Using Deep Learning for predicting hand written digits

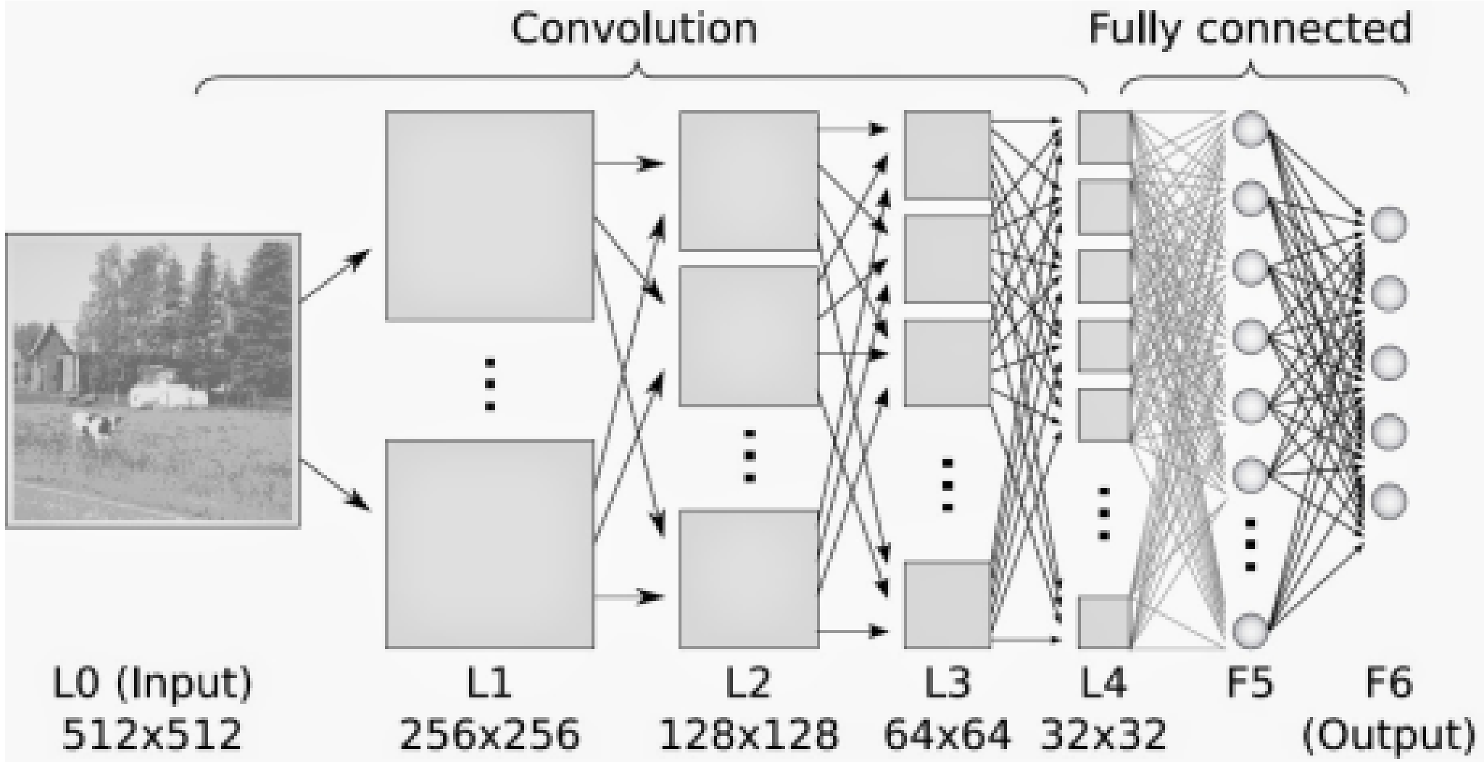
By: Pratap Timilsina

Objective

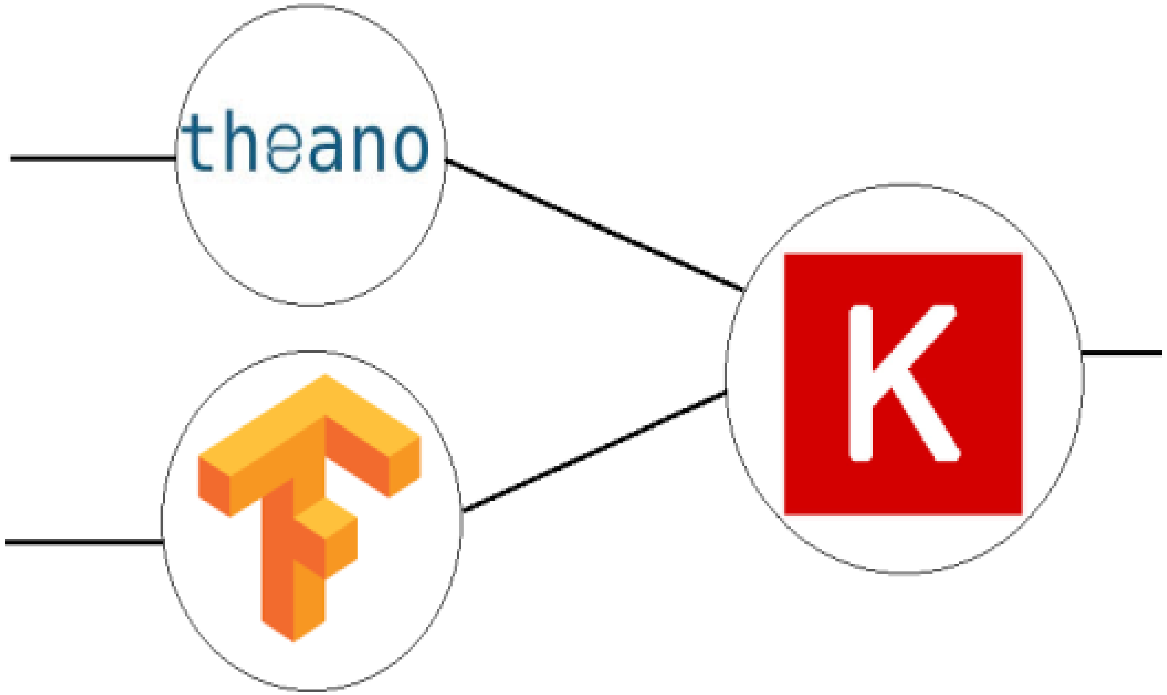
- Use AWS for Deep Learning
- Learn and use a Deep Learning Library to build a Neural Network for predicting hand written digits
- Optimize neural network with accuracy metric

Convolutional Neural Network (CNN)

- Convolutional neural networks are a special type of feed-forward networks.
- These models are designed to emulate the behavior of a visual cortex. CNNs perform very well on visual recognition tasks.



