CUDA as the Prerequisite for Tensor Flow

https://www.tensorflow.org/tutorials/

1. Find the version of your ubuntu

*uname -m && cat /etc/*release*

or

lsb_release -a

```
ubuntu@ubuntu-ThinkPad-Yoga-14: ~
ubuntu@ubuntu-ThinkPad-Yoga-14:~$ lsb_release -a
No LSB modules are available.
Distributor ID: Ubuntu
Description:    Ubuntu 14.04.5 LTS
Release:        14.04
Codename:       trusty
ubuntu@ubuntu-ThinkPad-Yoga-14:~$
```

Run lshw to find out your CPU feature

Ubuntu 14.04 support CUDA tool kit 8.0 :

X86_64 Ubuntu 14.04 kernel: 3.13; gcc: 4.8.2; glibc: 2.19

For ARMv8 CPU (aarch64) is the same version requirements.

2. find the graphics card your machine support

sudo lshw -C video | grep product:

```
ubuntu@ubuntu-ThinkPad-Yoga-14: ~
ubuntu@ubuntu-ThinkPad-Yoga-14:~$ sudo lshw -C video | grep product:
       product: Sky Lake Integrated Graphics
       product: GM108M [GeForce 940M]
ubuntu@ubuntu-ThinkPad-Yoga-14:~$
```

GPU GeForce 940M is CUDA capable (compute capability 5.0, see NVDA website

https://developer.nvidia.com/cuda-gpus

If needs GPU driver down load:

http://www.nvidia.com/Download/index.aspx?lang=en-us

Since I have GPU (GeForce 940M), to install CUDA tool kit 8.0, will have to check if the GPU is CUDA capable.

http://docs.nvidia.com/cuda/cuda-installation-guide-linux/#axzz4VZnqTJ2A

Cuda Compute Capability Explained (1)

https://stackoverflow.com/questions/10961476/what-are-the-differences-between-cuda-compute-capabilities

Feature Support	Compute Capability						
(Unlisted features are supported for all compute capabilities)	1.0	1.1	1.2	1.3	2.x	3.0	3.5, 5.0
Atomic functions operating on 32-bit integer values in global memory (Atomic Functions)	No	Yes					
atomicExch() operating on 32-bit floating point values in global memory (atomicExch())							
Atomic functions operating on 32-bit integer values in shared memory (Atomic Functions)	No		Yes				
atomicExch() operating on 32-bit floating point values in shared memory (atomicExch())							
Atomic functions operating on 64-bit integer values in global memory (Atomic Functions)							
Warp vote functions (Warp Vote Functions)							
Double-precision floating-point numbers	No			Yes			

Note: my laptop GeForce 940M, supports 5.0

Cuda Compute Capability Explained (2)

https://stackoverflow.com/questions/10961476/what-are-the-differences-between-cuda-compute-capabilities

Feature Support	Compute Capability						
(Unlisted features are supported for all compute capabilities)	1.0	1.1	1.2	1.3	2.x	3.0	3.5, 5.0
Atomic functions operating on 64-bit integer values in shared memory (Atomic Functions)	No				Yes		
Atomic addition operating on 32-bit floating point values in global and shared memory (atomicAdd())							
__ballot() (Warp Vote Functions)							
__threadfence_system() (Memory Fence Functions)							
__syncthreads_count(), __syncthreads_and(), __syncthreads_or() (Synchronization Functions)							
Surface functions (Surface Functions)							
3D grid of thread blocks							
Unified Memory Programming	No					Yes	
Funnel shift (see reference manual)	No						Yes
Dynamic Parallelism							

CUDA Installation Guide

http://docs.nvidia.com/cuda/cuda-installation-guide-linux/index.html#axzz4oHtT15GP

Find ubuntu gcc compiler version:

gcc -v

Note: the guideline for installation
Verify the system has a CUDA-capable GPU.
Verify the system is running a supported version of Linux.
Verify the system has gcc installed.
Verify the system has the correct kernel headers and development packages installed.
Download the NVIDIA CUDA Toolkit.
Handle conflicting installation methods.

