# Introduction To TensorFlow And A Case Study

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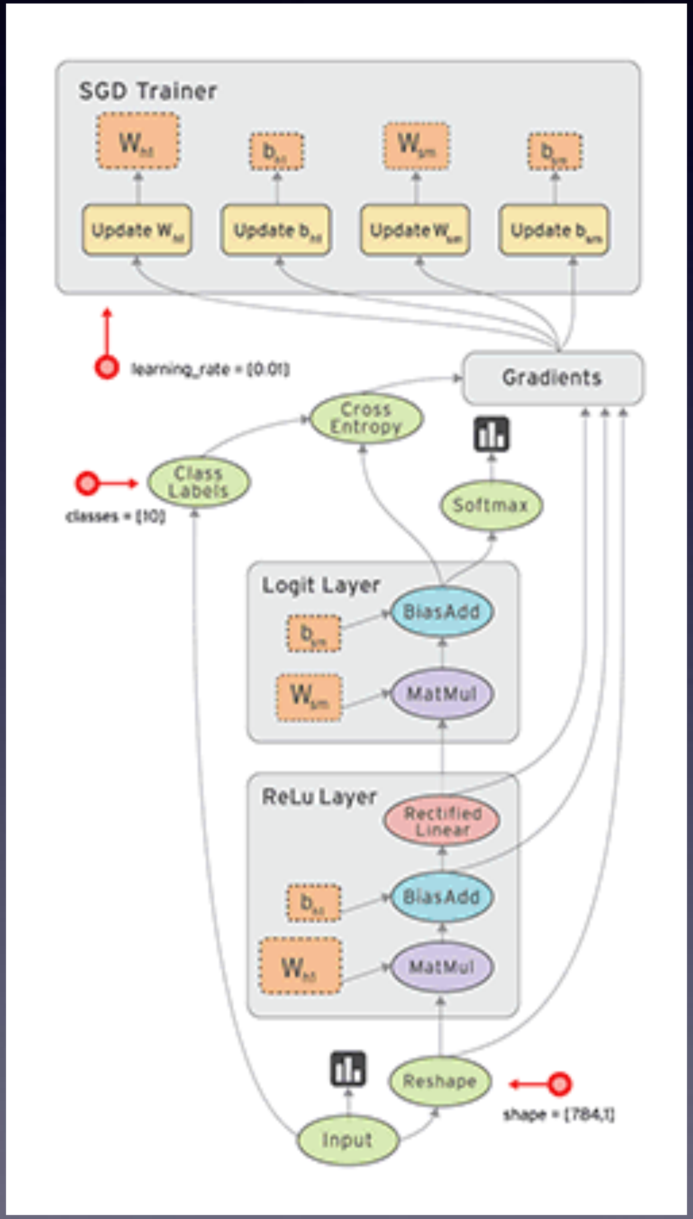
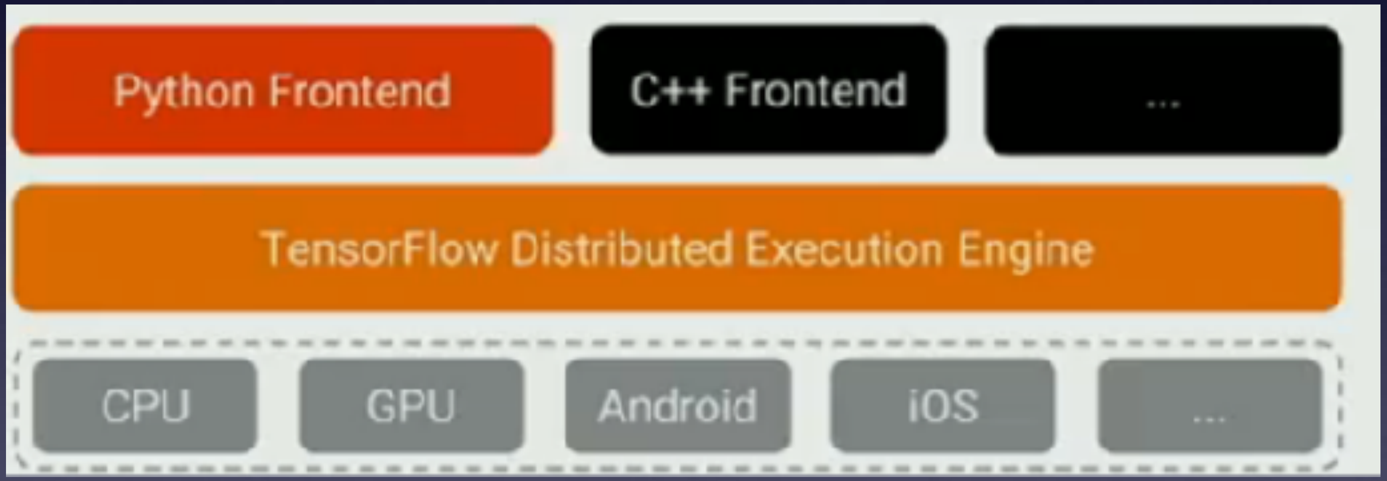
# Agenda

1. TensorFlow Features
2. A Toy Example But Not Mnist

# A Brief Introduction to TensorFlow





Python Frontend | C++ Frontend | ...

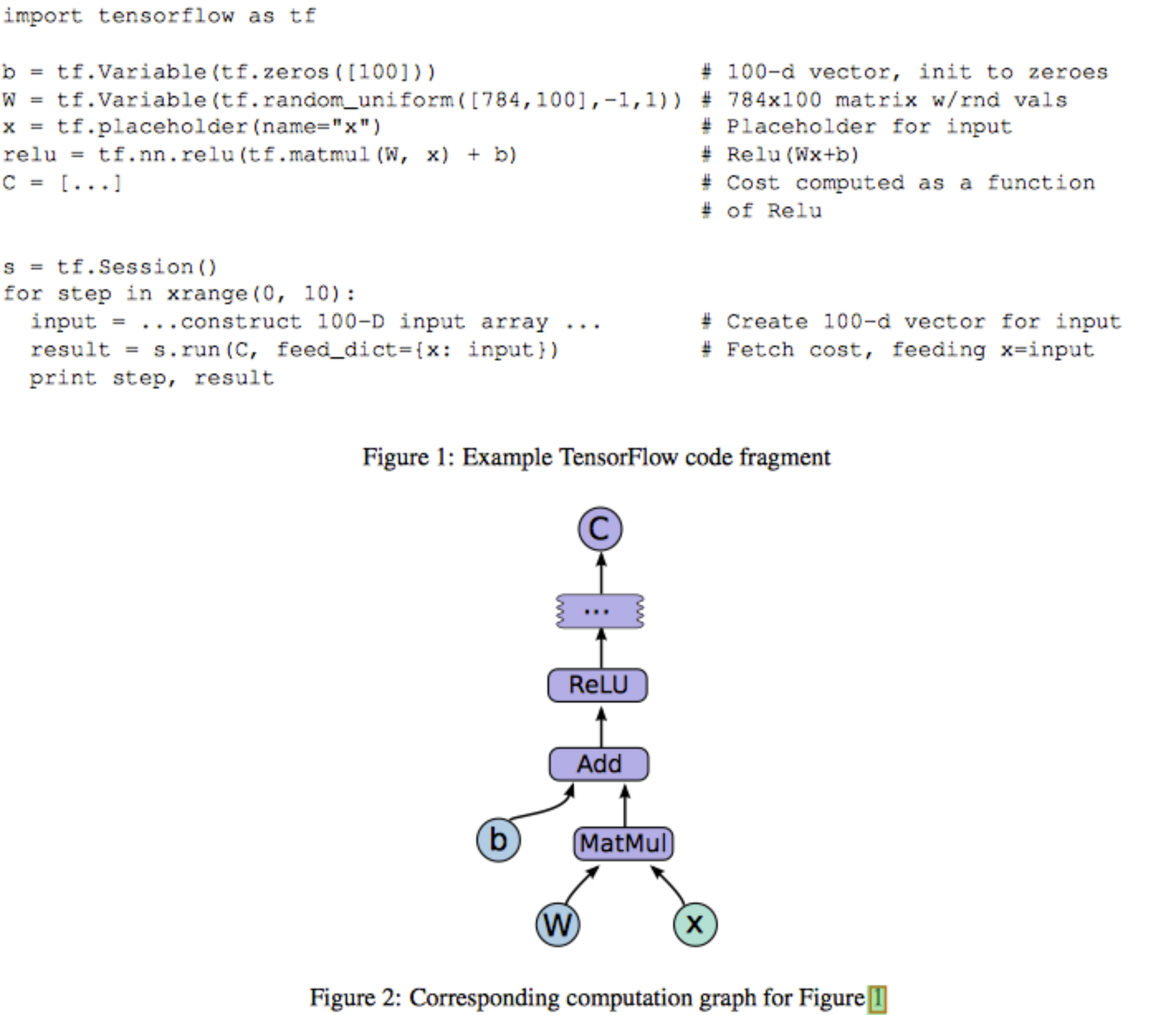
TensorFlow Distributed Execution Engine

CPU | GPU | Android | iOS | ...

# TensorFlow Features

1. Programming Model and Basic Concepts
2. Implementation
3. Extensions
4. Optimizations
5. New Features In TensorFlow 1.0
6. New Tips In TensorFlow Dev Submit

# Programming Model and Basic Concepts



```
import tensorflow as tf

b = tf.Variable(tf.zeros([100]))                   # 100-d vector, init to zeroes
W = tf.Variable(tf.random_uniform([784,100],-1,1)) # 784x100 matrix w/rnd vals
x = tf.placeholder(name="x")                       # Placeholder for input
relu = tf.nn.relu(tf.matmul(W, x) + b)             # Relu(Wx+b)
C = [...]                                          # Cost computed as a function
                                                   # of Relu

s = tf.Session()
for step in xrange(0, 10):
  input = ...construct 100-D input array ...       # Create 100-d vector for input
  result = s.run(C, feed_dict={x: input})          # Fetch cost, feeding x=input
  print step, result
```

Figure 1: Example TensorFlow code fragment

Figure 2: Corresponding computation graph for Figure 1

# Programming Model and Basic Concepts

1. Operations and Kernels
2. Sessions
3. Variables

Operation: An abstract computation, can have attributes
Kernel: A particular implementation of an operation that can be run a particular type of device(CPU or GPU)
Sessions: Interact with the TensorFlow system, Run the full graph or a few distinct subgraphs
Variables: A speical operation returns a handle to a persistent mutable tensor

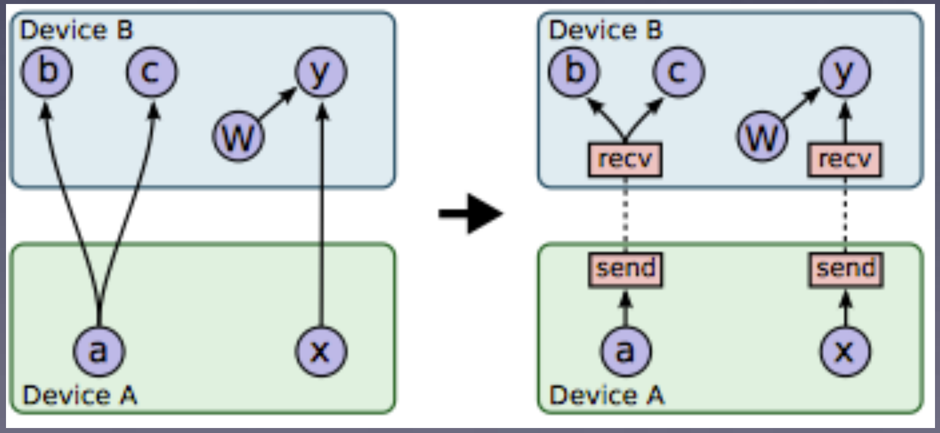
# Implementation

1. Single-Device Execution
2. Multi-Device Execution
   1. Node Placement
   2. Cross-Device Communication
3. Distributed Execution

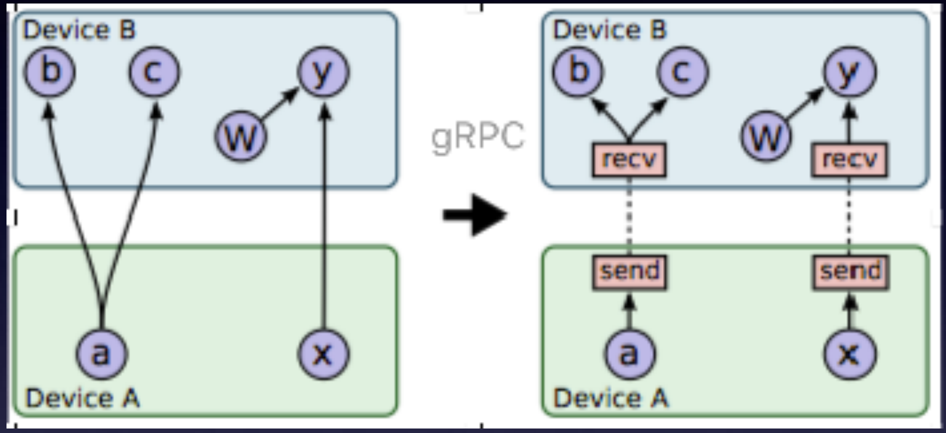
The nodes of the graph are executed in an order that respects the dependencies between the nodes

Node Placement：Based on heuristics associated with different operation types or is measured based on an actual set of placement decisions for earlier extentions of the graph

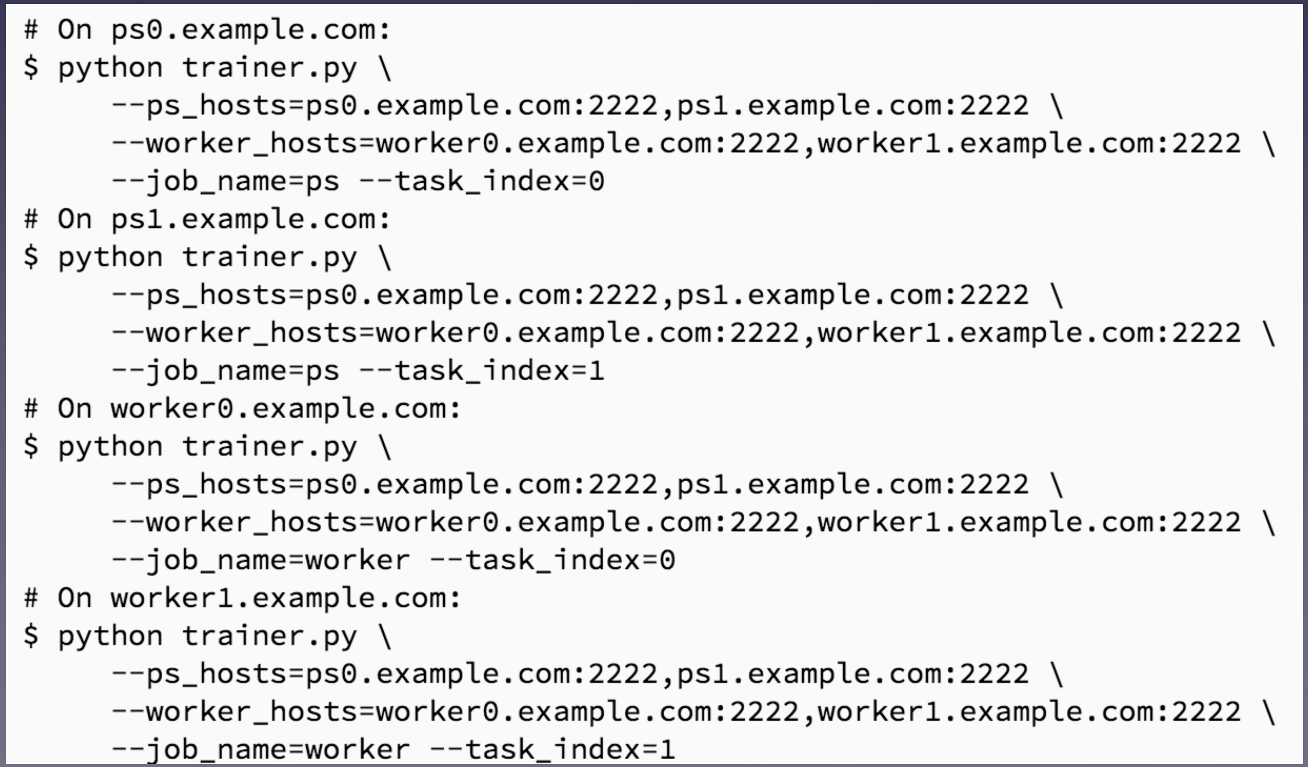
Cross-Device Communication:



Similar to multi-device execution, After device placement, a subgraph is created per device. Send/Receive node communicate across woker processes use remote communication such as TCP or RDMA.