Libraries Used



- Theano is a Python library that allows you to define, optimize, and evaluate mathematical expressions involving multi-dimensional arrays efficiently.

- TensorFlow™ is an open source software library for numerical computation using data flow graphs.

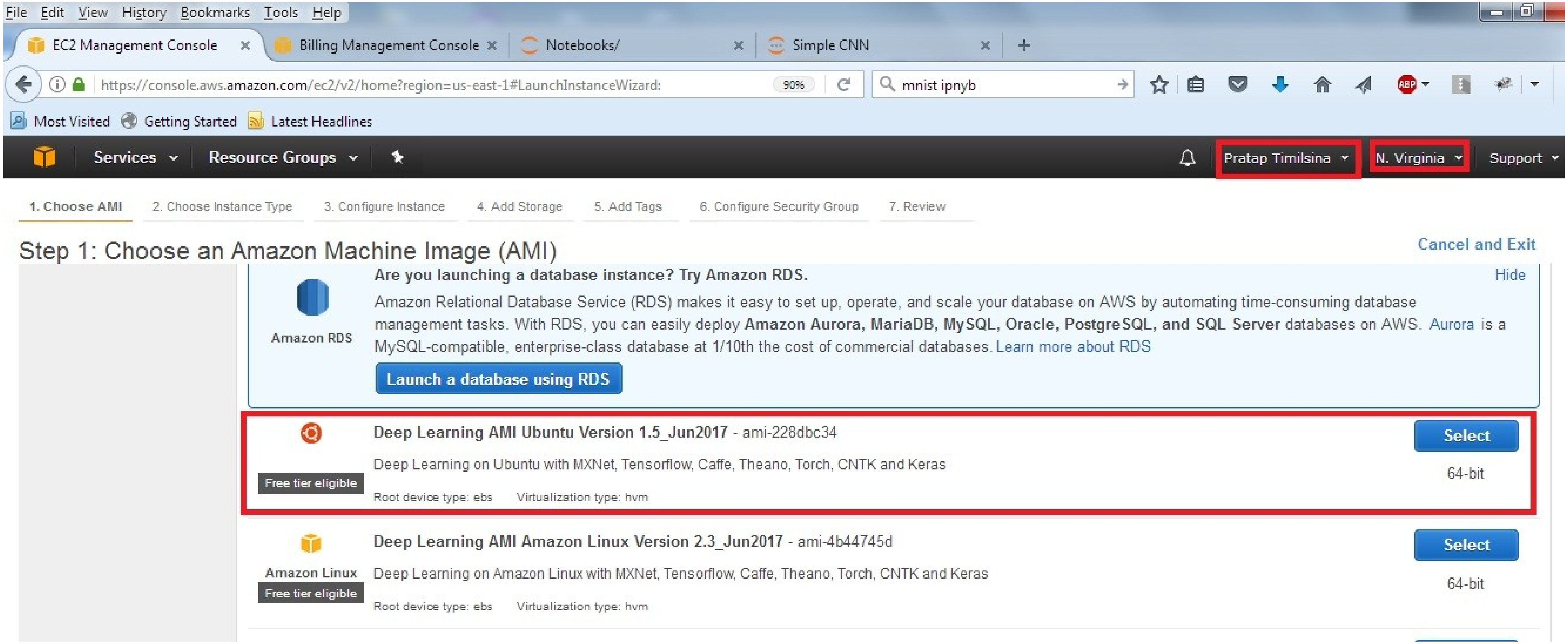
- Keras is a high-level neural networks library, written in Python and capable of running on top of either TensorFlow or Theano.

AWS

- Create EC2 instance
- Select Deep learning A
- Add security groups as

Type	Protocol	Port Range	Source
HTTPS	TCP	443	0.0.0.0/0
SSH	TCP	22	0.0.0.0/0
Custom TCP Rule	TCP	8888	0.0.0.0/0

AWS Deep Learning AMI



Step 1: Choose an Amazon Machine Image (AMI)

Are you launching a database instance? Try Amazon RDS.

Amazon Relational Database Service (RDS) makes it easy to set up, operate, and scale your database on AWS by automating time-consuming database management tasks. With RDS, you can easily deploy **Amazon Aurora, MariaDB, MySQL, Oracle, PostgreSQL, and SQL Server** databases on AWS. Aurora is a MySQL-compatible, enterprise-class database at 1/10th the cost of commercial databases. Learn more about RDS

Deep Learning AMI Ubuntu Version 1.5_Jun2017 - ami-228dbc34

Free tier eligible

Deep Learning on Ubuntu with MXNet, Tensorflow, Caffe, Theano, Torch, CNTK and Keras

