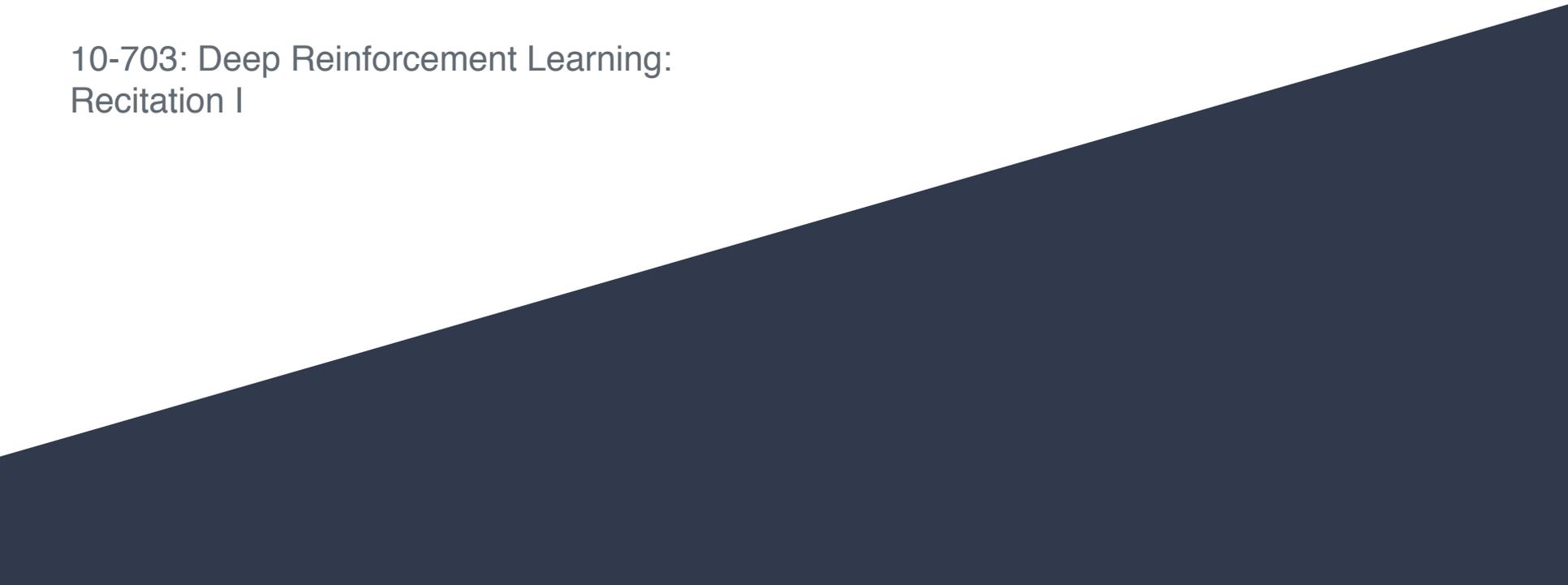


# AWS and OpenAI gym Tutorial

10-703: Deep Reinforcement Learning:  
Recitation I

A dark blue diagonal gradient bar that starts from the bottom left corner and extends towards the top right corner, covering the lower half of the slide.

# Objectives for Today

- What is AWS
- How do we use it (safely!)?
- What is OpenAI Gym
- How do we use it?

# Objectives for Today

- **What is AWS**
- **How do we use it (safely!)?**
- What is OpenAI Gym
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# Amazon Web Services

- On Demand Cloud Computing Resource
  - Compute
  - Storage
  - Databases
  - Analytics
  - Networking
  - Mobile
  - Developer Tools
  - Management Tools
  - IoT



## Cloud Products

Amazon Web Services offers a broad set of global cloud-based products including [compute](#), [storage](#), [databases](#), [analytics](#), [networking](#), [mobile](#), [developer tools](#), [management tools](#), [IoT](#), security and enterprise applications. These services help organizations move faster, lower IT costs, and scale. AWS is trusted by the largest enterprises and the hottest start-ups to power a wide variety of workloads including: web and mobile applications, game development, data processing and warehousing, storage, archive, and many others.

Get Started with  
AWS for Free

Create a Free  
Account

Sign up with Amazon Web Services and receive 12 months of access to the [AWS Free Usage Tier](#) and enjoy AWS Basic Support features including, 24x7x365 customer service, support forums, and more.

