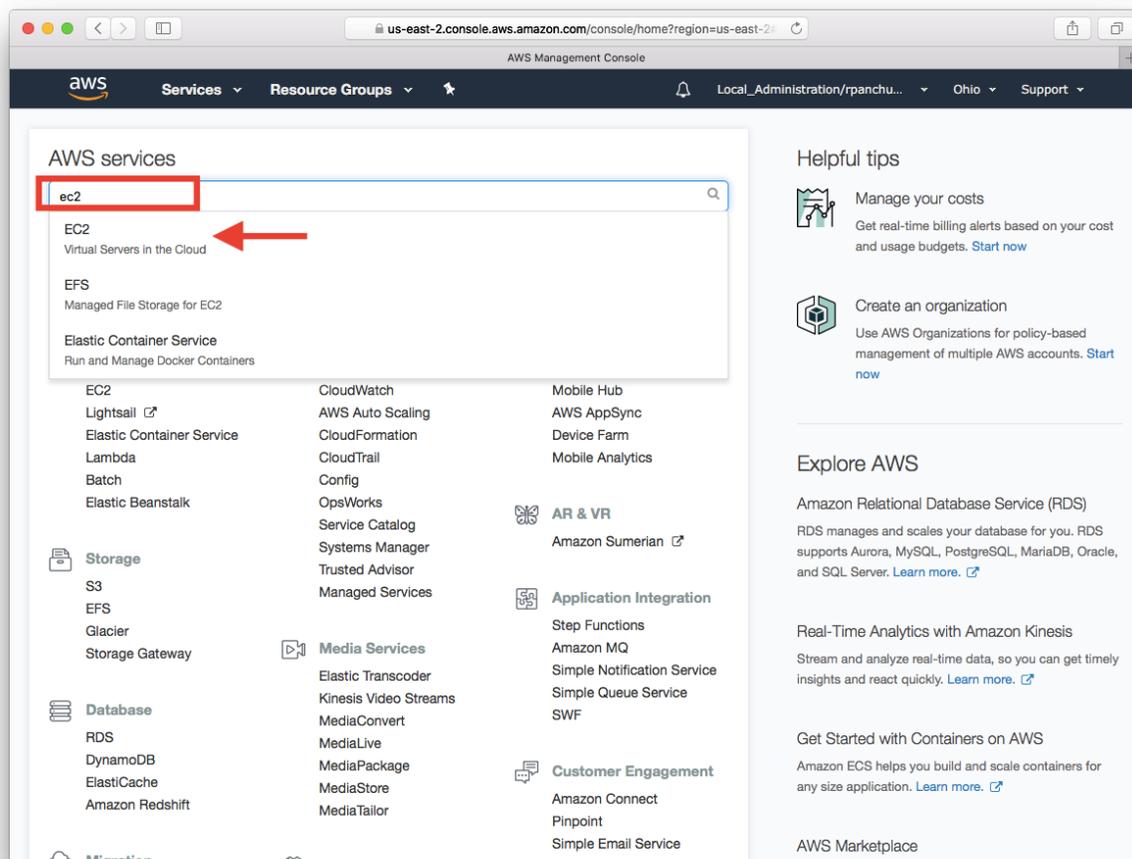


Get Started with Deep Learning Using the AWS Deep Learning AMI with Intel CPUs

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 displays the AWS Management Console interface for the EC2 Management Console in the us-east-2 region. The main content area is titled "Resources" and lists various Amazon EC2 resources currently in use in the US East (Ohio) region:

- 0 Running Instances
- 0 Elastic IPs
- 0 Dedicated Hosts
- 0 Snapshots
- 0 Volumes
- 0 Load Balancers
- 0 Key Pairs
- 1 Security Groups
- 0 Placement Groups

A blue notification box contains the text: "Learn more about the latest in AWS Compute from AWS re:Invent 2017 by viewing the EC2 Videos."