https://www.tensorflow.org/deploy/distributed



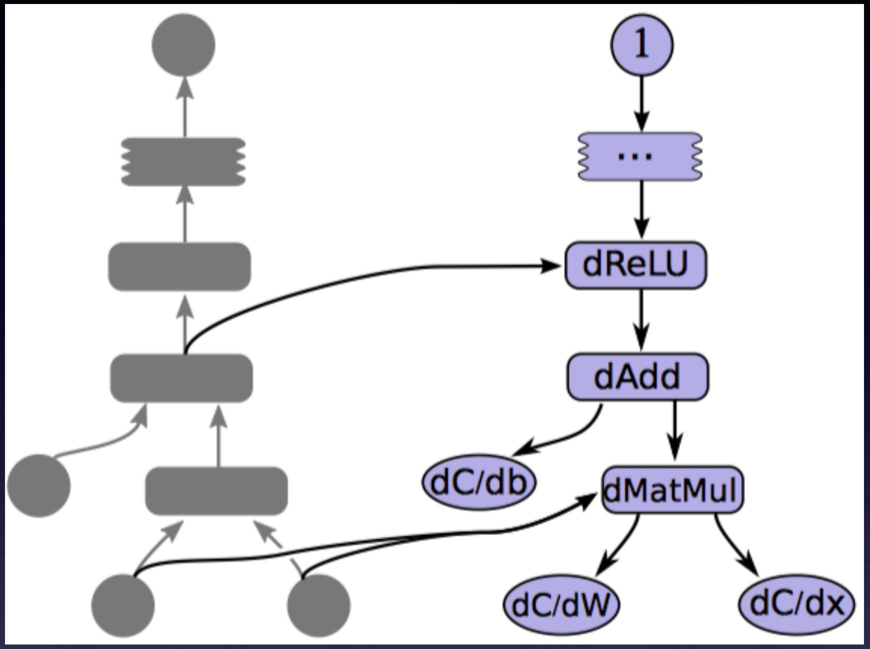
```
# On ps0.example.com:
$ python trainer.py \
     --ps_hosts=ps0.example.com:2222,ps1.example.com:2222 \
     --worker_hosts=worker0.example.com:2222,worker1.example.com:2222 \
     --job_name=ps --task_index=0
# On ps1.example.com:
$ python trainer.py \
     --ps_hosts=ps0.example.com:2222,ps1.example.com:2222 \
     --worker_hosts=worker0.example.com:2222,worker1.example.com:2222 \
     --job_name=ps --task_index=1
# On worker0.example.com:
$ python trainer.py \
     --ps_hosts=ps0.example.com:2222,ps1.example.com:2222 \
     --worker_hosts=worker0.example.com:2222,worker1.example.com:2222 \
     --job_name=worker --task_index=0
# On worker1.example.com:
$ python trainer.py \
     --ps_hosts=ps0.example.com:2222,ps1.example.com:2222 \
     --worker_hosts=worker0.example.com:2222,worker1.example.com:2222 \
     --job_name=worker --task_index=1
```

# Extensions

1. Gradient Computation
2. Partial Execution
3. Device Constraints
4. Control Flow
5. Input Operations
6. Queues
7. Containers

# Extensions

## Gradient Computation



## Device Constraints & Control Flow

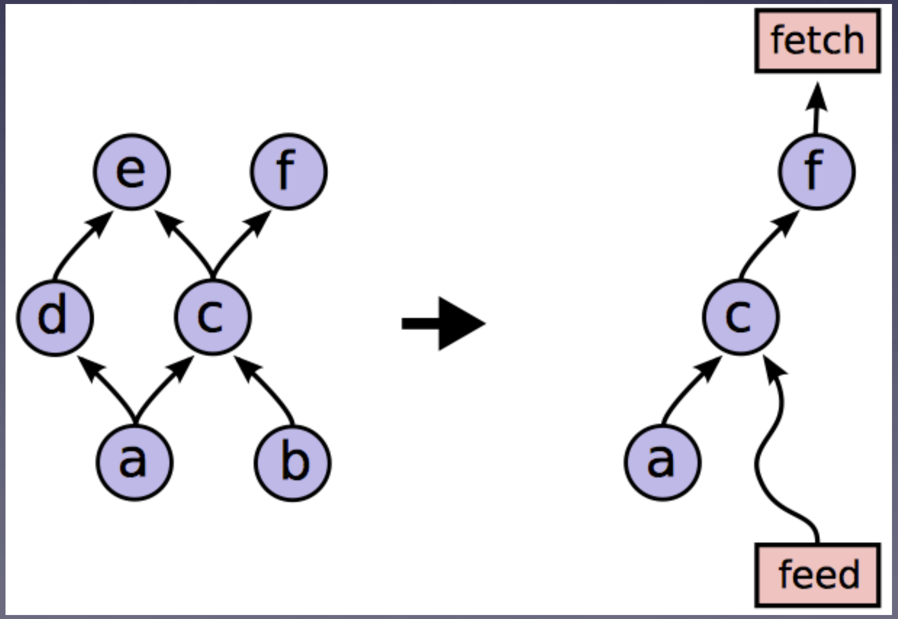
Device constraint examples:

1. “only place this node on a device of type GPU”
2. “this node can only be placed in /job:worker/task:1”
3. “Colocate this node with the node named variable1”

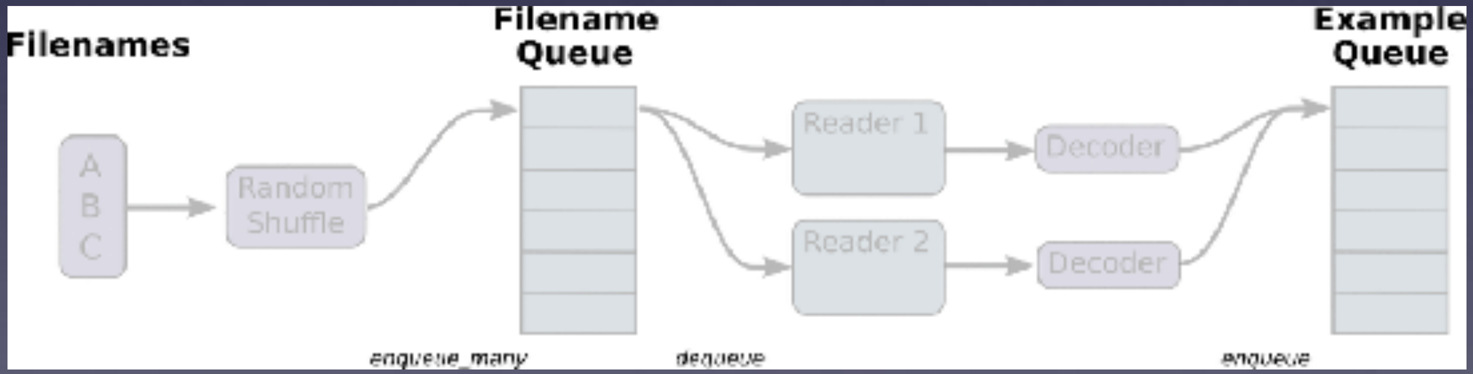
Control Flow: support of cyclic dataflow graph.

1. Switch, Merge: express if-conditions.
2. Enter, Leave, NextIteration: express iterations.
3. Distributed coordination mechanism is needed.

## Partial Execution



## Queue & Containers



- Containers: Useful for sharing states between disjoint companions from different Sessions.

# Optimizations

- Common subexpression elimination to remote redundant calculation
  - Controlling data communication and memory usage
  - Topological ordering of nodes to identify critical path
  - Prioritize computation/communication on critical path
- Asynchronous kernel to support non-blocking computation
- Reuse pre-existing highly-optimized numerical libraries
- lossy compression of data, similar to the DistBelief system

# New Features In TensorFlow 1.0

- XLA (experimental): initial release of XLA, a domain-specific compiler for TensorFlow graphs, that targets CPUs and GPUs.
- TensorFlow Debugger (tfdbg): command-line interface and API.
- New python 3 docker images added.
- Made pip packages pypi compliant. TensorFlow can now be installed by pip install tensorflow command.
- Several python API calls have been changed to resemble NumPy more closely.
- New (experimental) Java API.
- Android: new person detection + tracking demo implementing "Scalable Object Detection using Deep Neural Networks" (with additional YOLO object detector support)
- Android: new camera-based image stylization demo based on "A Learned Representation For Artistic Style"

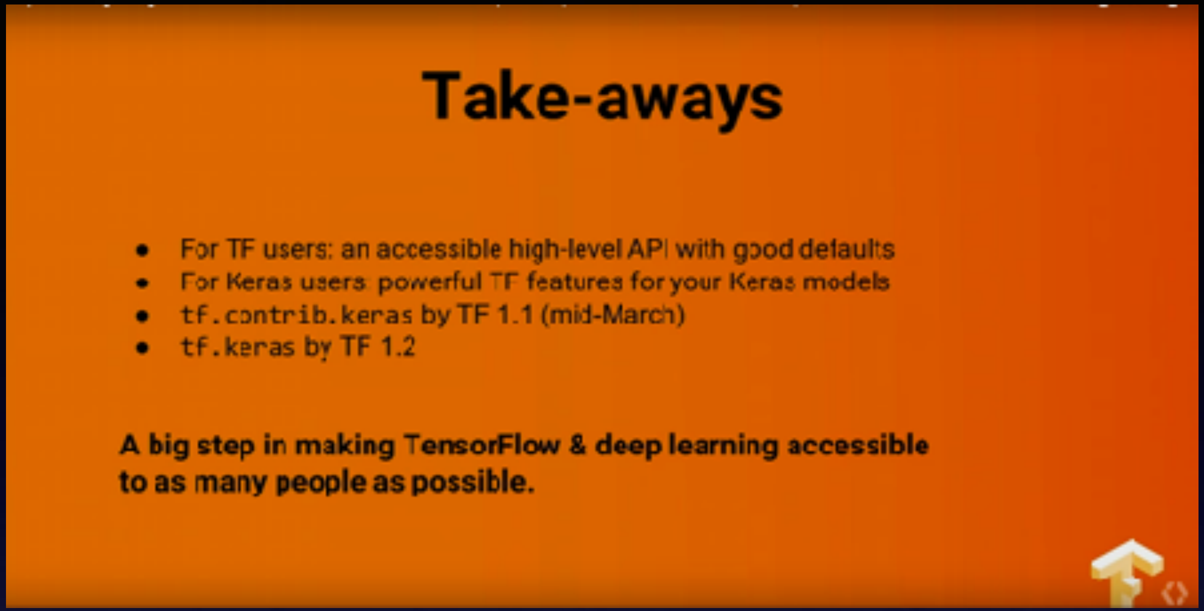
# New Tips In TensorFlow Dev Submit

## XLA

How do we
keep the strengths,
but add
more speed?!

Photo by Lwp Kommunikáció https://goo.gl/NDqj68

## Keras

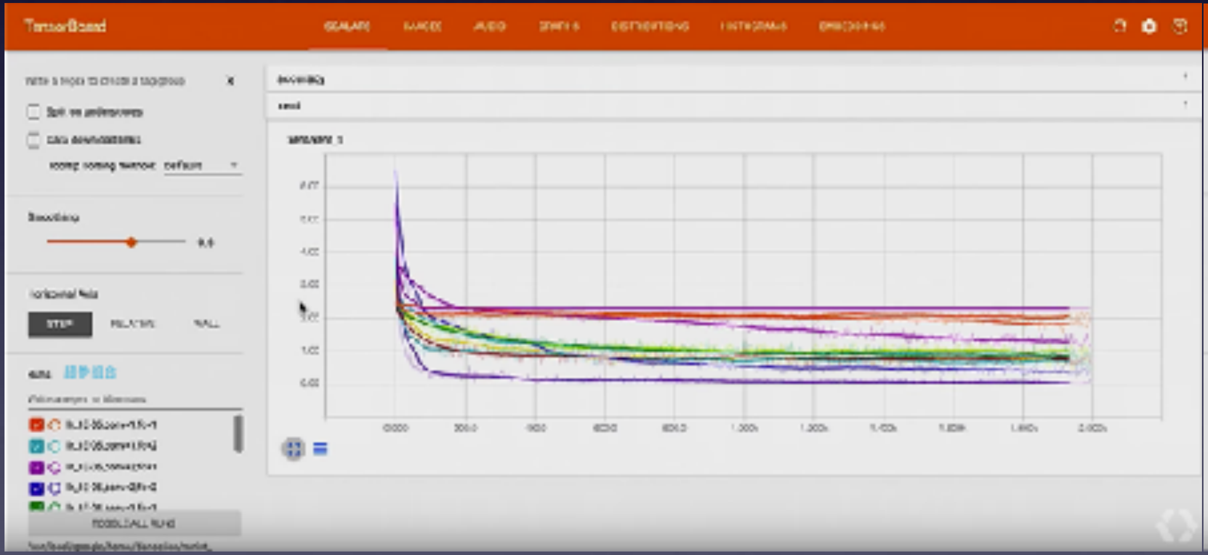


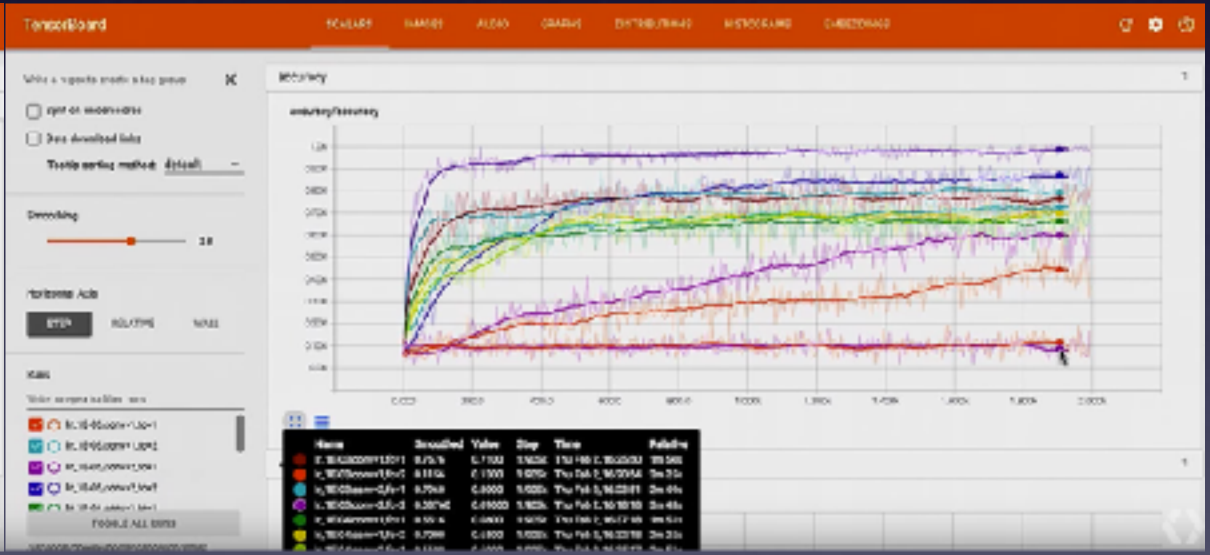
### Take-aways

- For TF users: an accessible high-level API with good defaults
- For Keras users: powerful TF features for your Keras models
- `tf.contrib.keras` by TF 1.1 (mid-March)
- `tf.keras` by TF 1.2

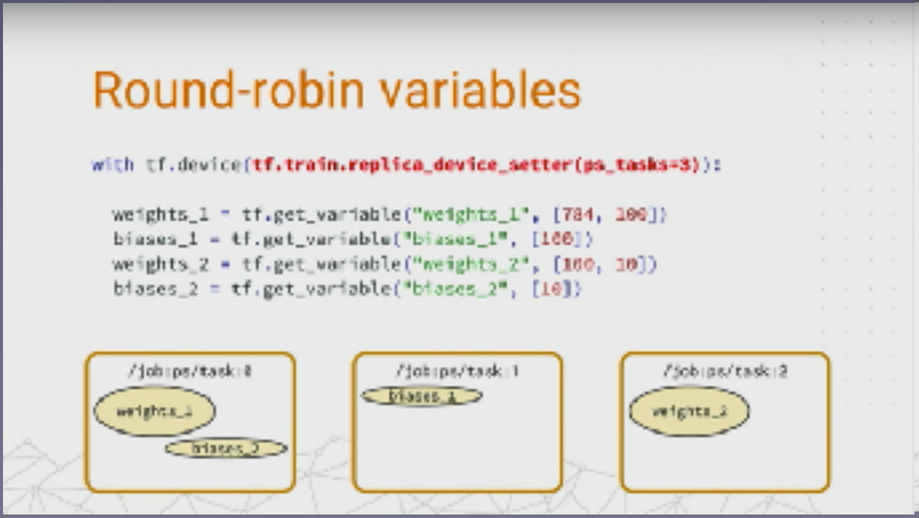
**A big step in making TensorFlow & deep learning accessible to as many people as possible.**

## Hyperparameter Search



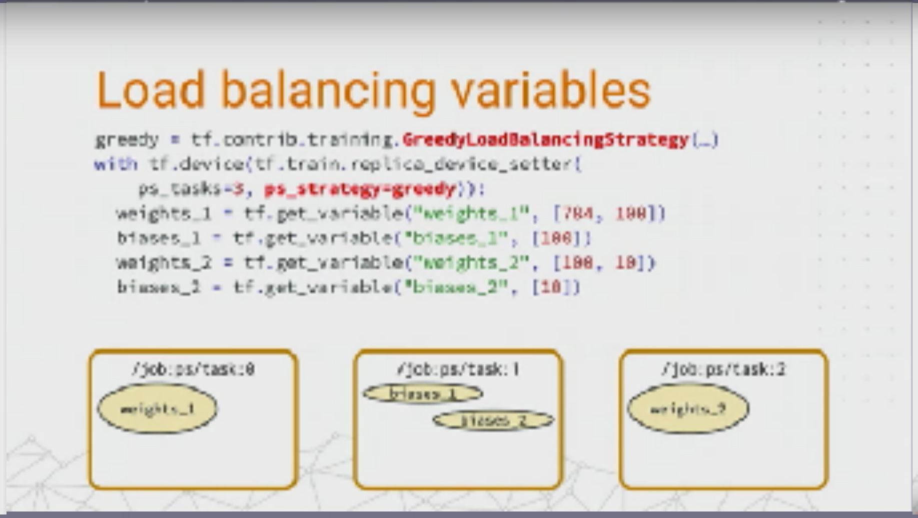


## Variables In Params



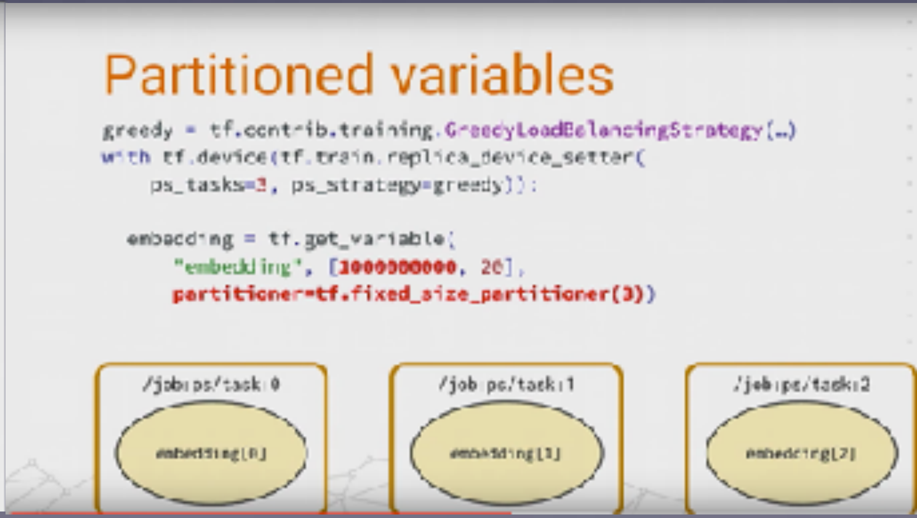
### Round-robin variables

```
with tf.device(tf.train.replica_device_setter(ps_tasks=3)):

  weights_1 = tf.get_variable("weights_1", [784, 100])
  biases_1 = tf.get_variable("biases_1", [100])
  weights_2 = tf.get_variable("weights_2", [100, 10])
  biases_2 = tf.get_variable("biases_2", [10])
```