Discover the AWS Platform, Products and Services (2:56)



Explore Our Products

# Amazon Web Services

- On Demand Cloud Computing Resource
  - **Compute - EC2**
  - Storage
  - Databases
  - Analytics
  - Networking
  - Mobile
  - Developer Tools
  - Management Tools
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Explore Our Products

# Amazon Web Services - EC2

- Login to your Account
  - use your Andrew ID, preferably



Sign in 

Email address of your AWS account

Or to sign in as an IAM user, enter your account ID or account alias instead.

Next

New to AWS?

Create a new AWS account

**Amazon Transcribe**

Automatically generate text from speech within audio and video files

The advertisement features a dark blue background with a white AWS logo in the bottom left. On the right, there is a white icon of a microphone connected to a document, which is then connected to a brain-like circuit icon, all enclosed in dashed white lines. The text "Amazon Transcribe" is in a large, bold, white font, and the description below it is in a smaller white font.

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# Amazon Web Services - EC2

- Click on Services

The screenshot displays the AWS console interface. At the top, the navigation bar includes the AWS logo, 'Services' (with a dropdown arrow), 'Resource Groups' (with a dropdown arrow), and a star icon. On the right side of the navigation bar, there are links for '15-681', 'M. Virginia', and 'Support'.

The main content area is divided into several sections:

- AWS services:** A search bar with the placeholder text 'Find a service by name or feature (for example, EC2, S3 or VM, storage)'. Below it are links for 'Recently visited services' and 'All services'.
- Build a solution:** A section titled 'Get started with simple wizards and automated workflows.' containing six cards:
  - Launch a virtual machine:** 'With EC2 -2-3 minutes'.
  - Build a web app:** 'With Elastic Beanstalk -6 minutes'.
  - Build using virtual servers:** 'With Lightsail -1-2 minutes'.
  - Connect an IoT device:** 'With AWS IoT'.
  - Start a development project:** (No time listed).
  - Register a domain:** 'With Route 53 -3 minutes'.A 'See more' link is located at the bottom of this section.
- Learn to build:** A section titled 'Learn to deploy your solutions through step-by-step guides, labs, and videos.' with a 'See all' link. It features three cards:
  - Websites:** '3 videos, 3 tutorials, 3 labs'.
  - DevOps:** '6 videos, 2 tutorials, 3 labs'.
  - Backup and recovery:** '3 videos, 2 tutorials, 3 labs'.Below these cards, the names of other categories are partially visible: 'Fin rials', 'Datahosos', and 'Minho'.

On the right side of the console, there is a 'Helpful tips' section with two items:

- Manage your costs:** 'Monitor your AWS costs, usage, and reservations using AWS Budgets. [Start now](#)'.
- Create an organization:** 'Use AWS Organizations for policy-based management of multiple AWS accounts. [Start now](#)'.

Below the helpful tips is an 'Explore AWS' section with the following items:

- Machine Learning with Amazon SageMaker:** 'The fastest way to build, train, and deploy machine learning models. [Learn more.](#)'
- Amazon Relational Database Service (RDS):** 'RDS manages and scales your database for you. RDS supports Aurora, MySQL, PostgreSQL, MariaDB, Oracle, and SQL Server. [Learn more.](#)'
- AWS Fargate Runs Containers for You:** 'AWS Fargate works with Amazon ECS to run and scale your containers for you. Pay only for the compute resources you need, scale quickly, and run any size application. [Learn more.](#)'

