

# Amazon Web Services (AWS)

**An Introduction to cloud computing**

Danny Lumian | Frank Burkholder

galvanize

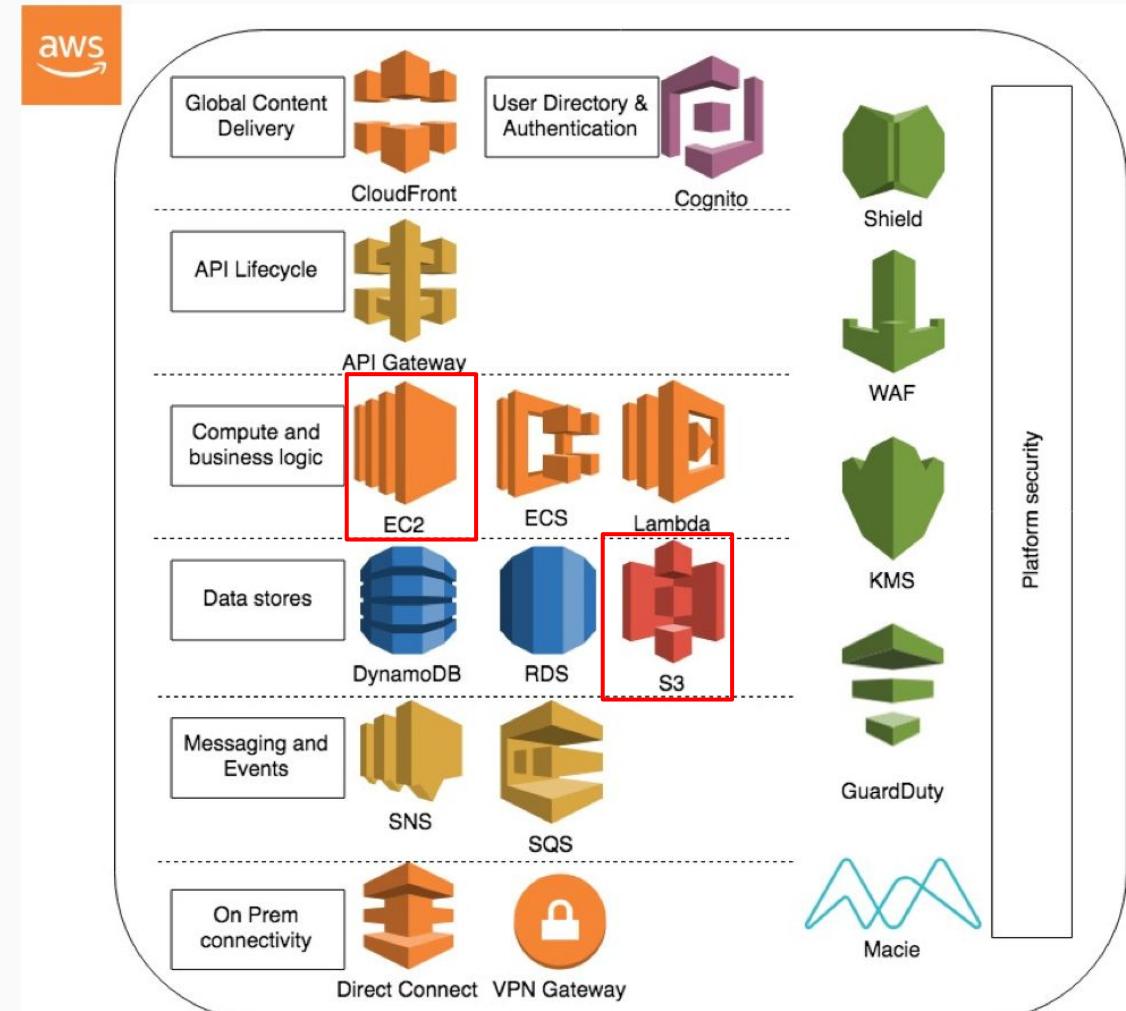
# Objectives

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- Introduction to AWS
- AWS
  - Check Credits
  - Create IAM role
  - Set up S3 & EC2 (console)
- Morning Individual Assignment
- AWS CLI
- Boto3
- Afternoon pair assignment

# AWS Ecosystem

- AWS offers many products for cloud computing
- Today will focus on:
  - S3 (data storage)
  - EC2 (computing)
- Alternatives to AWS:
  - [Google Cloud](#)
  - [Heroku](#)
  - [OpenShift](#)
  - [Elastic Map Reduce](#)
- Details will vary but important to understand the concepts of remote computing
  - Access & Permissions
  - File transfer & data storage



From: <https://aws.amazon.com/blogs/enterprise-strategy/offer-developer-apis-to-your-partners-and-customers/>

# Amazon Web Services (AWS)

- **Cloud services platform**
  - The delivery of computing services-servers, storage, databases, networking, software, analytics & more-over the internet
- **Advantages:** accessibility, dynamic scaling, no need for hardware or support staff, small upfront cost
- **Disadvantages:** security (someone else owns the server), recurring cost

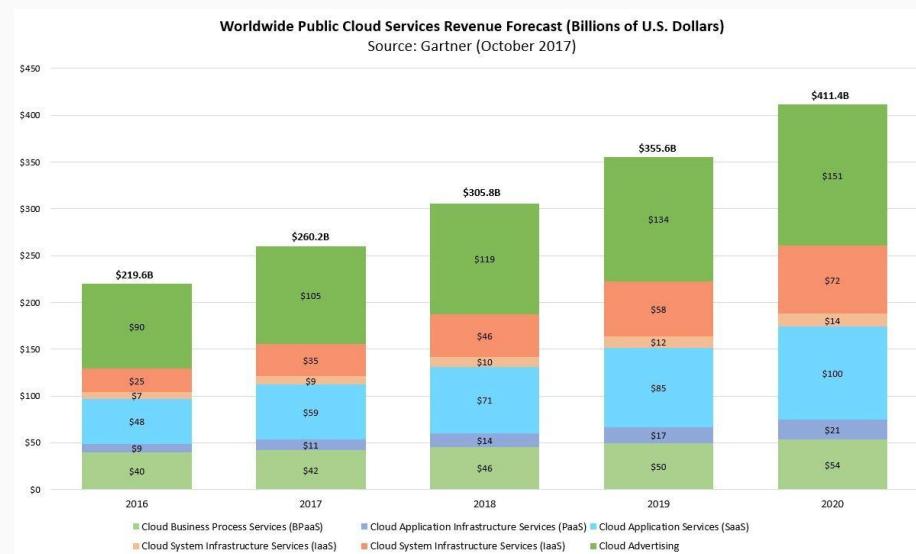
[History of AWS](#): First widely accessible cloud computing infrastructure service

- 2000: Amazon struggled with scaling
  - Started building internal solutions
  - Realized solution could be leveraged by others
- 2002: AWS launched
- 2006: Elastic Compute Cloud
- [AWS continues to grow and adapt](#)

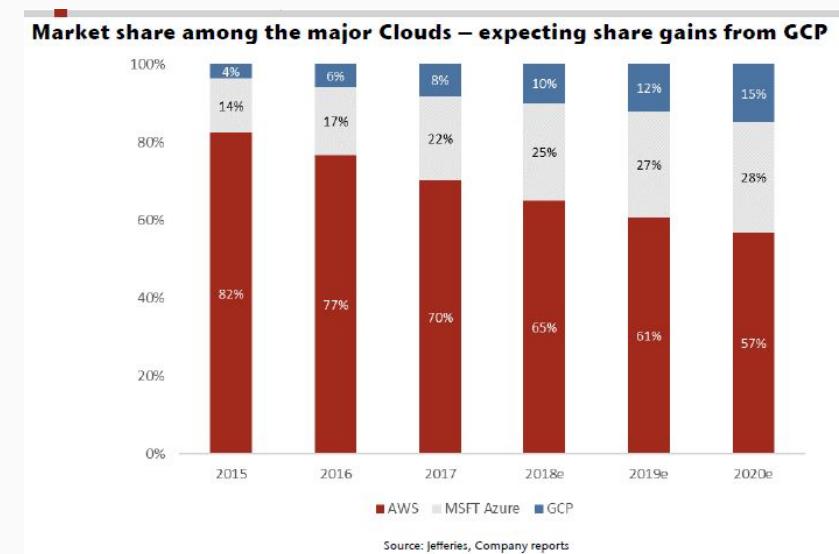
# Cloud Services: Value and Market Shares

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[Forbes](#): Expected value of over 400 billion by 2020



[ZDNet](#): AWS retains dominate position for CS



# Important Links for AWS

- [AWS Console](#): Hub for AWS information
  - Note: Can sign in with IAM role (limited access) or administrative/root account (check billing and payment methods)
- [IAM Roles](#)
- [EC2 prices](#): prices for available instances/hr
- [Documentation](#)
- [Information and Tutorials](#)
- [Review of Storage Types](#)

# S3 and EC2

- Simple Storage Service ([S3](#))
  - Long-term bid data storage
  - Used in DSI to store data, final models and results
  - [Creating a bucket](#), [Pricing](#), [FAQs](#)
- Elastic Cloud Compute ([EC2](#))
  - Provides secure, resizable compute capacity in the cloud
  - Used in DSI to train models, deploy applications (Flask web apps, databases)
  - If training neural net, will want a GPU instance
  - Use a Spark cluster (on Amazon Elastic Map Reduce) for distributed computing
  - [Instance types](#), [Launching EC2](#), [Pricing](#), [FAQs](#)

# Workflow

1. Upload/access data on S3
2. Use [pandas](#) or [boto](#) to pull a subset of the data to local machine
  - a. Note: pandas has option for S3 bucket URL, with chunksize option
3. Develop script to run subset of data locally
4. Start EC2 instance (with proper role and permissions)
5. Upload script to EC2 ([scp](#) or [git clone](#))
6. Run full dataset on EC2
  - a. Ideally data can fit in Elastic Block Storage ([EBS](#)), otherwise read from S3 bucket
7. Write results to S3 ([boto3](#))
8. Terminate EC2 instance and EBS

# Accessing Console and Checking for Credits

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# Overview: Account Balance

1. Log in (as root user) at: <https://aws.amazon.com/>
2. Select 'Services' (top left) and 'Billing' from drop down
3. Select 'Credits' navigation bar on left
4. Should see a table at bottom of page with credits

# Step 1: Sign in

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aws

**Root user sign in ⓘ**

Email: dlumian@gmail.com

Password [Forgot password?](#)

\*\*\*\*\*

**Sign in**

[Sign in to a different account](#)

[Create a new AWS account](#)

**AWS App Mesh**

Application level networking  
for all your services



aws

**About Amazon.com Sign In**

Amazon Web Services uses information from your Amazon.com account to identify you and allow access to Amazon Web Services. Your use of this site is governed by our Terms of Use and Privacy Policy linked below. Your use of Amazon Web Services products and services is governed by the AWS Customer Agreement linked below unless you have entered into a separate agreement with Amazon Web Services or an AWS Value Added Reseller to purchase these products and services. The AWS Customer Agreement was updated on March 31, 2017. For more information about these updates, see [Recent Changes](#).