Root device type: ebs Virtualization type: hvm

64-bit

Deep Learning AMI Amazon Linux Version 2.3_Jun2017 - ami-4b44745d

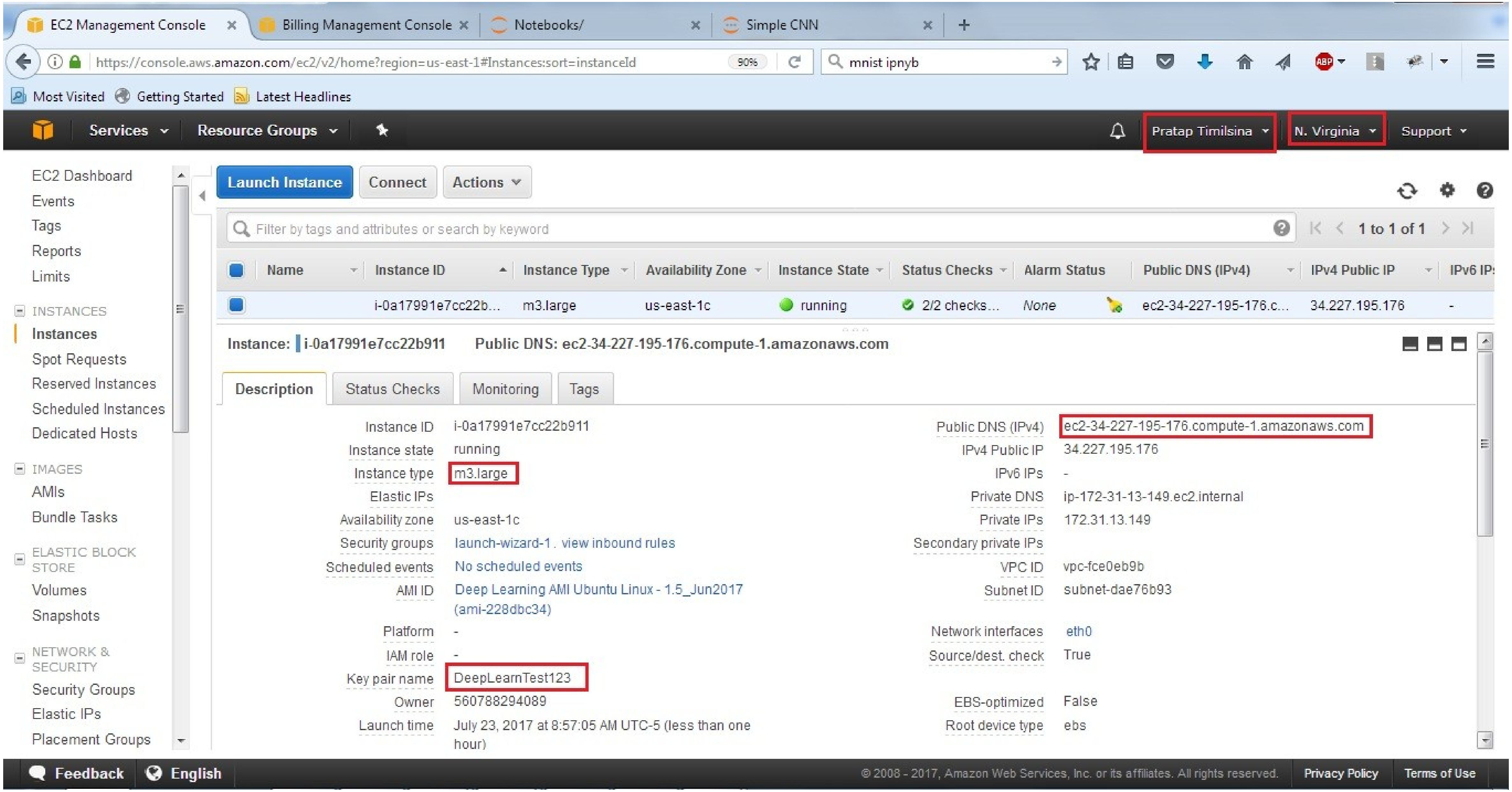
Deep Learning on Amazon Linux with MXNet, Tensorflow, Caffe, Theano, Torch, CNTK and Keras

Root device type: ebs Virtualization type: hvm

64-bit

- **Create AWS EC2 instance: Select Deep Learning AMI Ubuntu**
- **It is preinstalled with Deep learning libraries Tensorflow, Theano, Keras….so on….**
- **Anaconda is installed already with jupyter**

AWS EC2 Setup

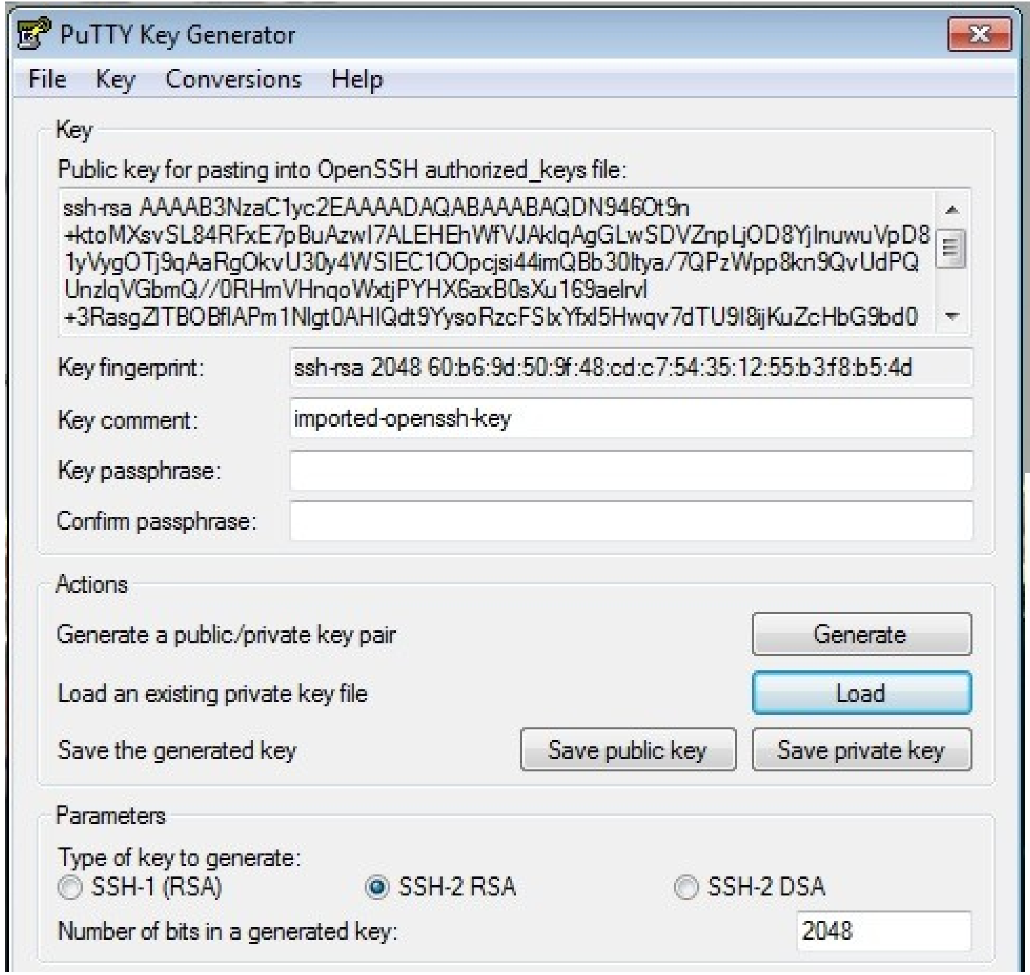


Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public IP	IPv6 IPs
	i-0a17991e7cc22b...	m3.large	us-east-1c	running	2/2 checks...	None	ec2-34-227-195-176.c...	34.227.195.176	-