# Amazon Web Services - EC2

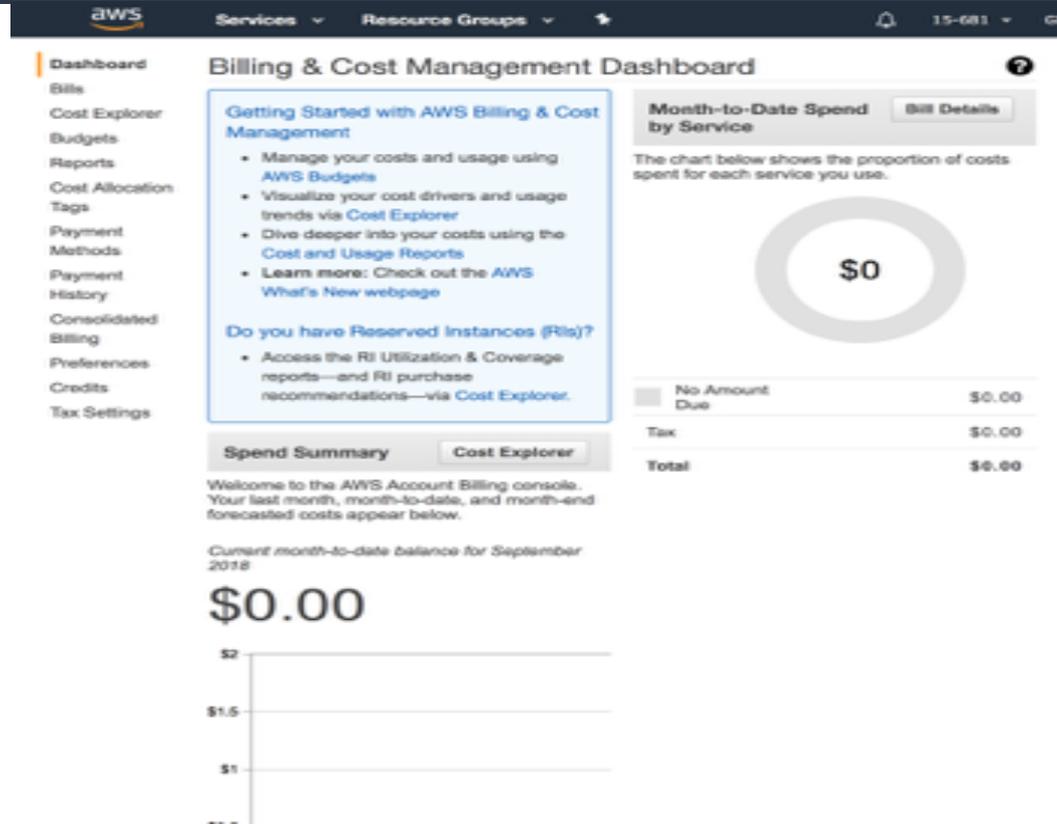
- Search for “billing”

The screenshot displays the AWS Management Console interface. At the top, the navigation bar includes the AWS logo, 'Services', 'Resource Groups', and a search icon. On the right side of the navigation bar, there are notification and account details: '15:58', 'N. Virginia', and 'Support'. The left-hand navigation pane shows 'History', 'EC2', and 'Console Home'. The main content area features a search bar with the text 'Billing' entered. Below the search bar, a dropdown menu is open, displaying a list of AWS services. The 'Billing' service is highlighted at the top of the dropdown, with a description: 'Access, analyze, and control your AWS costs and usage.' The list of services includes: EC2, Lightsail, Elastic Container Service, EKS, Lambda, Batch, Elastic Beanstalk, CodeStar, CodeCommit, CodeBuild, CodeDeploy, CodePipeline, Cloud9, X-Ray, Athena, EMR, CloudSearch, Elasticsearch Service, Kinesis, QuickSight, Data Pipeline, AWS Glue, Amazon Connect, Pinpoint, Simple Email Service, Business Productivity, Alexa for Business, Amazon Chime, WorkDocs, and WorkMail. At the bottom of the dropdown, there are icons for 'Storage' (S3, EFS, Glacier, Storage Gateway), 'Management Tools' (CloudWatch, AWS Auto Scaling, CloudFormation, CloudTrail, Config, OpsWorks), 'Security, Identity & Compliance' (IAM, Cognito, Secrets Manager, GuardDuty), and 'Desktop & App Streaming' (WorkSpaces, AppStream 2.0). A 'close' button is visible at the bottom of the dropdown menu.

# Amazon Web Services - Billing

TODO

- Set spending alarm under the **Budget** section
- Add credit using the promo code we provide under the **Credits** section
- Check live spending under the **Bills** section



