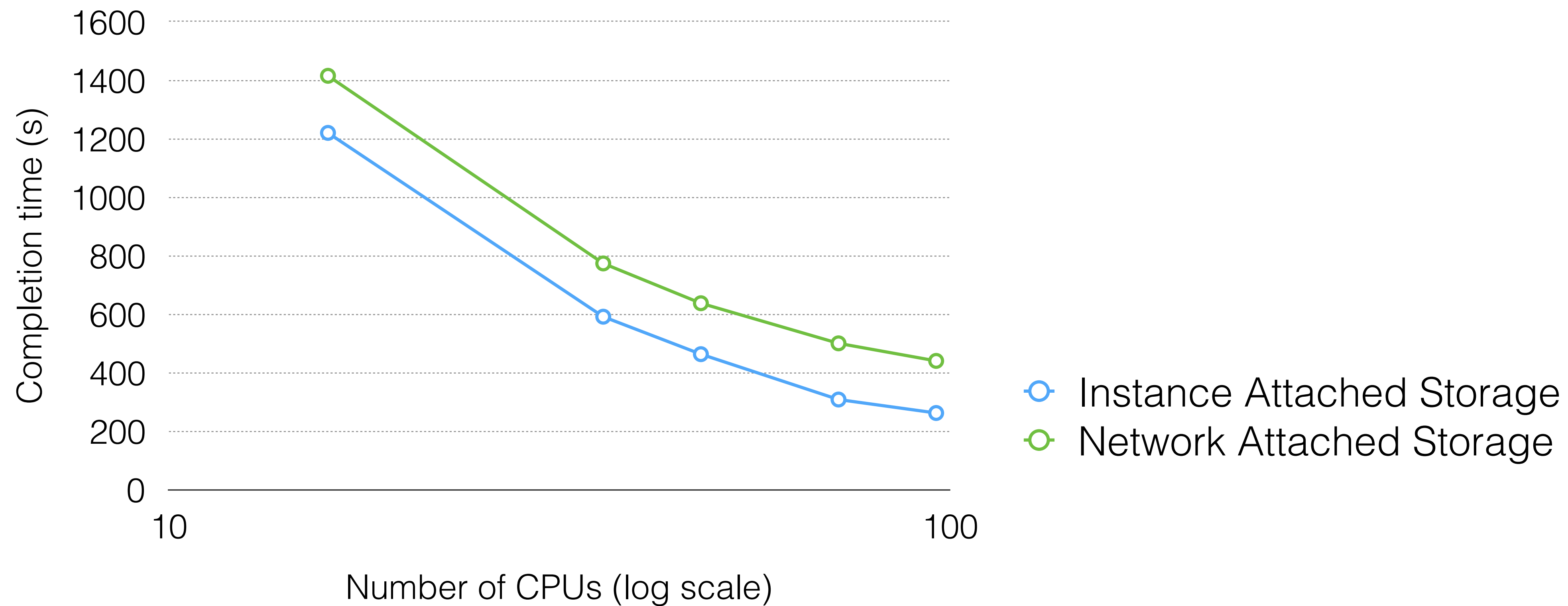
○ Compute Optimized Instances

The simulation cost increases with more vCPUs.



Cost is hourly price time simulation time. This assumes the instance is terminated immediately. Spot prices subject to variability.

Using instance attached storage (EBS) for simulation files was faster than using network attached storage (EFS)



Alarms

- Alarms take an action when the instance usage crosses a threshold.
- For example (and the only reason I use alarms):
 - Terminate the instance when the CPU is below 1% for 10 minutes
- Alarms cost \$0.10 each, though they save money by terminating idle instances (just make sure your results are on or moved to persistent storage).