Instance: i-0a17991e7cc22b911 Public DNS: ec2-34-227-195-176.compute-1.amazonaws.com

Instance ID	i-0a17991e7cc22b911	Public DNS (IPv4)	ec2-34-227-195-176.compute-1.amazonaws.com
Instance state	running	IPv4 Public IP	34.227.195.176
Instance type	m3.large	IPv6 IPs	-
Elastic IPs		Private DNS	ip-172-31-13-149.ec2.internal
Availability zone	us-east-1c	Private IPs	172.31.13.149
Security groups	launch-wizard-1 . view inbound rules	Secondary private IPs	
Scheduled events	No scheduled events	VPC ID	vpc-fce0eb9b
AMI ID	Deep Learning AMI Ubuntu Linux - 1.5_Jun2017 (ami-228dbc34)	Subnet ID	subnet-dae76b93
Platform	-	Network interfaces	eth0
IAM role	-	Source/dest. check	True
Key pair name	DeepLearnTest123		
Owner	560788294089	EBS-optimized	False
Launch time	July 23, 2017 at 8:57:05 AM UTC-5 (less than one hour)	Root device type	ebs

Putty Key Generator



Public key for pasting into OpenSSH authorized_keys file:

```
ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAABAQDN946Ot9n
+ktoMXsvSL84RFxE7pBuAzwI7ALEHEhWfVJAklqAgGLwSDVZnpLjOD8YjInuwuVpD8
1yVygOTj9qAaRgOkvU30y4WSIEC1OOpcjsi44imQBb30ltya/7QPzWpp8kn9QvUdPQ
UnzlqVGbmQ//0RHmVHnqoWxtjPYHX6axB0sXu169aelrvl
+3RasgZlTBOBflAPm1Nlgt0AHIQdt9YysoRzcFSlxYfxl5Hwqv7dTU9I8ijKuZcHbG9bd0
```

Key fingerprint: ssh-rsa 2048 60:b6:9d:50:9f:48:cd:c7:54:35:12:55:b3:f8:b5:4d

Key comment: imported-openssh-key

Key passphrase:

Confirm passphrase:

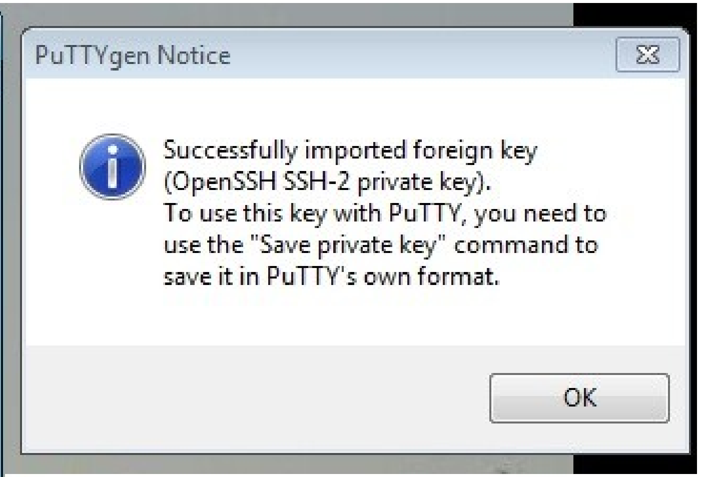
Generate a public/private key pair

Load an existing private key file

Save the generated key

Type of key to generate:
○ SSH-1 (RSA) ● SSH-2 RSA ○ SSH-2 DSA

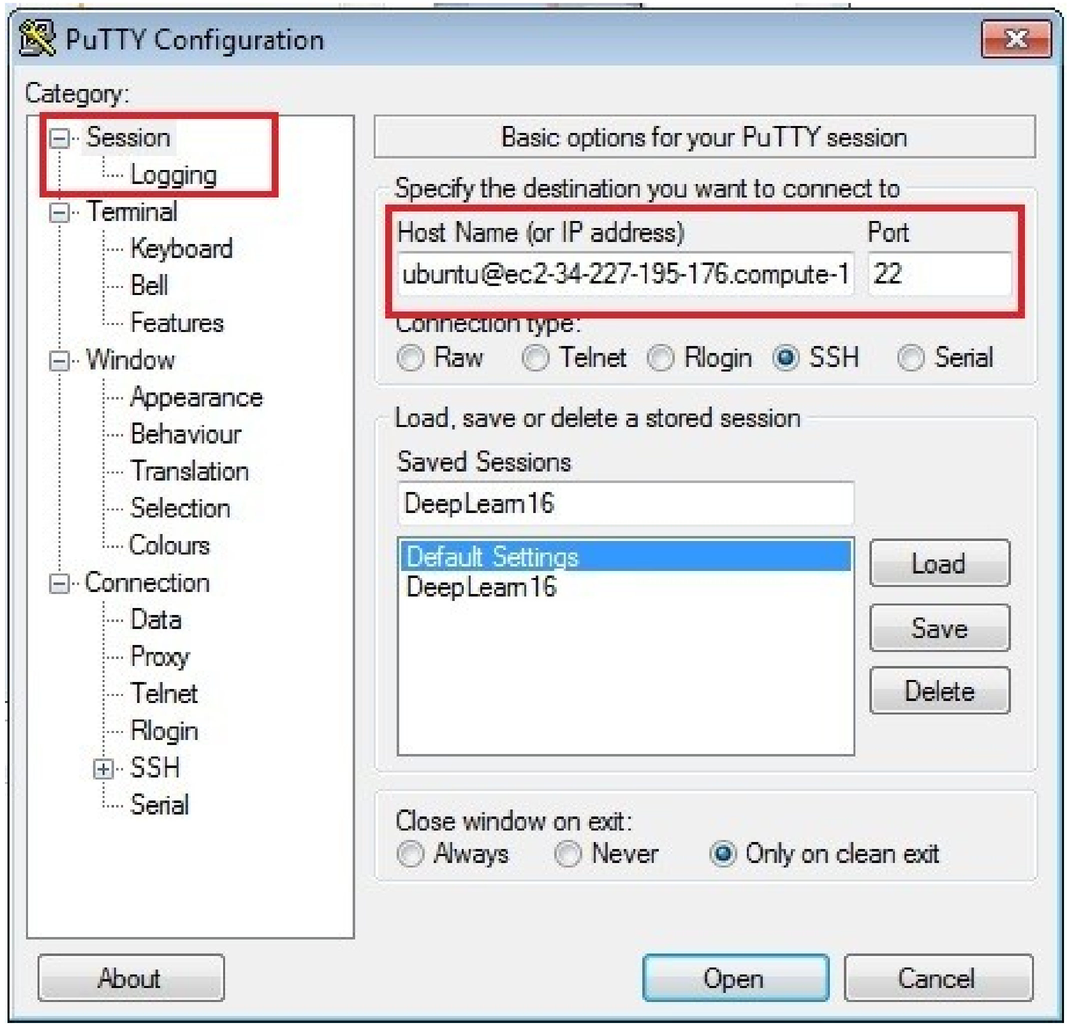
Number of bits in a generated key: 2048



Successfully imported foreign key (OpenSSH SSH-2 private key).
To use this key with PuTTY, you need to use the "Save private key" command to save it in PuTTY's own format.

- **Download DeepLearnTest123.pem key from aws which is used for authentication while SSH**
- **Winscp is used to transfer files from local machine to AWS Server**

SSH



Basic options for your PuTTY session

Specify the destination you want to connect to

Host Name (or IP address): ubuntu@ec2-34-227-195-176.compute-1

Port: 22

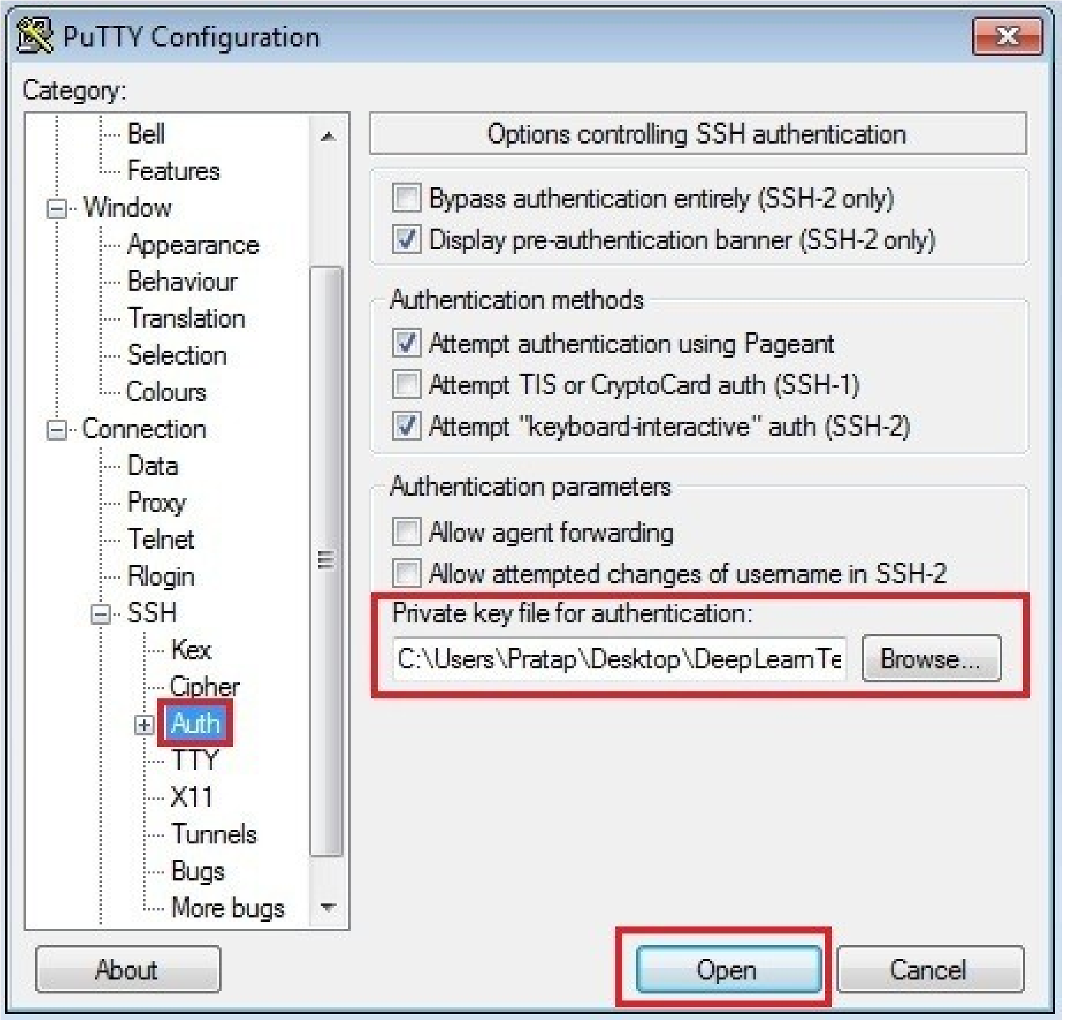
Connection type:
○ Raw ○ Telnet ○ Rlogin ● SSH ○ Serial

Load, save or delete a stored session

Saved Sessions: DeepLearn16

Default Settings
DeepLearn16

Close window on exit:
○ Always ○ Never ● Only on clean exit



Options controlling SSH authentication

□ Bypass authentication entirely (SSH-2 only)
☑ Display pre-authentication banner (SSH-2 only)