# Amazon Web Services - Dashboard

- Go to Launch Instance

The screenshot displays the AWS Management Console dashboard for the EC2 service. The top navigation bar includes the AWS logo, 'Services', 'Resource Groups', a search icon, a notification bell, the account ID '15-681', and the region 'N. Virg'. The left sidebar contains a navigation menu with categories: EC2 Dashboard (selected), INSTANCES (Instances, Launch Templates, Spot Requests, Reserved Instances, Dedicated Hosts, Scheduled Instances), IMAGES (AMIs, Bundle Tasks), and ELASTIC BLOCK STORE (Volumes, Snapshots). The main content area is titled 'Resources' and shows a summary of EC2 resources in the US East (N. Virginia) region: 0 Running Instances, 0 Elastic IPs, 0 Dedicated Hosts, 1 Snapshots, 0 Volumes, 0 Load Balancers, 1 Key Pairs, 17 Security Groups, and 0 Placement Groups. A blue callout box contains a link to 'Learn more about the latest in AWS Compute from AWS re:Invent 2017 by viewing the EC2 Videos.' Below this is the 'Create Instance' section, which includes a 'Launch Instance' button. The right sidebar contains 'Account Attributes' (Supported Platforms, Default VPC, Resource ID length management, Console experiments) and 'Additional Information' (Getting Started Guide, Documentation, All EC2 Resources, Forums, Pricing, Contact Us). The footer includes 'Feedback', 'English (US)', 'Privacy Policy', and 'Terms of Use'.

# Amazon Web Services - Choose an AMI

- AMIs have pre-installed deep learning frameworks
- Go to Community AMIs and choose the that fits your need

The screenshot shows the AWS console interface for selecting an AMI. The top navigation bar includes the AWS logo, 'Services', 'Resource Groups', and user information. A progress bar at the top indicates the current step: '1. Choose AMI'. The main heading is 'Step 1: Choose an Amazon Machine Image (AMI)'. Below the heading, there is a description of an AMI and a 'Cancel and Exit' link. The search bar contains the text 'deep learning'. The results section shows '110 results for "deep learning" on AWS Marketplace'. Two AMIs are listed:

AMI Name	AMI ID	Architecture
Deep Learning AMI (Ubuntu) Version 14.0	ami-0466e26ccc0a752c1	64-bit
Deep Learning AMI (Amazon Linux) Version 14.0	ami-0e3eac5e7ecd4c917	64-bit

# Amazon Web Services - Choose Instance Type

- Which instance to choose?

Step 2: Choose an Instance Type

<input type="checkbox"/>	GPU graphics	g3.xlarge	32	244	EBS only	Yes	10 Gigabit	Yes
<input type="checkbox"/>	GPU graphics	g3.16xlarge	64	488	EBS only	Yes	25 Gigabit	Yes
<input type="checkbox"/>	GPU instances	g2.2xlarge	8	15	1 x 60 (SSD)	Yes	High	-
<input type="checkbox"/>	GPU instances	g2.8xlarge	32	60	2 x 120 (SSD)	-	10 Gigabit	-
<input type="checkbox"/>	GPU compute	p2.xlarge	4	61	EBS only	Yes	High	Yes
<input type="checkbox"/>	GPU compute	p2.8xlarge	32	488	EBS only	Yes	10 Gigabit	Yes
<input type="checkbox"/>	GPU compute	p2.16xlarge	64	732	EBS only	Yes	25 Gigabit	Yes
<input type="checkbox"/>	GPU compute	p3.2xlarge	8	61	EBS only	Yes	Up to 10 Gigabit	Yes
<input type="checkbox"/>	GPU compute	p3.8xlarge	32	244	EBS only	Yes	10 Gigabit	Yes
<input type="checkbox"/>	GPU compute	p3.16xlarge	64	488	EBS only	Yes	25 Gigabit	Yes
<input type="checkbox"/>	Memory optimized	r5d.large	2	16	1 x 75 (SSD)	Yes	Up to 10 Gigabit	Yes
<input type="checkbox"/>	Memory optimized	r5d.xlarge	4	32	1 x 150 (SSD)	Yes	Up to 10 Gigabit	Yes
<input type="checkbox"/>	Memory optimized	r5d.2xlarge	8	64	1 x 300 (SSD)	Yes	Up to 10 Gigabit	Yes

[Cancel](#) [Previous](#) [Review and Launch](#) [Next: Configure Instance Details](#)

## Amazon Web Services - Choose Instance Type

Instance Name	Number/GPU Type	Price (on-demand) per hour	Architecture /Speed
p2.xlarge	1 K80	\$0.9	Kepler (Slow)
p2.8xlarge	8 K80	\$7.2	Kepler (Slow)
p2.16xlarge	16 K80	\$14.4	Kepler (Slow)

Instance Name	Number/GPU Type	Price (on-demand) per hour	Architecture/ Speed
g3.4xlarge	1 M60	\$1.14	Maxwell (medium speed)
g3.8xlarge	2 M60	\$2.28	Maxwell (medium speed)
g3.16xlarge	4 M60	\$4.56	Maxwell (medium speed)

## Amazon Web Services - Choose Instance Type

Instance Name	Number/GPU Type	Price (on-demand) per hour	Architecture/Speed
p3.2xlarge	1 V100	\$3.06	Volta (fastest architecture so far!)
p3.8xlarge	4 V100	\$12.24	Volta (fastest architecture so far!)
p3.16xlarge	8 V100	\$24.48	Volta (fastest architecture so far!)