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English ▾

# Step 2: Navigate to Billing

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The screenshot shows the AWS Management Console navigation bar with a red box highlighting the 'Services' dropdown menu. Below the menu, a search bar and two sorting options ('Group' and 'A-Z') are visible. The main content area displays a grid of AWS service icons and names. The 'Billing' service is highlighted with a red box in the 'Compute' section of the first row. Other services listed include Lightsail, ECR, ECS, EKS, Lambda, Batch, Elastic Beanstalk, and Serverless Application Repository under Compute; S3, EFS, FSx, S3 Glacier, Storage Gateway, and AWS Backup under Storage; RDS, DynamoDB, ElastiCache, Neptune, Amazon Redshift, and Amazon DocumentDB under Database; AWS Migration Hub, Application Discovery Service, Database Migration Service, Server Migration Service, AWS Transfer for SFTP, and Snowball under Migration & Transfer; AWS RoboMaker, Amazon Managed Blockchain, Satellite, Ground Station, AWS Organizations, CloudWatch, CloudFormation, CloudTrail, AWS Auto Scaling, CloudFormation, Config, OpsWorks, Service Catalog, Systems Manager, Trusted Advisor, Managed Services, Control Tower, AWS License Manager, AWS Well-Architected Tool, Personal Health Dashboard under Management & Governance; Analytics, Athena, EMR, CloudSearch, Elasticsearch Service, Kinesis, QuickSight, Data Pipeline, AWS Glue, MSK under Analytics; Business Applications, Alexa for Business, Amazon Chime, WorkMail under Business Applications; End User Computing, WorkSpaces, AppStream 2.0, WorkDocs, WorkLink under End User Computing; 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 under Security, Identity, & Compliance; 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 under Internet Of Things; Game Development, Amazon GameLift under Game Development; AWS Amplify, Mobile Hub, AWS AppSync, Device Farm under Mobile. A sidebar on the right contains sections for 'on the go', 'Backup & Restore with Amazon', 'Cloud at a Summit', 'Run Containers with AWS Fargate', and a feedback form.

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

Group A-Z

Billing

Compute

Robotics

Analytics

Business Applications

Storage

Management & Governance

Security, Identity, & Compliance

Database

Migration & Transfer

Media Services

Mobile

History

Console Home

AWS Cost Explorer

EC2

Elastic Beanstalk

S3

Lightsail

ECR

ECS

EKS

Lambda

Batch

Elastic Beanstalk

Serverless Application Repository

CloudWatch

Amazon Managed Blockchain

Satellite

Ground Station

AWS Organizations

CloudFormation

Config

OpsWorks

Service Catalog

Systems Manager

Trusted Advisor

Managed Services

Control Tower

AWS License Manager

AWS Well-Architected Tool

Personal Health Dashboard

Elastic Transcoder

Kinesis Video Streams

MediaConnect

MediaConvert

MediaLive

MediaPackage

IoT Core

Amazon FreeRTOS

IoT 1-Click

IoT Analytics

IoT Device Defender

IoT Device Management

IoT Events

IoT Greengrass

IoT SiteWise

IoT Things Graph

Amazon GameLift

AWS Amplify

Mobile Hub

AWS AppSync

Device Farm

WorkSpaces

AppStream 2.0

WorkDocs

WorkLink

WorkMail

Alexa for Business

Amazon Chime

WorkMail

WorkLink

End User Computing

WorkSpaces

AppStream 2.0

WorkDocs

WorkLink

Amazon Macie

AWS Single Sign-On

Certificate Manager

Key Management Service

CloudHSM

Directory Service

WAF & Shield

Artifact

Security Hub

on the go

Manage your AWS management Console using the AWS Console

Backup & Restore with Amazon

are building backup & restore solutions

Learn more

Cloud at a Summit

Join the cloud computing community

boration, and learn about

Run Containers with AWS Fargate

Run your containers without having to

Learn more

your relational database in the

to tell us about your experience with

Management Console.

close

▲ close

Amazon Redshift

CloudTrail

Amazon Chime

# Step 3: Select Credits

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AWS Services Resource Groups 🔍

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**Home**

Cost Management

Cost Explorer

Budgets

Cost & Usage Reports

Cost allocation tags

Billing

Bills

Payment history

**Credits**

Preferences

Billing preferences

Payment methods

Consolidated billing

Tax settings

**Billing & Cost Management Dashboard**

**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 March 2019*

**\$0.00**

\$8  
\$6  
\$4  
\$2  
\$0

Last Month (February 2019) Month-to-Date (March 2019) Forecast (March 2019)

No Amount Due

**Month-to-Date Spend by Service** [Bill Details](#)

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

\$0

# Step 4: Check Balance

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AWS Services Resource Groups ⚡ 🔔 dlumian Global Support

Home Cost Management

Cost Explorer Budgets

Cost & Usage Reports Cost allocation tags

Billing Bills Payment history

**Credits**

Preferences Billing preferences Payment methods Consolidated billing Tax settings

## Credits

Please enter your code below to redeem your credits.

Promo Code

Security Check  Refresh Image

Please type the characters as shown above

By clicking "Redeem" you indicate that you have read and agree to the terms of the AWS Promotional Credit Terms & Conditions located [here](#).

**Redeem**

The table below displays all AWS credits redeemed by your account. Credits are automatically applied to charges associated with qualifying AWS service usage. Please note that the values for used and remaining credit amounts are updated each month when your invoice is finalized.

Expiration Date	Credit Name	Amount Used	Amount Remaining	Applicable Products
11/30/2019	AWS Activate - Galvanize SF Education	\$235.08	\$764.92	<a href="#">See complete list</a>

Total Credit Amount Remaining (as of 03/01/2019): \$764.92

# Creating IAM Role

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# IAM Role

- [Instructions](#) linked on [Welcome Page](#)
- Search console for IAM
- Click Users (left side)
- Click Add User
- Enter User Name
- Select 'Programmatic access'
- Click 'Next: Permissions'
- Select 'Attach existing policies directly'
- Select 'AdministratorAccess'
- Select 'Next: Tags'
- Select 'Next: Review'
- Select 'Create User'
- Download Credentials
- Can enable (limited) [console access](#)
- Sign in using root
- Select Users
- Select user (just created)
- Select Security Credentials
- Create console password
  - Should be different than root password
- Note Account Id
- Log out of console
- At login page
  - Select different account
- Sign in with account id, alias and psw
- Should not have access to Billing

# Instance Limits

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# Instance Limits

- AWS has limits on the number/amount of resources you can use
- Increases to these limits can be requested
- Access to GPU EC2 instances will have to be requested

# Checking Instance Limits

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Servi<sup>ces</sup> ▾ Resource Groups ▾ 🔍

dlumian ▾ Ohio ▾ Support ▾

EC2 Dashboard

Events

Tags

Reports

Limits

Instances

Launch Templates

Spot Requests

Reserved Instances

Dedicated Hosts

Capacity Reservations

AMIs

Bundle Tasks

Volumes

Snapshots

Lifecycle Manager

Security Groups

Elastic IPs

Placement Groups

Key Pairs

Network Interfaces

Load Balancers

Target Groups

## EC2 Service Limits

Amazon EC2 provides different resources that you can use, such as instances and volumes. When you create your AWS account, AWS sets limits for these resources on a per-region basis. This page lists your EC2 service limits in US East (Ohio).

### Instance Limits

Name	Current Limit	Action
Running On-Demand EC2 instances ⓘ	20	<a href="#">Request limit increase</a>
Running On-Demand a1.2xlarge instances	3	<a href="#">Request limit increase</a>
Running On-Demand a1.4xlarge instances	3	<a href="#">Request limit increase</a>
Running On-Demand a1.large instances	3	<a href="#">Request limit increase</a>
Running On-Demand a1.medium instances	3	<a href="#">Request limit increase</a>
Running On-Demand a1.xlarge instances	3	<a href="#">Request limit increase</a>
Running On-Demand c4.2xlarge instances	5	<a href="#">Request limit increase</a>
Running On-Demand c4.4xlarge instances	1	<a href="#">Request limit increase</a>
Running On-Demand c4.8xlarge instances	1	<a href="#">Request limit increase</a>
Running On-Demand c4.large instances	5	<a href="#">Request limit increase</a>
Running On-Demand c4.xlarge instances	5	<a href="#">Request limit increase</a>
Running On-Demand c5.18xlarge instances	0	<a href="#">Request limit increase</a>
Running On-Demand c5.2xlarge instances	0	<a href="#">Request limit increase</a>
Running On-Demand c5.4xlarge instances	0	<a href="#">Request limit increase</a>
Running On-Demand c5.9xlarge instances	0	<a href="#">Request limit increase</a>
Running On-Demand c5.large instances	5	<a href="#">Request limit increase</a>
Running On-Demand c5.xlarge instances	2	<a href="#">Request limit increase</a>
Running On-Demand r5d.18xlarge instances	0	<a href="#">Request limit increase</a>