Authentication methods
☑ Attempt authentication using Pageant
□ Attempt TIS or CryptoCard auth (SSH-1)
☑ Attempt "keyboard-interactive" auth (SSH-2)

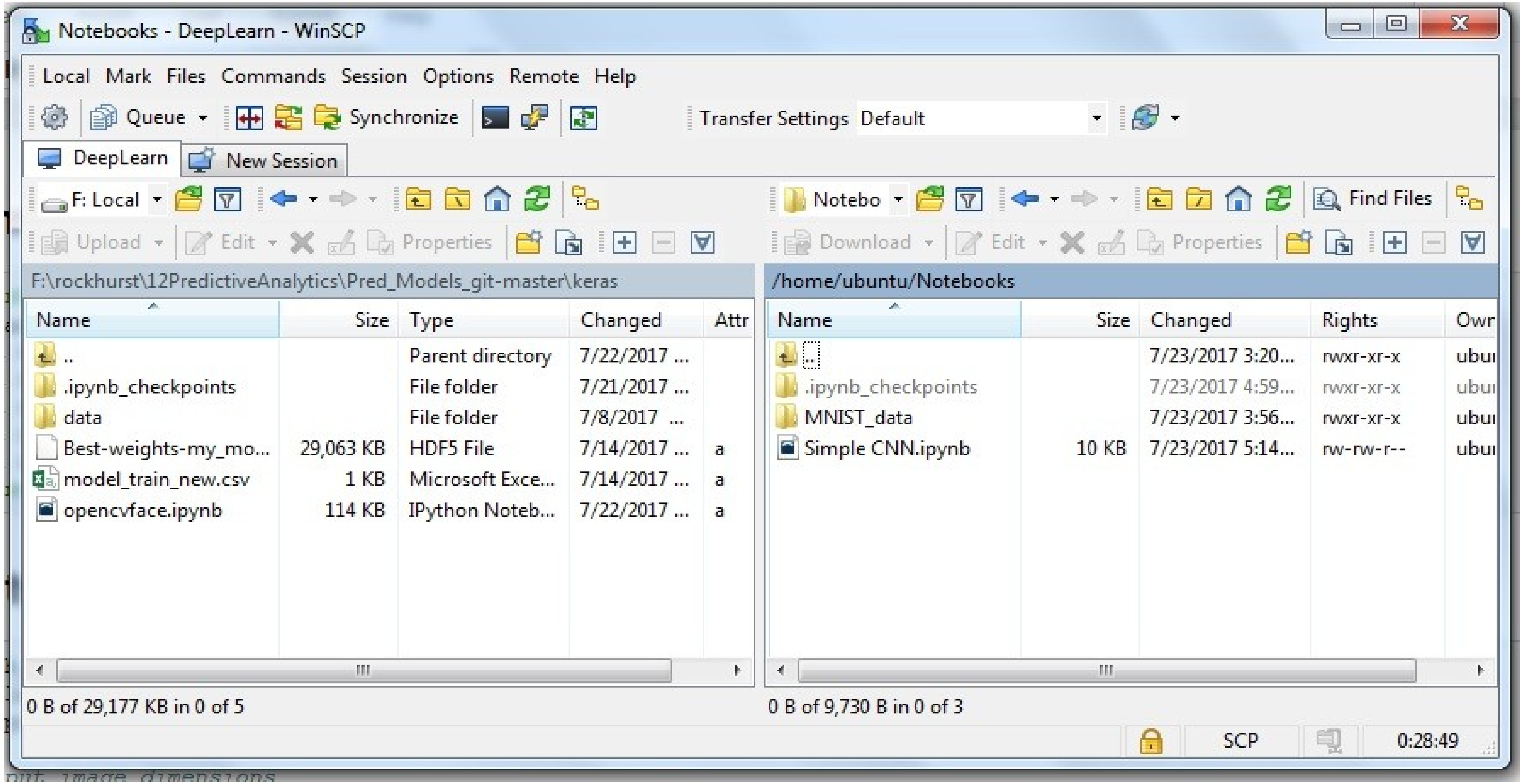
Authentication parameters
□ Allow agent forwarding
□ Allow attempted changes of username in SSH-2

Private key file for authentication:
C:\Users\Pratap\Desktop\DeepLearnTe

st **Name**:ubuntu@ec2-34-227-195-176.compute-1.amazonaws.com

Private key file for authentication:
C:\Users\Pratap\Desktop\DeepLearnTest123.ppk

Winscp



F:\rockhurst\12PredictiveAnalytics\Pred_Models_git-master\keras

Name	Size	Type	Changed	Attr
..		Parent directory	7/22/2017 ...	
.ipynb_checkpoints		File folder	7/21/2017 ...	
data		File folder	7/8/2017 ...	
Best-weights-my_mo...	29,063 KB	HDF5 File	7/14/2017 ...	a
model_train_new.csv	1 KB	Microsoft Exce...	7/14/2017 ...	a
opencvface.ipynb	114 KB	IPython Noteb...	7/22/2017 ...	a

