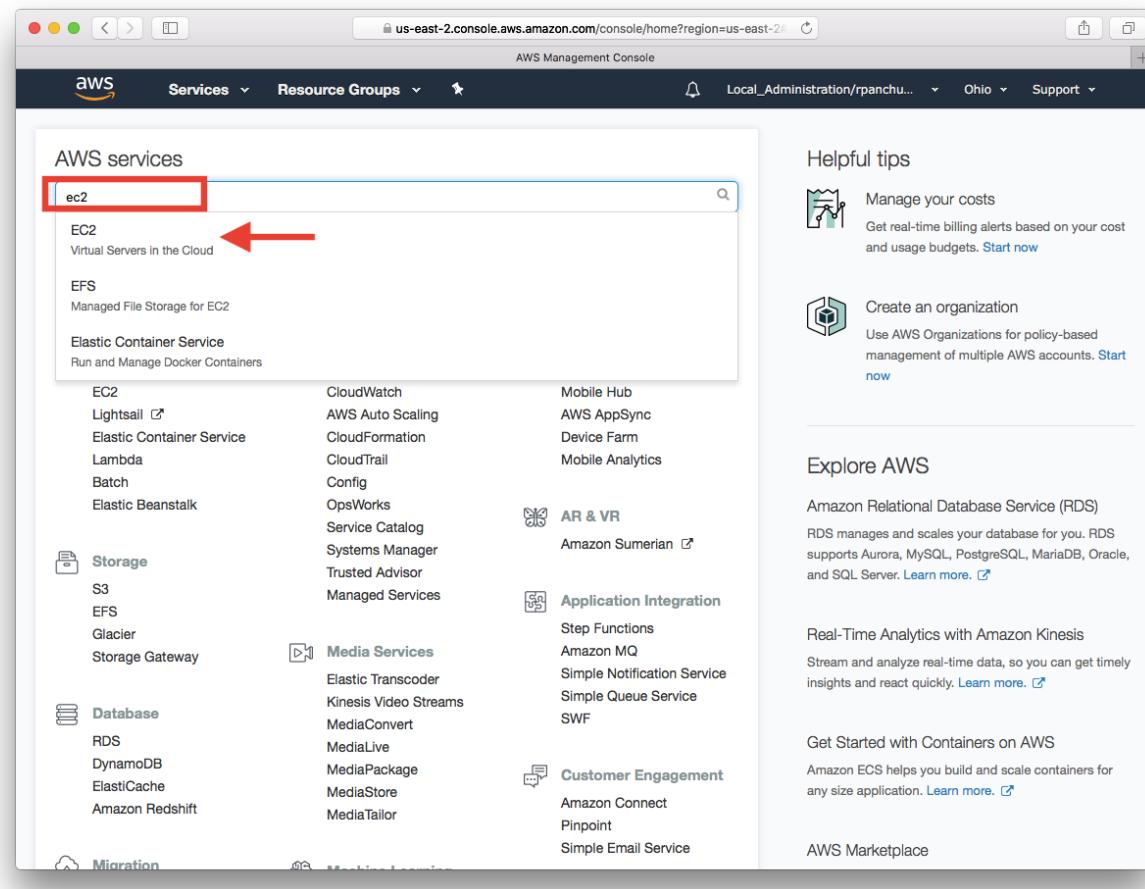


# Get Started with Deep Learning Using the AWS Deep Learning AMI with Intel CPUs

The [AWS Deep Learning AMIs](#) (Amazon Machine Images) let you build, train, and deploy deep learning applications in the cloud at any scale. The AMIs come pre-installed with open-source deep learning frameworks. In this article, we will show you how to get started with the AWS Deep Learning AMIs using [compute optimized instances](#) based on Intel® Xeon® processors.

## Step 1a: Open the AWS EC2 Console

Sign into the AWS Management Console, then type EC2 in the search bar and select EC2 to open the EC2 service console.



## Step 1b: Click on the “Launch Instance” button

The screenshot shows the AWS EC2 Management Console interface. On the left, there's a navigation sidebar with categories like EC2 Dashboard, Instances, Images, and Network & Security. The main area is titled 'Resources' and displays statistics for the US East (Ohio) region: 0 Running Instances, 0 Dedicated Hosts, 0 Volumes, 0 Key Pairs, 0 Elastic IPs, 0 Snapshots, 0 Load Balancers, and 1 Security Groups. Below this is a 'Create Instance' section with a 'Launch Instance' button highlighted by a red box. To the right, there are sections for 'Account Attributes' (Supported Platforms: VPC, Default VPC: vpc-15628b7c), 'Additional Information' (Getting Started Guide, Documentation, All EC2 Resources, Forums, Pricing, Contact Us), and 'AWS Marketplace' (listing Barracuda CloudGen Firewall for AWS - PAYG). At the bottom, there are links for Feedback, English (US), and standard footer links.