The "Create Instance" section is visible, with the "Launch Instance" button highlighted by a red rectangular box. Below this button, a note states: "Note: Your instances will launch in the US East (Ohio) region."

The "Service Health" section shows the status for "US East (Ohio)":

- Service Status:** US East (Ohio): This service is operating normally.
- Availability Zone Status:**
 - us-east-2a: Availability zone is operating normally.
 - us-east-2b: Availability zone is operating normally.

The "Scheduled Events" section shows "US East (Ohio): No events".

The right-hand sidebar contains "Account Attributes" (Supported Platforms, VPC, Default VPC, vpc-15628b7c, Resource ID length management) and "Additional Information" (Getting Started Guide, Documentation, All EC2 Resources, Forums, Pricing, Contact Us). The "AWS Marketplace" section at the bottom right promotes "Barracuda CloudGen Firewall for AWS - PAYG" with a 5-star rating and pricing details.

The footer of the console includes "Feedback", "English (US)", and copyright information: "© 2008 - 2018, Amazon Web Services, Inc. or its affiliates. All rights reserved." along with links for "Privacy Policy" and "Terms of Use".

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 Management Console interface for selecting an Amazon Machine Image (AMI). The page title is "Step 1: Choose an Amazon Machine Image (AMI)". The search bar contains the text "deep learning ami ubuntu". The left sidebar shows the "AWS Marketplace" tab selected. The main content area displays three AMIs:

- Deep Learning AMI (Ubuntu)**: Sold by Amazon Web Services, 5 stars, \$0.023 to \$41.944/hr incl EC2 charges + other AWS usage fees. Includes Apache MXNet, TensorFlow, PyTorch, Caffe, ...
- Deep Learning Base AMI (Ubuntu)**: Sold by Amazon Web Services, 4 stars, \$0.023 to \$41.944/hr incl EC2 charges + other AWS usage fees. Includes NVIDIA CUDA, cuDNN, GPU drivers, Intel MKL-DNN and other low-level system libraries for deploying your own custom deep learning ...
- NVIDIA Volta Deep Learning AMI**: Sold by NVIDIA, 5 stars, \$0.023 to \$41.944/hr incl EC2 charges + other AWS usage fees.

The "Select" button for the "Deep Learning AMI (Ubuntu)" is highlighted with a red box.

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

The screenshot shows the AWS Management Console interface for the 'Deep Learning AMI (Ubuntu)'. The page is divided into several sections:

- Product Details:** Sold by Amazon Web Services, Customer Rating of 5 stars, 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, and AWS Services Required Amazon EC2, Amazon EBS.
- Highlights:** Used Ubuntu 16.04 (ami-cd0f5cb6) as base AMI.
- Pricing Details:** A table showing hourly fees for various instance types, including R3, R4, M5, M4, H1, High I/O, T2, C4, M5, X1, T2 Double, T2 Extra, High I/O Extra, and C4 Extra.

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

The 'Continue' button is highlighted with a red box at the bottom right of the details panel.

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 Management Console interface for configuring an EC2 instance. The current step is 'Step 2: Choose an Instance Type'. The 'Filter by' dropdown is set to 'Compute optimized'. The 'Currently selected' instance is 'c5.18xlarge (278 ECUs, 72 vCPUs, 3 GHz, Intel Xeon Platinum 8124M, 144 GiB memory, EBS only)'. A note indicates that the vendor recommends using a 'p3.2xlarge' instance for the best experience. A table lists various instance types, with 'c5.18xlarge' selected. The 'Next: Configure Instance Details' button is highlighted.