0 B of 29,177 KB in 0 of 5

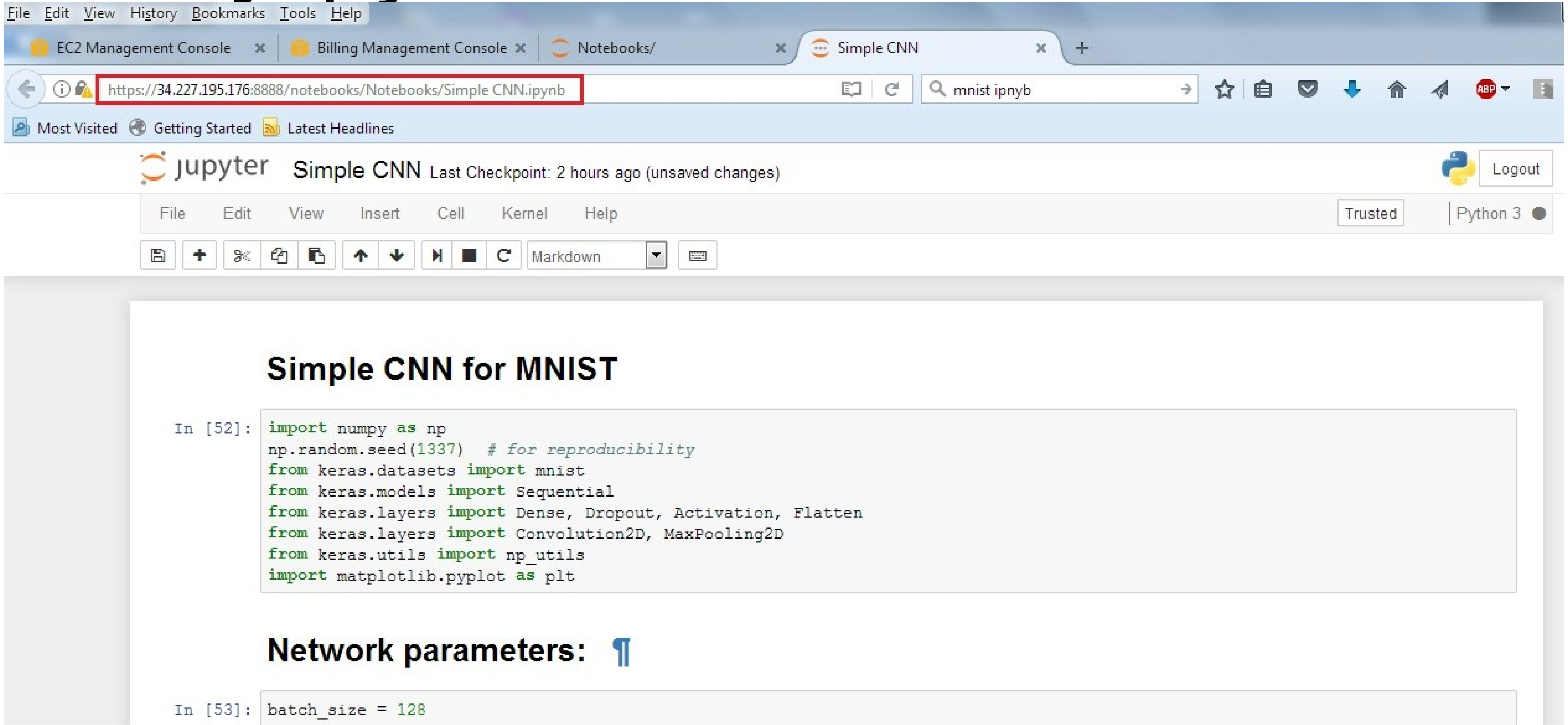
/home/ubuntu/Notebooks

Name	Size	Changed	Rights	Owr
..		7/23/2017 3:20...	rwxr-xr-x	ubu
.ipynb_checkpoints		7/23/2017 4:59...	rwxr-xr-x	ubu
MNIST_data		7/23/2017 3:56...	rwxr-xr-x	ubu
Simple CNN.ipynb	10 KB	7/23/2017 5:14...	rw-rw-r--	ubu

0 B of 9,730 B in 0 of 3

- **Winscp is set as SSH**
- **Winscp is used to transfer files from local machine to AWS Server**

AWS Jupyter


File Edit View History Bookmarks Tools Help
EC2 Management Console
Billing Management Console
Notebooks/
Simple CNN
https://34.227.195.176:8888/notebooks/Notebooks/Simple CNN.ipynb
mnist ipnyb
Most Visited
Getting Started
Latest Headlines
jupyter
Simple CNN Last Checkpoint: 2 hours ago (unsaved changes)
Logout
File Edit View Insert Cell Kernel Help
Trusted
Python 3
Markdown

Simple CNN for MNIST

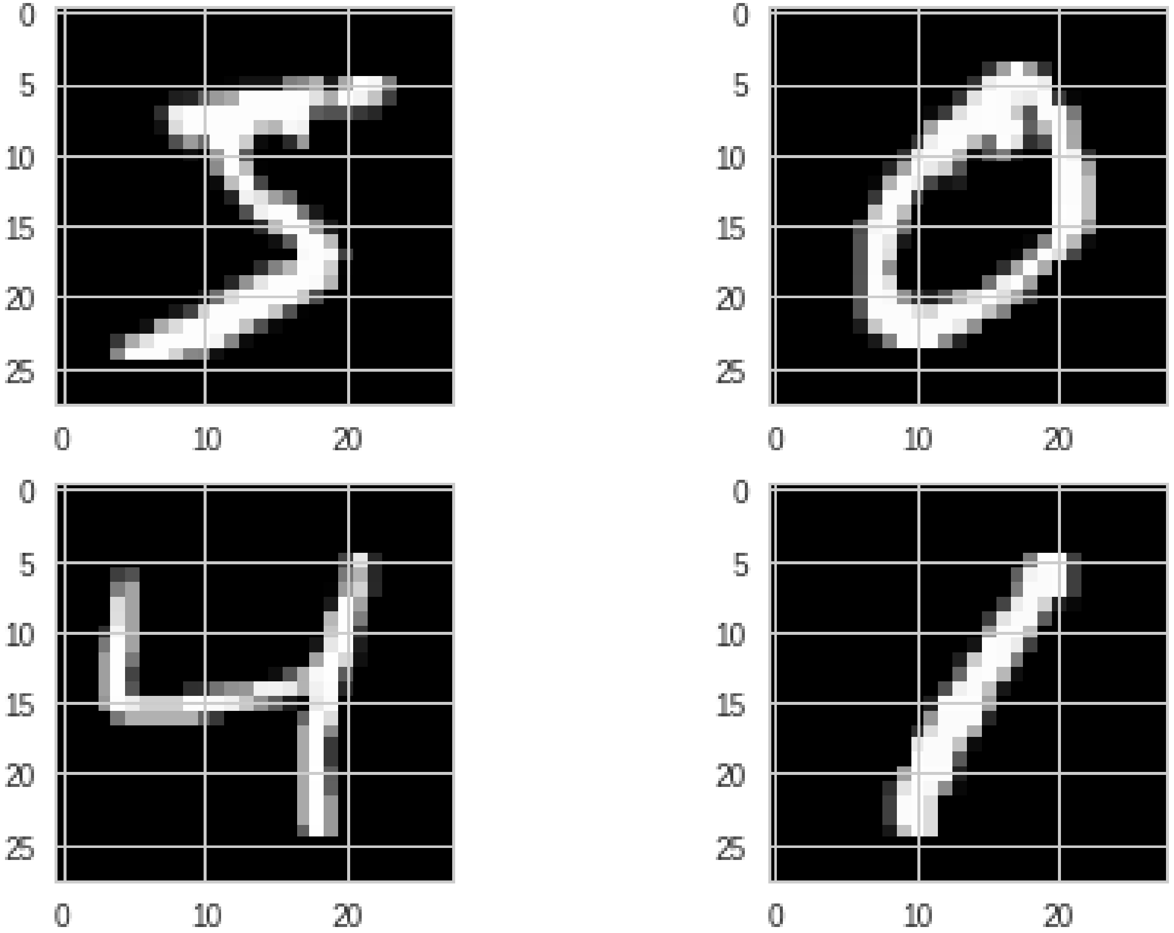
In [52]:
```
import numpy as np
np.random.seed(1337)  # for reproducibility
from keras.datasets import mnist
from keras.models import Sequential
from keras.layers import Dense, Dropout, Activation, Flatten
from keras.layers import Convolution2D, MaxPooling2D
from keras.utils import np_utils
import matplotlib.pyplot as plt
```