Read more at: http://docs.nvidia.com/cuda/cuda-installation-guide-linux/index.html#ixzz4oCNBURHX
Follow us: @GPUComputing on Twitter | NVIDIA on Facebook

Verify Correct Kernel Header CUDA

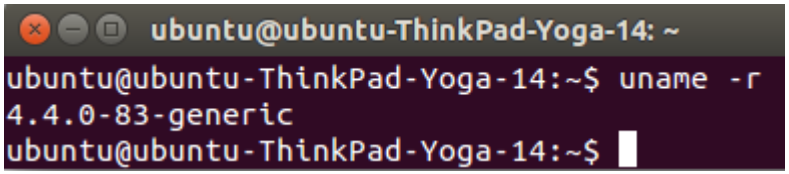
http://docs.nvidia.com/cuda/cuda-installation-guide-linux/index.html#axzz4oHtT15GP

The kernel headers and development packages has to be installed.

1. the Runfile is not good, Runfile installation performs no package validation; 2. the RPM and Deb installations of the driver will make an attempt to install the kernel header; http://docs.nvidia.com/cuda/cuda-installation-guide-linux/index.html#ixzz4oHvMk6G3

2. Find the version of your linux kernel

uname -r



This is the version of the kernel headers and development packages that must be installed prior to installing the CUDA Drivers.

To install the header and the package:

```
sudo apt-get install linux-headers-$(uname -r)
```

The NVIDIA CUDA Toolkit is available at http://developer.nvidia.com/cuda-downloads.

Installation Instructions:

`sudo dpkg -i cuda-repo-ubuntu1404-8-0-local-ga2_8.0.61-1_amd64.deb`

`sudo apt-get update`

`sudo apt-get install cuda`

Make sure do download verification:
? ? ?

add CUDA to the PATH

export PATH=/usr/local/cuda-8.0/bin${PATH:+:${PATH}}

Export PATH and Profiler Installation

PATH is a global OS variable contains names of files to be executed without specyfing the whole path. For example You can just write startx to start graphic environemnt instead of /bin/some other folders/startx

Run . ~/.profile for changes to take immediate effect

To add a directory to your $PATH, follow any one of the below. (example, to add '/usr/hitech/picc/9.82/bin/picc'

simply edit ~/.profile

```
gedit ~/.profile
find the following line:
PATH="$HOME/bin:$PATH"
and change it to:
PATH="$HOME/bin:
$PATH:/usr/hitech/picc/9.82/bin"

Or run the below command in terminal
export PATH=$PATH:/usr/hitech/picc/9.82/bin
```

export PATH=/usr/local/cuda-8.0/bin${PATH:+:${PATH}}

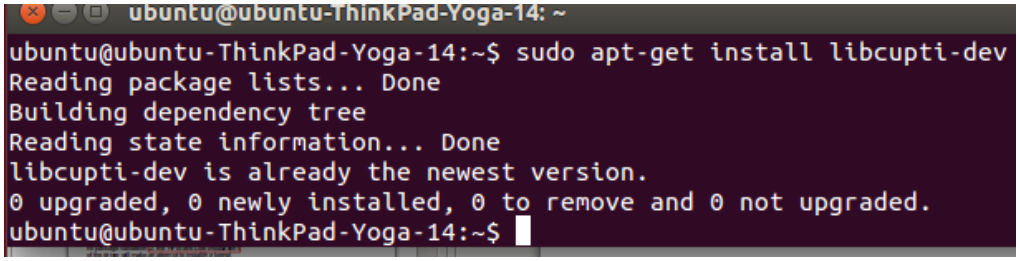
The libcupti-dev library, which is the NVIDIA CUDA Profile Tools Interface. This library provides advanced profiling support. To install this library, issue the following command

https://www.tensorflow.org/install/install_linux

Note: when I did the above for libcupti-dev, I have got a some kind symbolic link error messsage, after searching google, I did:

sudo apt-get update
sudo apt-get upgrade

Then retry install libcupti-dev, the error is gone.



cuDNN v5.1 Installation

Deep Neural Network library (cuDNN)

cuDNN accelerates widely used deep learning frameworks, including Caffe, Caffe2, TensorFlow, Theano, Torch, and Microsoft Cognitive Toolkit. See supported frameworks for more details.