## Step 2a: Select the AWS Deep Learning AMI.

Click on the “AWS Marketplace” tab on the left, and then search for “deep learning ami ubuntu.” Select the Deep Learning AMI (Ubuntu). AMIs are also available for Ubuntu and Amazon Linux. More details about the AMI: <https://aws.amazon.com/machine-learning/amis/>

The screenshot shows the AWS EC2 Management Console interface. The user is in the process of creating a new instance, specifically at the step where they choose the AMI. A search bar at the top right contains the query "deep learning ami ubuntu". The results list three items:

- Deep Learning AMI (Ubuntu)**: Sold by Amazon Web Services, starting at \$0.023/hour. It is described as a Linux/Unix AMI optimized for deep learning frameworks like MXNet, TensorFlow, PyTorch, and Caffe. A red box highlights the "Select" button next to this item, which has a small number "3" above it, indicating multiple instances can be selected.
- Deep Learning Base AMI (Ubuntu)**: Sold by Amazon Web Services, starting at \$0.023/hour. It is described as a foundational platform for NVIDIA CUDA, cuDNN, GPU drivers, and Intel MKL-DNN.
- NVIDIA Volta Deep Learning AMI**: Sold by NVIDIA, starting at \$0.00/hour. It is described as a high-performance deep learning AMI.

The sidebar on the left shows navigation steps: 1. Choose AMI, 2. Choose Instance Type, 3. Configure Instance, 4. Add Storage, 5. Add Tags, 6. Configure Security Group, 7. Review. The "Choose AMI" step is highlighted. The sidebar also includes sections for Quick Start, My AMIs, AWS Marketplace (which is highlighted with a red box), Community AMIs, Categories, Operating System, Software Pricing Plans, and Feedback.

**Step 2b: On the details page, Click Continue after reviewing the hourly fees.**

The screenshot shows the AWS EC2 Management Console with the URL <https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2>. The page is titled "Deep Learning AMI (Ubuntu)".

**Pricing Details**

Instance Type	Software	EC2	Total
R3 Eight Extra Large	\$0.00	\$2.66	<b>\$2.66/hr</b>
R4 16 Extra Large	\$0.00	\$4.256	<b>\$4.256/hr</b>
M5 Extra Large	\$0.00	\$0.192	<b>\$0.192/hr</b>
M4 Extra Large	\$0.00	\$0.20	<b>\$0.20/hr</b>
H1 2 Extra Large	\$0.00	\$0.55	<b>\$0.55/hr</b>
High I/O Quadruple Extra Large	\$0.00	\$1.248	<b>\$1.248/hr</b>
T2 Large	\$0.00	\$0.093	<b>\$0.093/hr</b>
C4 Double Extra Large	\$0.00	\$0.398	<b>\$0.398/hr</b>
M5 Large	\$0.00	\$0.096	<b>\$0.096/hr</b>
R3 Double Extra Large	\$0.00	\$0.665	<b>\$0.665/hr</b>
C5 Large	\$0.00	\$0.085	<b>\$0.085/hr</b>
M5 Double Extra Large	\$0.00	\$0.384	<b>\$0.384/hr</b>
X1 32 Extra Large	\$0.00	\$13.338	<b>\$13.338/hr</b>
T2 Double Extra Large	\$0.00	\$0.371	<b>\$0.371/hr</b>
T2 Extra Large	\$0.00	\$0.186	<b>\$0.186/hr</b>
High I/O Extra Large	\$0.00	\$0.853	<b>\$0.853/hr</b>
C4 Eight Extra Large	\$0.00	\$1.591	<b>\$1.591/hr</b>
M4 Quadruple Extra Large	\$0.00	\$0.896	<b>\$0.896/hr</b>

**Product Details**

Sold by: Amazon Web Services  
Customer Rating: ★★★★☆ (5)  
Latest Version: 6.0  
Base Operating System: Linux/Unix, Ubuntu 16.04  
Delivery Method: 64-bit Amazon Machine Image (AMI)  
License Agreement: [End User License Agreement](#)  
On Marketplace Since: 11/14/17  
AWS Services Required: Amazon EC2, Amazon EBS

**Highlights**

- Used Ubuntu 16.04 (ami-cd0f5cb6) as base AMI

**Buttons:** Cancel (red box), Continue

### Step 3a: Select an instance type

Choose an instance type for your deep learning training and deployment needs and based on hourly pricing, and then click “Configure Instance Details”. Here we have picked a c5.18xlarge instance which is based on Intel’s latest Skylake processors (278 ECUs, 72 vCPUs, 3 GHz, Intel Xeon Platinum 8124M, 144 GiB memory, EBS only) .

