Appendix E: TensorFlow code Sample

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#! /usr/bin/python
import numpy as np
import tensorflow as tf
import time
import dataset
import utilities

# Tensorflow convinience functions
def weight_variable(shape, name):
   initial = tf.truncated_normal(shape, stddev=0.1)
   return tf.Variable(initial, name=name)

def bias_variable(shape, name):
   initial = tf.constant(0.1, shape=shape)
   return tf.Variable(initial, name=name)

def conv2d(x, W):
   return tf.nn.conv2d(x, W, strides=[1, 1, 1, 1], padding='SAME')

def max_pool_3x3(x, name):
   return tf.nn.max_pool(x, ksize=[1, 3, 3, 1], strides=[1, 2, 2, 1], padding='VALID', name=name)

def max_pool_2x2(x, name):
   return tf.nn.max_pool(x, ksize=[1, 2, 2, 1], strides=[1, 2, 2, 1], padding='SAME', name=name)

def doDumbNet(trainDir, valDir, trainCsv, valCsv):
   f1 = open('log_%d' % (time.time()), 'w+')
   f1.write('AAAAA\n')
   f1.write("Start %s\n" % time.time())
   f1.flush()

   # Force CPU only mode because net overflows GPU mem
   with tf.device('/cpu:0'):
      sess = tf.Session()

      # Constants
      nClasses = 38
      imageSize = 256
      batchSize = 10
      learningRate = 1e-4
      dropOutValue = 0.5
      f1.write('nClasses: %d, imageSize: %d, batchSize: %d, learningRate: %e, dropOut: %f\n'
               % (nClasses, imageSize, batchSize, learningRate, dropOutValue))
      f1.flush()
      x = tf.placeholder("float", shape=[None, imageSize, imageSize, 1], name="Input")
      y_ = tf.placeholder("float", shape=[None, nClasses], name="Output")

      # CONVOLUTIONAL NEURAL NET
      # The first two dimensions are the patch size, the next is the number of input channels,
      # and the last is the number of output channels.
      # We will also have a bias vector with a component for each output channel.
      d1 = 32
      d2 = 32
      d3 = 64
      d4 = 64
      d5 = 64
      fc = 300

      W_conv1 = weight_variable([5, 5, 1, d1], name="Weights_conv1")
      b_conv1 = bias_variable([d1], name="b_conv1")

      # We then convolve x_image with the weight tensor,
      # add the bias, apply the ReLU function, and finally max pool.
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    h_conv1 = tf.nn.sigmoid(conv2d(x, W_conv1) + b_conv1)
    h_pool1 = max_pool_2x2(h_conv1, name="pool1")

    # SECOND CONV LAYER
    # In order to build a deep network, we stack several layers of this type.
    # The second layer will have 64 features for each 5x5 patch.
    W_conv2 = weight_variable([5, 5, d1, d2], name="Weights_conv2")
    b_conv2 = bias_variable([d2], name="biases_conv2")

    h_conv2 = tf.nn.sigmoid(conv2d(h_pool1, W_conv2) + b_conv2)
    h_pool2 = max_pool_2x2(h_conv2, name="pool2")

    # THIRD CONV LAYER
    W_conv3 = weight_variable([5, 5, d2, d3], name="Weights_conv3")
    b_conv3 = bias_variable([d3], name="biases_conv3")

    h_conv3 = tf.nn.sigmoid(conv2d(h_pool2, W_conv3) + b_conv3)
    h_pool3 = max_pool_2x2(h_conv3, name="pool3")

    # FOURTH CONV LAYER
    W_conv4 = weight_variable([3, 3, d3, d4], name="Weights_conv4")
    b_conv4 = bias_variable([d4], name="biases_conv4")

    h_conv4 = tf.nn.sigmoid(conv2d(h_pool3, W_conv4) + b_conv4)
    h_pool4 = max_pool_2x2(h_conv4, name="pool4")

    # FIFTH CONV LAYER
    W_conv5 = weight_variable([3, 3, d4, d5], name="Weights_conv5")
    b_conv5 = bias_variable([d5], name="biases_conv5")

    h_conv5 = tf.nn.sigmoid(conv2d(h_pool4, W_conv5) + b_conv5)
    h_pool5 = max_pool_2x2(h_conv5, name="pool5")

    # DENSELY CONNECTED LAYER
    # Now that the image size has been reduced to 8x8,
    # we add a fully-connected layer with 300 neurons to allow processing on the entire image.
    # We reshape the tensor from the pooling layer into a batch of vectors, multiply by a weight
    # matrix, add a bias, and apply a ReLU.