### Load balancing variables

```
greedy = tf.contrib.training.GreedyLoadBalancingStrategy(…)
with tf.device(tf.train.replica_device_setter(
    ps_tasks=3, ps_strategy=greedy)):
  weights_1 = tf.get_variable("weights_1", [784, 100])
  biases_1 = tf.get_variable("biases_1", [100])
  weights_2 = tf.get_variable("weights_2", [100, 10])
  biases_2 = tf.get_variable("biases_2", [10])
```

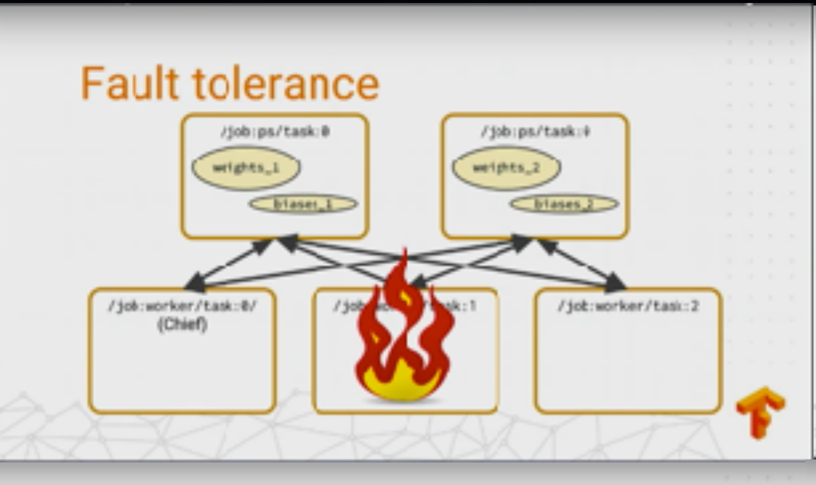


### Partitioned variables

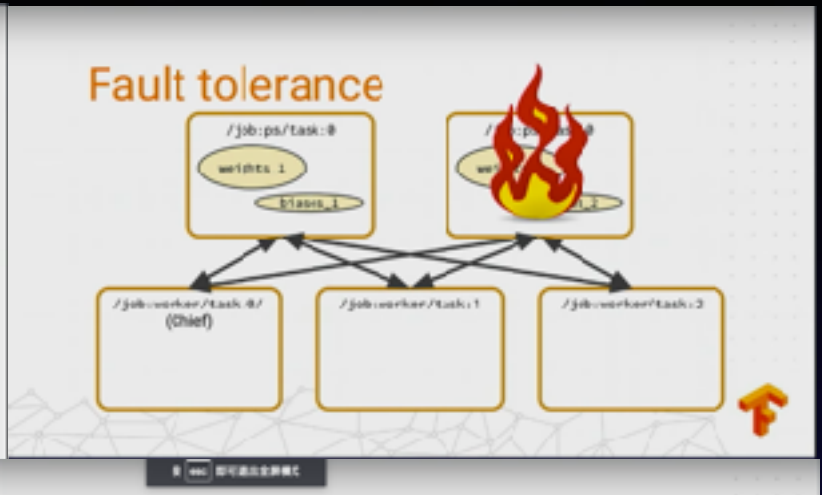
```
greedy = tf.contrib.training.GreedyLoadBalancingStrategy(…)
with tf.device(tf.train.replica_device_setter(
    ps_tasks=3, ps_strategy=greedy)):

  embedding = tf.get_variable(
      "embedding", [1000000000, 20],
      partitioner=tf.fixed_size_partitioner(3))
```

# New Tips In TensorFlow Dev Submit

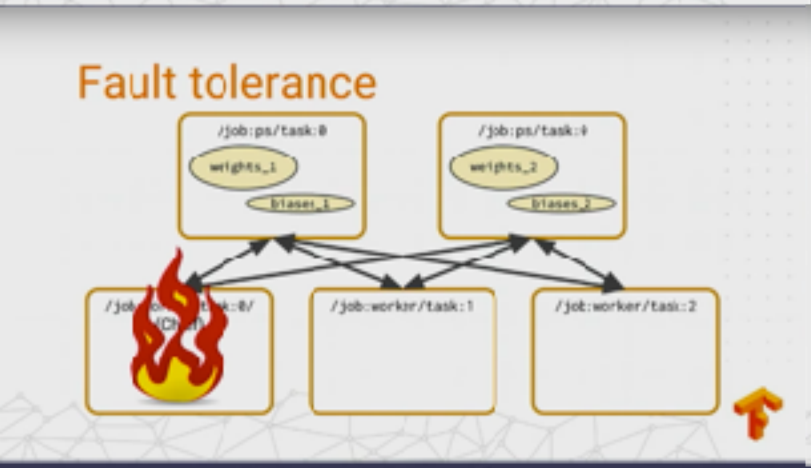
## fault tolerance in Distributed TensorFlow



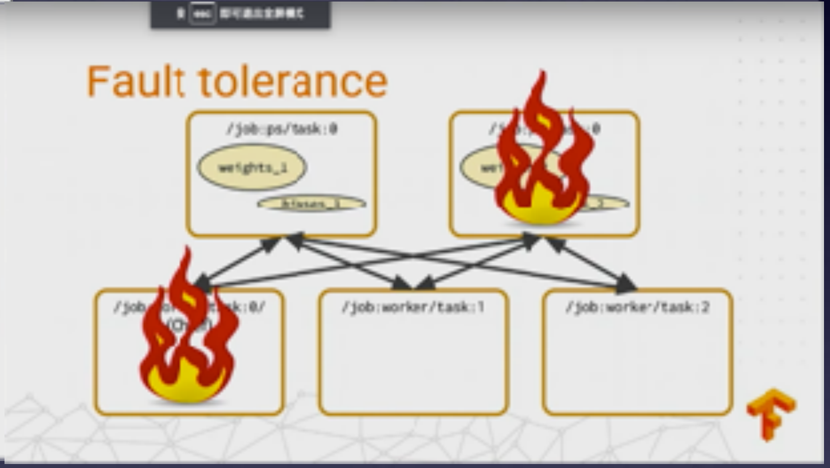
Fault tolerance



Fault tolerance

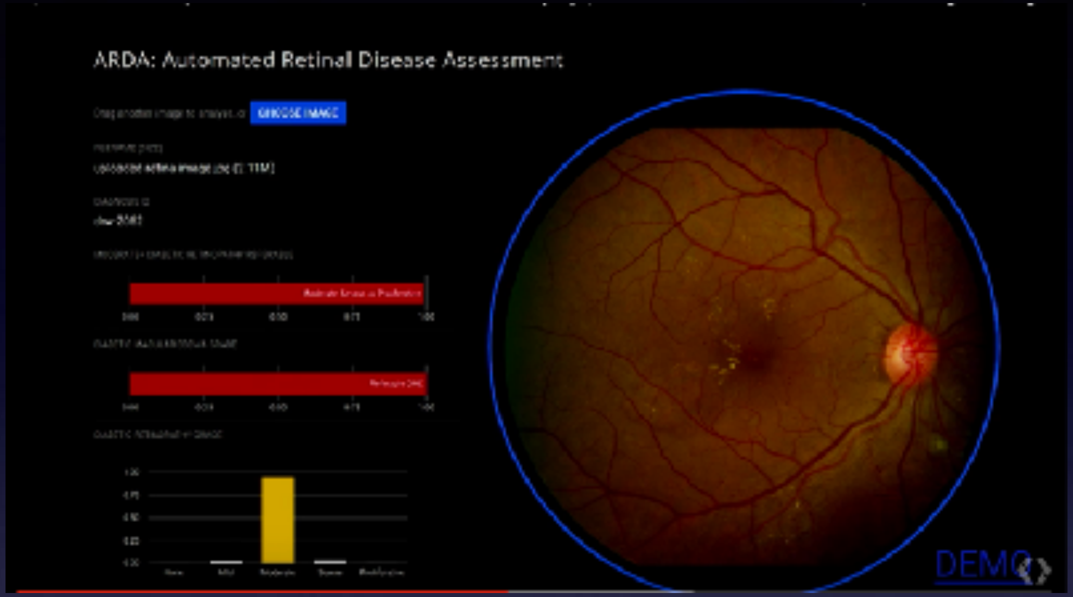


Fault tolerance



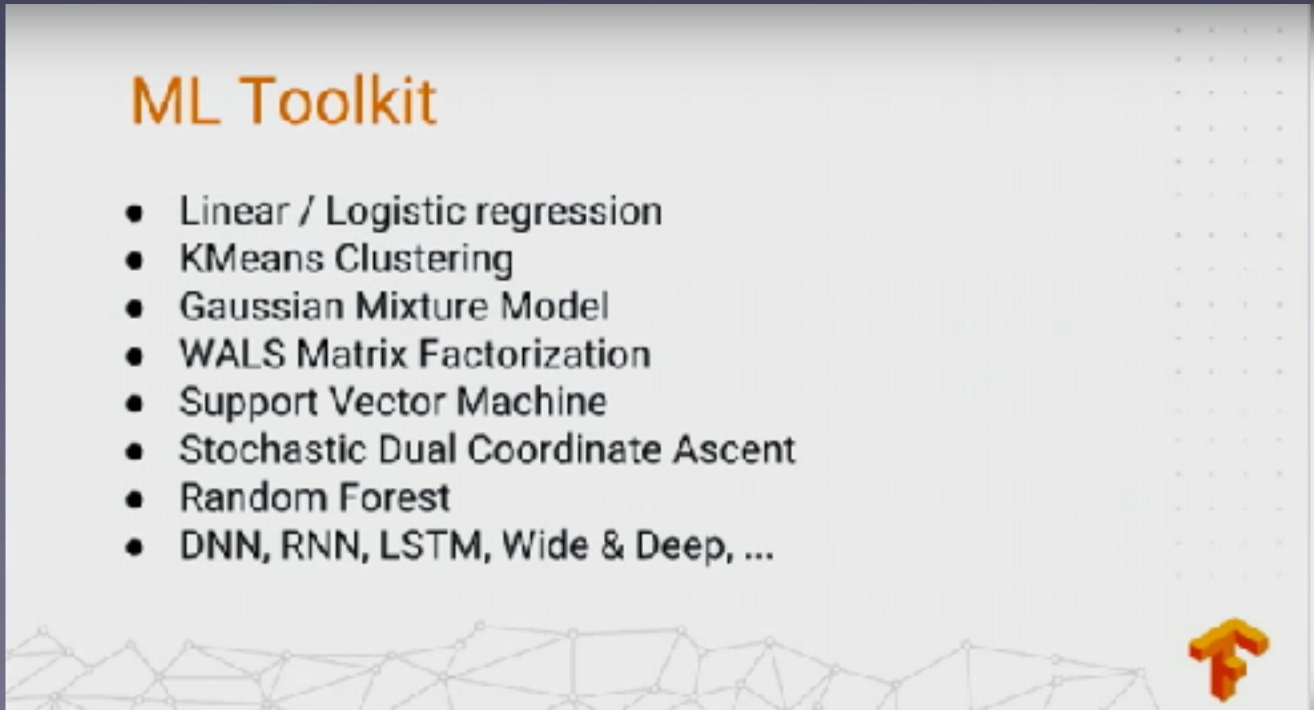
Fault tolerance

## retinal disease detection



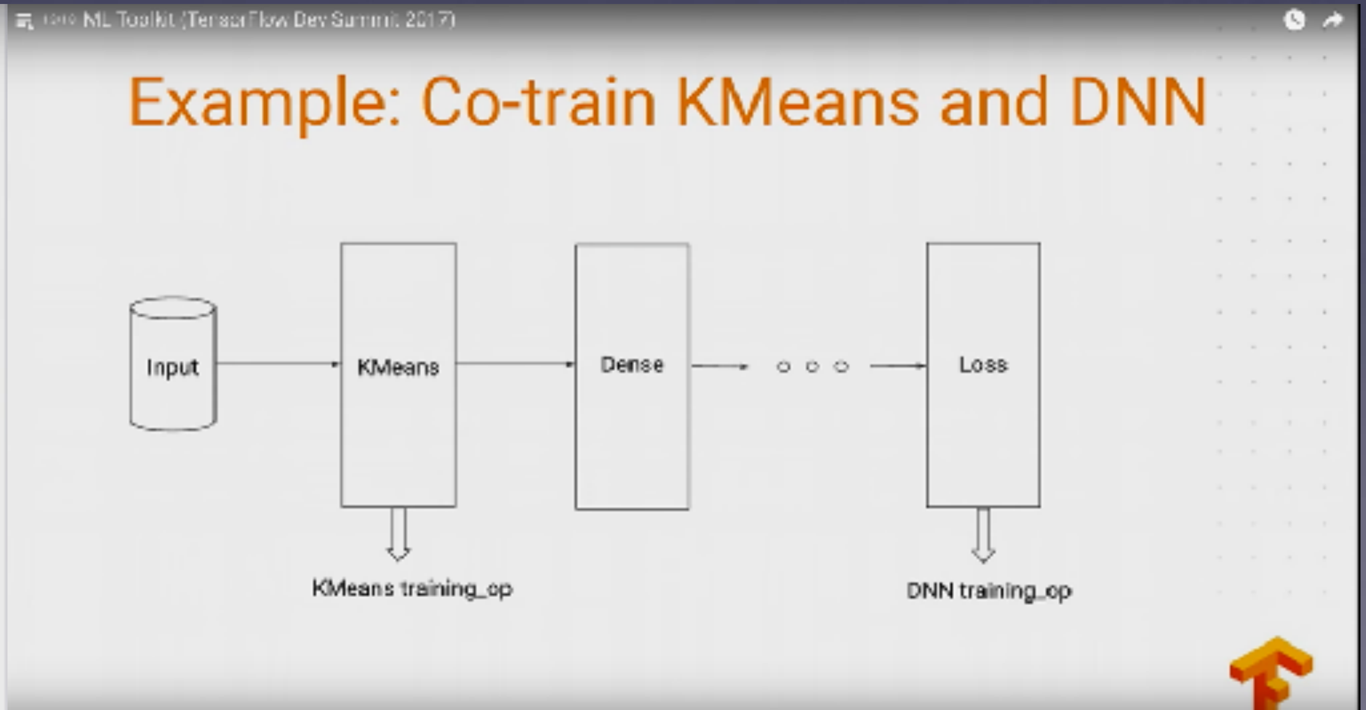
ARDA: Automated Retinal Disease Assessment

## ML ToolKit



### ML Toolkit

- Linear / Logistic regression
- KMeans Clustering
- Gaussian Mixture Model
- WALS Matrix Factorization
- Support Vector Machine
- Stochastic Dual Coordinate Ascent
- Random Forest
- DNN, RNN, LSTM, Wide & Deep, ...