Feedback English (US)

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# S3 Bucket

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# Overview: S3 Bucket

1. From console, select 'S3'
2. Select 'Create New Bucket'
3. Name Bucket
4. Configure options (leave defaults)
5. Set Permissions (leave defaults)
6. Review

# Step 1: Locate S3

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## AWS Management Console

**AWS services**

**Find Services**  
You can enter names, keywords or acronyms.

**Recently visited services**

[S3](#)   [Billing](#)

**All services**

<a href="#">Compute</a> <ul style="list-style-type: none"><li><a href="#">EC2</a></li><li><a href="#">Lightsail</a></li><li><a href="#">ECR</a></li><li><a href="#">ECS</a></li><li><a href="#">EKS</a></li><li><a href="#">Lambda</a></li><li><a href="#">Batch</a></li><li><a href="#">Elastic Beanstalk</a></li><li><a href="#">Serverless Application Repository</a></li></ul>	<a href="#">Developer Tools</a> <ul style="list-style-type: none"><li><a href="#">CodeStar</a></li><li><a href="#">CodeCommit</a></li><li><a href="#">CodeBuild</a></li><li><a href="#">CodeDeploy</a></li><li><a href="#">CodePipeline</a></li><li><a href="#">Cloud9</a></li><li><a href="#">X-Ray</a></li></ul>	<a href="#">Machine Learning</a> <ul style="list-style-type: none"><li><a href="#">Amazon SageMaker</a></li><li><a href="#">Amazon Comprehend</a></li><li><a href="#">AWS DeepLens</a></li><li><a href="#">Amazon Lex</a></li><li><a href="#">Machine Learning</a></li><li><a href="#">Amazon Polly</a></li><li><a href="#">Rekognition</a></li><li><a href="#">Amazon Transcribe</a></li><li><a href="#">Amazon Translate</a></li><li><a href="#">Amazon Personalize</a></li><li><a href="#">Amazon Forecast</a></li><li><a href="#">Amazon Textract</a></li></ul>	<a href="#">Mobile</a> <ul style="list-style-type: none"><li><a href="#">AWS Amplify</a></li><li><a href="#">Mobile Hub</a></li><li><a href="#">AWS AppSync</a></li><li><a href="#">Device Farm</a></li></ul>
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			<a href="#">Customer Engagement</a> <ul style="list-style-type: none"><li><a href="#">Amazon Connect</a></li><li><a href="#">Pinpoint</a></li><li><a href="#">Simple Email Service</a></li></ul>

**Access resources on the go**

Access the Management Console using the AWS Console Mobile App. [Learn more](#)

**Explore AWS**

**AWS Marketplace**  
Find, buy, and deploy popular software products that run on AWS. [Learn more](#)

**Amazon RDS**  
Set up, operate, and scale your relational database in the cloud. [Learn more](#)

**Run Serverless Containers with AWS Fargate**  
AWS Fargate runs and scales your containers without having to manage servers or clusters. [Learn more](#)

**Amazon SageMaker**  
Machine learning for every developer and data scientist. [Learn more](#)

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# Step 2: Create New Bucket

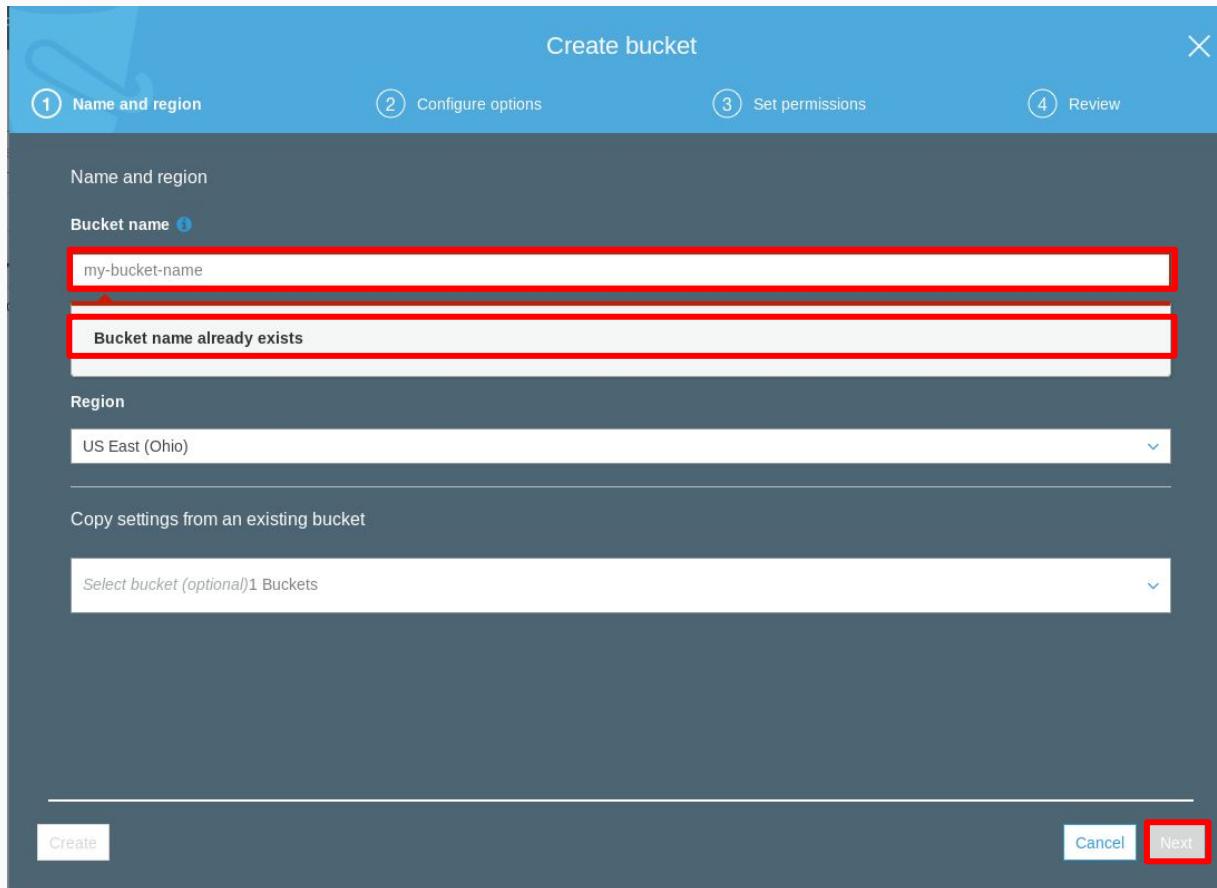
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The screenshot shows the AWS S3 console interface. At the top, there's a banner for 'AWS Transfer for SFTP'. Below it, the main header includes 'Services', 'Resource Groups', and user information ('danny @ 3457-8654-8326'). The left sidebar has sections for 'Amazon S3', 'Buckets' (which is selected), 'Public access settings for this account', and 'Feature spotlight'. The main content area is titled 'S3 buckets' and features a search bar ('Search for buckets') and a button ('+ Create bucket'). There are also buttons for 'Edit public access settings', 'Empty', and 'Delete'. A summary at the bottom right shows '1 Buckets', '1 Regions', and the creation date 'Nov 27, 2018 1:04:32 PM GMT-0700'. The table lists one bucket named 'emotion-face-classifier'.

Bucket name	Access	Region	Date created
emotion-face-classifier	Bucket and objects not public	US East (Ohio)	Nov 27, 2018 1:04:32 PM GMT-0700

# Step 3: Select Unique Bucket Name

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# Step 4: Configure Options

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Create bucket

1 Name and region      2 Configure options      3 Set permissions      4 Review

**Properties**

**Versioning**  
 Keep all versions of an object in the same bucket. [Learn more ↗](#)

**Server access logging**  
 Log requests for access to your bucket. [Learn more ↗](#)

**Tags**  
You can use tags to track project costs. [Learn more ↗](#)

Key Value  
[+ Add another](#)

**Object-level logging**  
 Record object-level API activity using AWS CloudTrail for an additional cost. See [CloudTrail pricing ↗](#) or [learn more ↗](#)

**Default encryption**  
 Automatically encrypt objects when they are stored in S3. [Learn more ↗](#)

► Advanced settings

**Management**

Previous Next

# Step 5: Set Permissions

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Create bucket X

1 Name and region    2 Configure options    3 Set permissions 4 Review

Note: You can grant access to specific users after you create the bucket.

**Public access settings for this bucket**

Use the Amazon S3 block public access settings to enforce that buckets don't allow public access to data. You can also configure the Amazon S3 block public access settings at the account level. [Learn more](#)

**Manage public access control lists (ACLs) for this bucket**

Block new public ACLs and uploading public objects (Recommended)

Remove public access granted through public ACLs (Recommended)

**Manage public bucket policies for this bucket**

Block new public bucket policies (Recommended)

Block public and cross-account access if bucket has public policies (Recommended)

**Manage system permissions**

Do not grant Amazon S3 Log Delivery group write access to this bucket

▼

Previous Next

# Step 6: Review

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Create bucket

X

1 Name and region    2 Configure options    3 Set permissions    4 Review

Name and region

Bucket name: lumian-test-bucket    Region: US East (Ohio)

Options

Versioning	Disabled
Server access logging	Disabled
Tagging	0 Tags
Object-level logging	Disabled
Default encryption	None
CloudWatch request metrics	Disabled
Object lock	Disabled

Permissions

Block new public ACLs and uploading public objects	True
Remove public access granted through public ACLs	True
Block new public bucket policies	True
Block public and cross-account access if bucket has public policies	True
Custom permissions	Disabled

Previous    Create bucket

# Overview: S3 File Upload

1. From console, select 'S3'
2. Select Bucket
3. Select Upload
4. Select file(s)
5. Set Permissions (leave defaults)
6. Set Properties (leave defaults)
7. Review

# Step 1: Locate S3

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You can enter names, keywords or acronyms.