The screenshot shows the AWS EC2 Management Console interface for creating a new instance. The top navigation bar includes 'Services', 'Resource Groups', and tabs for '1. Choose AMI', '2. Choose Instance Type', '3. Configure Instance', '4. Add Storage', '5. Add Tags', '6. Configure Security Group', and '7. Review'. The current step is '2. Choose Instance Type'. A note at the top states: '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.' Below this is a table of instance types. The 'Filter by' dropdown is set to 'Compute optimized'. The table columns include Family, Type, vCPUs, Memory (GiB), Instance Storage (GB), EBS-Optimized Available, Network Performance, and IPv6 Support. The 'c5.18xlarge' row is highlighted with a red box. At the bottom right of the table area, the 'Next: Configure Instance Details' button is also highlighted with a red box.

	Family	Type	vCPUs	Memory (GiB)	Instance Storage (GB)	EBS-Optimized Available	Network Performance	IPv6 Support
<input type="checkbox"/>	Compute optimized	c5.large	2	4	EBS only	Yes	Up to 10 Gigabit	Yes
<input type="checkbox"/>	Compute optimized	c5.xlarge	4	8	EBS only	Yes	Up to 10 Gigabit	Yes
<input type="checkbox"/>	Compute optimized	c5.2xlarge	8	16	EBS only	Yes	Up to 10 Gigabit	Yes
<input type="checkbox"/>	Compute optimized	c5.4xlarge	16	32	EBS only	Yes	Up to 10 Gigabit	Yes
<input type="checkbox"/>	Compute optimized	c5.9xlarge	36	72	EBS only	Yes	10 Gigabit	Yes
<input checked="" type="checkbox"/>	Compute optimized	c5.18xlarge	72	144	EBS only	Yes	25 Gigabit	Yes
<input type="checkbox"/>	Compute optimized	c4.large	2	3.75	EBS only	Yes	Moderate	Yes
<input type="checkbox"/>	Compute optimized	c4.xlarge	4	7.5	EBS only	Yes	High	Yes

### Step 3b: Launch your instance

Compute optimized Instances (C5 and C4) types are [Available Only in a VPC](#). Choose the default vpc or create a new VPC based on your needs. Click “Review and Launch”.

By default, the tenancy is a shared hardware instance. You have the option of choosing Dedicated hosts or dedicated instance at extra costs. For more details visit:

<https://aws.amazon.com/ec2/dedicated-hosts/> and

<https://aws.amazon.com/ec2/pricing/dedicated-instances/>

The screenshot shows the AWS EC2 Management Console interface for launching a new instance. The current step is "Step 3: Configure Instance Details". The configuration options include:

- Number of instances:** 1
- Purchasing option:** Request Spot instances (unchecked)
- Network:** vpc-15628b7c (default) - This section is highlighted with a red box. It includes a "Create new VPC" button.
- Subnet:** No preference (default subnet in any Availability Zone) - This section is highlighted with a red box. It includes a "Create new subnet" button.
- Auto-assign Public IP:** Use subnet setting (Enable)
- Placement group:** Add instance to placement group (unchecked)
- IAM role:** None - This section is highlighted with a red box. It includes a "Create new IAM role" button.
- Shutdown behavior:** Stop
- Enable termination protection:** Protect against accidental termination (unchecked)
- Monitoring:** Enable CloudWatch detailed monitoring (Additional charges apply)
- EBS-optimized instance:** Launch as EBS-optimized instance (checked)
- Tenancy:** Shared - Run a shared hardware instance - This section is highlighted with a red box. It includes a note: "Additional charges will apply for dedicated tenancy."

At the bottom, the navigation buttons are: Cancel, Previous, **Review and Launch** (highlighted with a blue box), and Next: Add Storage.

## Step 3c: Launch your instance

Click Launch on the Review page.