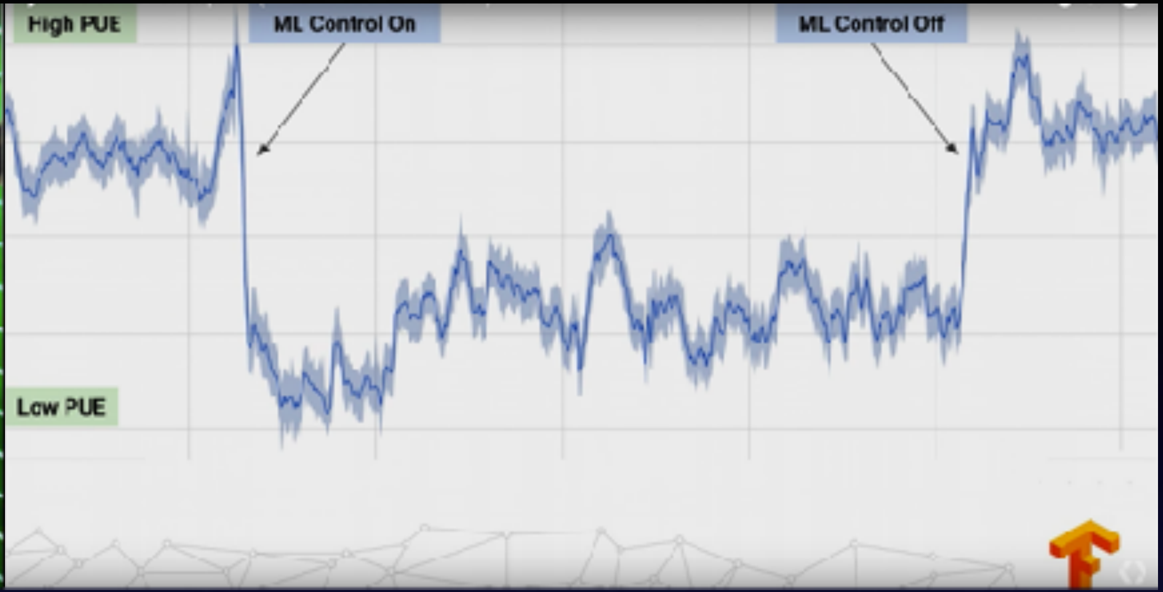


ML Toolkit (TensorFlow Dev Summit 2017)

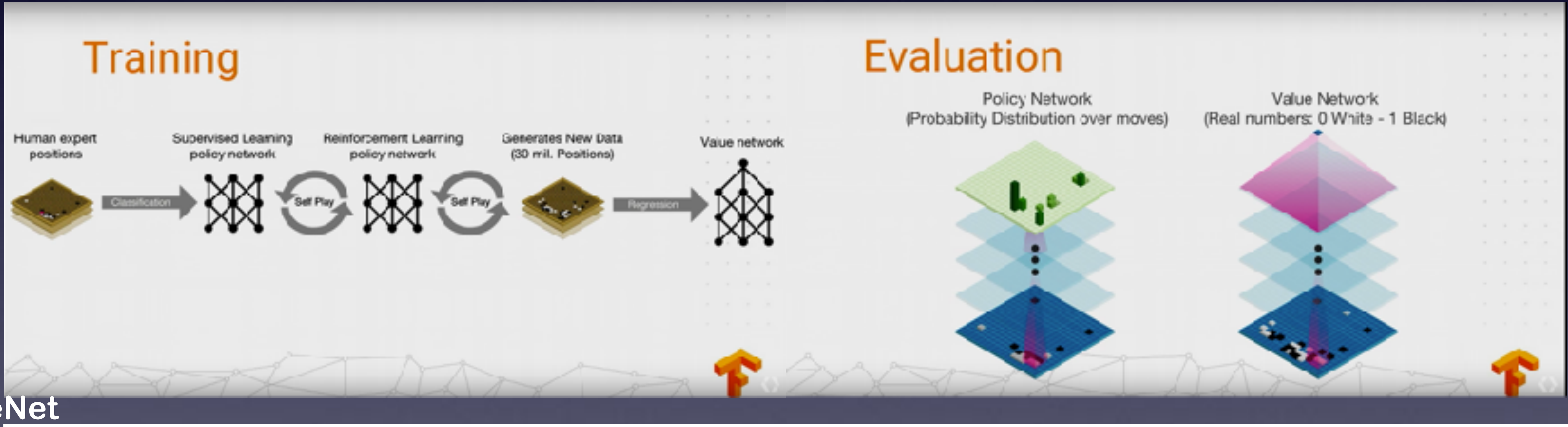
### Example: Co-train KMeans and DNN

# New Tips In TensorFlow Dev Submit

Data Center Cooling



AlphaGo



## Training

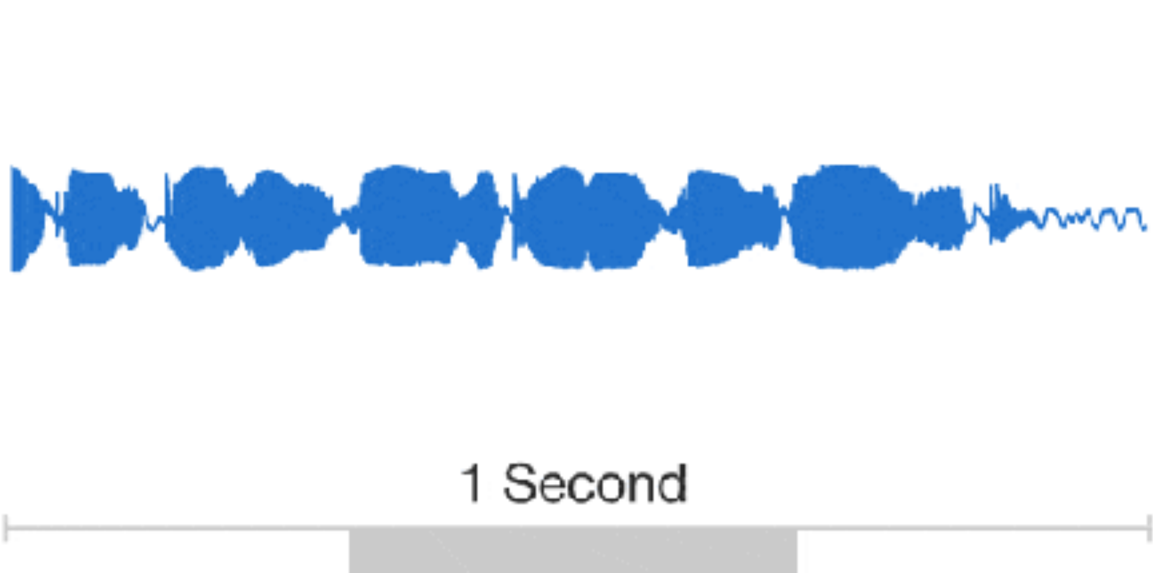
Human expert positions → Classification → Supervised Learning policy network → Self Play → Reinforcement Learning policy network → Self Play → Generates New Data (30 mil. Positions) → Regression → Value network

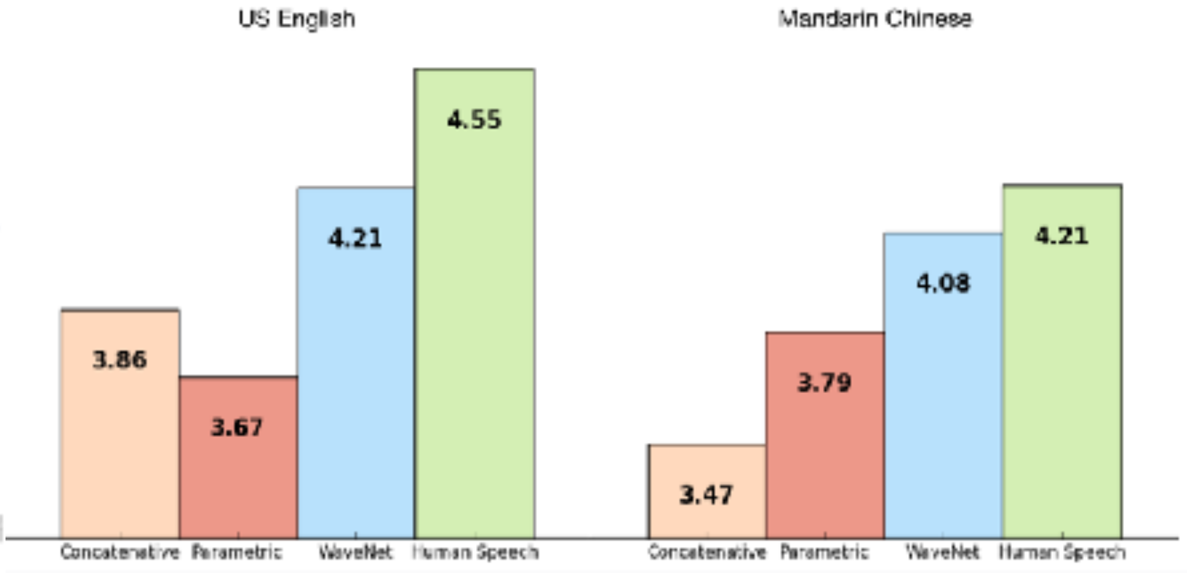
## Evaluation

Policy Network
(Probability Distribution over moves)

Value Network
(Real numbers: 0 White - 1 Black)

WaveNet

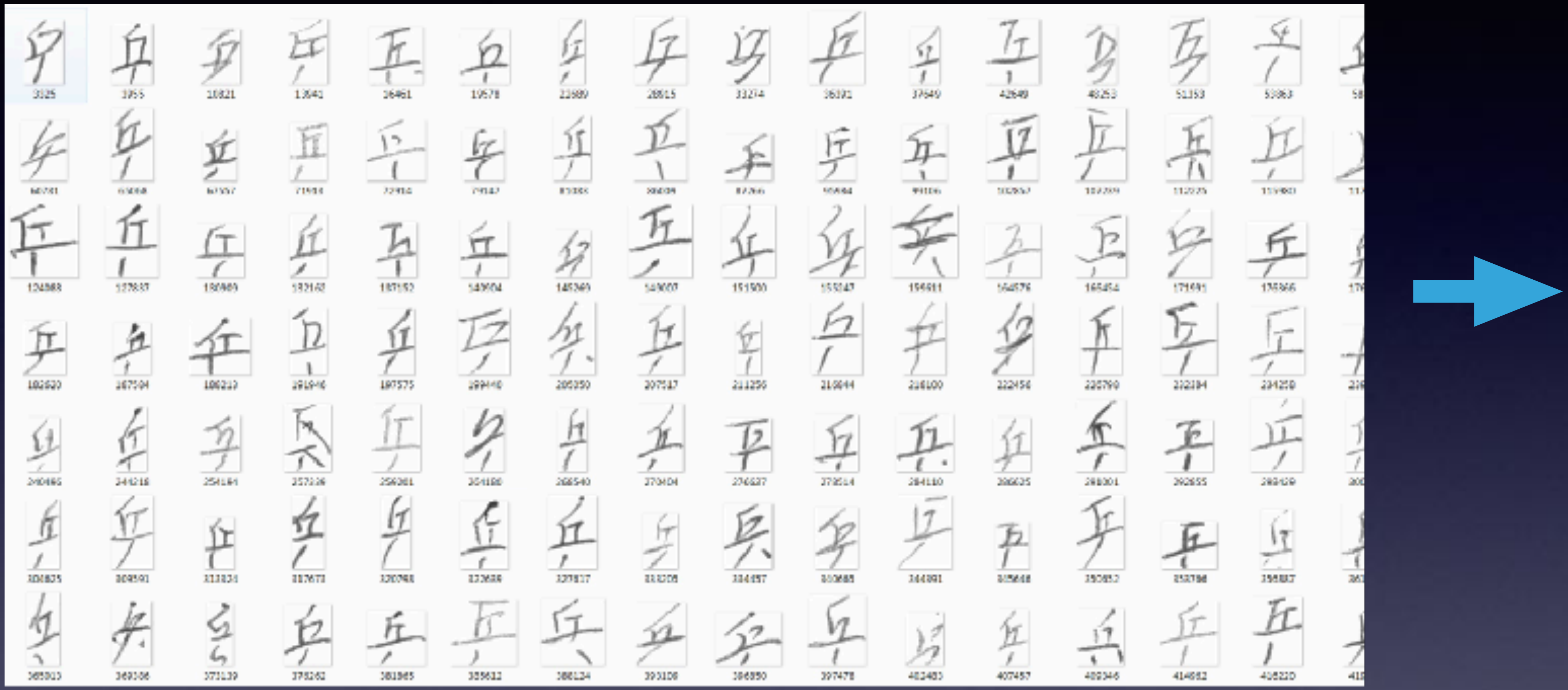




# TensorFlow & DeepLearning Tutorial

1. https://web.stanford.edu/class/cs20si/syllabus.html
2. https://github.com/aymericdamien/TensorFlow-Examples
3. https://github.com/tflearn/tflearn
4. https://youtu.be/oYbVFhK_olY?list=PLSPWNkAMSvv5DKeSVDbEbUKSsK4Z-GgiP
5. http://rll.berkeley.edu/deeprlcourse/
6. http://cs231n.github.io/
7. https://cs224d.stanford.edu/
8. http://selfdrivingcars.mit.edu/
9. …

# Handwriting Recognition



乒

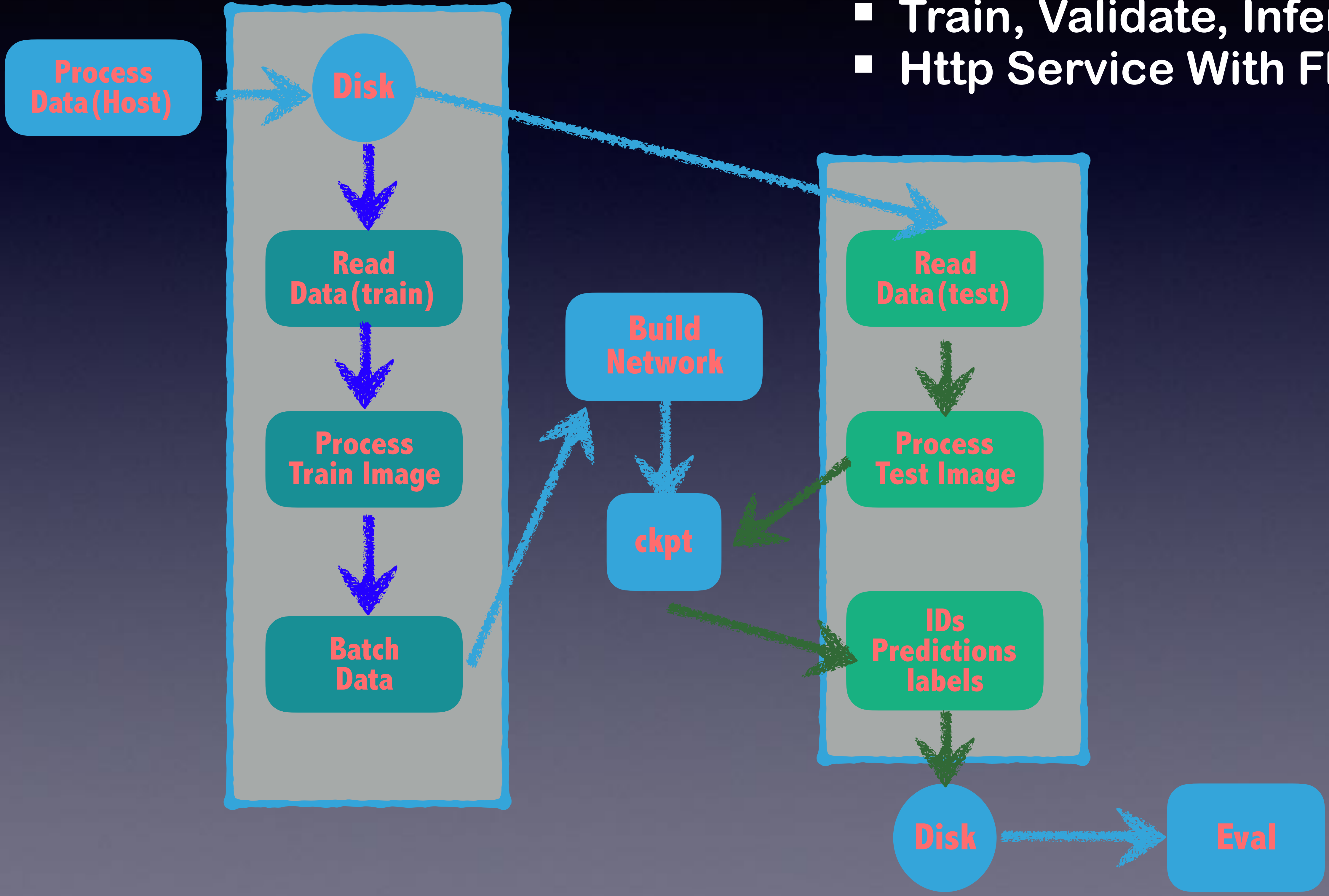
data_url: http://www.nlpr.ia.ac.cn/CN/folder/folder8.shtml

```
wget http://www.nlpr.ia.ac.cn/databases/download/feature_data/HWDB1.1trn_gnt.zip
wget http://www.nlpr.ia.ac.cn/databases/download/feature_data/HWDB1.1tst_gnt.zip
```

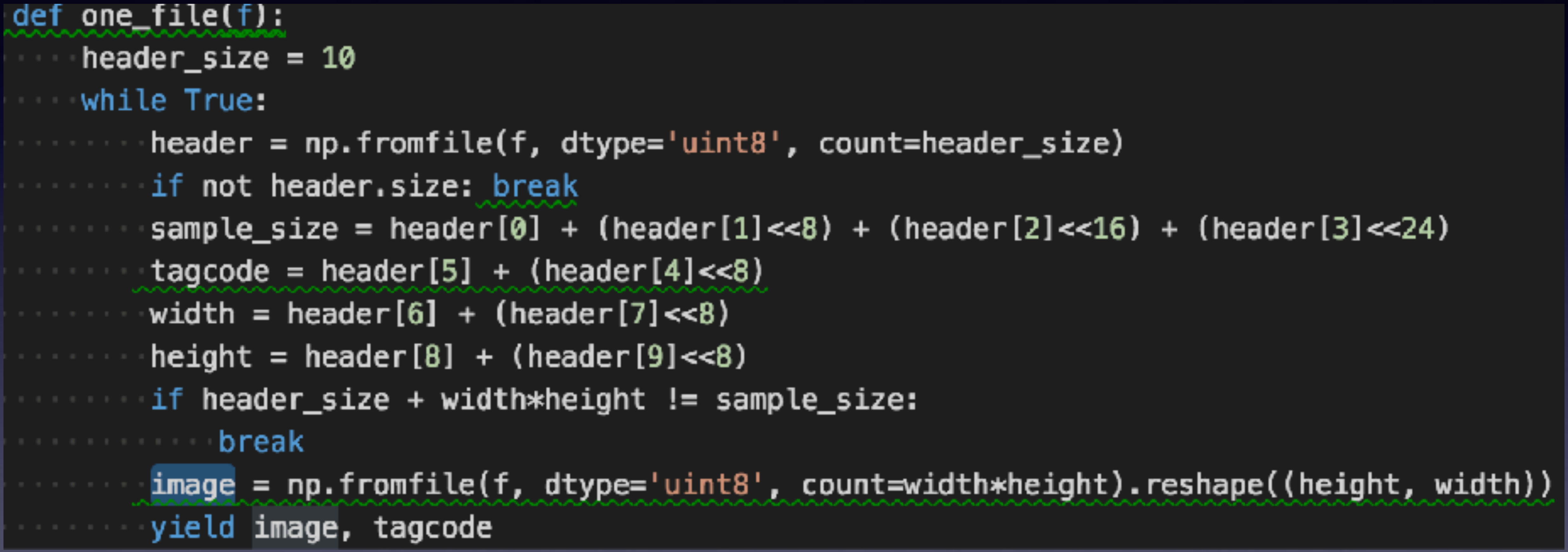
https://pan.baidu.com/s/1dEYbiDz

# Handwriting Recognition

- Read Image Data In TensorFlow
- Preprocess Your Image Data
- Build Network
- Train, Validate, Inference
- Http Service With Flask