	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 Management Console interface for configuring an EC2 instance. The page title is "Step 3: Configure Instance Details". The breadcrumb navigation shows the steps: 1. Choose AMI, 2. Choose Instance Type, 3. Configure Instance, 4. Add Storage, 5. Add Tags, 6. Configure Security Group, 7. Review. The main content area is titled "Step 3: Configure Instance Details" and includes a sub-header "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." The form contains several sections: "Number of instances" (1), "Purchasing option" (Request Spot instances), "Network" (vpc-15628b7c (default)), "Subnet" (No preference (default subnet in any Availability Zone)), "Auto-assign Public IP" (Use subnet setting (Enable)), "Placement group" (Add instance to placement group), "IAM role" (None), "Shutdown behavior" (Stop), "Enable termination protection" (Protect against accidental termination), "Monitoring" (Enable CloudWatch detailed monitoring), "EBS-optimized instance" (Launch as EBS-optimized instance), and "Tenancy" (Shared - Run a shared hardware instance). The "Review and Launch" button is highlighted with a red box. The footer includes "Feedback", "English (US)", and copyright information.

Step 3c: Launch your instance

Click Launch on the Review page.

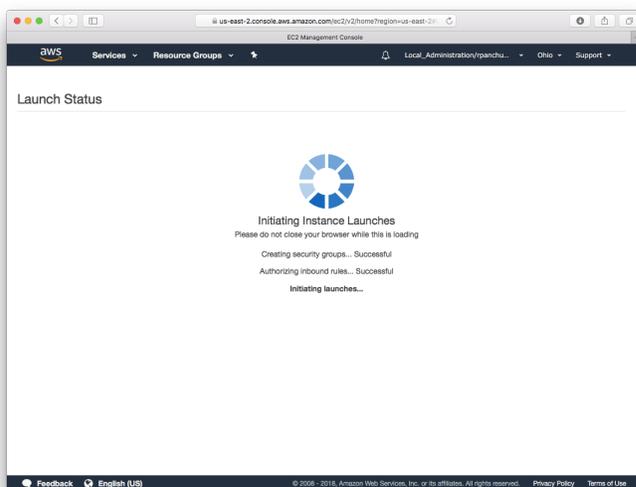
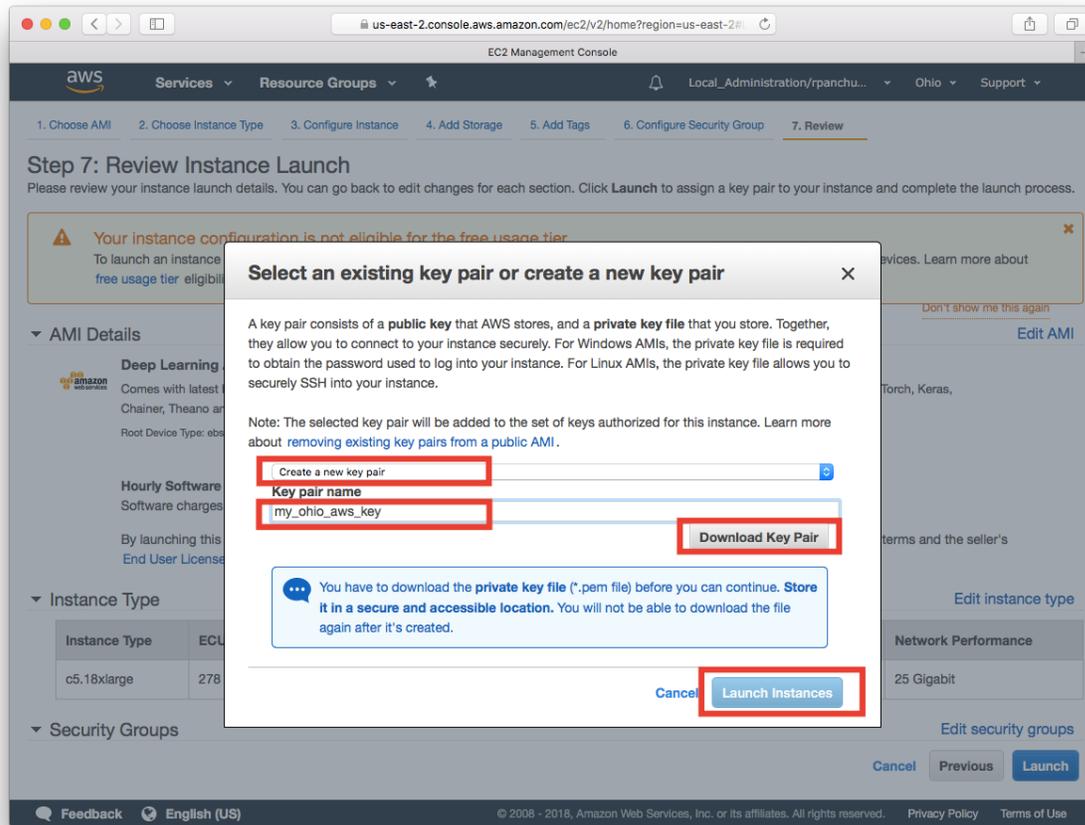
The screenshot shows the AWS Management Console interface for launching an EC2 instance. The breadcrumb trail indicates the current step is '7. Review'. A warning message states: 'Your instance configuration is not eligible for the free usage tier'. Below this, the 'AMI Details' section shows 'Deep Learning AMI (Ubuntu)' with specifications for EBS and virtualization. The 'Instance Type' section features a table with the following data:

Instance Type	ECUs	vCPUs	Memory (GiB)	Instance Storage (GB)	EBS-Optimized Available	Network Performance
c5.18xlarge	278	72	144	EBS only	Yes	25 Gigabit

The 'Security Groups' section is partially visible. At the bottom right, the 'Launch' button is highlighted with a red box, alongside 'Cancel' and 'Previous' buttons.

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”.



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

The screenshot shows the AWS Management Console interface. At the top, the browser address bar displays the URL: `us-east-2.console.aws.amazon.com/ec2/v2/home?region=us-east-2#`. The console header includes the AWS logo, navigation menus for 'Services' and 'Resource Groups', and user information for 'Local_Administration/rpanchu...'. The main content area is titled 'Launch Status' and features a green notification box with a checkmark icon. The notification text reads: 'Your instances are now launching. The following instance launches have been initiated: **i-074f6253178f31e90** View launch log'. The instance ID 'i-074f6253178f31e90' is highlighted with a red rectangular box. Below this, there is a blue information box with an 'i' icon, titled 'Get notified of estimated charges', which includes a link to 'Create billing alerts'. Further down, the page provides instructions on 'How to connect to your instances' and a section for 'Getting started with your software' with two buttons: 'View Usage Instructions' and 'Open Your Software on AWS Marketplace'. At the bottom, there are links for 'Feedback', 'English (US)', and copyright information for 2008-2018.

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

EC2 Management Console

aws Services Resource Groups Local_Administration/rpanchu... Ohio Support

Launch Status

✔ Your instances are now launching
The following instance launches have been initiated: **i-074f6253178f31e90** [View launch log](#)

ℹ 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.

Getting started with your software

To get started with Deep Learning AMI (Ubuntu) [View Usage Instructions](#)