https://developer.nvidia.com/rdp/form/cudnn-download-survey

Step 5. Just Download cuDNN 5.1 click Here and follow the steps (Tested on Ubuntu 16.04, CUDA toolkit 8.0)

```
$ tar xvzf cudnn-8.0-linux-x64-v5.1-ga.tgz
$ sudo cp -P cuda/include/cudnn.h /usr/local/cuda/include
$ sudo cp -P cuda/lib64/libcudnn* /usr/local/cuda/lib64
$ sudo chmod a+r /usr/local/cuda/include/cudnn.h /usr/local/cuda/lib64/libcudnn*
```

Now set Path variables

```
$ vim ~/.bashrc

export LD_LIBRARY_PATH="$LD_LIBRARY_PATH:/usr/local/cuda/lib64:/usr/local/cuda/extras/CUPTI/lib64"
export CUDA_HOME=/usr/local/cuda
```

and done

https://stackoverflow.com/questions/41991101/importerror-libcudnn-when-running-a-tensorflow-program

Tensor Flow Installation on Ubuntu 14.04

https://www.tensorflow.org/tutorials/

After all the prerequisite, now follow the tensor flow installation recommendation, go with virtualenv installation for isolated python environment.5 Steps from the tensor flow tutorial:
Step 1: sudo apt-get install python3-pip python3-dev python-virtualenv

Step 2: virtualenv --system-site-packages -p python3 ~/tensorflow

Step 3: $source ~/tensorflow/bin/activate # bash, sh, ksh, or zsh (note, you can use the following for your choice:
 $ source ~/tensorflow/bin/activate.csh # csh or tcsh) if it is successful, then The preceding source command should change your prompt to the following:
(tensorflow)$

Note: check your python version
$python --version

```
ubuntu@ubuntu-ThinkPad-Yoga-14: ~/tensorflow
(tensorflow)ubuntu@ubuntu-ThinkPad-Yoga-14:~/tensorflow$ python --version
Python 3.4.3
(tensorflow)ubuntu@ubuntu-ThinkPad-Yoga-14:~/tensorflow$
```

Step 4: pip3 install --upgrade tensorflow-gpu
But had error message of no download was found, so upgrade pip and tensorflow as follows, then install again, the error was gone.

pip install --upgrade pip
pip install --upgrade tensorflow

```
ubuntu@ubuntu-ThinkPad-Yoga-14:~/tensorflow$ ls
bin  include  lib
ubuntu@ubuntu-ThinkPad-Yoga-14:~/tensorflow$ source ~/tensorflow/bin/activate
(tensorflow)ubuntu@ubuntu-ThinkPad-Yoga-14:~/tensorflow$ ls
bin  include  lib
(tensorflow)ubuntu@ubuntu-ThinkPad-Yoga-14:~/tensorflow$
```

Step 5. Just Download cuDNN 5.1 click Here and follow the steps (Tested on Ubuntu 16.04, CUDA toolkit 8.0)

Note: see cuDNN installation slide.

I have had an error after installation of Tensorflow, “ImportError: libcudnn.Version: cannot open shared object file: No such file or director“, after reinstall cuDNN, the error is gone.

Tensor Flow Installation on Ubuntu 14.04

https://www.tensorflow.org/tutorials/

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Step 1: sudo apt-get install python3-pip python3-dev python-virtualenv

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 $ source ~/tensorflow/bin/activate.csh # csh or tcsh) if it is successful, then The preceding source command should change your prompt to the following:
(tensorflow)$

Note: check your python version
$python --version

```
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(tensorflow)ubuntu@ubuntu-ThinkPad-Yoga-14:~/tensorflow$ python --version
Python 3.4.3
(tensorflow)ubuntu@ubuntu-ThinkPad-Yoga-14:~/tensorflow$
```

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But had error message of no download was found, so upgrade pip and tensorflow as follows, then install again, the error was gone.

pip install --upgrade pip
pip install --upgrade tensorflow

```
ubuntu@ubuntu-ThinkPad-Yoga-14: ~/tensorflow
ubuntu@ubuntu-ThinkPad-Yoga-14:~/tensorflow$ ls
bin  include  lib
ubuntu@ubuntu-ThinkPad-Yoga-14:~/tensorflow$ source ~/tensorflow/bin/activate
(tensorflow)ubuntu@ubuntu-ThinkPad-Yoga-14:~/tensorflow$ ls
bin  include  lib
(tensorflow)ubuntu@ubuntu-ThinkPad-Yoga-14:~/tensorflow$
```