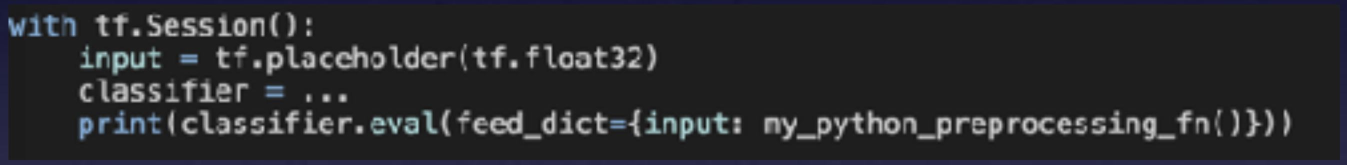
# gnt—>image/labels



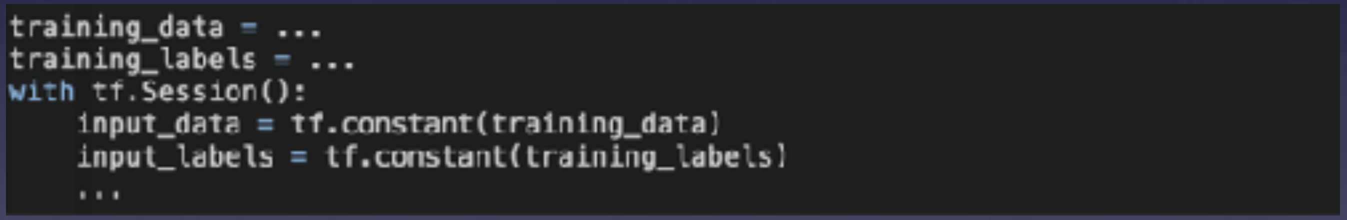
```python
def one_file(f):
    header_size = 10
    while True:
        header = np.fromfile(f, dtype='uint8', count=header_size)
        if not header.size: break
        sample_size = header[0] + (header[1]<<8) + (header[2]<<16) + (header[3]<<24)
        tagcode = header[5] + (header[4]<<8)
        width = header[6] + (header[7]<<8)
        height = header[8] + (header[9]<<8)
        if header_size + width*height != sample_size:
            break
        image = np.fromfile(f, dtype='uint8', count=width*height).reshape((height, width))
        yield image, tagcode
```

# Read Image Data I—Reading Data In TensorFlow

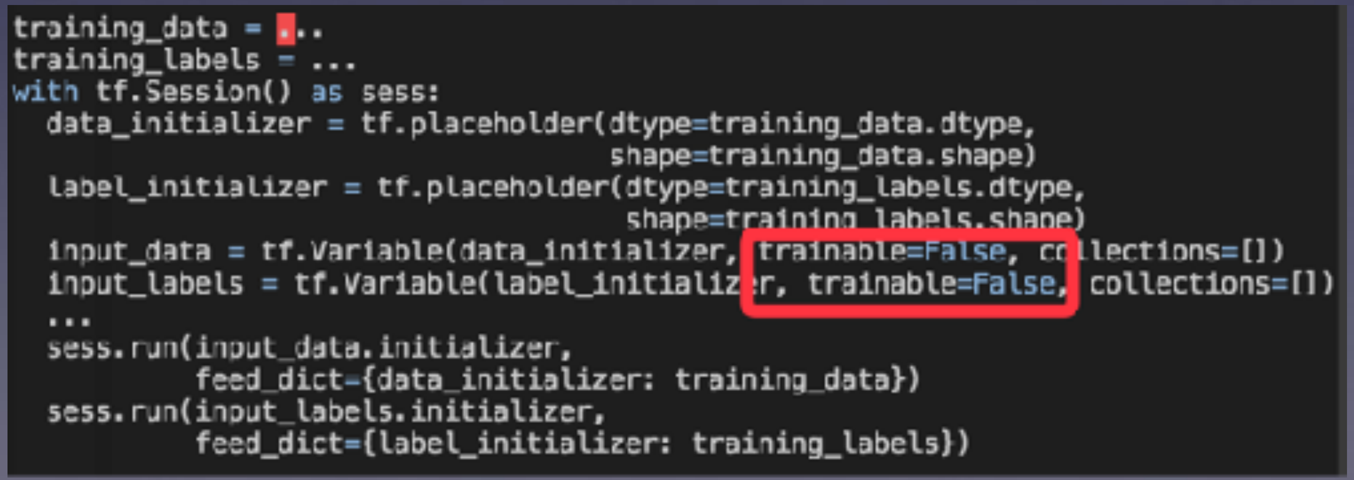
- Feeding: build feed_dict when running each step
- Reading from files: build an input pipeline reads the data from files at the beginn of a TensorFlow graph
- Preloaded data: new a constant or variable in the TensorFlow graph holds all th data(Usually small data).



```
with tf.Session():
    input = tf.placeholder(tf.float32)
    classifier = ...
    print(classifier.eval(feed_dict={input: my_python_preprocessing_fn()}))
```



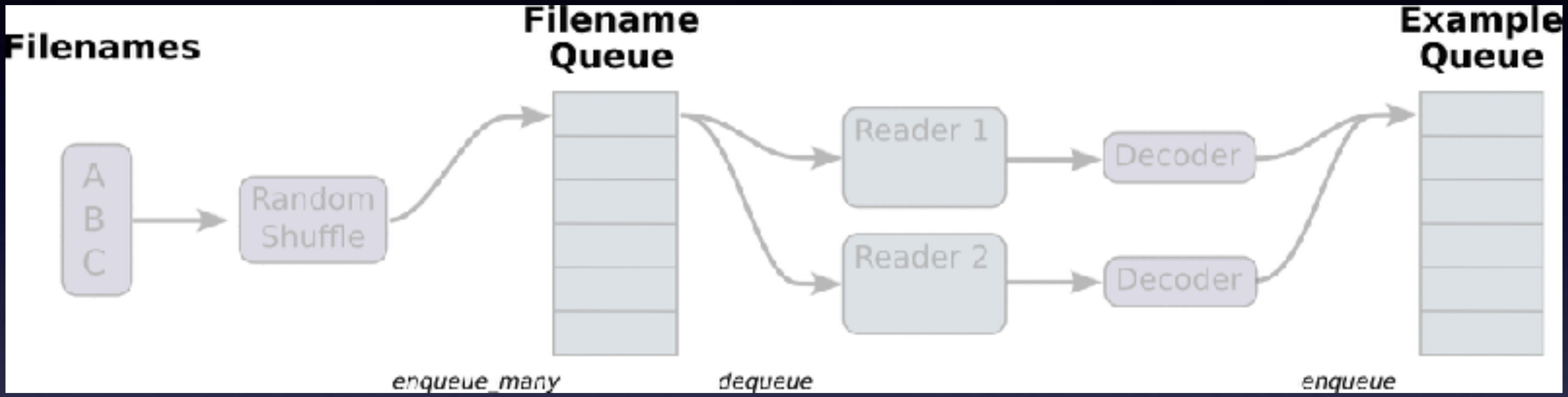
```
training_data = ...
training_labels = ...
with tf.Session():
    input_data = tf.constant(training_data)
    input_labels = tf.constant(training_labels)
    ...
```



```
training_data = ...
training_labels = ...
with tf.Session() as sess:
  data_initializer = tf.placeholder(dtype=training_data.dtype,
                                    shape=training_data.shape)
  label_initializer = tf.placeholder(dtype=training_labels.dtype,
                                     shape=training_labels.shape)
  input_data = tf.Variable(data_initializer, trainable=False, collections=[])
  input_labels = tf.Variable(label_initializer, trainable=False, collections=[])
  ...
  sess.run(input_data.initializer,
           feed_dict={data_initializer: training_data})
  sess.run(input_labels.initializer,
           feed_dict={label_initializer: training_labels})
```

- Get the list of filenames/labels
- New the filenames queue(shuffling/epoch)
- Apply reader with your file format
- Decoder for a record read by the reader
- Preprocess your data/label(data augmentation in TensorFlow)
- Shuffle and batch with the queue

# Read Image Data II—Reading Data In TensorFlow



**If you have many small files, covert it to TFRecords first**

[https://github.com/burness/tensorflow-101/tree/master/covert_to_tfrecord](https://github.com/burness/tensorflow-101/tree/master/covert_to_tfrecord)

# Read Image Data III—Image Decode

tf.image.decode_png

tf.image.decode_jpeg

[height, width, channels]

tf.image.decode_gif

[num_frames, height, width, 3]

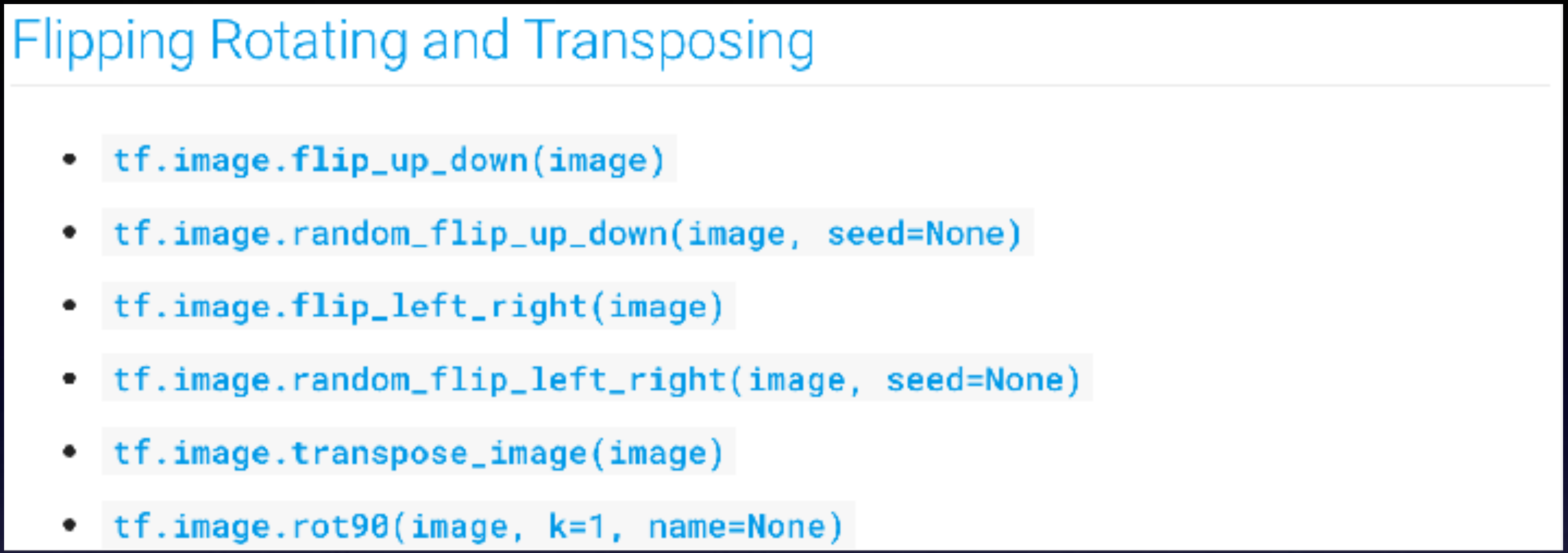
tf.image.decode_jpeg(contents, channels=None, ratio=None, fancy_upscaling=None, try_recover_truncated=None, acceptable_fraction=None, dct_method=None, name=None)

tf.image.decode_png(contents, channels=None, dtype=None, name=None)

tf.image.decode_gif(contents, name=None)

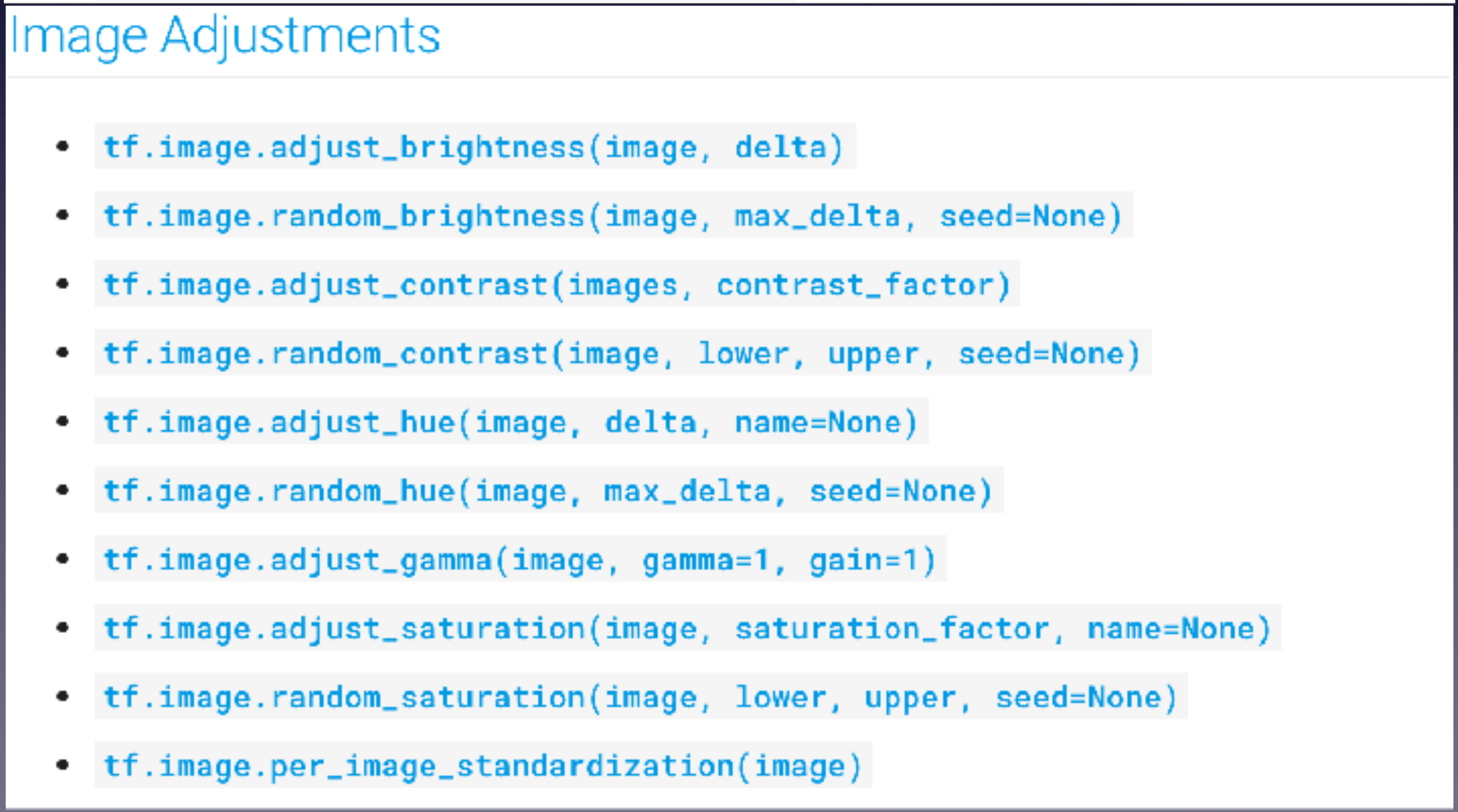
tf.image.decode_image(contents, channels=None, name=None) (r1.0)