The screenshot shows the AWS EC2 Management Console interface. At the top, there's a navigation bar with tabs: 1. Choose AMI, 2. Choose Instance Type, 3. Configure Instance, 4. Add Storage, 5. Add Tags, 6. Configure Security Group, and 7. Review. The 7. Review tab is currently selected. Below the tabs, a section titled "Step 7: Review Instance Launch" contains a message: "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." A warning box is present, stating: "Your instance configuration is not eligible for the free usage tier. To launch an instance that's eligible for the free usage tier, check your AMI selection, instance type, configuration options, or storage devices. Learn more about [free usage tier](#) eligibility and usage restrictions." There are "Don't show me this again" and "Edit AMI" buttons next to the warning. The main content area includes sections for "AMI Details" (Deep Learning AMI (Ubuntu)), "Instance Type" (c5.18xlarge), and "Security Groups". At the bottom right of the main content area, there are "Cancel", "Previous", and "Launch" buttons, with the "Launch" button being highlighted by a red box.

## Step 4: Choose or create a new private key file

Choose an existing private key file or create a new one by selecting “create a new key pair”, and click “Download Key Pair” to save it. Then, click “Launch Instance”.

Your instance configuration is not eligible for the free usage tier

To launch an instance you must be eligible for the free usage tier

Select an existing key pair or create a new key pair

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

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

Create a new key pair

Key pair name

my\_ohio\_aws\_key

Download Key Pair

You have to download the private key file (\*.pem file) before you can continue. **Store it in a secure and accessible location.** You will not be able to download the file again after it's created.

Cancel Launch Instances

Initiating Instance Launches

Please do not close your browser while this is loading.

Creating security groups... Successful

Authorizing inbound rules... Successful

Initiating launches...

Feedback English (US)

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## Step 5: Click on the instance id to see your instance status

The screenshot shows the AWS EC2 Management Console with the URL [us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2](https://us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2). The top navigation bar includes 'Services', 'Resource Groups', and 'Support'. The main content area is titled 'Launch Status'.

A green notification box at the top states: 'Your instances are now launching'. Below it, a red box highlights the instance ID 'i-074f6253178f31e90'. To the right of the ID is a link 'View launch log'.

Below the notification, there's a blue info icon with the text 'Get notified of estimated charges'. It explains that users can create billing alerts to receive email notifications when estimated charges on their AWS bill exceed a defined amount.

The 'How to connect to your instances' section contains instructions: '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.' It also says to click 'View Instances' to monitor the instances' status.

The 'Getting started with your software' section has two buttons: 'View Usage Instructions' and 'Open Your Software on AWS Marketplace'.

The 'Helpful resources' section lists links to 'How to connect to your Linux instance', 'Learn about AWS Free Usage Tier', 'Amazon EC2: User Guide', and 'Amazon EC2: Discussion Forum'.

At the bottom, there are links for 'Feedback', 'English (US)', and legal notices: '© 2008 - 2018, Amazon Web Services, Inc. or its affiliates. All rights reserved.', 'Privacy Policy', and 'Terms of Use'.

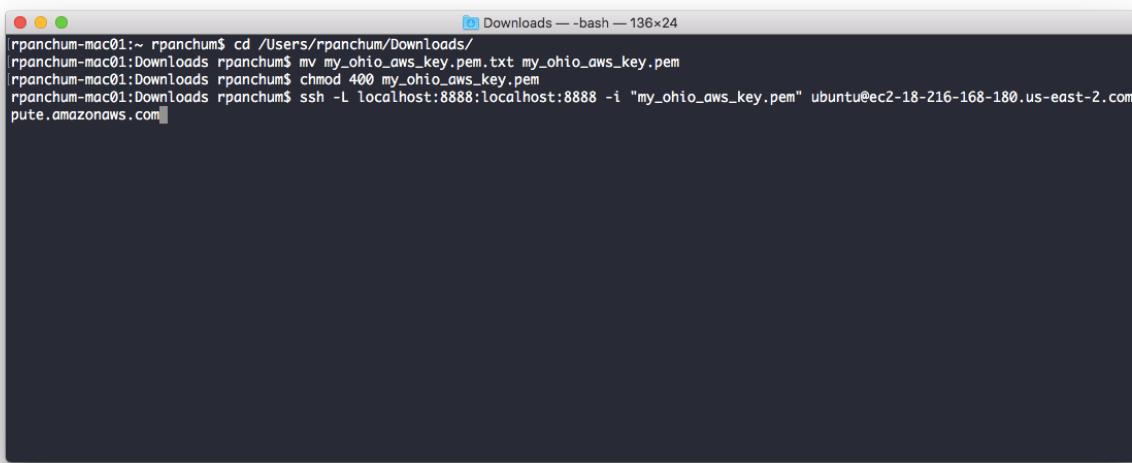
**Step 6: Click “Connect” to view instructions to ssh into the instance.**