Instances | EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Instances:sort=instanceId

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Filter by tags and attributes or search by keyword

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	Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public
<input type="checkbox"/>		i-0558a0059aa9097...	t2.micro	us-east-2b	running	2/2 checks ...	None	ec2-18-222-35-37.us-e...	18.222.35.37
<input checked="" type="checkbox"/>		i-0884a292ab5e3d8...	t2.xlarge	us-east-2a	running	2/2 checks ...	None	ec2-13-59-13-222.us-e...	13.59.13.222

Instance: i-0884a292ab5e3d881

Public DNS: ec2-13-59-13-222.us-east-2.compute.amazonaws.com

Description

Status Checks

Monitoring

Tags

CloudWatch alarms: No alarms configured

Create Alarm

CloudWatch metrics: Basic monitoring. [Enable Detailed Monitoring](#)

Showing data for: Last Hour

Below are your CloudWatch metrics for the selected resources (a maximum of 10). Click on a graph to see an expanded view. All times shown are in UTC. [View all](#)

[CloudWatch metrics](#)

CPU Utilization (Percent)

Disk Reads (Bytes)

Disk Read Operations (Operations)

Disk Writes (Bytes)

Disk Write Operations (Operations)

Network In (Bytes)

Network Out (Bytes)

Network Packets In (Count)

Network Packets Out (Count)

Feedback

English (US)

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Click on monitoring tab

Then on Create Alarm button

Instances | EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Instances:sort=instanceId

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Filter by tags and attributes or search by keyword

	Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public
<input type="checkbox"/>		i-0558a0059aa9097...	t2.micro	us-east-2b	running	2/2 checks ...	None	ec2-18-222-35-37.us-e...	18.222.35.37
<input checked="" type="checkbox"/>		i-0884a292ab5e3d8...	t2.xlarge	us-east-2a	running	2/2 checks ...	None	ec2-13-59-13-222.us-e...	13.59.13.222

Instance Details

Describe Instance

CloudWatch Metrics

CPU Utilization Percent

Disk Write Rate

Network Out (Bytes)

Network Packets In (Count)

Network Packets Out (Count)

Create Alarm

You can use CloudWatch alarms to be notified automatically whenever metric data reaches a level you define.

To edit an alarm, first choose whom to notify and then define when the notification should be sent.

☐ Send a notification to: No SNS topics found...

☒ Take the action:

- Recover this instance
- Stop this instance
- Terminate this instance
- Reboot this instance

AWS will use the existing Service Linked Role to perform this EC2 action.
[Learn more.](#)
AWSServiceRoleForCloudWatchEvents (show IAM policy document)

Whenever: Average of CPU Utilization

Is: < 0.5 Percent

For at least: 3 consecutive period(s) of 5 Minutes

Name of alarm: awsec2-i-0884a292ab5e3d881-High-CPU-Utiliz

Cancel | Create Alarm

Feedback

English (US)

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Alarms cost \$0.10 each.

They save money by terminating idle instances (just make sure your results are on or moved to persistent storage).

Download Results

- If you used an alarm to terminate your instance, you'll need to launch another instance to get your results.
- Use scp (Mac/Linux) or pscp (Windows) to download your result.

```
scp -i aws_ohio.pem -r ec2-user@18.222.35.37:~/efs/my_model/results/ .
```

```
pscp -i aws_ohio.ppk -r ec2-user@18.222.35.37:~/efs/my_model/results/ .
```

copy this

to here

Downloading Results

#These commands are run locally.

download results file

```
scp -i ~/aws_ohio.pem -r ec2-user@18.222.35.37:~/efs/example_noResults/result .
```

Terminate Instance

- When you're done, you terminate your instance
- *Not much else to say, this one is pretty self explanatory.*

Instances | EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Instances:sort=instanceState

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Filter by tags and attributes or search

1 to 2 of 2

Name	Instance ID	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public
	i-06db84b469e3		running	2/2 checks ...	None	ec2-18-218-51-41.us-e...	18.218.51.4
	i-0fa6727b0599802de		running	2/2 checks ...	None	ec2-3-17-176-79.us-ea...	3.17.176.79

Instance: i-0fa6727b0599802de Public DNS: ec2-3-17-176-79.us-east-2.compute.amazonaws.com