# Read Image Data IV—Data Augmentation In TensorFlow



## Flipping Rotating and Transposing

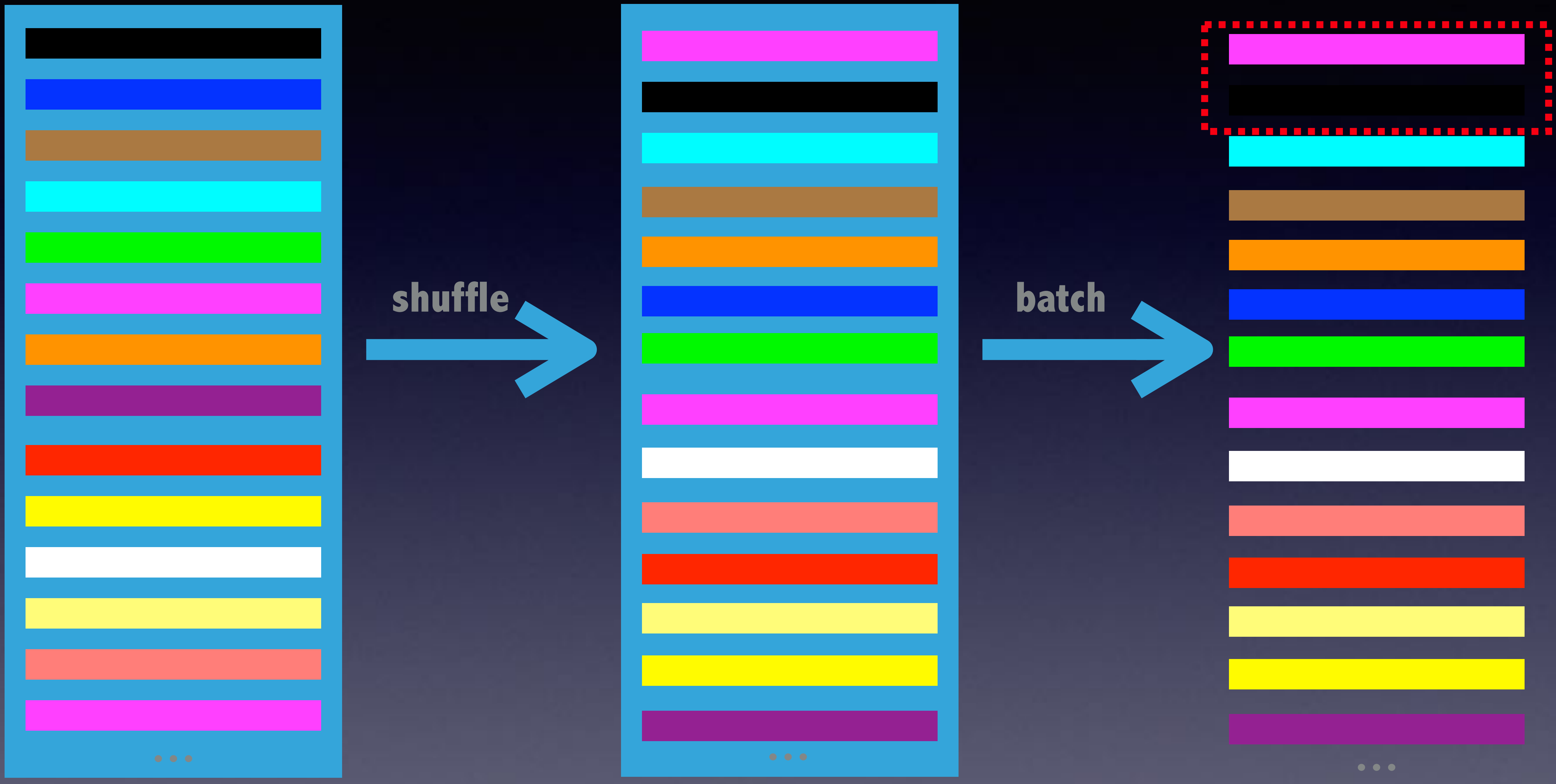
- `tf.image.flip_up_down(image)`
- `tf.image.random_flip_up_down(image, seed=None)`
- `tf.image.flip_left_right(image)`
- `tf.image.random_flip_left_right(image, seed=None)`
- `tf.image.transpose_image(image)`
- `tf.image.rot90(image, k=1, name=None)`



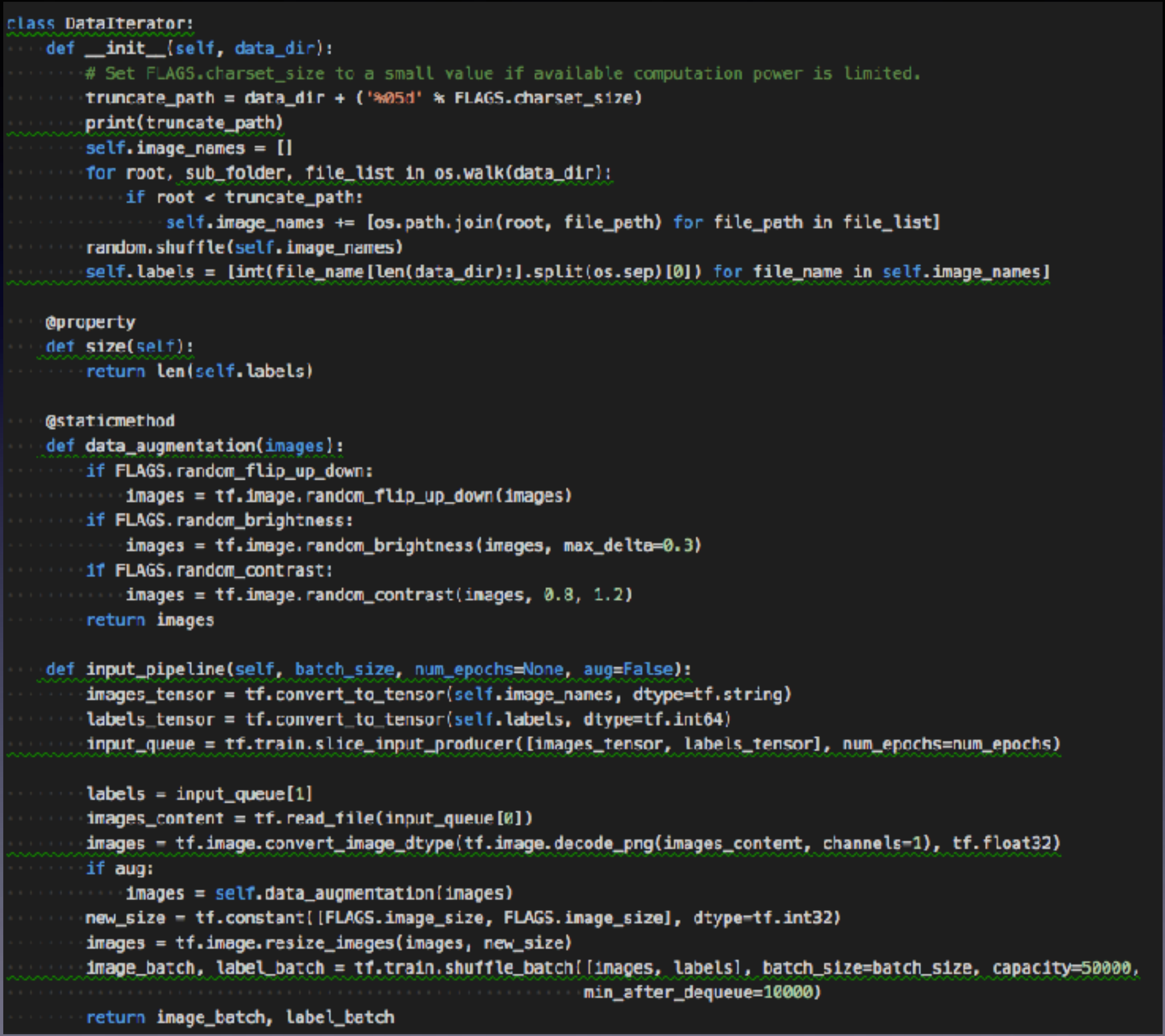
## Image Adjustments

- `tf.image.adjust_brightness(image, delta)`
- `tf.image.random_brightness(image, max_delta, seed=None)`
- `tf.image.adjust_contrast(images, contrast_factor)`
- `tf.image.random_contrast(image, lower, upper, seed=None)`
- `tf.image.adjust_hue(image, delta, name=None)`
- `tf.image.random_hue(image, max_delta, seed=None)`
- `tf.image.adjust_gamma(image, gamma=1, gain=1)`
- `tf.image.adjust_saturation(image, saturation_factor, name=None)`
- `tf.image.random_saturation(image, lower, upper, seed=None)`
- `tf.image.per_image_standardization(image)`

# Read Image Data V—Shuffle And Batch



# Read Image Data VI—Put It Together



```python
class DataIterator:
    def __init__(self, data_dir):
        # Set FLAGS.charset_size to a small value if available computation power is limited.
        truncate_path = data_dir + ('%05d' % FLAGS.charset_size)
        print(truncate_path)
        self.image_names = []
        for root, sub_folder, file_list in os.walk(data_dir):
            if root < truncate_path:
                self.image_names += [os.path.join(root, file_path) for file_path in file_list]
        random.shuffle(self.image_names)
        self.labels = [int(file_name[len(data_dir):].split(os.sep)[0]) for file_name in self.image_names]

    @property
    def size(self):
        return len(self.labels)

    @staticmethod
    def data_augmentation(images):
        if FLAGS.random_flip_up_down:
            images = tf.image.random_flip_up_down(images)
        if FLAGS.random_brightness:
            images = tf.image.random_brightness(images, max_delta=0.3)
        if FLAGS.random_contrast:
            images = tf.image.random_contrast(images, 0.8, 1.2)
        return images

    def input_pipeline(self, batch_size, num_epochs=None, aug=False):
        images_tensor = tf.convert_to_tensor(self.image_names, dtype=tf.string)
        labels_tensor = tf.convert_to_tensor(self.labels, dtype=tf.int64)
        input_queue = tf.train.slice_input_producer([images_tensor, labels_tensor], num_epochs=num_epochs)

        labels = input_queue[1]
        images_content = tf.read_file(input_queue[0])
        images = tf.image.convert_image_dtype(tf.image.decode_png(images_content, channels=1), tf.float32)
        if aug:
            images = self.data_augmentation(images)
        new_size = tf.constant([FLAGS.image_size, FLAGS.image_size], dtype=tf.int32)
        images = tf.image.resize_images(images, new_size)
        image_batch, label_batch = tf.train.shuffle_batch([images, labels], batch_size=batch_size, capacity=50000,
                                                          min_after_dequeue=10000)
        return image_batch, label_batch
```

# Build Network—Slim

```
input = ...
with tf.name_scope('conv1_1') as scope:
  kernel = tf.Variable(tf.truncated_normal([3, 3, 64, 128], dtype=tf.float32,
                                           stddev=1e-1), name='weights')
  conv = tf.nn.conv2d(input, kernel, [1, 1, 1, 1], padding='SAME')
  biases = tf.Variable(tf.constant(0.0, shape=[128], dtype=tf.float32),
                       trainable=True, name='biases')
  bias = tf.nn.bias_add(conv, biases)
  conv1 = tf.nn.relu(bias, name=scope)
```

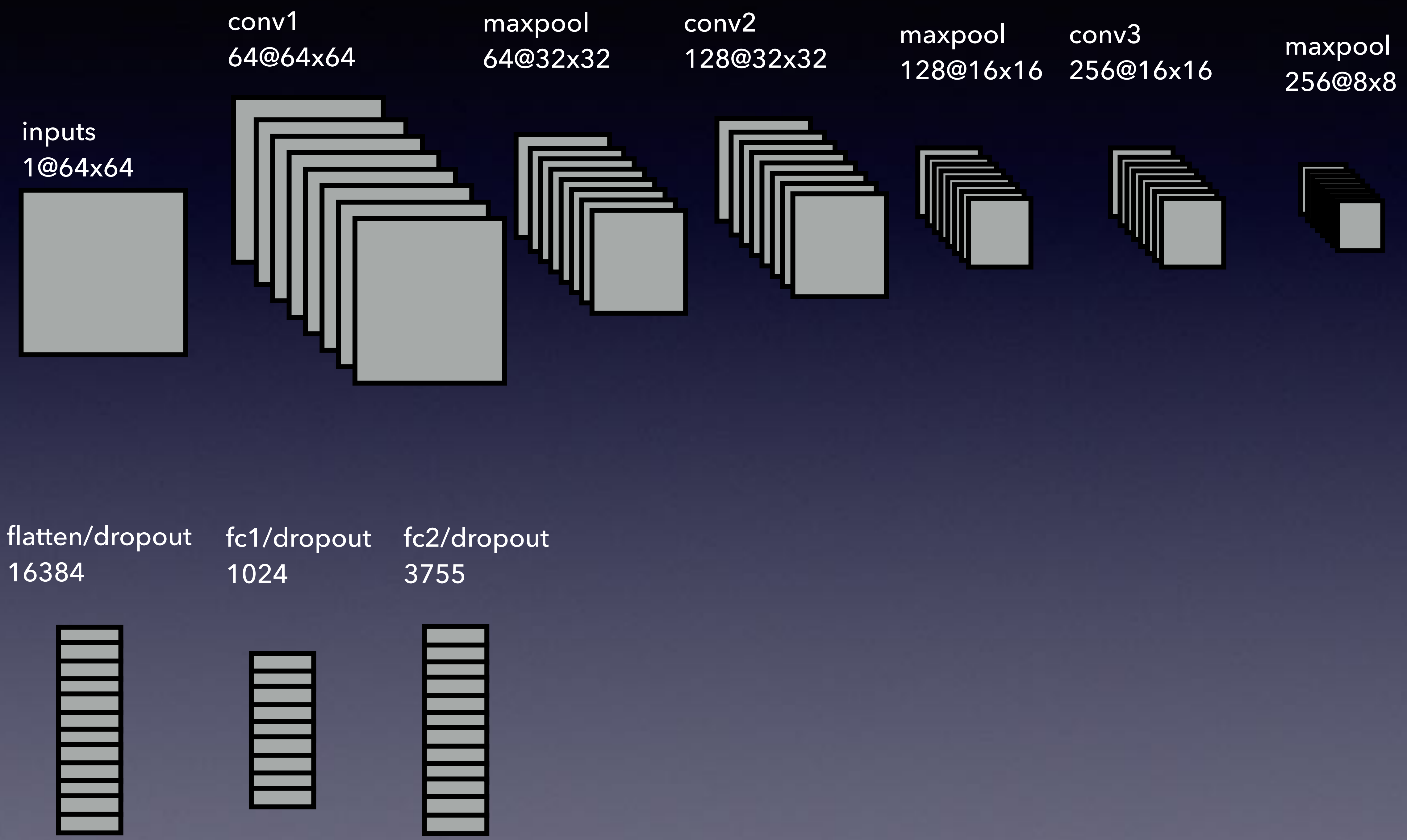
```
input = ...
net = slim.conv2d(input, 128, [3, 3], scope='conv1_1')
```