The screenshot shows the AWS EC2 Management Console interface. On the left, there's a navigation sidebar with sections like EC2 Dashboard, Events, Tags, Reports, Limits, Instances, Images, AMIs, Bundle Tasks, Elastic Block Store, Volumes, Snapshots, Network & Security, Security Groups, Elastic IPs, Placement Groups, Key Pairs, Network Interfaces, Load Balancing, Load Balancers, and Target Groups. The 'Instances' section is currently selected. In the main content area, there's a search bar at the top with the placeholder 'search : i-074f6253178f31e90'. Below it is a table with columns: Name, Instance ID, Instance Type, Availability Zone, Instance State, Status Checks, and Alarm Status. A single row is selected, showing 'i-074f6253178f31e90' in the Instance ID column, 'c5.18xlarge' in the Instance Type column, 'us-east-2c' in the Availability Zone column, 'running' in the Instance State column, and 'None' in the Alarm Status column. At the bottom of the table, there are tabs for Description, Status Checks, Monitoring, and Tags. The 'Description' tab is active. Below the tabs, detailed information is provided for the selected instance: Instance ID (i-074f6253178f31e90), Instance state (running), Instance type (c5.18xlarge), and Elastic IPs (dotted). To the right, there are fields for Public DNS (IPv4) (highlighted with a red box), IPv4 Public IP (18.216.168.180), IPv6 IPs (-), and Private DNS (ip-172-31-36-3.us-east-2.compute.internal). At the very bottom of the page, there are links for Feedback, English (US), and a copyright notice: © 2008 - 2018, Amazon Web Services, Inc. or its affiliates. All rights reserved. Privacy Policy and Terms of Use.

## Step 7: Connect to your instance via Terminal

Open a terminal then connect to your instance using SSH. (NOTE: Replace text below in red.)

```
cd /Users/your_username/Downloads/  
chmod 0400 <your .pem file name>  
ssh -L localhost:8888:localhost:8888 -i <your .pem file name>  
ubuntu@<Your instance DNS>  
  
#If you need to connect via proxy:  
ssh -o ProxyCommand='nc -x <your_proxy_address>:<your_proxy_port> <Your  
instance DNS> 22' -L localhost:8888:localhost:8888 -i <your .pem file  
name> ubuntu@<Your instance DNS>
```



```
rpanchum-mac01:~ rpanchum$ cd /Users/rpanchum/Downloads/  
rpanchum-mac01:Downloads rpanchum$ mv my_ohio_aws_key.pem.txt my_ohio_aws_key.pem  
rpanchum-mac01:Downloads rpanchum$ chmod 400 my_ohio_aws_key.pem  
rpanchum-mac01:Downloads rpanchum$ ssh -L localhost:8888:localhost:8888 -i "my_ohio_aws_key.pem" ubuntu@ec2-18-216-168-180.us-east-2.compute.amazonaws.com
```

```
Downloads — ubuntu@ip-172-31-36-3: ~ -- nc -s ssh -o ProxyCommand=nc -L localhost:8888:localhost:8888 -i "my_ohio_aws_key.pem" ubuntu@ec2-18-216-168-180.us-east-2.compute.amazonaws.com 22
Warning: Permanently added 'ec2-18-216-168-180.us-east-2.compute.amazonaws.com' (ECDSA) to the list of known hosts.

=====
|_|_|_) Deep Learning AMI (Ubuntu)
__\|_|__|_

Welcome to Ubuntu 16.04.4 LTS (GNU/Linux 4.4.0-1052-aws x86_64v)

Please use one of the following commands to start the required environment with the framework of your choice:
For MXNet(+Keras1) with Python3 (CUDA 9/MKL) _____ source activate mxnet_p36
For MXNet(+Keras1) with Python2 (CUDA 9/MKL) _____ source activate mxnet_p27
For TensorFlow(+Keras2) with Python3 (CUDA 9/MKL) _____ source activate tensorflow_p36
For TensorFlow(+Keras2) with Python2 (CUDA 9/MKL) _____ source activate tensorflow_p27
For Theano(+Keras2) with Python3 (CUDA 9) _____ source activate theano_p36
For Theano(+Keras2) with Python2 (CUDA 9) _____ source activate theano_p27
For PyTorch with Python3 (CUDA 9) _____ source activate pytorch_p36
For PyTorch with Python2 (CUDA 9) _____ source activate pytorch_p27
For CNTK(+Keras2) with Python3 (CUDA 9) _____ source activate cntk_p36
For CNTK(+Keras2) with Python2 (CUDA 9) _____ source activate cntk_p27
For Caffe2 with Python2 (CUDA 9) _____ source activate caffe2_p27
For Caffe with Python2 (CUDA 8) _____ source activate caffe_p27
For Caffe with Python3 (CUDA 8) _____ source activate caffe_p35
For Chainer with Python2 (CUDA 9) _____ source activate chainer_p27
For Chainer with Python3 (CUDA 9) _____ source activate chainer_p36
For base Python2 (CUDA 9) _____ source activate python2
For base Python3 (CUDA 9) _____ source activate python3

Official Conda User Guide: https://conda.io/docs/user-guide/index.html
AWS Deep Learning AMI Homepage: https://aws.amazon.com/machine-learning/amis/
Developer Guide and Release Notes: https://docs.aws.amazon.com/dlami/latest/devguide/what-is-dlami.html
Support: https://forums.aws.amazon.com/forum.jspa?forumID=263

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

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

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

*** System restart required ***

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.

ubuntu@ip-172-31-36-3:~$
```