    W_fc1 = weight_variable([8 * 8 * d5, fc], name="Weights_fc1")
    b_fc1 = bias_variable([fc], name="biases_fc1")

    h_conv5_flat = tf.reshape(h_pool5, [-1, 8 * 8 * d5])
    h_fc1 = tf.nn.sigmoid(tf.matmul(h_conv5_flat, W_fc1) + b_fc1)

    # DROPOUT
    keep_prob = tf.placeholder("float")
    h_fc1_drop = tf.nn.dropout(h_fc1, keep_prob)

    # READOUT LAYER
    W_fc2 = weight_variable([fc, nClasses], name="Weights_fc2")
    b_fc2 = bias_variable([nClasses], name="biases_fc2")
    y_conv = tf.nn.softmax(tf.matmul(h_fc1_drop, W_fc2) + b_fc2)

    # Load the dataset
    datasets = dataset.read_data_sets(trainDir, valDir, trainCsv, valCsv)

    # Train and eval the model
    cross_entropy = -tf.reduce_sum(y_ * tf.log(tf.clip_by_value(y_conv, 1e-10, 1.0)))
    tf.scalar_summary('cross entropy', cross_entropy)

    # train_step = tf.train.GradientDescentOptimizer(0.00001).minimize(cross_entropy)
    train_step = tf.train.AdamOptimizer(learningRate).minimize(cross_entropy)
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      correct_prediction = tf.equal(tf.argmax(y_conv, 1), tf.argmax(y_, 1))
      accuracy = tf.reduce_mean(tf.cast(correct_prediction, "float"))
      sess.run(tf.initialize_all_variables())
)
      # saver = tf.train.Saver()
      # saver.restore(sess, 'my-model-batch1-10000')

      for i in xrange(5000):
         step_start = time.time()

         batch = datasets.train.get_sequential_batch(batchSize)
         train_step.run(feed_dict={x: batch[0], y_: batch[1], keep_prob: 1}, session=sess)

         if i % 25 == 0:
            # evaluate accuracy on random 100 samples from train set
            batch = datasets.train.get_random_batch(100)
            f1.write("step %d finished, time = %s\n" % (i, time.time() - step_start))
            acc, cross_entropyD, yD = sess.run([accuracy, cross_entropy, y_conv],
                                               feed_dict={x: batch[0], y_: batch[1], keep_prob: 1})
            f1.write("Cross entropy = " + str(cross_entropyD) + "\n")
            f1.write("Accuracy = " + str(acc) + "\n")
            f1.write("Y = " + str(np.argmax(yD, axis=1)) + "\n")
            f1.write("\n--- %s seconds ---\n\n" % (time.time() - start_time))
            f1.flush()

         f1.write("\nstep %d finished, %d seconds \n" % (i, time.time() - step_start))
         f1.flush()

   saver.save(sess, 'my-model-%d' % (time.time()), global_step=10000)  # Evaluate the prediction
   test = datasets.validation.getAll()
   acc, y_convD, correct_predictionD = sess.run([accuracy, y_conv, correct_prediction],
                                                feed_dict={x: test[0], y_: test[1], keep_prob: 1.0})
   f1.write("Accuracy = " + str(acc) + "\n")
   f1.write("Correct prediction %d\n" % (sum(correct_predictionD)))
   f1.write("y %s\n" % str(test[1]))
   f1.write("y from net %s\n" % str(np.argmax(y_convD, axis=1)))
   f1.write("\n--- %s seconds ---\n\n" % (time.time() - start_time))
   f1.flush()
   f1.close()

start_time = time.time()
doDumbNet('train/train', 'train/validation', 'whales.csv', 'whales.csv')
```