https://github.com/tensorflow/tensorflow/tree/master/tensorflow/contrib/slim

https://github.com/tflearn/tflearn

https://github.com/fchollet/keras

# Build Network—Build Graph



inputs
1@64x64

conv1
64@64x64

maxpool
64@32x32

conv2
128@32x32

maxpool
128@16x16

conv3
256@16x16

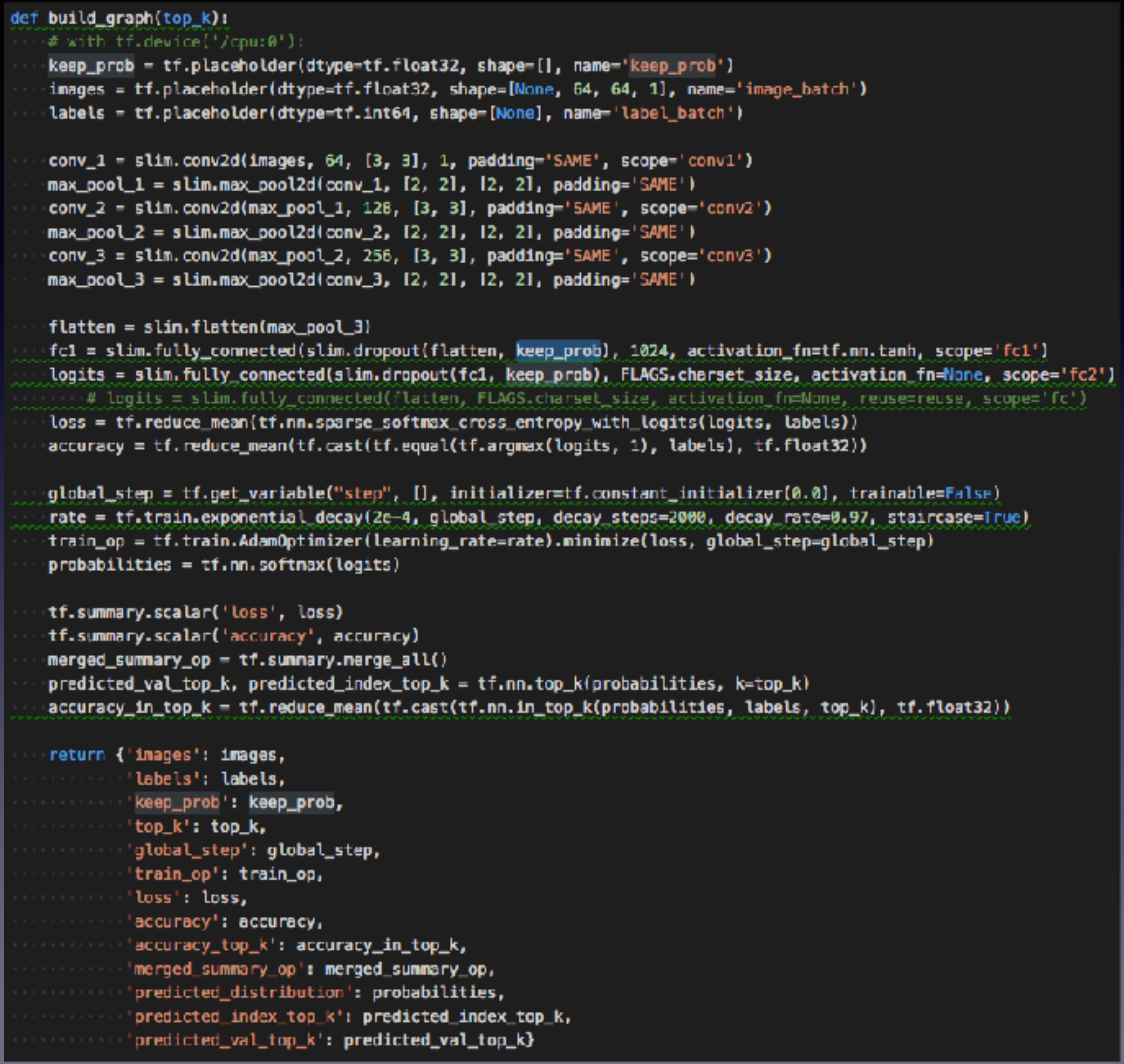
maxpool
256@8x8

flatten/dropout
16384

fc1/dropout
1024

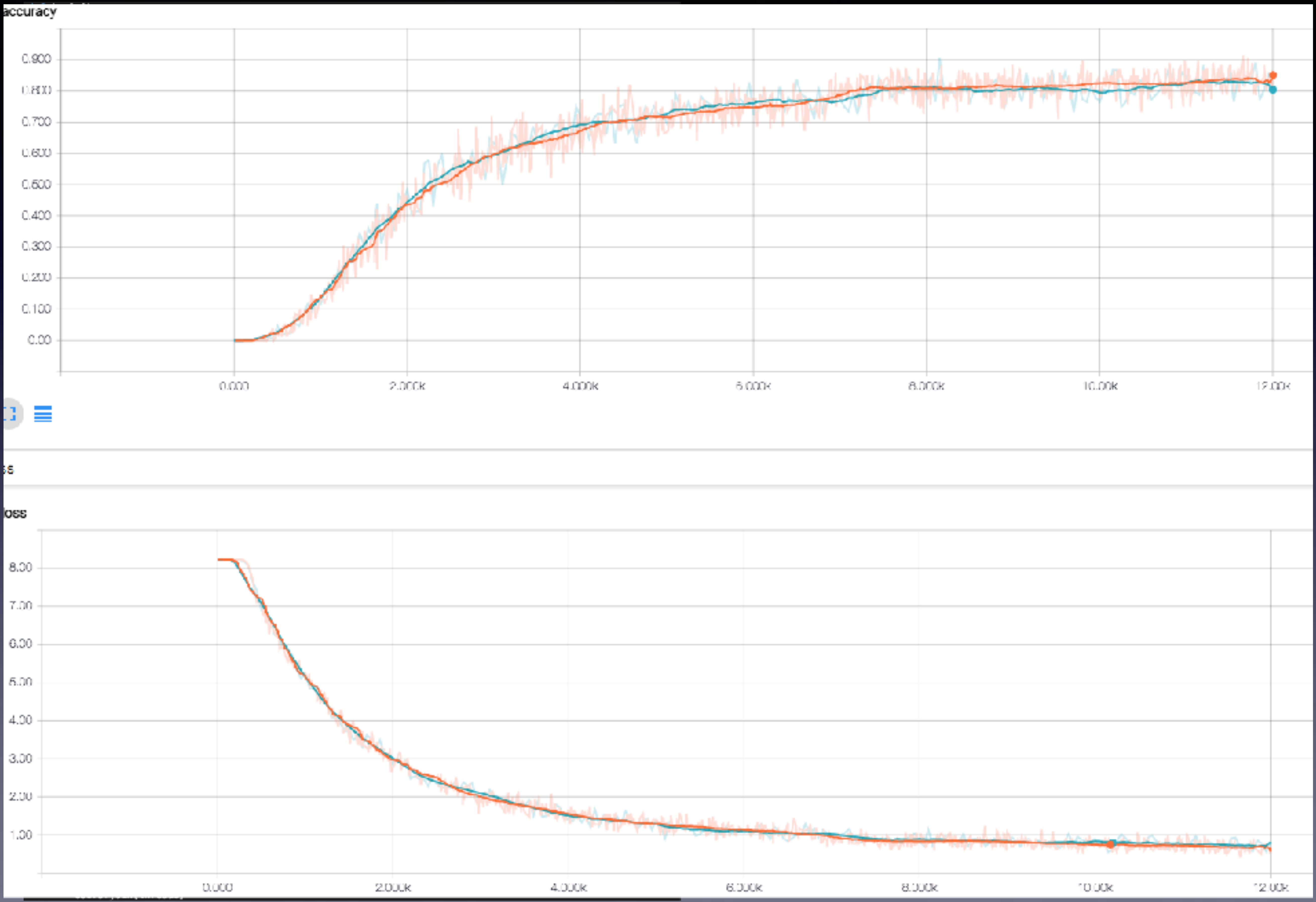
fc2/dropout
3755

# Build Network—Build Graph

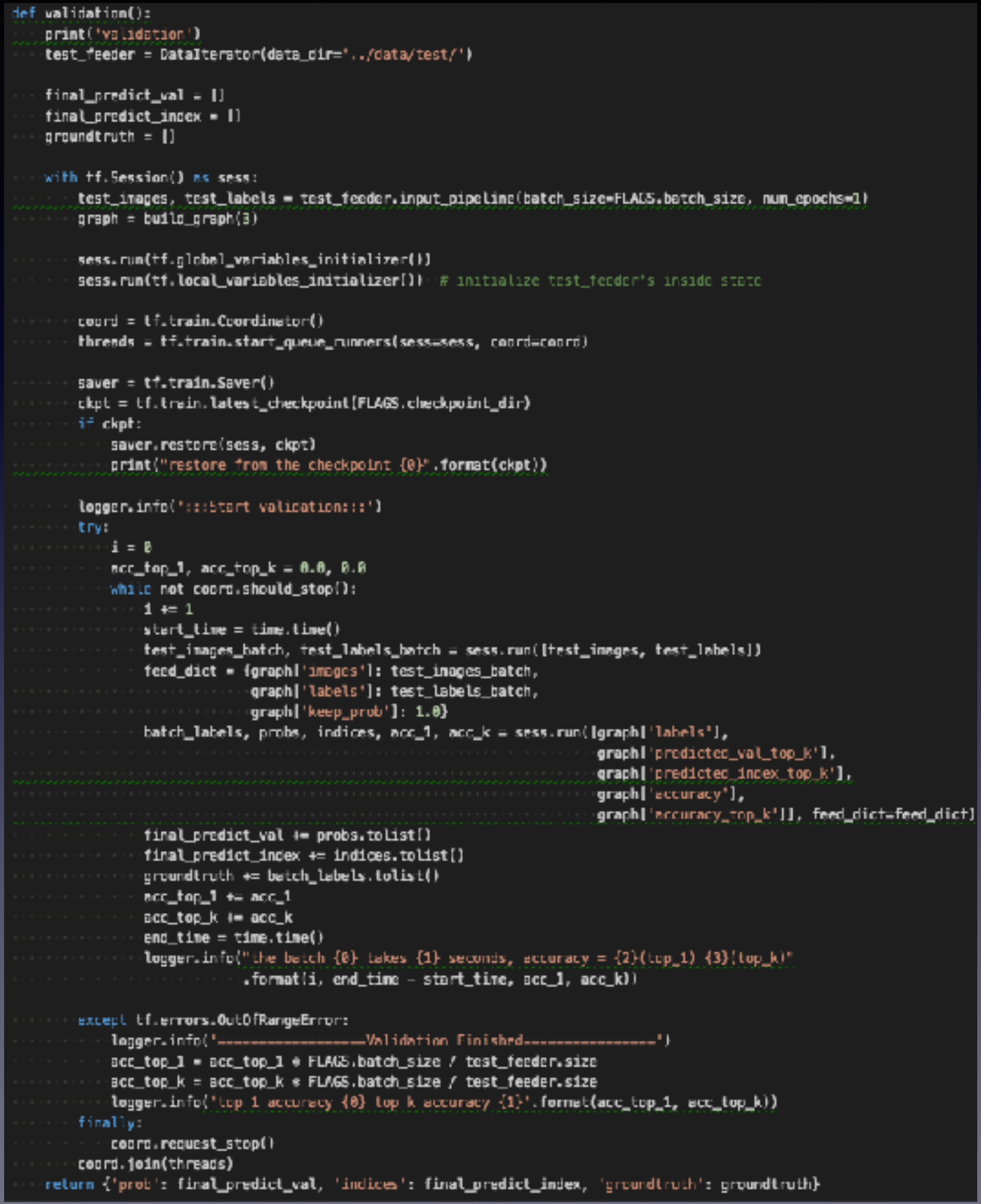


```python
def build_graph(top_k):
    # with tf.device('/cpu:0'):
    keep_prob = tf.placeholder(dtype=tf.float32, shape=[], name='keep_prob')
    images = tf.placeholder(dtype=tf.float32, shape=[None, 64, 64, 1], name='image_batch')
    labels = tf.placeholder(dtype=tf.int64, shape=[None], name='label_batch')

    conv_1 = slim.conv2d(images, 64, [3, 3], 1, padding='SAME', scope='conv1')
    max_pool_1 = slim.max_pool2d(conv_1, [2, 2], [2, 2], padding='SAME')
    conv_2 = slim.conv2d(max_pool_1, 128, [3, 3], padding='SAME', scope='conv2')
    max_pool_2 = slim.max_pool2d(conv_2, [2, 2], [2, 2], padding='SAME')
    conv_3 = slim.conv2d(max_pool_2, 256, [3, 3], padding='SAME', scope='conv3')
    max_pool_3 = slim.max_pool2d(conv_3, [2, 2], [2, 2], padding='SAME')

    flatten = slim.flatten(max_pool_3)
    fc1 = slim.fully_connected(slim.dropout(flatten, keep_prob), 1024, activation_fn=tf.nn.tanh, scope='fc1')
    logits = slim.fully_connected(slim.dropout(fc1, keep_prob), FLAGS.charset_size, activation_fn=None, scope='fc2')
        # logits = slim.fully_connected(flatten, FLAGS.charset_size, activation_fn=None, reuse=reuse, scope='fc')
    loss = tf.reduce_mean(tf.nn.sparse_softmax_cross_entropy_with_logits(logits, labels))
    accuracy = tf.reduce_mean(tf.cast(tf.equal(tf.argmax(logits, 1), labels), tf.float32))

    global_step = tf.get_variable("step", [], initializer=tf.constant_initializer(0.0), trainable=False)
    rate = tf.train.exponential_decay(2e-4, global_step, decay_steps=2000, decay_rate=0.97, staircase=True)
    train_op = tf.train.AdamOptimizer(learning_rate=rate).minimize(loss, global_step=global_step)
    probabilities = tf.nn.softmax(logits)

    tf.summary.scalar('loss', loss)
    tf.summary.scalar('accuracy', accuracy)
    merged_summary_op = tf.summary.merge_all()
    predicted_val_top_k, predicted_index_top_k = tf.nn.top_k(probabilities, k=top_k)
    accuracy_in_top_k = tf.reduce_mean(tf.cast(tf.nn.in_top_k(probabilities, labels, top_k), tf.float32))

    return {'images': images,
            'labels': labels,
            'keep_prob': keep_prob,
            'top_k': top_k,
            'global_step': global_step,
            'train_op': train_op,
            'loss': loss,
            'accuracy': accuracy,
            'accuracy_top_k': accuracy_in_top_k,
            'merged_summary_op': merged_summary_op,
            'predicted_distribution': probabilities,
            'predicted_index_top_k': predicted_index_top_k,
            'predicted_val_top_k': predicted_val_top_k}
```

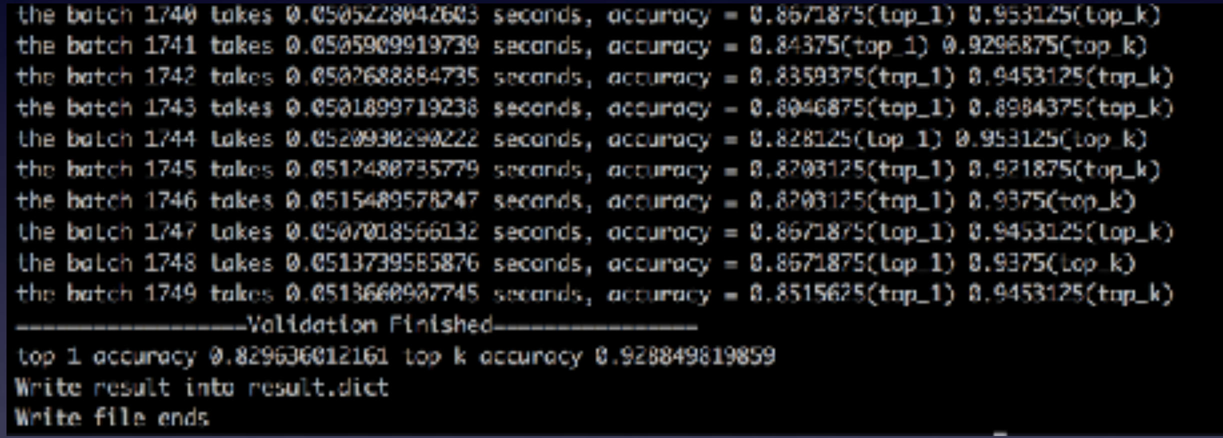
# Train, Validate, Inference



# Train, Validate, Inference

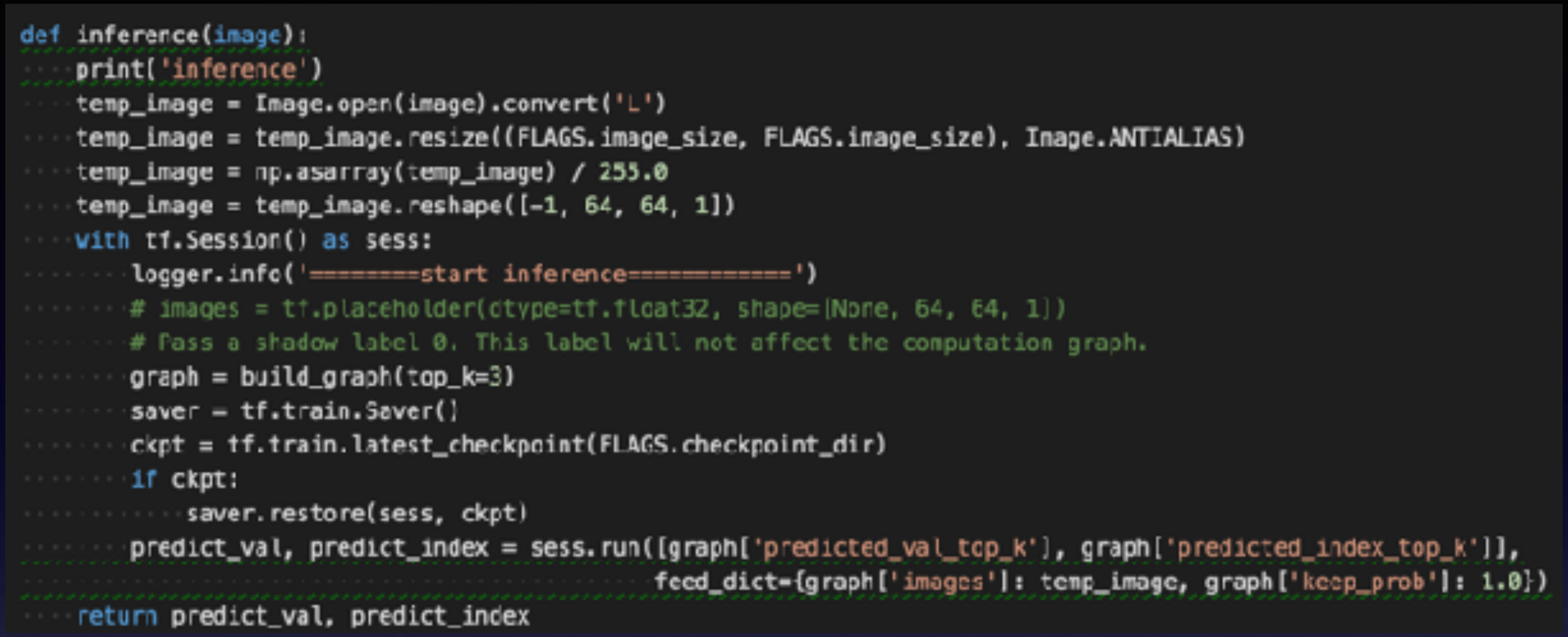


```python
def validation():
    print('validation')
    test_feeder = DataIterator(data_dir='../data/test/')

    final_predict_val = []
    final_predict_index = []
    groundtruth = []

    with tf.Session() as sess:
        test_images, test_labels = test_feeder.input_pipeline(batch_size=FLAGS.batch_size, num_epochs=1)
        graph = build_graph(3)

        sess.run(tf.global_variables_initializer())
        sess.run(tf.local_variables_initializer())  # initialize test_feeder's inside state

        coord = tf.train.Coordinator()
        threads = tf.train.start_queue_runners(sess=sess, coord=coord)

        saver = tf.train.Saver()
        ckpt = tf.train.latest_checkpoint(FLAGS.checkpoint_dir)
        if ckpt:
            saver.restore(sess, ckpt)
            print("restore from the checkpoint {0}".format(ckpt))

        logger.info(':::Start validation:::')
        try:
            i = 0
            acc_top_1, acc_top_k = 0.0, 0.0
            while not coord.should_stop():
                i += 1
                start_time = time.time()
                test_images_batch, test_labels_batch = sess.run([test_images, test_labels])
                feed_dict = {graph['images']: test_images_batch,
                             graph['labels']: test_labels_batch,
                             graph['keep_prob']: 1.0}
                batch_labels, probs, indices, acc_1, acc_k = sess.run([graph['labels'],
                                                                        graph['predicted_val_top_k'],
                                                                        graph['predicted_index_top_k'],
                                                                        graph['accuracy'],
                                                                        graph['accuracy_top_k']], feed_dict=feed_dict)
                final_predict_val += probs.tolist()
                final_predict_index += indices.tolist()
                groundtruth += batch_labels.tolist()
                acc_top_1 += acc_1
                acc_top_k += acc_k
                end_time = time.time()
                logger.info("the batch {0} takes {1} seconds, accuracy = {2}(top_1) {3}(top_k)"
                            .format(i, end_time - start_time, acc_1, acc_k))

        except tf.errors.OutOfRangeError:
            logger.info('==================Validation Finished================')
            acc_top_1 = acc_top_1 * FLAGS.batch_size / test_feeder.size
            acc_top_k = acc_top_k * FLAGS.batch_size / test_feeder.size
            logger.info('top 1 accuracy {0} top k accuracy {1}'.format(acc_top_1, acc_top_k))
        finally:
            coord.request_stop()
        coord.join(threads)
    return {'prob': final_predict_val, 'indices': final_predict_index, 'groundtruth': groundtruth}
```