Network parameters: ¶

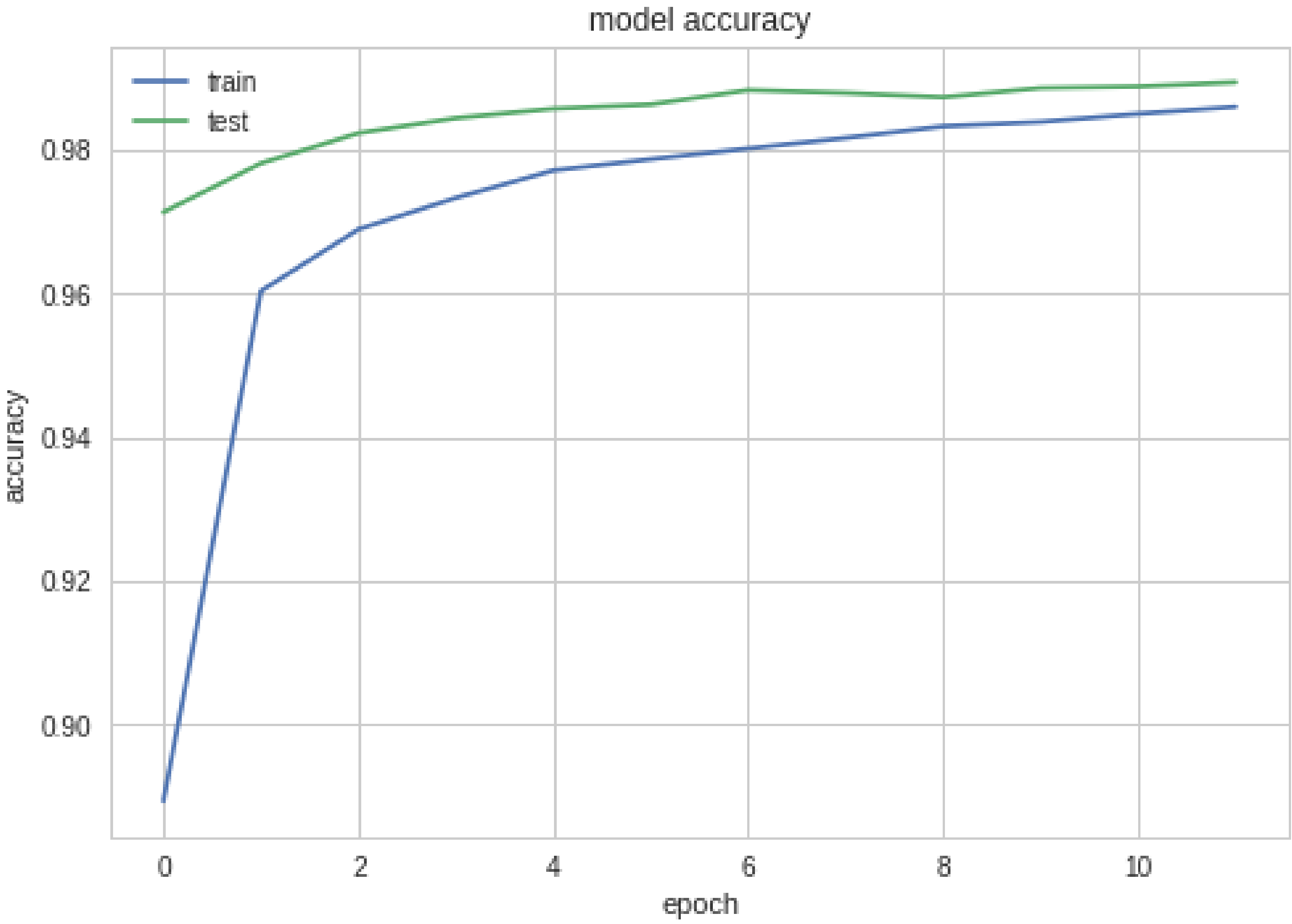
In [53]:
```
batch_size = 128
```

On Browser: https://34.227.195.176:8888 we are able to login jupyter where we can run CNN digit predicting algorithm using preinstalled deep learning libraries

Hand Written Letters



Result(Accuracy)



- **Run Simple CNN to predict hand written digits**
- **CNN is able to predict a digit given a picture of a hand-written digit with 98.94% accuracy**

Conculsion

- Able to setup AWS EC2 instance with preinstalled Deep learning libraries
- Putty SSH to AWS server using private key generated using puttygen
- Run Jupyter on browser (Jupyter is on EC2)
- Able to get digit prediction accuracy of 99%

Future Plan

- Automate AWS steps with boto3
- Image Recognition using human, cat, dog images
- Use GPU in aws for fast data processing