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[S3](#)   [Billing](#)

**All services**

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# Step 2: Select Bucket

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The screenshot shows the AWS S3 console interface. The left sidebar has 'Amazon S3' selected under 'Buckets'. The main content area is titled 'S3 buckets' and contains a search bar and buttons for 'Create bucket', 'Edit public access settings', 'Empty', and 'Delete'. A summary at the top right indicates '2 Buckets' and '1 Regions'. Below is a table listing two buckets:

Bucket name	Access	Region	Date created
emotion-face-classifier	Bucket and objects not public	US East (Ohio)	Nov 27, 2018 1:04:32 PM GMT-0700
lumian-test-bucket	Bucket and objects not public	US East (Ohio)	Mar 31, 2019 3:50:18 PM GMT-0600

The 'lumian-test-bucket' row is highlighted with a red box around its entire row.

# Step 3: Select Upload

galvanize

AWS Services Resource Groups ▾ Global ▾ Support ▾

Amazon S3 > lumian-test-bucket

Overview Properties Permissions Management

Upload Create folder Download Actions ▾ US East (Ohio) ⚙

This bucket is empty. Upload new objects to get started.

 Upload an object

Buckets are globally unique containers for everything that you store in Amazon S3.  
[Learn more](#)

 Set object properties

After you create a bucket, you can upload your objects (for example, your photo or video files).  
[Learn more](#)

 Set object permissions

By default, the permissions on an object are private, but you can set up access control policies to grant permissions to others.  
[Learn more](#)

[Get started](#)

# Step 4a: Select File(s)

galvanize

Upload X

① Select files    ② Set permissions    ③ Set properties    ④ Review

To upload a file larger than 80 GB, use the AWS CLI, AWS SDK, or Amazon S3 REST API. [Learn more ↗](#)

Drag and drop files and folders here

OR

Add files

---

Upload Next

## Step 4b: Select File(s)

galvanize

The screenshot shows the AWS S3 "Upload" interface. At the top, there's a navigation bar with four steps: 1. Select files (highlighted with a red border), 2. Set permissions, 3. Set properties, and 4. Review. Below the navigation bar, it says "1 Files Size: 3.6 KB Target path: lumian-test-bucket". There's a note: "To upload a file larger than 80 GB, use the AWS CLI, AWS SDK, or Amazon S3 REST API. Learn more" with a link icon. A blue "Add more files" button is below. The main area shows a single file entry: "cancer.csv - 3.6 KB" with a delete "X" icon. At the bottom, there are two buttons: "Upload" on the left and "Next" on the right.

Upload

① Select files   ② Set permissions   ③ Set properties   ④ Review

1 Files   Size: 3.6 KB   Target path: lumian-test-bucket

To upload a file larger than 80 GB, use the AWS CLI, AWS SDK, or Amazon S3 REST API. [Learn more](#)

+ Add more files

cancer.csv  
- 3.6 KB

Upload   Next

# Step 5: Set Permissions

galvanize

Upload X

① Select files    ② Set permissions    ③ Set properties    ④ Review

1 Files    Size: 3.6 KB    Target path: lumian-test-bucket

Manage users

User ID	Objects	Object permissions
dumian(Owner)	<input checked="" type="checkbox"/> Read	<input checked="" type="checkbox"/> Read <input checked="" type="checkbox"/> Write

Access for other AWS account + Add account

Account	Objects	Object permissions
---------	---------	--------------------

Manage public permissions

Do not grant public read access to this object(s) (Recommended)

Upload Previous Next

# Step 6: Set Properties

galvanize

Upload X

1 Files Size: 3.6 KB Target path: lumian-test-bucket

① Select files ✓ ② Set permissions ✓ ③ Set properties ④ Review

**Storage class**  
Choose a storage class based on your use case and access requirements. [Learn more](#) or see [Amazon S3 pricing](#)

Storage class	Designed for	Availability Zones	Min storage duration	Min billable object size	Monitoring and automation fees	Retrieval fees
<input type="radio"/> Standard	Frequently accessed data	≥ 3	-	-	-	-
<input checked="" type="radio"/> Intelligent-Tiering	Long-lived data with changing or unknown access patterns	≥ 3	30 days	-	Per-object fees apply	-
<input type="radio"/> Standard-IA	Long-lived, infrequently accessed data	≥ 3	30 days	128KB	-	Per-GB fees apply
<input type="radio"/> One Zone-IA	Long-lived, infrequently accessed, non-critical data	≥ 1	30 days	128KB	-	Per-GB fees apply
<input type="radio"/> Glacier	Archive data with retrieval times ranging from minutes to hours	≥ 3	90 days	-	-	Per-GB fees apply
<input type="radio"/> Glacier Deep Archive	Archive data that rarely, if ever, needs to be retrieved with retrieval times in	≥ 3	180 days	-	-	Per-GB fees apply

Upload Previous Next

# Step 7: Review

galvanize

Upload X

④ Review

Select files Set permissions Set properties

**Files** Edit

1 Files Size: 30.0 B

**Permissions** Edit

1 grantees

**Properties** Edit

**Encryption** No **Storage class** Standard

**Metadata**

**Tag**

[Previous](#) [Upload](#)

# Step 8: Check Bucket Contents

galvanize

The screenshot shows the AWS S3 console interface. At the top, there's a navigation bar with the AWS logo, 'Services' dropdown, 'Resource Groups' dropdown, a star icon, and user information ('danny @ 3457-8654-8326', 'Global', 'Support'). Below the navigation bar, the path 'Amazon S3 > lumian-test-bucket' is displayed. The main area has tabs for 'Overview', 'Properties', 'Permissions', and 'Management', with 'Management' currently selected. A search bar contains the placeholder text 'Type a prefix and press Enter to search. Press ESC to clear.' Below the search bar are buttons for 'Upload', '+ Create folder', 'Download', and 'Actions'. To the right of these buttons is the region 'US East (Ohio)' with a refresh icon. A progress bar indicates 'Viewing 1 to 1'. The main content area displays a table with one item: 'cancer.csv'. The table columns are 'Name', 'Last modified', 'Size', and 'Storage class'. The file 'cancer.csv' was last modified on Mar 31, 2019 at 4:14:54 PM GMT-0600, is 3.6 KB in size, and is stored in the 'Standard' storage class. There are checkboxes next to each column header and the file name.

Name	Last modified	Size	Storage class
cancer.csv	Mar 31, 2019 4:14:54 PM GMT-0600	3.6 KB	Standard

# Step 9: Check File URL

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The screenshot shows the AWS S3 console interface. At the top, there's a navigation bar with the AWS logo, 'Services' dropdown, 'Resource Groups' dropdown, and a star icon. Below the navigation bar, the path 'Amazon S3 > lumian-test-bucket > cancer.csv' is displayed. The main content area shows the file 'cancer.csv' with its status as 'Latest version'. Below the file name, there are four tabs: 'Overview' (selected), 'Properties' (highlighted in blue), 'Permissions', and 'Select from'. Underneath these tabs are five buttons: 'Open', 'Download', 'Download as', 'Make public', and 'Copy path'. The 'Properties' section contains the following details:

- Owner**: c997e92c700083567c1517cb8291f4e3d07c1d915bf00794f6663842e219e807
- Last modified**: Mar 31, 2019 4:14:54 PM GMT-0600
- Etag**: 9b42c56c596eb08254f2ab4602409f93
- Storage class**: Standard
- Server-side encryption**: None
- Size**: 3.6 KB
- Key**: cancer.csv
- Object URL**: <https://s3.us-east-2.amazonaws.com/lumian-test-bucket/cancer.csv>

# EC2 Instance

galvanize

# Overview: EC2

1. From console, select 'EC2'
2. Launch Instance
3. Choose AMI (Ubuntu Server 18.04 LTS (HVM), SSD Volume Type)
4. Choose Instance Type (t2.micro)
5. Review and Launch
6. Check Instance

# Step 1: Locate EC2

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AWS Management Console

**AWS services**

**Find Services**  
You can enter names, keywords or acronyms.

Example: Relational Database Service, database, RDS

▼ Recently visited services

S3 Billing

▼ All services

- Compute
  - EC2
  - Lightsail
  - ECR
  - ECS
  - EKS
  - Lambda
  - Batch
  - Elastic Beanstalk
  - Serverless Application Repository
- Storage
  - S3
  - EFS
  - FSx
  - S3 Glacier
  - Storage Gateway
  - AWS Backup
- Developer Tools
  - CodeStar
  - CodeCommit
  - CodeBuild
  - CodeDeploy
  - CodePipeline
  - Cloud9
  - X-Ray
- Robotics
  - AWS RoboMaker
- Blockchain
  - Amazon Managed Blockchain
- Satellite
  - Ground Station
- Machine Learning
  - Amazon SageMaker
  - Amazon Comprehend
  - Amazon Lex
  - Machine Learning
  - Amazon Polly
  - Rekognition
  - Amazon Transcribe
  - Amazon Translate
  - Amazon Personalize
  - Amazon Forecast
  - Amazon Textract
- Analytics
  - Athena
  - EMR
  - CloudSearch
- Mobile
  - AWS Amplify
  - Mobile Hub
  - AWS AppSync
  - Device Farm
- AR & VR
  - Amazon Sumerian
- Application Integration
  - Step Functions
  - Amazon MQ
  - Simple Notification Service
  - Simple Queue Service
  - SWF
- Customer Engagement

**Access resources on the go**

Access the Management Console using the AWS Console Mobile App. [Learn more](#)

**Explore AWS**

**Visit AWS around the world at a Summit**  
AWS Global Summits bring the cloud computing community together to connect, collaborate, and learn about AWS. [Learn more](#)

**Run Serverless Containers with AWS Fargate**  
AWS Fargate runs and scales your containers without having to manage servers or clusters. [Learn more](#)

**Open Distro for Elasticsearch**  
A 100% open-source, community driven distribution of Elasticsearch with enterprise-grade security and alerting features. [Learn more](#)