Description Status Checks Monitoring Tags

Instance ID	i-0fa6727b0599802de	Public DNS (IPv4)	ec2-3-17-176-79.us-east-2.compute.amazonaws.com
Instance state	running	IPv4 Public IP	3.17.176.79
Instance type	c5.4xlarge	IPv6 IPs	-
Elastic IPs		Private DNS	ip-172-31-13-185.us-east-2.compute.internal
Availability zone	us-east-2a	Private IPs	172.31.13.185
Security groups	Basic: view inbound rules. view outbound rules	Secondary private IPs	
Scheduled events	No scheduled events	VPC ID	vpc-fe0a3097
AMI ID	RadianceWorkshop (ami-0a1c68afad094b151)	Subnet ID	subnet-4b494322
Platform	-	Network interfaces	eth0
IAM role	-	Source/dest. check	True
Key pair name	aws_ohio	T2/T3 Unlimited	-
Owner	885639356958	EBS-optimized	True
Launch time	August 18, 2019 at 6:02:55 PM UTC-7 (2 hours)	Root device type	ebs
Termination protection	False	Root device	/dev/xvda
Lifecycle	spot	Block devices	/dev/xvda
Monitoring	basic	Elastic Graphics ID	-
Alarm status	None	Elastic Inference accelerator ID	-
Kernel ID	-	Capacity Reservation	-
RAM disk ID	-	Capacity Reservation Settings	Open
Placement group	-		

Feedback English (US)

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Possibly the easiest step.

Invoice your client

- Activate tags for cost tracking
- Be diligent about tagging resources (this is the hard part)
 - Resources can NOT be tagged retroactively
- Use cost explorer to aggregate costs for each project

EC2 Management Console

https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Home:

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Resources

You are using the following Amazon EC2 resources in the US East (Ohio) region:

2 Running Instances

0 Elastic IPs

0 Dedicated Hosts

2 Snapshots

2 Volumes

0 Load Balancers

2 Key Pairs

4 Security Groups

0 Placement Groups

Learn more about the latest in AWS Compute from AWS re:Invent by viewing the [EC2 Videos](#).

Create Instance

To start using Amazon EC2 you will want to launch a virtual server, known as an Amazon EC2 instance.

Launch Instance

Note: Your instances will launch in the US East (Ohio) region

Service Health

Service Status:

US East (Ohio):

Availability Zone Status:

us-east-2a:

us-east-2b:

us-east-2c:

Service Health Dashboard

Scheduled Events

US East (Ohio):

No events

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My Service Quotas

My Billing Dashboard

My Security Credentials

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Contact Us

AWS Marketplace

Find free software trial products in the AWS Marketplace from the [EC2 Launch Wizard](#). Or try these popular AMIs:

Barracuda CloudGen Firewall for AWS - PAYG

By Barracuda Networks, Inc.

Rating

Starting from \$0.60/hr or from \$4,599/yr (12% savings) for software + AWS usage fees

View all Infrastructure Software

Matillion ETL for Amazon Redshift

By Matillion

Rating

Starting from \$1.37/hr or from \$9,950/yr (17% savings) for software + AWS usage fees

View all Business Software

Trend Micro Deep Security

By Trend Micro

Rating

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Getting Started with AWS Billing & Cost Management

- Manage your costs and usage using [AWS Budgets](#)
- Visualize your cost drivers and usage trends via [Cost Explorer](#)
- Dive deeper into your costs using the [Cost and Usage Reports](#) with [Athena integration](#)
- Learn more:** Check out the [AWS What's New webpage](#)

Do you have Reserved Instances (RIs)?

- Access the RI Utilization & Coverage reports—and RI purchase recommendations—via [Cost Explorer](#).

Spend Summary

Cost Explorer

Welcome to the AWS Billing & Cost Management console. Your last month, month-to-date, and month-end forecasted costs appear below.