# Amazon Web Services - Configure Instance

- Check “Request Spot Instances”
- Enter maximum price of \$1

The screenshot shows the AWS console interface for configuring an instance. The top navigation bar includes the AWS logo, 'Services', 'Resource Groups', and user information. The breadcrumb trail indicates the current step: '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 3: Configure Instance Details', with a sub-heading explaining the purpose of this step.

Configuration options shown include:

- Number of instances:** 1 (with a 'Launch into Auto Scaling Group' link).
- Purchasing option:**  Request Spot instances.
- Current price:** A table showing prices for various availability zones in us-east-1.
- Maximum price:** \$ 1.
- Persistent request:**  Persistent request.
- Launch group:** [Optional]
- Request valid from:** Any time (with an 'Edit' link).
- Request valid to:** Any time (with an 'Edit' link).
- Network:** vpc-50da21e0 (default) (with a 'Create new VPC' link).

At the bottom, there are buttons for 'Cancel', 'Previous', 'Review and Launch', and 'Next: Add Storage'.

Availability Zone	Current price
us-east-1a	\$0.270
us-east-1b	\$0.270
us-east-1c	\$0.4617
us-east-1d	\$0.270
us-east-1e	\$0.270
us-east-1f	\$0.2809

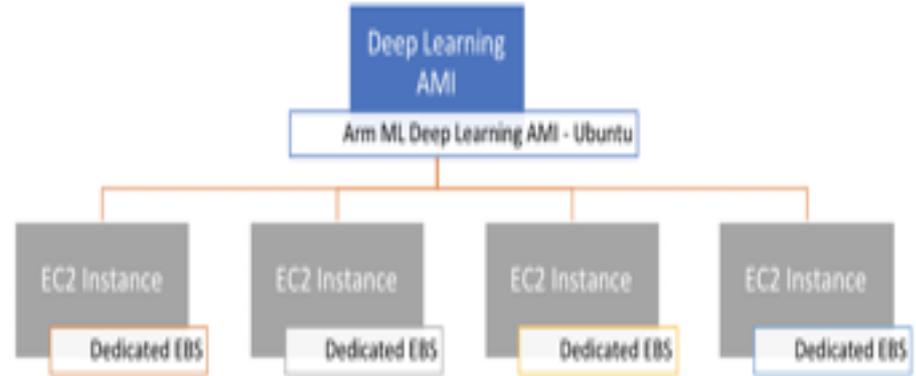
## Amazon Web Services - Add Storage

Three types:

- EBS: Local storage per instance
- EFS: Common file sharing among instances
- S3 buckets

Configure EBS before launching the Instance

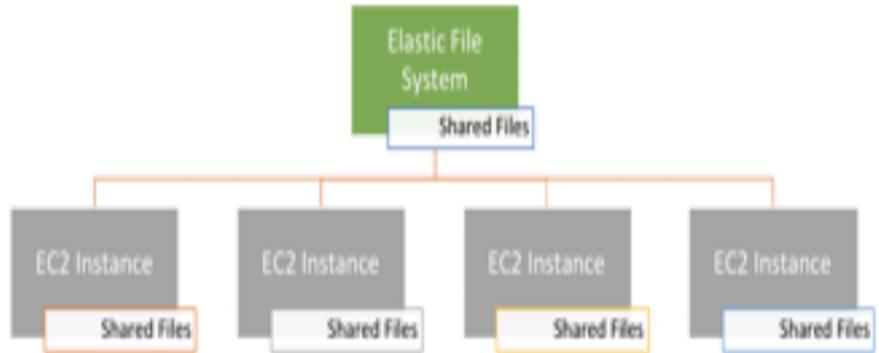
EFS can be configured/accessed once we are within the instance



## Amazon Web Services - Setting up EFS

Only three commands to mount EFS:

- `sudo apt-get install nfs-common`
- `sudo mkdir efs`
- `sudo mount -t nfs4 -o nfservers=4.1, rsize=1048576, wsize=1048576, hard, timeo=600, retrans=2 fs-ff38fd86..efs.us-east-2.amazonaws.com:/ efs`



# Amazon Web Services - Add Storage

- Keep in mind that ~50GB of the default 75GB is occupied by AMI Image files

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	En
Root	/dev/sda1	snap-0296485d8533ca3c5	75	General Purpose SSD (GP2)	225 / 3000	N/A	<input checked="" type="checkbox"/>	Not

[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) © 2008 - 2018, Amazon Web Services, Inc. or its affiliates. All rights reserved. Privacy Policy Terms of Use

# Amazon Web Services - Review & Launch

- Time to Launch

aws Services Resource Groups 15-681 N. Virginia 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 Spot Instance Request

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-17`, 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](#)

**Deep Learning AMI (Ubuntu) Version 14.0 - ami-0466e26ccc0e752c1**

Comes with latest binaries of deep learning frameworks pre-installed in separate virtual environments: MXNet, TensorFlow, Caffe, Caffe2, PyTorch, Keras, Chainer, Theano and CNTK. Fully-configured with NVIDIA CUDA, cuDNN and NCCL as well as Intel MKL-DNN

Root Device Type: ebs Virtualization type: hvm

Instance Type [Edit instance type](#)

Instance Type	ECUs	vCPUs	Memory (GiB)	Instance Storage (GiB)	EBS-Optimized Available	Network Performance
p2.xlarge	11.75	4	61	EBS only	Yes	High

Security Groups [Edit security groups](#)

[Cancel](#) [Previous](#) [Launch](#)

# Amazon Web Services - Review & Launch

- **First time users:** Select create a new key pair from drop down menu
- Download key and put it in some location on your machine (e.g., `~/aws/key_name.pem`)

The screenshot shows the AWS console interface during the 'Review Spot Instance Request' step. The breadcrumb navigation at the top indicates the following steps: 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 7: Review Spot Instance Request'. Below this, there is a warning box titled 'Improve your instances' and a section for 'AMI Details' showing 'Deep Learning AMI (Ubuntu)'. A modal dialog is open in the foreground, titled 'Select an existing key pair or create a new key pair'. The dialog contains the following text: '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.' Below this, there is a note: '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.' The dialog has two input fields: 'Choose an existing key pair' with a dropdown menu showing 'deepRL', and 'Select a key pair' with a dropdown menu showing 'deepRL'. There is a checked checkbox with the text: 'I acknowledge that I have access to the selected private key file (deepRL.pem), and that without this file, I won't be able to log into my instance.' At the bottom of the dialog are 'Cancel' and 'Request Spot Instances' buttons. In the background, a table for 'Instance Type' is visible with columns for Instance Type, ECUs, vCPU, and others. The table shows a row for 'p2.xlarge' with 11.75 ECUs and 4 vCPUs. At the bottom of the console, there are 'Feedback', 'English (US)', and 'Launch' buttons.

# Amazon Web Services - Launch Instance

- Click on Connect

The screenshot displays the AWS Management Console interface for an EC2 instance. The top navigation bar includes the AWS logo, 'Services', 'Resource Groups', and user information. The left sidebar contains a navigation menu with categories like EC2 Dashboard, INSTANCES, IMAGES, ELASTIC BLOCK STORE, and NETWORK & SECURITY. The main content area shows a table of instances with columns for Name, Instance ID, Instance Type, Availability Zone, Instance State, and Status Checks. A single instance is listed with ID 'i-0b6d216519f4a6660', type 'p2.xlarge', and state 'running'. Below the table, the instance details for 'i-0b6d216519f4a6660' are shown, including its Public DNS, Instance ID, Instance state, Instance type, and IP addresses.