**AWS Marketplace**  
Find, buy, and deploy popular software products that run on AWS. [Learn more](#)

# Step 2: Launch Instance

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AWS Services Resource Groups ▾

EC2 Dashboard Events Tags Reports Limits 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

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

0 Running Instances	0 Elastic IPs
0 Dedicated Hosts	1 Snapshots
0 Volumes	0 Load Balancers
0 Key Pairs	19 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:  
Availability zone is operating normally
- ✓ us-east-2b:  
Availability zone is operating normally
- ✓ us-east-2c:  
Availability zone is operating normally

[Service Health Dashboard](#)

**Scheduled Events**  
US East (Ohio):  
No events

**Account Attributes**

Supported Platforms VPC  
Default VPC vpc-139a9d7b  
Resource ID length management  
Console experiments

**Additional Information**

Getting Started Guide Documentation All EC2 Resources Forums Pricing 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](#)

# Step 3: Choose AMI

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Servi<sup>ces</sup> ▾ Re<sup>source Groups</sup> ▾

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 ⓘ

1 to 38 of 38 AMIs

 <b>Amazon Linux 2 AMI (HVM), SSD Volume Type</b> - ami-02bccb802e03574ba (64-bit x86) / ami-06a134062219ad132 (64-bit Arm)	<input checked="" type="radio"/> 64-bit (x86) <input type="radio"/> 64-bit (Arm)	<b>Select</b>
 <b>Amazon Linux AMI 2018.03.0 (HVM), SSD Volume Type</b> - ami-0cd3dfa4e37921605	<input checked="" type="radio"/> 64-bit (x86) <input type="radio"/> 64-bit (Arm)	<b>Select</b>
 <b>Red Hat Enterprise Linux 7.6 (HVM), SSD Volume Type</b> - ami-0b500ef59d8335eee (64-bit x86) / ami-0302c1ecc74930ba5 (64-bit Arm)	<input checked="" type="radio"/> 64-bit (x86) <input type="radio"/> 64-bit (Arm)	<b>Select</b>
 <b>SUSE Linux Enterprise Server 15 (HVM), SSD Volume Type</b> - ami-0eb9f58db22854f8f (64-bit x86) / ami-064a69af69b77fa05 (64-bit Arm)	<input checked="" type="radio"/> 64-bit (x86) <input type="radio"/> 64-bit (Arm)	<b>Select</b>
 <b>Ubuntu Server 18.04 LTS (HVM), SSD Volume Type</b> - ami-0c55b159cbfafe1f0 (64-bit x86) / ami-0f2057f28f0a44d06 (64-bit Arm)	<input checked="" type="radio"/> 64-bit (x86) <input type="radio"/> 64-bit (Arm)	<b>Select</b>
Are you launching a database instance? Try Amazon RDS.		

# Step 4: Choose Instance Type

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Screenshot of the AWS EC2 instance creation wizard Step 4: Choose Instance Type.

The page shows the following navigation steps:

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 <small>Free tier eligible</small>	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	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

Buttons at the bottom:

- Cancel
- Previous
- Review and Launch
- Next: Configure Instance Details

# Step 5: Configure Instance

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AWS Services Resource Groups ▾

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

Step 3: Configure Instance Details

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

Number of instances  Launch into Auto Scaling Group [①](#)

Purchasing option  Request Spot instances

Network  [①](#) [C Create new VPC](#)

Subnet  [①](#) [Create new subnet](#)

Auto-assign Public IP  [①](#)

Placement group  Add instance to placement group

Capacity Reservation  [①](#) [C Create new Capacity Reservation](#)

IAM role  [①](#) [C Create new IAM role](#)

Shutdown behavior  [①](#)

Enable termination protection  Protect against accidental termination

Monitoring  Enable CloudWatch detailed monitoring  
Additional charges apply.

Tenancy  [①](#)  
Additional charges will apply for dedicated tenancy.

Elastic Inference  Add an Elastic Inference accelerator

[Cancel](#) [Previous](#) [Review and Launch](#) [Next: Add Storage](#)

# Step 6: Add Storage

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Screenshot of the AWS EC2 instance creation wizard Step 6: Add Storage.

The navigation bar shows the steps: 1. Choose AMI, 2. Choose Instance Type, 3. Configure Instance, 4. Add Storage (highlighted), 5. Add Tags, 6. Configure Security Group, 7. Review.

**Step 4: Add Storage**

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

Volume Type	Device	Snapshot	Size (GiB)	Volume Type	IOPS	Throughput (MB/s)	Delete on Termination	Encrypted
Root	/dev/sda1	snap-0273e1ffcd240e41	8	General Purpose SSD (gp2)	100 / 3000	N/A	<input checked="" type="checkbox"/>	Not Encrypted

[Add New Volume](#)

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

# Step 7: Add Tags

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Sales      Services ▾      Resource Groups ▾     

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

**Step 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	(127 characters maximum)	Value	(255 characters maximum)	Instances	Volumes	
Name		Test_EC2		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

[Add another tag](#)    (Up to 50 tags maximum)

# Step 8: Security Groups

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Screenshot of the AWS EC2 instance creation wizard, Step 6: Configure Security Group.

The page shows the configuration for a new security group named "launch-wizard-18". A warning message at the bottom advises against using a source of 0.0.0.0/0.

**Assign a security group:**

- Create a new security group
- Select an existing security group

**Security group name:** launch-wizard-18

**Description:** launch-wizard-18 created 2019-04-01T09:14:01.340-06:00

Type	Protocol	Port Range	Source	Description
SSH	TCP	22	Custom	0.0.0.0/0 e.g. SSH for Admin Desktop

**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.

# Step 9: Review & Launch

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Sales 3457-8654-8326 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 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, launch-wizard-18, 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

Ubuntu Server 18.04 LTS (HVM), SSD Volume Type - ami-0c55b159cbfafe1f0  
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

**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 name: launch-wizard-18  
Description: launch-wizard-18 created 2019-04-01T09:14:01.340-06:00

Type <small>i</small>	Protocol <small>i</small>	Port Range <small>i</small>	Source <small>i</small>	Description <small>i</small>
SSH	TCP	22	0.0.0.0/0	

**Instance Details** Edit instance details

**Storage** Edit storage

**Cancel** **Previous** **Launch**

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# Step 10: Select PEM Key

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## Select an existing key pair or create a new key pair

X

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

example\_key



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

Cancel

Launch Instances

# Step 11: Image Launch

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AWS Services Resource Groups 🔍

Notification Bell danny @ 3457-8654-8326 Ohio Support

## Launch Status

Your instances are now launching

The following instance launches have been initiated: i-02762f51477656d42 [View launch log](#)

Get notified of estimated charges

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

### How to connect to your instances

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

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

Here are some helpful resources to get you started

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

While your instances are launching you can also

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

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

[Manage security groups](#)

[View Instances](#)

# Step 12: View Image

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Screenshot of the AWS EC2 Dashboard showing the instance "Test\_EC2".

The dashboard includes a sidebar with navigation links for EC2 Dashboard, Events, Tags, Reports, Limits, Instances (selected), Launch Templates, Spot Requests, Reserved Instances, Dedicated Hosts, Capacity Reservations, AMIs, Bundle Tasks, and Lifecycle Manager.

The main content area shows the instance details:

Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public IP	IPv6 IPs	Key Name	Monitoring	Last Launch Time
Test_EC2	i-02762f51477656d42	t2.micro	us-east-2b	running	Initializing	None	ec2-18-188-148-214.us-east-2.compute.amazonaws.com	18.188.148.214	-	example_key	disabled	April 1, 2019

Below the table, the instance details are expanded:

Description		Status Checks	Monitoring	Tags
Instance ID	i-02762f51477656d42	Test_EC2	Public DNS: ec2-18-188-148-214.us-east-2.compute.amazonaws.com	
Instance state	running			
Instance type	t2.micro			
Elastic IPs				
Availability zone	us-east-2b			
Security groups	launch-wizard-18, view inbound rules, view outbound rules			
Scheduled events	No scheduled events			

At the bottom, there are links for Feedback, English (US), and footer information: © 2008 - 2019, Amazon Web Services, Inc. or its affiliates. All rights reserved. Privacy Policy Terms of Use

# EC2 Instance Connect

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# Overview: EC2 Connect

1. Get PEM Key [Follow this guide](#)
2. SSH to Instance
3. SCP or git clone to upload files
4. Screen/Tmux
5. Run program
6. Save output
7. Terminate instance

# Step 1a: PEM Key

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Screenshot of the AWS EC2 Dashboard showing the following details:

- Resources:** You are using the following Amazon EC2 resources in the US East (Ohio) region:
  - 1 Running Instances
  - 0 Dedicated Hosts
  - 2 Volumes
  - 1 Key Pairs
  - 0 Placement Groups
  - 0 Elastic IPs
  - 1 Snapshots
  - 0 Load Balancers
  - 21 Security Groups
- Create Instance:** A button labeled "Launch Instance" is present.
- Service Health:**
  - Service Status:** US East (Ohio) is operating normally.
  - Availability Zone Status:**
    - us-east-2a: Availability zone is operating normally
    - us-east-2b: Availability zone is operating normally
    - us-east-2c: Availability zone is operating normally
- Scheduled Events:** No events scheduled.
- Account Attributes:**
  - Supported Platforms:** VPC
  - Default VPC:** vpc-139a9d7b
  - Resource ID length management:** Console experiments
- Additional Information:**
  - Getting Started Guide
  - Documentation
  - All EC2 Resources
  - Forums
  - Pricing
  - 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](#)

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# Step 1b: PEM Key

galvanize

The screenshot shows the AWS EC2 Dashboard with the 'Key Pairs' section selected. The main content area displays a table of key pairs. A single row is visible, representing the 'example\_key' pair. The table has two columns: 'Key pair name' and 'Fingerprint'. The 'Key pair name' column contains 'example\_key'. The 'Fingerprint' column contains '0a:67:d1:e3:f7:17:b6:51:8c:e8:3c:f1:fb:ae:5b:26:ae:50:8f:f5'. Below the table, a detailed view for the 'example\_key' key pair is shown, listing its name and fingerprint again.