#### **Step 8a: Activate desired environment.**

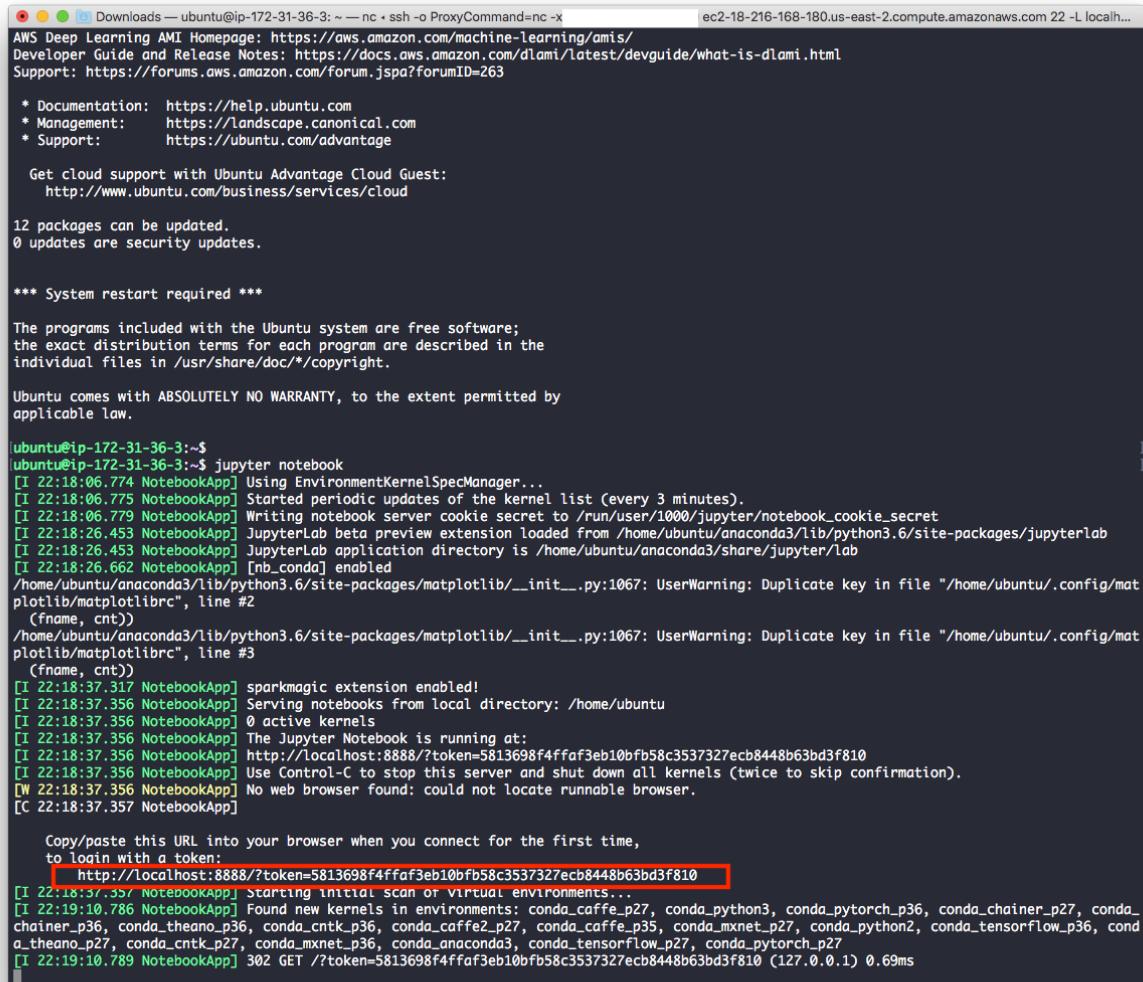
Example to activate mxnet with Python 3 type: source activate mxnet p36