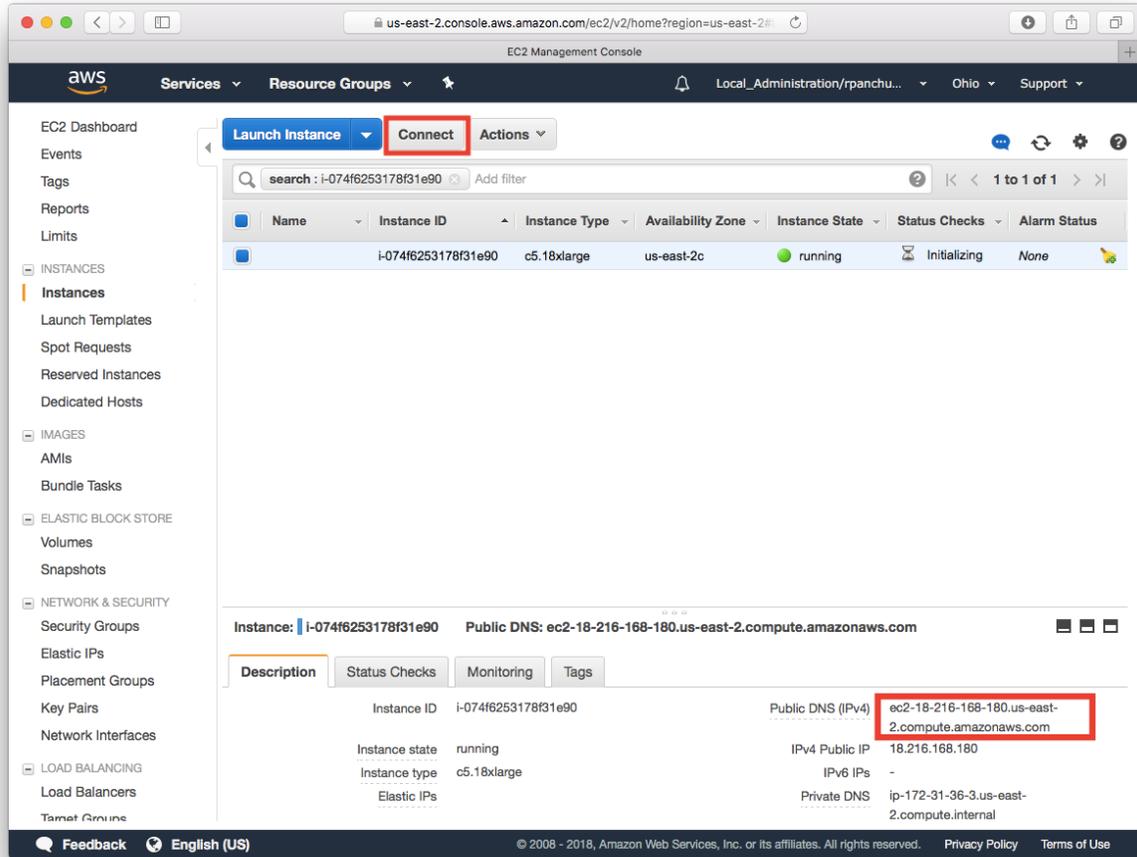
To manage your software subscription [Open Your Software on AWS Marketplace](#)

Here are some helpful resources to get you started

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

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

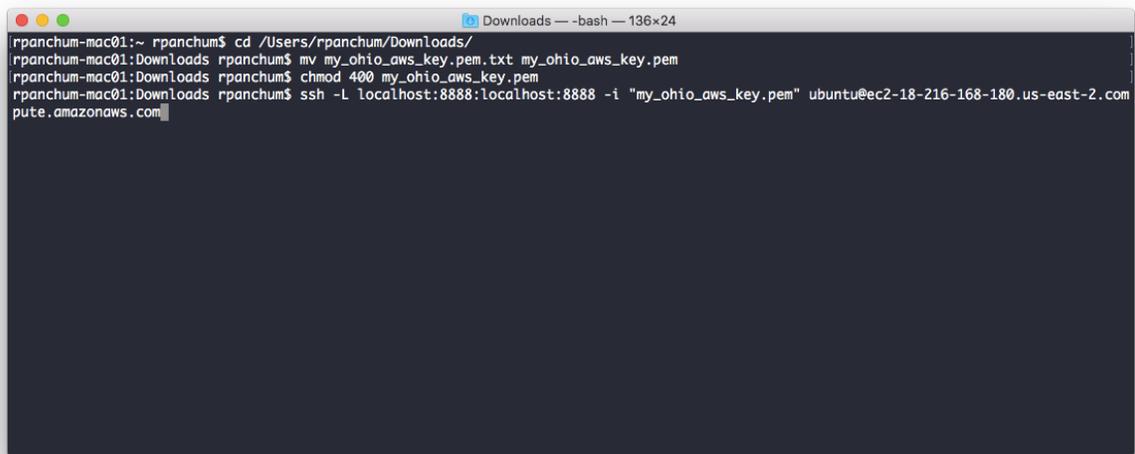
Step 6: Click “Connect” to view instructions to ssh into the instance.