Key pair name	Fingerprint
example_key	0a:67:d1:e3:f7:17:b6:51:8c:e8:3c:f1:fb:ae:5b:26:ae:50:8f:f5

**Key Pair: example\_key**

Key pair name	example_key
Fingerprint	0a:67:d1:e3:f7:17:b6:51:8c:e8:3c:f1:fb:ae:5b:26:ae:50:8f:f5

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## Step 1c: PEM Key

galvanize

### Create Key Pair

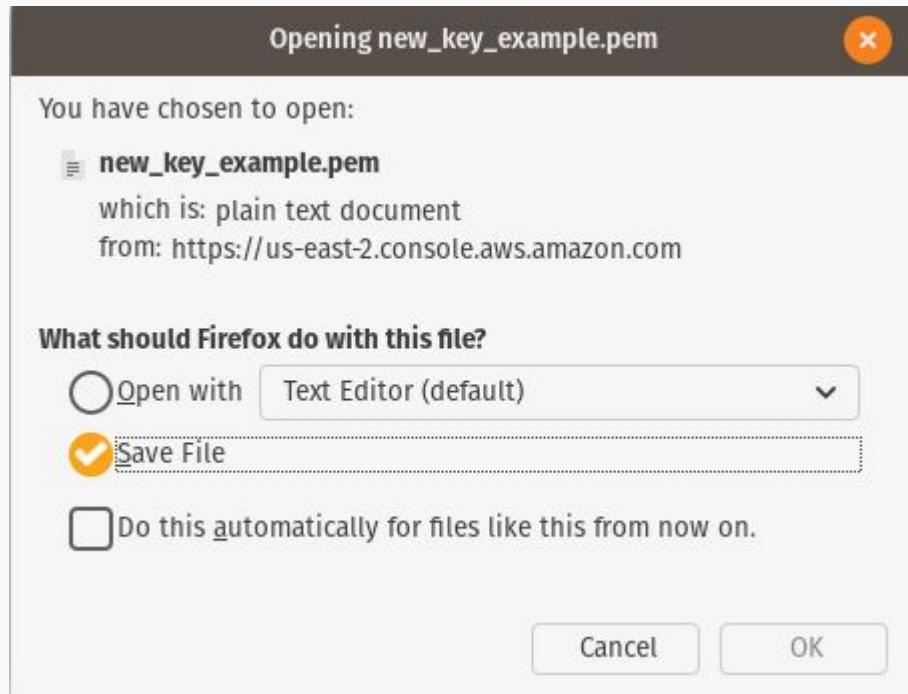
X

Key pair name:

[Cancel](#) [Create](#)

# Step 1d: PEM Key

galvanize



# Step 1e: PEM Key

1. Move key from downloads to `~/.ssh/` file
  - a. `mv ~/Downloads/example.pem ~/.ssh/`
2. Check permissions of file
  - a. (from `~/.ssh`) `ls -la`
3. Make sure file is read only for owner
  - a. `chmod 400 example.pem`

```
danny@pop-os:~/Downloads$ ls
example_key.pem
danny@pop-os:~/Downloads$ mv example_key.pem ~/.ssh/
danny@pop-os:~/Downloads$ cd .ssh
danny@pop-os:~/.ssh$ ls -la
total 12
drwx----- 2 danny danny 4096 Apr  1 09:28 .
drwxr-xr-x 29 danny danny 4096 Apr  1 09:01 ..
-rw-rw-r--  1 danny danny 1692 Mar 31 18:41 example_key.pem
danny@pop-os:~/.ssh$ chmod 400 example_key.pem
danny@pop-os:~/.ssh$ ls
example_key.pem
danny@pop-os:~/.ssh$ ls -la
total 12
drwx----- 2 danny danny 4096 Apr  1 09:28 .
drwxr-xr-x 29 danny danny 4096 Apr  1 09:01 ..
-rw-rw-r--  1 danny danny 1692 Mar 31 18:41 example_key.pem
```

# Step 2: SSH into Instance

galvanize

The screenshot shows the AWS EC2 Instances page. On the left, there's a sidebar with navigation links for EC2 Dashboard, Events, Tags, Reports, Limits, Instances (selected), 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), and Load Balancing (Load Balancers, Target Groups). The main content area has tabs for Launch Instance, Connect, and Actions. A search bar at the top says "Filter by tags and attributes or search by keyword". Below it is a table with columns: Name, Instance ID, Instance Type, Availability Zone, Instance State, Status Checks, Alarm Status, Public DNS (IPv4), IPv4 Public IP, IPv6 IPs, Key Name, Monitoring, and Launch Time. One row is shown: Test\_EC2, i-02762f51477656d42, t2.micro, us-east-2b, running, 2/2 checks ..., None, ec2-18-188-148-214.us..., 18.188.148.214, -, example\_key, disabled, April 1, 2019. Below the table, a detailed view for instance i-02762f51477656d42 is displayed. It includes tabs for Description, Status Checks, Monitoring, and Tags. The Description tab shows various details like Instance ID, State, Type, Zone, Security Groups, AMI ID, Platform, IAM role, Key pair name, Owner, Launch time, and Termination protection. The Status Checks tab shows 2/2 checks passed. The Monitoring tab indicates monitoring is disabled. The Tags tab shows a single tag named example\_key. On the right side of the instance details, several network-related fields are listed: Public DNS (IPv4) (highlighted in red), IPv4 Public IP (18.188.148.214), IPv6 IPs (-), Private DNS (ip-172-31-19-90.us-east-2.compute.internal), Private IPs (172.31.19.90), Secondary private IPs, VPC ID (vpc-139a9d7b), Subnet ID (subnet-181a7e62), Network interfaces (eth0), Source/dest. check (True), T2/T3 Unlimited (Disabled), EBS-optimized (False), Root device type (ebs), Root device (/dev/sda1), and Block devices (/dev/sda1).

Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public IP	IPv6 IPs	Key Name	Monitoring	Launch Time
Test_EC2	i-02762f51477656d42	t2.micro	us-east-2b	running	2/2 checks ...	None	ec2-18-188-148-214.us...	18.188.148.214	-	example_key	disabled	April 1, 2019

Instance: i-02762f51477656d42 (Test\_EC2)    Public DNS: ec2-18-188-148-214.us-east-2.compute.amazonaws.com

Description

Instance ID	i-02762f51477656d42
Instance state	running
Instance type	t2.micro
Elastic IPs	
Availability zone	us-east-2b
Security groups	launch-wizard-18, view inbound rules, view outbound rules
Scheduled events	No scheduled events
AMI ID	ubuntu/images/hvm-ssd/ubuntu-bionic-18.04-amd64-server-20190212.1 (ami-0c55b159cbfafe1f0)
Platform	-
IAM role	-
Key pair name	example_key
Owner	345786548326
Launch time	April 1, 2019 at 9:17:44 AM UTC-6 (less than one hour)
Termination protection	False
Last activity	normal

Status Checks

Monitoring

Tags

Public DNS (IPv4) FOZ-18-188-148-214.us-east-2.compute.amazonaws.com

IPv4 Public IP 18.188.148.214

IPv6 IPs -

Private DNS ip-172-31-19-90.us-east-2.compute.internal

Private IPs 172.31.19.90

Secondary private IPs

VPC ID vpc-139a9d7b

Subnet ID subnet-181a7e62

Network interfaces eth0

Source/dest. check True

T2/T3 Unlimited Disabled

EBS-optimized False

Root device type ebs

Root device /dev/sda1

Block devices /dev/sda1

# Step2: SSH into Instance

```
ssh -i path/to/example.pem user@instance
```

```
ssh -i ~/.ssh/example.pem ubuntu@ec2-18-188-148-214.us-east-2.compute.amazonaws.com
```

# Step 2: SSH into Instance

galvanize

```
danny@pop-os:~/ssh$ ssh -i example_key.pem ec2-18-188-148-214.us-east-2.compute.amazonaws.com
The authenticity of host 'ec2-18-188-148-214.us-east-2.compute.amazonaws.com (18.188.148.214)' can't be e
stablished.
ECDSA key fingerprint is SHA256:FjKAE/mm72IUrb3FKN3Xe2tmvDxZj4KpRAaFE//NKgw.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'ec2-18-188-148-214.us-east-2.compute.amazonaws.com,18.188.148.214' (ECDSA) to
the list of known hosts.
Connection closed by 18.188.148.214 port 22
danny@pop-os:~/ssh$ ssh -i example_key.pem ubuntu@ec2-18-188-148-214.us-east-2.compute.amazonaws.com
Welcome to Ubuntu 18.04.2 LTS (GNU/Linux 4.15.0-1032-aws x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/advantage

System information as of Mon Apr  1 15:53:00 UTC 2019

System load:  0.02      Processes:          83
Usage of /:   13.6% of 7.69GB  Users logged in:     0
Memory usage: 14%           IP address for eth0: 172.31.19.90
Swap usage:   0%

* Ubuntu's Kubernetes 1.14 distributions can bypass Docker and use containerd
directly, see https://bit.ly/ubuntu-containedr or try it now with

  snap install microk8s --classic

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

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

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

ubuntu@ip-172-31-19-90:~$ ls
ubuntu@ip-172-31-19-90:~$ pwd
/home/ubuntu
```

# Step3: SCP Files

```
scp -i path/to/example.pem file_to_upload user@instance:path/to/store/
```

```
scp -i ~/.ssh/example_key.pem count_for_me.py  
ubuntu@ec2-18-188-148-214.us-east-2.compute.amazonaws.com:/home/ubuntu/
```

# Step4: Screen or tmux

- EC2 instance will stop working when disconnected from a local terminal, unless a multiplexer like [screen](#) or [tmux](#) is used

1. \$ screen -S my-session # creates a session called my-session
2. Start your web app, or model training, or whatever process you want to continue.
3. Typing **Ctrl - a**, then **d** to *detach* from the session.
4. You can now safely interrupt the ssh session; your EC2 instance will keep working.
5. ssh back into your instance.
6. \$ screen -ls # lists available screen sessions
7. \$ screen -R my-session # re-attaches to my-session