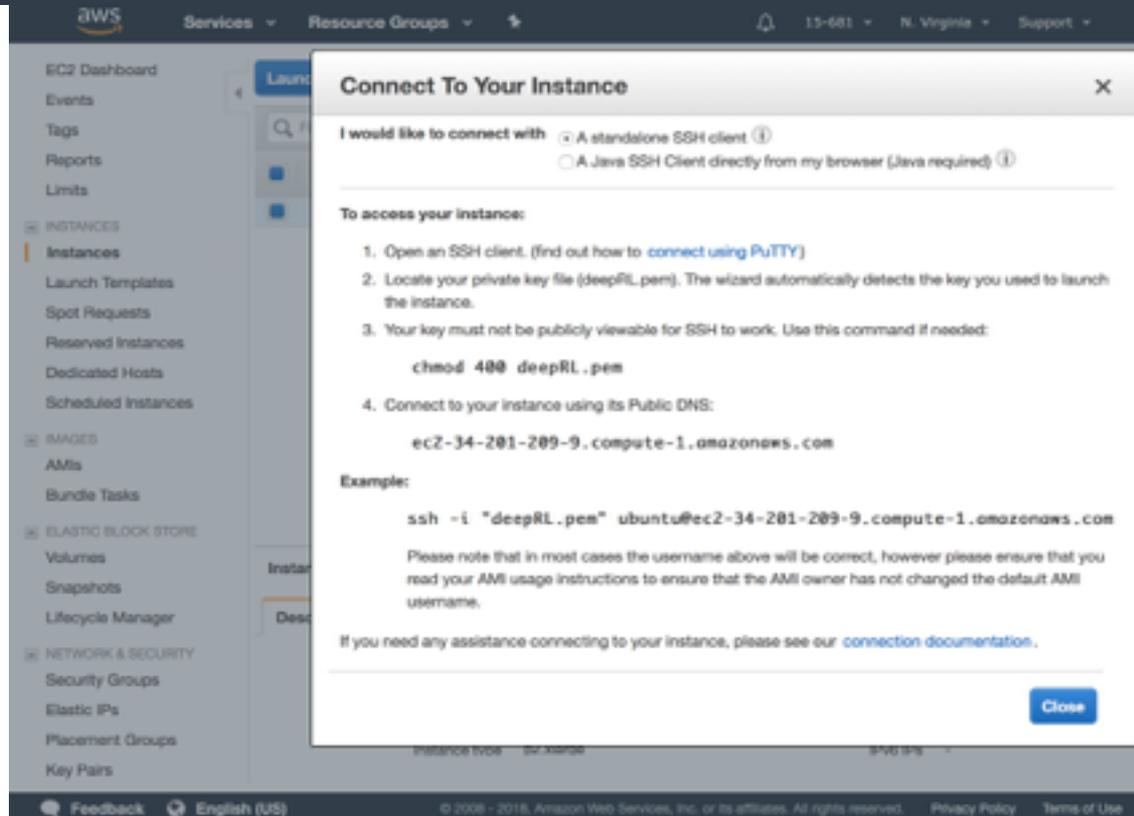
Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks
	i-0b6d216519f4a6660	p2.xlarge	us-east-1c	running	2/2 checks ...

Instance: i-0b6d216519f4a6660		Public DNS: ec2-34-201-209-9.compute-1.amazonaws.com	
<b>Description</b>			
Instance ID	i-0b6d216519f4a6660	Public DNS (IPv4)	ec2-34-201-209-9.compute-1.amazonaws.com
Instance state	running	IPv4 Public IP	34.201.209.9
Instance type	p2.xlarge	IPv6 IPs	-

# Amazon Web Services - Launch Instance

- Remember to change permissions for the key file
- ssh into the instance from your terminal: use the complete path of the key file



The screenshot shows the AWS Management Console interface. On the left is a navigation sidebar with categories like INSTANCES, IMAGES, ELASTIC BLOCK STORE, and NETWORK & SECURITY. The main content area displays the 'Connect To Your Instance' dialog box. The dialog has a title bar with a close button (X). Below the title, it asks 'I would like to connect with' and offers two radio button options: 'A standalone SSH client' (selected) and 'A Java SSH Client directly from my browser (Java required)'. Underneath, it provides instructions on how to access the instance, including a list of steps and a terminal command example. A 'Close' button is located at the bottom right of the dialog.

**Connect To Your Instance**

I would like to connect with  A standalone SSH client <sup>?</sup>  
 A Java SSH Client directly from my browser (Java required) <sup>?</sup>

To access your instance:

1. Open an SSH client. (find out how to [connect using PuTTY](#))
2. Locate your private key file (`deepRL.pem`). The wizard automatically detects the key you used to launch the instance.
3. Your key must not be publicly viewable for SSH to work. Use this command if needed:  

```
chmod 400 deepRL.pem
```
4. Connect to your instance using its Public DNS:  

```
ec2-34-201-209-9.compute-1.amazonaws.com
```

**Example:**

```
ssh -i "deepRL.pem" ubuntu@ec2-34-201-209-9.compute-1.amazonaws.com
```

Please note that in most cases the username above will be correct, however please ensure that you read your AMI usage instructions to ensure that the AMI owner has not changed the default AMI username.