Current month-to-date balance for August 2019

\$19.01

\$28

\$21

\$14

\$7

\$0

Last Month
(July 2019)

Month-to-Date
(August 2019)

Forecast
(August 2019)

\$8.32

\$19.01

\$26.41

Important Information about these Costs

Top Free Tier Services by Usage

View all

Month-to-Date Spend by Service

Bill Details

The chart below shows the proportion of costs spent for each service you use.

\$0

EC2

\$17.78

EFS

\$0.94

CloudWatch

\$0.29

DataTransfer

\$0.00

Other Services

\$0.00

Tax

\$0.00

Total

\$19.01

Click cost allocation tags

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Cost Allocation Tags

AWS-Generated Cost Allocation Tags

A *resource created by tag* is an AWS-generated cost allocation tag containing resource creator information that is automatically applied to the resources that you create. This feature is only available in the Billing & Cost Management console, and will not appear anywhere else in the AWS console, including the Tag Editor.

Activate

User-Defined Cost Allocation Tags

✔ Finished loading tags.

Activating tags for cost allocation tells AWS that the associated cost data for these tags should be made available throughout the billing pipeline. Once activated, cost allocation tags can be used as a dimension of grouping and filtering in Cost Explorer, as well as for refining AWS budget criteria.

Activate

Deactivate

Undo

Filter: All

Search for a tag key...

Tags per page: 100

<input type="checkbox"/>	Tag key*	Status
<input checked="" type="checkbox"/>	project	Active
<input type="checkbox"/>		Inactive
<input type="checkbox"/>	Project	Inactive
<input type="checkbox"/>	aws:ec2spot:fleet-request-id	Inactive

Select the tag(s) to track for cost allocations

Activate them

Click cost explorer button

Cost Reports

https://console.aws.amazon.com/cost-reports/home#/dashboard

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AWS Cost Management

Month-to-date costs

\$18.99

↑ 330%
Over last month

Forecasted month end costs

\$42.26

↑ 408%
Over last month

August trends

Service usage

Amazon Elastic Compute Cloud - Compute costs are up \$14.00 (623%)

AmazonCloudWatch costs are up \$0.01 (5%)

Account usage

Andrew McNeil (885639356958) costs are up \$14.58 (330%)

Region usage

us-west-2 costs are up \$3.95 (89%)

Daily unblended costs (\$)

Explore costs

Date	Cost (\$)
Jul-01	0.2
Jul-02	0.2
Jul-03	0.2
Jul-04	0.2
Jul-05	0.2
Jul-06	0.2
Jul-07	0.2
Jul-08	0.2
Jul-09	0.2
Jul-10	0.2
Jul-11	0.2
Jul-12	0.2
Jul-13	0.2
Jul-14	0.2
Jul-15	0.2
Jul-16	0.2
Jul-17	0.2
Jul-18	0.2
Jul-19	0.2
Jul-20	0.2
Jul-21	0.2
Jul-22	0.2
Jul-23	0.2
Jul-24	0.2
Jul-25	0.2
Jul-26	0.2
Jul-27	0.2
Jul-28	0.2
Jul-29	0.2
Jul-30	0.2
Jul-31	0.5
Aug-01	1.3
Aug-02	0.9
Aug-03	0.2
Aug-04	0.2
Aug-05	0.3
Aug-06	0.3
Aug-07	0.3
Aug-08	0.3
Aug-09	1.3
Aug-10	2.4
Aug-11	0.4
Aug-12	0.7
Aug-13	0.7
Aug-14	0.7
Aug-15	1.8
Aug-16	1.6
Aug-17	4.5

Recently accessed reports

View all reports

Report name	Report type	Time granularity	Last accessed
Daily costs	Cost & Usage	Daily	5 days ago

Viewing 1 of 7 total reports

Feedback

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Click explore costs

Bask in the glory!



Andy's Cloud College

THIS DIPLOMA IS PRESENTED TO

You

For Clouding Along During the Cloud Course

21 August 2019