# Step5: Run Program

- \$ scp -i ~/.ssh/example\_key.pem count\_for\_me.py [ubuntu@ec2-18-188-148-214.us-east-2.compute.amazonaws.com](mailto:ubuntu@ec2-18-188-148-214.us-east-2.compute.amazonaws.com):/home/ubuntu/
- \$ ssh -i ~/.ssh/example.pem [ubuntu@ec2-18-188-148-214.us-east-2.compute.amazonaws.com](mailto:ubuntu@ec2-18-188-148-214.us-east-2.compute.amazonaws.com)
- \$ screen -S new-session
- \$ python count\_for\_me.py
- Ctrl-a, then d (detach screen)
- \$ exit
- \$ ssh -i ~/.ssh/example.pem ubuntu@ec2-18-188-148-214.us-east-2.compute.amazonaws.com
- \$ screen -ls
- \$ screen -R new-session

# Step6: Save Results

- Save results to local computer
- Save results to S3 bucket
- Save entire image
- Write output to Github

# Step 7: Terminate Instance

galvanize

Instances | EC2 Management Console - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Inbox (3) - dluodian@ | My Drive - Google Dr | Lecture\_AWS\_4\_1 | Galvanize, Inc. - My A | Inbox - danny.lumian | Instances | EC2 Mana | g5chool/dsi-welcom | dsi-big-o/pair.md at | DSI\_Lectures/big-O | Screenshots and score

Instances | EC2 Management Console - Mozilla Firefox

Services Resource Groups

EC2 Dashboard

Events

Tags

Reports

Limits

INSTANCES

Instances

Launch Templates

Spot Requests

Reserved Instances

Dedicated Hosts

Capacity Reservations

IMAGES

AMIs

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

Launch Instance Connect

Actions

Connect

Get Windows Password

Create Template From Instance

Launch More Like This

Instance State

Start

Stop

Stop

Reboot

CloudWatch Monitoring

Terminate

Terminate is not supported for instances that are in the following states (terminated). When terminating please only select instances that are (pending, rebooting, running, shutting-down, stopped, stopping, terminating).

Status Public DNS (IPv4) IPv4 Public IP IPv6 IPs Key Name Monitoring Launch Ti

example\_key disabled April 1, 20

Instance: i-02762f51477656d42 (Test\_EC2) Public DNS: -

Instance ID	i-02762f51477656d42	Public DNS (IPv4)	-
Instance state	terminated	IPv4 Public IP	-
Instance type	t2.micro	IPv6 IPs	-
Elastic IPs	-	Private DNS	-
Availability zone	us-east-2b	Private IPs	-
Security groups	-	Secondary private IPs	-
Scheduled events	-	VPC ID	-
AMI ID	ubuntu/images/hvm-ssd/ubuntu-bionic-18.04-amd64-server-20190212.1 (ami-0c5b159cbfafe1f0)	Subnet ID	-
Platform	-	Network Interfaces	-
IAM role	-	Source/dest. check	False
Key pair name	example_key	T2/T3 Unlimited	Disabled
Owner	345786548326	EBS-optimized	False
Launch time	April 1, 2019 at 9:17:44 AM UTC-6 (1 hour)	Root device type	ebs
Termination protection	-	Root device	-
Life cycle	normal	Block devices	-

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# Step 8 (Optional): Save Instance Image

galvanize

Instances | EC2 Management Console - Mozilla Firefox

File Edit View History Bookmarks Tools Help

abc - Abstract Base Classe Instances | EC2 Management My Drive - Google Drive Lecture\_AWS\_4\_1\_19 - Goog g86 Denver Jan 2019 - Goog Inbox (3) - dlumian@gmail.com ubuntu screenshot shortc https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Instances: ... ☆ ⓘ danny @ 3457-8654-8326 Ohio Support

Instances | EC2 Management Console - Mozilla Firefox

File Edit View History Bookmarks Tools Help

abc - Abstract Base Classe Instances | EC2 Management My Drive - Google Drive Lecture\_AWS\_4\_1\_19 - Goog g86 Denver Jan 2019 - Goog Inbox (3) - dlumian@gmail.com ubuntu screenshot shortc https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#Instances: ... ☆ ⓘ danny @ 3457-8654-8326 Ohio Support

AWS Services Resource Groups

EC2 Dashboard Events Tags Reports Limits

**INSTANCES**

- Instances** Launch Instance Connect Actions
- 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

Launch Instance Connect Actions

Connect Get Windows Password Create Template From Instance Launch More Like This

Instance State Instance Settings Image Networking CloudWatch Monitoring

Create Image Bundle Instance (instance store AMI)

Instance: i-0c746ee63ab8cb64 Public DNS: ec2-18-191-219-112.us-east-2.compute.amazonaws.com

Description	Status Checks	Monitoring	Tags
Instance ID: i-0c746ee63ab8cb64	Public DNS: ec2-18-191-219-112.us-east-2.compute.amazonaws.com		
Instance state: running			
Instance type: t2.micro			
Elastic IPs:			
Availability zone: us-east-2b			
Security groups: launch-wizard-20, view inbound rules, view outbound rules			
Scheduled events: No scheduled events			
AMI ID: ubuntu/images/hvm-ssd/ubuntu-bionic-18.04-amd64-server-20190212.1 (ami-0c55b159cbfafe1f0)			
Platform: -			
IAM role: -			
Key pair name: example_key			
Owner: 345786548326			
Network interfaces: eth0			
Source/dest. check: True			
T2/T3 Unlimited: Disabled			
EBS-optimized: False			

# Morning (Individual) Sprint

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# EC2 Images & Log In

galvanize

# Deep Learning Instances

- Worked with basic instance this morning
- AWS has many instances which come with pre-built dependencies
- Can save your own image and launch from it
- Can use deep learning instances which come with:
  - Python tools
  - Keras
  - Docker
- Be sure to activate environment

Launch instance wizard | EC2 Management Console - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Inbox (6) drianum@gmail.com My Drive - Google Drive Lecture\_AWS\_4\_1\_39 - Google Sheets Launch instance wizard | S3 Management Console Configuring the AWS CLI - aws\_boto3\_notebook

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

Services Resource Groups

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

Step 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.

Cancel and Exit

deep learning

Quick Start (?)

My AMIs (0)  
AWS Marketplace (119)  
Community AMIs (142)

Free tier only ⓘ

Deep Learning AMI (Microsoft Windows Server 2016) - ami-0391a856d6111ec4  
Windows Root device type: ebs Virtualization type: hvm ENA Enabled: Yes

Deep Learning AMI (Ubuntu) Version 22.0 - ami-0174e69c12bae5410  
MXNet-1.4, TensorFlow-1.13, PyTorch-1.0, Keras-2.2, Chainer-5.3, Caffe2-0.8, Theano-1.0 & CNTK-2.6, configured with NVIDIA CUDA, cuDNN, NCCL, Intel MKL-DNN, Docker & NVIDIA-Docker. For a fully managed experience, check: https://aws.amazon.com/sagemaker

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

Deep Learning AMI (Amazon Linux) Version 22.0 - ami-0a13eb27aa8e0e92a  
Amazon Linux MXNet-1.4, TensorFlow-1.13, PyTorch-1.0, Keras-2.2, Chainer-5.3, Caffe2-0.8, Theano-1.0 & CNTK-2.6, configured with NVIDIA CUDA, cuDNN, NCCL, Intel MKL-DNN, Docker & NVIDIA-Docker. For a fully managed experience, check: https://aws.amazon.com/sagemaker

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

Deep Learning Base AMI (Ubuntu) Version 17.0 - ami-0840efaf078ac7fb73  
Ubuntu Comes with foundational platform of NVIDIA CUDA, cuDNN, NCCL, GPU Drivers, Intel MKL-DNN and other system libraries to deploy your own custom deep learning environment. For a fully managed experience, check: https://aws.amazon.com/sagemaker

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

Deep Learning Base AMI (Amazon Linux) Version 17.0 - ami-01a09790ae210cec  
Amazon Linux Comes with foundational platform of NVIDIA CUDA, cuDNN, NCCL, GPU Drivers, Intel MKL-DNN and other system libraries to deploy your own custom deep learning environment. For a fully managed experience, check: https://aws.amazon.com/sagemaker

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

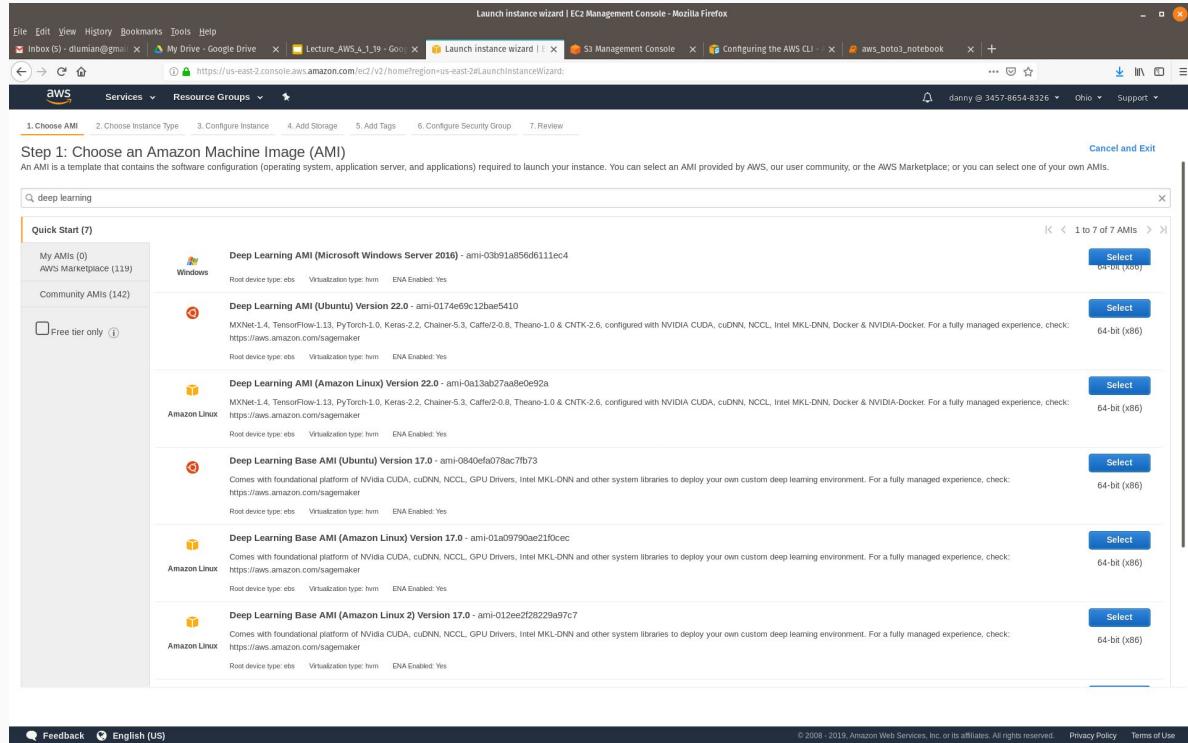
Deep Learning Base AMI (Amazon Linux 2) Version 17.0 - ami-012ee2f28229a97c7  
Amazon Linux 2 Comes with foundational platform of NVIDIA CUDA, cuDNN, NCCL, GPU Drivers, Intel MKL-DNN and other system libraries to deploy your own custom deep learning environment. For a fully managed experience, check: https://aws.amazon.com/sagemaker