**Example to activate tensorflow with Python 3 type:** source activate tensorflow\_p36

```
[ubuntu@ip-172-31-36-3:~$ source activate tensorflow_p36  
(tensorflow_p36) ubuntu@ip-172-31-36-3:~$
```

## Step 8b: Launching Jupyter notebooks

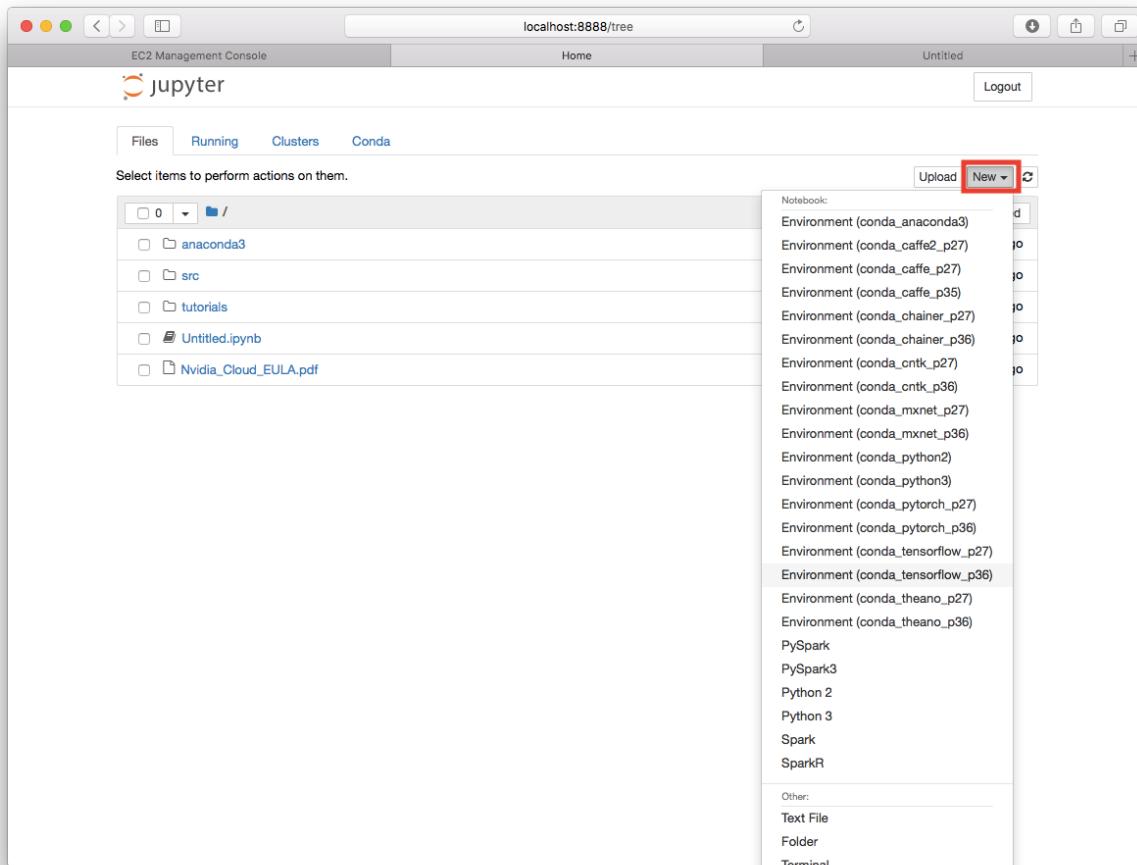
In the terminal, use the command: jupyter notebook. Then copy the URL indicated.



```
Downloads — ubuntu@ip-172-31-36-3: ~ — nc + ssh -o ProxyCommand=nc -x ec2-18-216-168-180.us-east-2.compute.amazonaws.com 22 -L local...  
AWS Deep Learning AMI Homepage: https://aws.amazon.com/machine-learning/amis/  
Developer Guide and Release Notes: https://docs.aws.amazon.com/dlami/latest/devguide/what-is-dlami.html  
Support: https://forums.aws.amazon.com/forum.jspa?forumID=263  
  
* Documentation: https://help.ubuntu.com  
* Management: https://landscape.canonical.com  
* Support: https://ubuntu.com/advantage  
  
Get cloud support with Ubuntu Advantage Cloud Guest:  
http://www.ubuntu.com/business/services/cloud  
  
12 packages can be updated.  
0 updates are security updates.  
  
*** System restart required ***  
  
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.  
  
[ubuntu@ip-172-31-36-3:~]$ jupyter notebook  
[I 22:18:06.774 NotebookApp] Using EnvironmentKernelSpecManager...  
[I 22:18:06.775 NotebookApp] Started periodic updates of the kernel list (every 3 minutes).  
[I 22:18:06.779 NotebookApp] Writing notebook server cookie secret to /run/user/1000/jupyter/notebook_cookie_secret  
[I 22:18:26.453 NotebookApp] JupyterLab beta preview extension loaded from /home/ubuntu/anaconda3/lib/python3.6/site-packages/jupyterlab  
[I 22:18:26.453 NotebookApp] JupyterLab application directory is /home/ubuntu/anaconda3/share/jupyter/lab  
[I 22:18:26.662 NotebookApp] [nb_conda] enabled  
/home/ubuntu/anaconda3/lib/python3.6/site-packages/matplotlib/__init__.py:1067: UserWarning: Duplicate key in file "/home/ubuntu/.config/matplotlib/matplotlibrc", line #2  