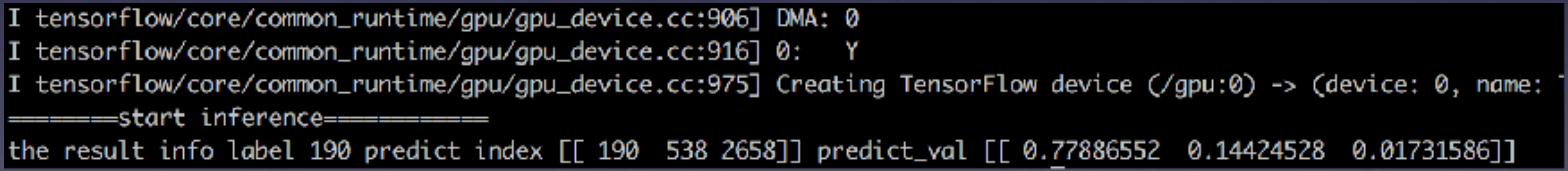


```
the batch 1740 takes 0.0505228042603 seconds, accuracy = 0.8671875(top_1) 0.953125(top_k)
the batch 1741 takes 0.0505909919739 seconds, accuracy = 0.84375(top_1) 0.9296875(top_k)
the batch 1742 takes 0.0502688884735 seconds, accuracy = 0.8359375(top_1) 0.9453125(top_k)
the batch 1743 takes 0.0501899719238 seconds, accuracy = 0.8046875(top_1) 0.8984375(top_k)
the batch 1744 takes 0.0520930290222 seconds, accuracy = 0.828125(top_1) 0.953125(top_k)
the batch 1745 takes 0.0512480735779 seconds, accuracy = 0.8203125(top_1) 0.921875(top_k)
the batch 1746 takes 0.0515489578247 seconds, accuracy = 0.8203125(top_1) 0.9375(top_k)
the batch 1747 takes 0.0507018566132 seconds, accuracy = 0.8671875(top_1) 0.9453125(top_k)
the batch 1748 takes 0.0513739585876 seconds, accuracy = 0.8671875(top_1) 0.9375(top_k)
the batch 1749 takes 0.0513660907745 seconds, accuracy = 0.8515625(top_1) 0.9453125(top_k)
==================Validation Finished================
top 1 accuracy 0.829636012161 top k accuracy 0.928849819859
Write result into result.dict
Write file ends
```

# Train, Validate, Inference

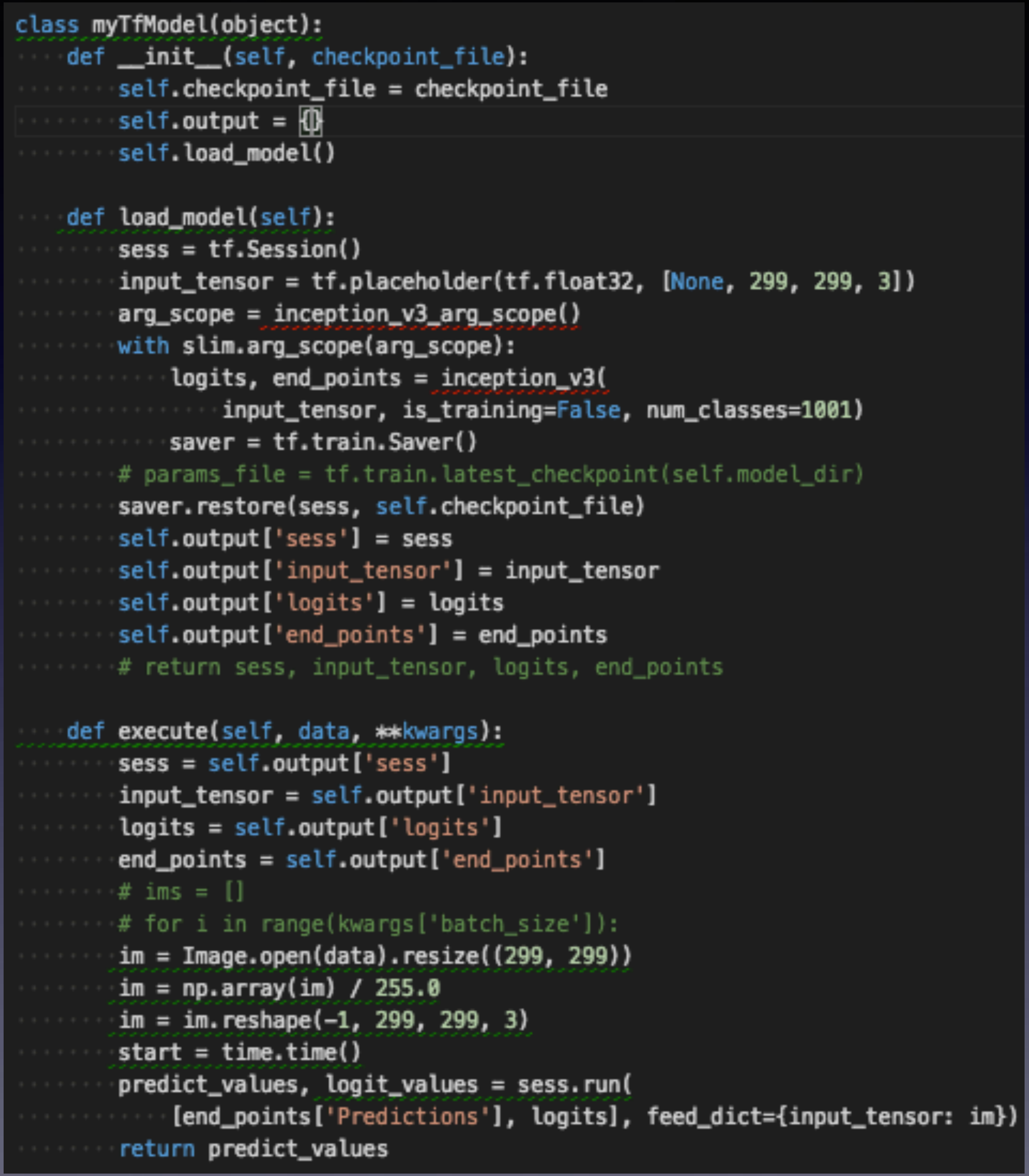


```python
def inference(image):
    print('inference')
    temp_image = Image.open(image).convert('L')
    temp_image = temp_image.resize((FLAGS.image_size, FLAGS.image_size), Image.ANTIALIAS)
    temp_image = np.asarray(temp_image) / 255.0
    temp_image = temp_image.reshape([-1, 64, 64, 1])
    with tf.Session() as sess:
        logger.info('========start inference============')
        # images = tf.placeholder(dtype=tf.float32, shape=[None, 64, 64, 1])
        # Pass a shadow label 0. This label will not affect the computation graph.
        graph = build_graph(top_k=3)
        saver = tf.train.Saver()
        ckpt = tf.train.latest_checkpoint(FLAGS.checkpoint_dir)
        if ckpt:
            saver.restore(sess, ckpt)
        predict_val, predict_index = sess.run([graph['predicted_val_top_k'], graph['predicted_index_top_k']],
                                               feed_dict={graph['images']: temp_image, graph['keep_prob']: 1.0})
    return predict_val, predict_index
```

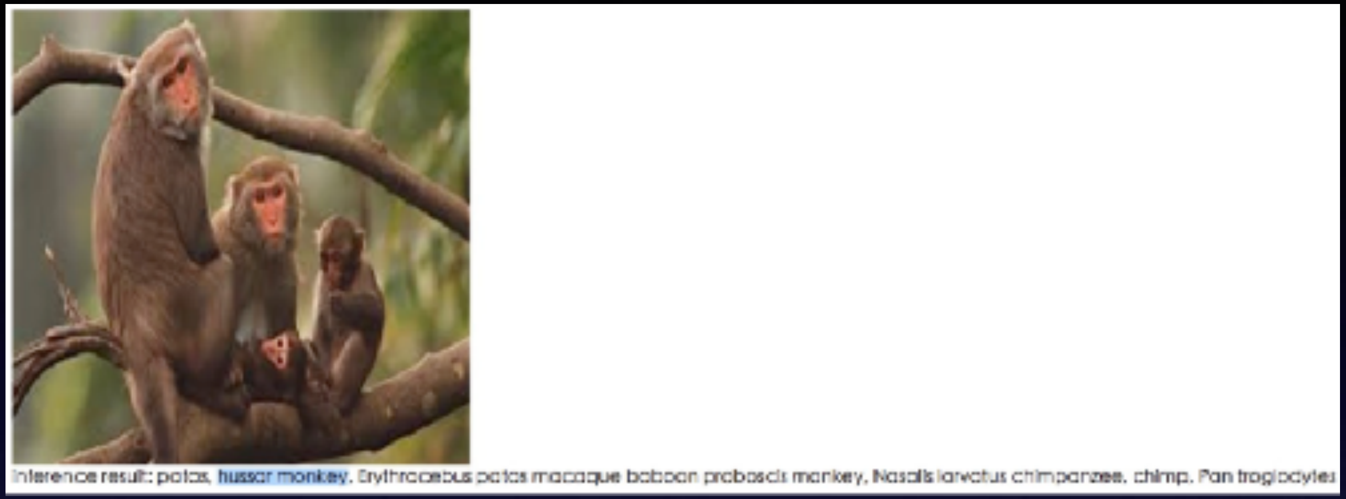


```
I tensorflow/core/common_runtime/gpu/gpu_device.cc:906] DMA: 0
I tensorflow/core/common_runtime/gpu/gpu_device.cc:916] 0:   Y
I tensorflow/core/common_runtime/gpu/gpu_device.cc:975] Creating TensorFlow device (/gpu:0) -> (device: 0, name:
=======start inference==========
the result info label 190 predict index [[ 190  538 2658]] predict_val [[ 0.77886552  0.14424528  0.01731586]]
```

# Http Service With Flask



```python
class myTfModel(object):
    def __init__(self, checkpoint_file):
        self.checkpoint_file = checkpoint_file
        self.output = {}
        self.load_model()

    def load_model(self):
        sess = tf.Session()
        input_tensor = tf.placeholder(tf.float32, [None, 299, 299, 3])
        arg_scope = inception_v3_arg_scope()
        with slim.arg_scope(arg_scope):
            logits, end_points = inception_v3(
                input_tensor, is_training=False, num_classes=1001)
            saver = tf.train.Saver()
        # params_file = tf.train.latest_checkpoint(self.model_dir)
        saver.restore(sess, self.checkpoint_file)
        self.output['sess'] = sess
        self.output['input_tensor'] = input_tensor
        self.output['logits'] = logits
        self.output['end_points'] = end_points
        # return sess, input_tensor, logits, end_points

    def execute(self, data, **kwargs):
        sess = self.output['sess']
        input_tensor = self.output['input_tensor']
        logits = self.output['logits']
        end_points = self.output['end_points']
        # ims = []
        # for i in range(kwargs['batch_size']):
        im = Image.open(data).resize((299, 299))
        im = np.array(im) / 255.0
        im = im.reshape(-1, 299, 299, 3)
        start = time.time()
        predict_values, logit_values = sess.run(
            [end_points['Predictions'], logits], feed_dict={input_tensor: im})
        return predict_values
```

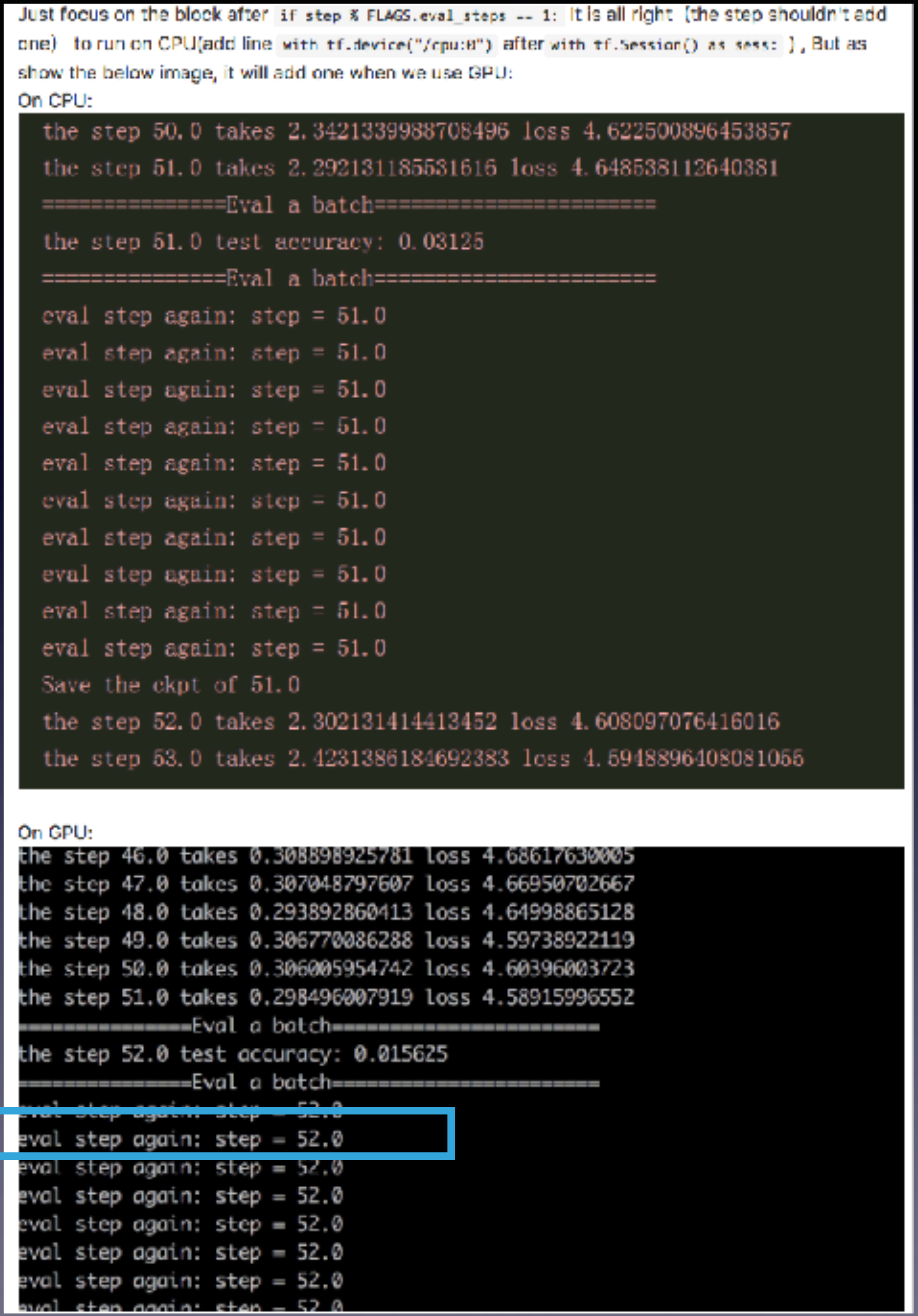


Inference result: patas, hussar monkey, Erythrocebus patas macaque baboon proboscis monkey, Nasalis larvatus chimpanzee, chimp, Pan troglodytes

**Here is Inception-V3 not the above model**

https://github.com/burness/tensorflow-101/

# Maybe A Bug



Just focus on the block after `if step % FLAGS.eval_steps -- 1:` It is all right (the step shouldn't add one) to run on CPU(add line `with tf.device("/cpu:0")` after `with tf.Session() as sess:` ), But as show the below image, it will add one when we use GPU:

On CPU:

```
the step 50.0 takes 2.3421339988708496 loss 4.6225008964538 57
the step 51.0 takes 2.292131185531616 loss 4.648538112640381
===============Eval a batch=======================
the step 51.0 test accuracy: 0.03125
===============Eval a batch=======================
eval step again: step = 51.0
eval step again: step = 51.0
eval step again: step = 51.0
eval step again: step = 51.0
eval step again: step = 51.0
eval step again: step = 51.0
eval step again: step = 51.0
eval step again: step = 51.0
eval step again: step = 51.0
eval step again: step = 51.0
Save the ckpt of 51.0
the step 52.0 takes 2.302131414413452 loss 4.608097076416016
the step 53.0 takes 2.4231386184692383 loss 4.594889640808105 6
```

On GPU:

```
the step 46.0 takes 0.308898925781 loss 4.68617630005
the step 47.0 takes 0.307048797607 loss 4.66950702667
the step 48.0 takes 0.293892860413 loss 4.64998865128
the step 49.0 takes 0.306770086288 loss 4.59738922119
the step 50.0 takes 0.306005954742 loss 4.60396003723
the step 51.0 takes 0.298496007919 loss 4.58915996552
===============Eval a batch=======================
the step 52.0 test accuracy: 0.015625
===============Eval a batch=======================
eval step again: step = 52.0
eval step again: step = 52.0
eval step again: step = 52.0
eval step again: step = 52.0
eval step again: step = 52.0
eval step again: step = 52.0
eval step again: step = 52.0
eval step again: step = 52.0
```

http://stackoverflow.com/questions/42328949/maybe-a-bug-different-eval-step-between-cpu-and-gpu

# Thank You & QA

整理内容和回放视频将会通过前沿技术研究公众号发布，敬请关注