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.com  
pute.amazonaws.com
```

```
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 localh...
rpanchum-mac01:Downloads rpanchum$ ssh -o ProxyCommand='nc -x ec2-18-216-168-180.us-east-2.compute.amazonaws.com 22'
-L localhost:8888:localhost:8888 -i "my_ohio_aws_key.pem" ubuntu@ec2-18-216-168-180.us-east-2.compute.amazonaws.com
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`

```
Downloads — ubuntu@ip-172-31-36-3: ~ — nc + ssh -o ProxyCommand=nc -x ec...
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 localh...
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.

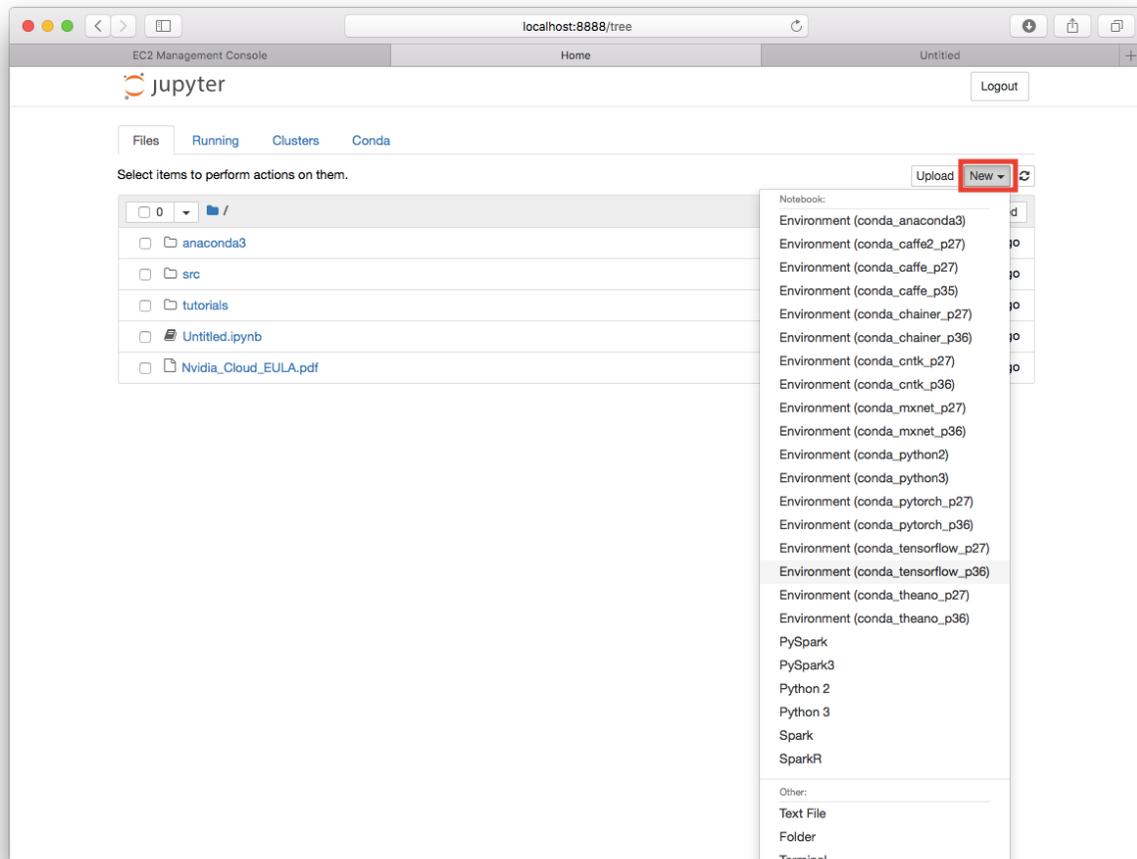
Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

ubuntu@ip-172-31-36-3:~$
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 of 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/>