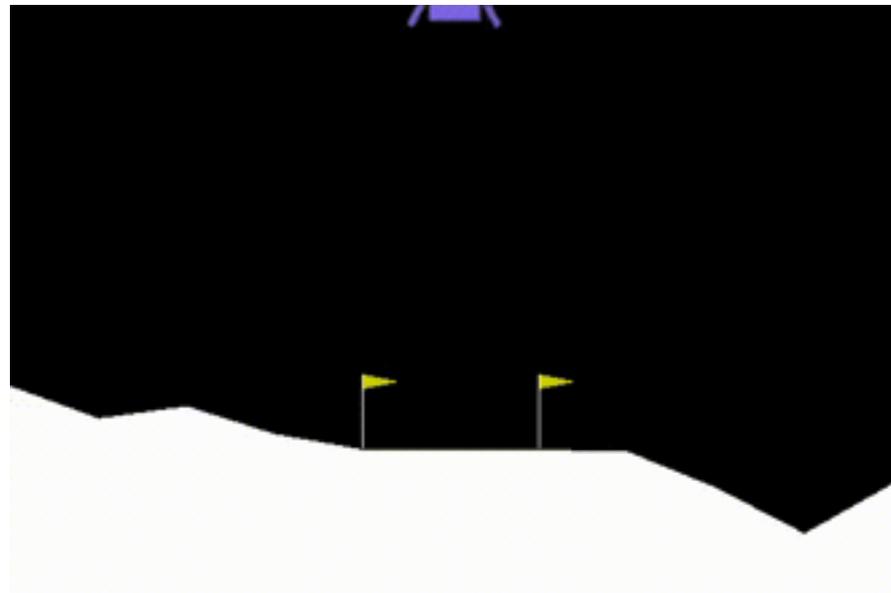
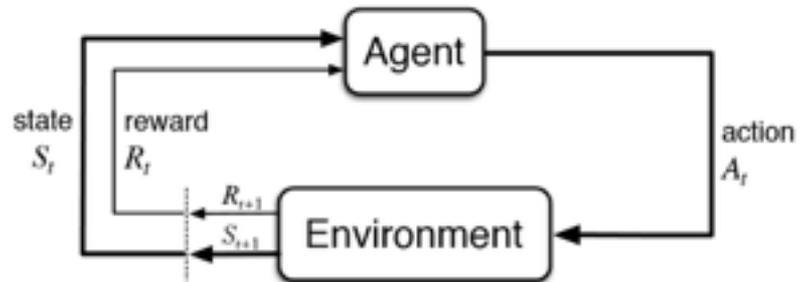
If you need any assistance connecting to your instance, please see our [connection documentation](#).

Close

# Objectives for Today

- What is AWS
- How do we use it (safely!)?
- **What is OpenAI Gym**
- **How do we use it?**

# OpenAI Gym



## OpenAI Gym - Biggest Contribution

To solve such a problem, **you need the ability to:**

- Define the environment
- Generate samples from the environment
- Sample an action from the action space
- Retrieve the next state after taking an action
- Retrieve the reward of taking an action
- Check if the episode has ended
- Reset the episode when the episode ends

OpenAI gym **gives you the ability to:**

- DO ALL OF THESE THINGS !



# OpenAI Gym - Getting Started

Install directly using pip:

- `pip install gym`

Build from source

- `git clone https://github.com/openai/gym`
- `cd gym`
- `pip install -e . #minimal install`

Add new environment

- `cd gym`
- `Pip install -e .[box2d] #installs all box2d environments`

# OpenAI Gym - Basic Concepts

Define the environment

- `env = gym.make('LunarLander-v2')`

Sample an action from the action space

- `action = env.action_space.sample()`

Reset the episode when the episode ends

- `state = env.reset()`

Retrieve the next state, reward and the indicator of the episode termination

- `next_state, reward, done, info = env.step(action)`

# OpenAI Gym - Additional Features

Render the environment

- `env.render()`

Record the environment

- `env = gym.wrapper.Monitor(env, \'.', force=True)`

Check out the state space and action space

- `Print (env.action_space)`
- `Print (env.observation_space)`

Let's look at a demo.