(fname, cnt)  
/home/ubuntu/anaconda3/lib/python3.6/site-packages/matplotlib/__init__.py:1067: UserWarning: Duplicate key in file "/home/ubuntu/.config/matplotlib/matplotlibrc", line #3  
(fname, cnt)  
[I 22:18:37.317 NotebookApp] sparkmagic extension enabled!  
[I 22:18:37.356 NotebookApp] Serving notebooks from local directory: /home/ubuntu  
[I 22:18:37.356 NotebookApp] 0 active kernels  
[I 22:18:37.356 NotebookApp] The Jupyter Notebook is running at:  
[I 22:18:37.356 NotebookApp] http://localhost:8888/?token=5813698f4ffaf3eb10bfb58c3537327ecb8448b63bd3f810  
[I 22:18:37.356 NotebookApp] Use Control-C to stop this server and shut down all kernels (twice to skip confirmation).  
[W 22:18:37.356 NotebookApp] No web browser found: could not locate runnable browser.  
[C 22:18:37.357 NotebookApp]  
  
Copy/paste this URL into your browser when you connect for the first time,  
to login with a token:  
http://localhost:8888/?token=5813698f4ffaf3eb10bfb58c3537327ecb8448b63bd3f810  
[I 22:18:37.357 NotebookApp] Starting initial scan or virtual environments...  
[I 22:19:10.786 NotebookApp] Found new kernels in environments: conda_caffe_p27, conda_python3, conda_pytorch_p36, conda_chainer_p27, conda_chainer_p36, conda_theano_p36, conda_cntk_p36, conda_caffe2_p27, conda_caffe_p35, conda_mxnet_p27, conda_python2, conda_tensorflow_p36, conda_theano_p27, conda_cntk_p27, conda_mxnet_p36, conda_anaconda3, conda_tensorflow_p27, conda_pytorch_p27  
[I 22:19:10.789 NotebookApp] 302 GET /?token=5813698f4ffaf3eb10bfb58c3537327ecb8448b63bd3f810 (127.0.0.1) 0.69ms
```

## Step 9: Start a new notebook

Open a browser window and navigate to the URL indicated in the last step. Choose New and start a new notebook.



**Next Steps:** To run benchmarks, please visit *Benchmarks* section in :

<https://ai.intel.com/amazon-web-services-works-with-intel-to-enable-optimized-deep-learning-frameworks-on-amazon-ec2-cpu-instances/>