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

Select 64-bit (x86)

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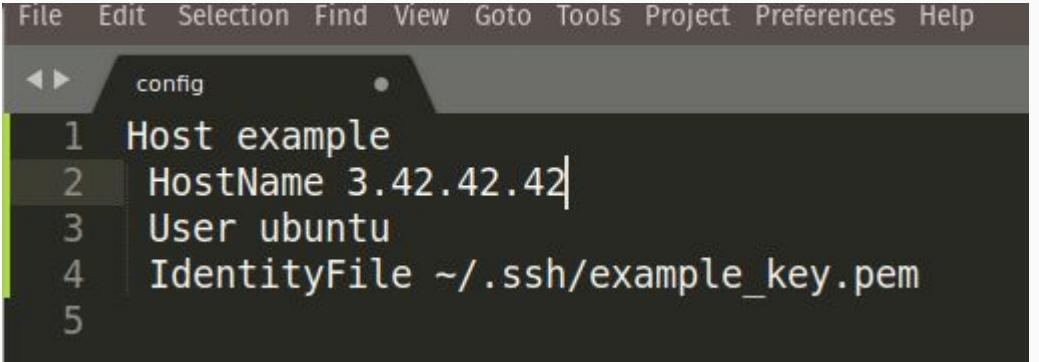
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galvanize

## ~/.ssh/config

- Can create login shortcuts for instances
- Set up config file
- Launch using: \$ssh example



A screenshot of a terminal window showing the contents of a `.ssh/config` file. The window has a dark background and a light-colored menu bar at the top. The file content is displayed in a text editor-like interface with line numbers on the left. The configuration entries are:

```
1 Host example
2 HostName 3.42.42.42
3 User ubuntu
4 IdentityFile ~/.ssh/example_key.pem
5
```

galvanize

# AWS CLI

galvanize

# AWS CLI

- [Documentation](#)
- Download (pip install awscli)
- Get credentials from console (Account name->Get Security Credentials)
- Run aws configure (will create ~/.aws/credentials)
  - AWS Access Key ID
  - AWS Secret Access Key
  - Default region name (us-east-1)
  - Default output format (json/text)

# AWS CLI-List buckets

- Test install by listing buckets
- aws s3api list-buckets

```
danny@pop-os:~/Downloads$ aws s3api list-buckets
{
    "Buckets": [
        {
            "Name": "emotion-face-classifier",
            "CreationDate": "2018-11-27T20:04:32.000Z"
        },
        {
            "Name": "lumian-test-bucket",
            "CreationDate": "2019-03-31T21:50:18.000Z"
        }
    ],
    "Owner": {
        "DisplayName": "dlumian",
        "ID": "c997e92c700083567c1517cb8291f4e3d07c1d915bf00794f6663842e219e807"
    }
}
```

Boto3

galvanize

# Boto3

galvanize

- Documentation

```
In [7]: import boto3

In [8]: s3 = boto3.resource('s3')

In [9]: for b in s3.buckets.all():
...:     print(b.name)
...
...
emotion-face-classifier
lumian-test-bucket
```

## Using Boto 3

To use Boto 3, you must first import it and tell it what service you are going to use:

```
import boto3

# Let's use Amazon S3
s3 = boto3.resource('s3')
```

Now that you have an `s3` resource, you can make requests and process responses from the service. The following uses the `buckets` collection to print out all bucket names:

```
# Print out bucket names
for bucket in s3.buckets.all():
    print(bucket.name)
```

It's also easy to upload and download binary data. For example, the following uploads a new file to S3. It assumes that the bucket `my-bucket` already exists:

```
# Upload a new file
data = open('test.jpg', 'rb')
s3.Bucket('my-bucket').put_object(Key='test.jpg', Body=data)
```

Resources and Collections will be covered in more detail in the following sections, so don't worry if you do not completely understand the examples.

# Boto3-File upload

```
# from lecture_AWS folder  
  
import boto3  
  
s3 = boto3.resource('s3')  
  
img = open('data/g_logo.png', 'rb')  
  
s3.Bucket('lumian-test-bucket').put_object(Key='test.png',  
Body=img)
```

# Boto3-Check Upload

```
from boto3 import client  
  
conn = client('s3')  
  
for key in conn.list_objects(Bucket='bucket_name')['Contents']:  
    print(key['Key'])
```

aws\_boto3\_notebook.ipynb

galvanize

# Demo: Launch EC2 instance

galvanize

1. Choose an instance (AMI)
2. Choose an instance type (general purpose, GPU)
3. Configure instance (accept defaults)
  - a. If you want to be able to access S3-add a [S3 role to your IAM user](#) and select it here
4. Add storage (accept defaults)
5. Add tags (give it a name)
6. Give it a security group
  - a. Accept existing for SSH, if you want an application available to others on the web, add a new **Custom TCP** with the desired **Port Range** and **Source** of anywhere
7. Review
8. Specify which .pem key-pair will be used to connect (via ssh) to the instance
  - a. This file should be moved to your ~/.ssh directory and its file permissions modified so that only the owner can read it (e.g.: \$ chmod 400 ~/.ssh/mykeypair.pem)

# Workflow Revisited: GitHub Sync

galvanize

1. Create an EC2 instance with permission to write to s3 (without ever having to copy your AWS credentials to the instance!)

- Go to AWS Console
- Choose Roles
- Create Role
- AWS Service -> EC2, click Next: Permissions
- Search box -> type S3 -> check AmazonS3FullAccess, Next: Review
- Create Role
- Create a new EC2 instance (or choose an existing one) and assign it the IAM role that you just created.
- SSH into your EC2 instance and use `aws s3 cp <origin> <destination> to copy a file from EC2 to s3!

2. Create a new github repository with source code for your project. Just like normal.

3. Clone github repository onto your EC2 instance to keep your code and compare resources synced.

- `git clone https://github.com/username/reponame` to your EC2 instance and you're done.
- To remove the friction of supplying your username/password every time you push/pull, run the following commands \*\*on your remote machine\*\*:

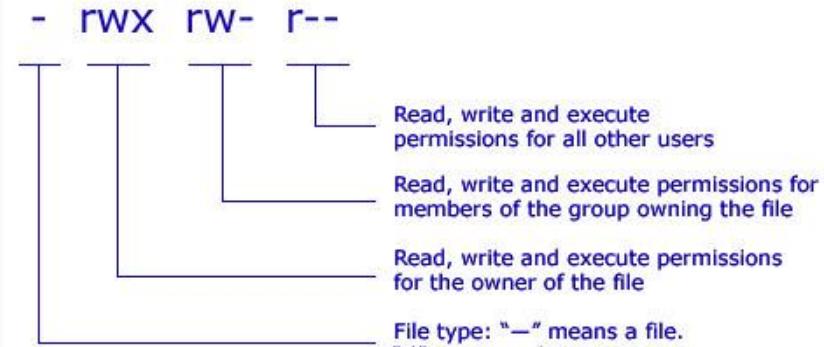
- Create an SSH key: `ssh-keygen -b 4096`
- Tell SSH to use it. (this assumes that there's no existing SSH config on the instance) `echo "IdentityFile ~/.ssh/id\_rsa" > ~/.ssh/config`
  - Then copy and paste the public key as a new authorized SSH key on GitHub `cat ~/.ssh/id\_rsa.pub`
  - Then `git clone git@github.com:username/reponame` just works.

4. Write code on your local machine (or your remote instance!), and keep all machines synced with frequent add/commit/push/pull. This is the beauty of version control!

# General: Commands and Permissions

- ssh
  - Provides secure, encrypted connection between computers
- scp
  - Secure copy files
- rsync
  - File copying system (e.g., moving whole filesystems)
- ssh-keygen
  - Generate authentication keys

- Permissions
  - To see permissions use ls -la
  - Keys should be read only by owner



# Final thoughts and Misc. info

- [Elastic Beanstalk](#): Alternative to EC2
- Always check status (billing) and terminate instances when done
- [Be secure with your keys](#)
- [Credentials to environ vars](#)
- `matplotlib.use('agg')`

```
/ This will be a memorable month -- no
\ matter how hard you try to forget it. /
```



# Objectives

galvanize

- Introduction to AWS
- AWS
  - Check Credits
  - Create IAM role
  - Set up S3 & EC2 (console)
- Morning Individual Assignment
- AWS CLI
- Boto3
- Afternoon pair assignment

# Afternoon (Pair) Sprint

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