Step 5. Just Download cuDNN 5.1 click Here and follow the steps (Tested on Ubuntu 16.04, CUDA toolkit 8.0)

$ tar xvzf cudnn-8.0-linux-x64-v5.1-ga.tgz
 $ sudo cp -P cuda/include/cudnn.h /usr/local/cuda/include
 $ sudo cp -P cuda/lib64/libcudnn* /usr/local/cuda/lib64
 $ sudo chmod a+r /usr/local/cuda/include/cudnn.h /usr/local/cuda/lib64/libcudnn*

Activate and Deactivate Tensor Flow

To activate:

```
$ source ~/tensorflow/bin/activate      # bash, sh, ksh, or zsh
$ source ~/tensorflow/bin/activate.csh  # csh or tcsh
```

To deactivate:

$deactivate

Your prompt will become the following to indicate that your tensorflow environment is active:

```
(tensorflow)$
```

Tensor Flow Lecture Notes 1

https://www.tensorflow.org/get_started/get_started

Two rows and
3 columns

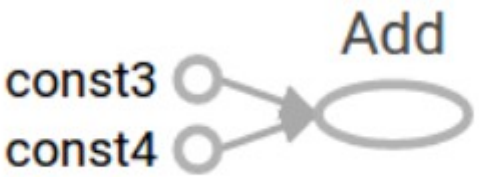
Define Tensor:

```
3 # a rank 0 tensor; this is a scalar with shape []

[1. ,2., 3.] # a rank 1 tensor; this is a vector with shape [3]

[[1., 2., 3.], [4., 5., 6.]] # a rank 2 tensor; a matrix with shape [2, 3]

[[[1., 2., 3.]], [[7., 8., 9.]]] # a rank 3 tensor with shape [2, 1, 3]
```

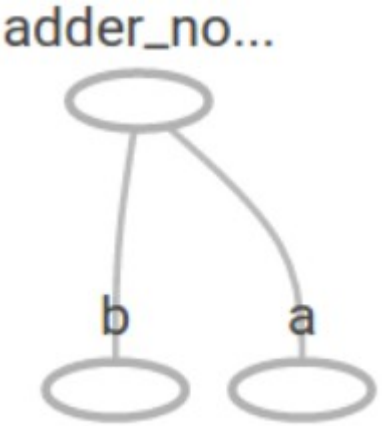


Import Tensorflow

The canonical import statement for TensorFlow programs:

```
import tensorflow as tf
```

This gives Python access to all of TensorFlow's classes, methods, and symbols.



A computational graph is a series of TensorFlow operations arranged into a graph of nodes.

Create 2 floating point Tensors node1 and node2 as follows:

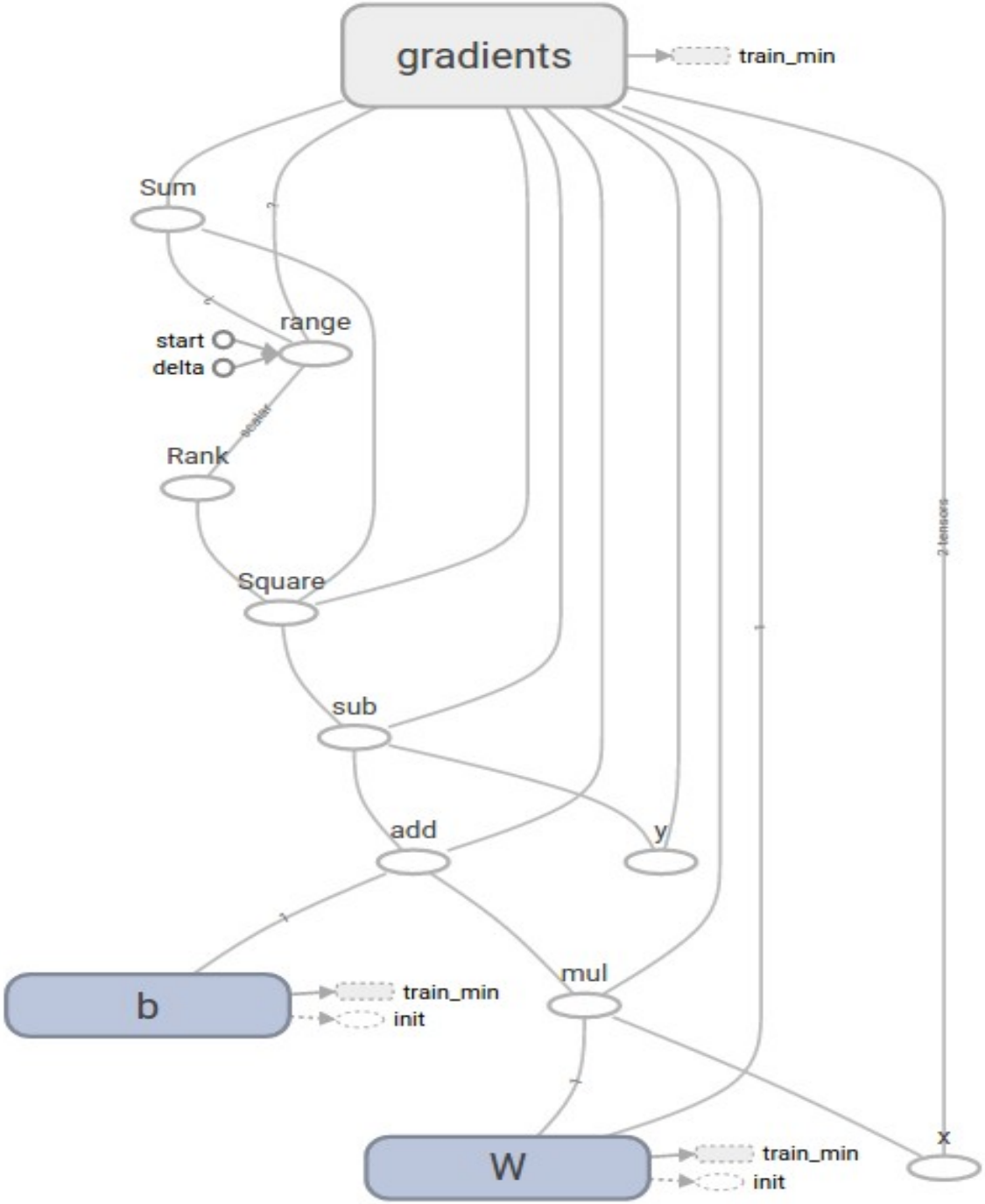
```
node1 = tf.constant(3.0, dtype=tf.float32)
node2 = tf.constant(4.0) # also tf.float32 implicitly
print(node1, node2)
```

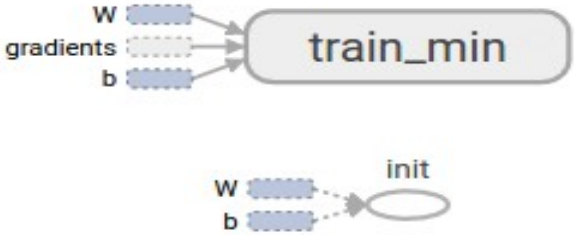
The final print statement produces

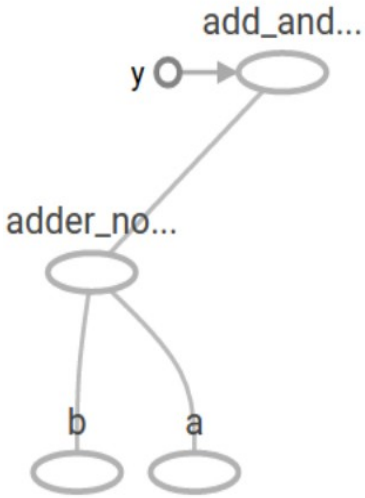
```
Tensor("Const:0", shape=(), dtype=float32) Tensor("Const_1:0", shape=(), dtype=float32)
```

Notice that printing the nodes does not output the values 3.0 and 4.0 as you might expect. Instead, they are nodes that, when evaluated, would produce 3.0 and 4.0, respectively.

Tensor Flow Lecture Notes 1







Your First Python Program

The program first.py

```
print(“Harry, hello”)
```

To run it:

$python first.py