IE 345 - K “Introduction to Deep Learning: Fundamentals Concepts”

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Neural Networking using TensorFlow

pg. 93 - 99

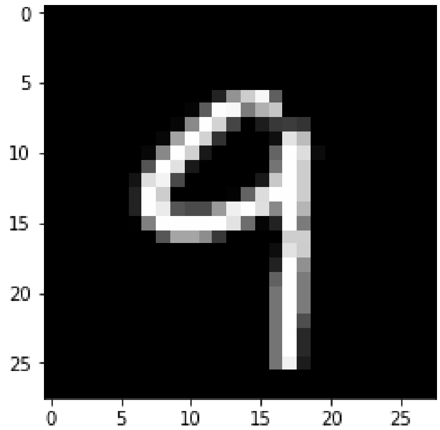
In [2]:
```
# Import MNIST data
from tensorflow.examples.tutorials.mnist import input_data

mnist = input_data.read_data_sets('/tmp/data/', one_hot = True)
```

```
Extracting /tmp/data/train-images-idx3-ubyte.gz
Extracting /tmp/data/train-labels-idx1-ubyte.gz
Extracting /tmp/data/t10k-images-idx3-ubyte.gz
Extracting /tmp/data/t10k-labels-idx1-ubyte.gz
```

In [2]:
```
import numpy as np
import tensorflow as tf
import matplotlib.pyplot as plt
```

In [3]:
```
plt.imshow(np.reshape(mnist.train.images[8], [28, 28]), cmap='gray')
plt.show()
```



In [4]:
```
# Parameters
learning_rate = 0.1
num_steps = 500
batch_size = 128
display_step = 100
```

In [5]:
```
# Network Parameters
n_hidden_1 = 10 # 1st layer number of neurons
n_hidden_2 = 10 # 2nd layer number of neurons
num_input = 784 # MNIST data input (img shape: 28*28)
num_classes = 10 # MNIST total classes (0-9 digits)
```

In [6]:
```
# TF Graph Input
X = tf.placeholder("float", [None, num_input])
Y = tf.placeholder("float", [None, num_classes])
```

In [7]:
```
# Store layers weight & bias
weights = {
    'h1': tf.Variable(tf.random_normal([num_input, n_hidden_1])),
    'h2': tf.Variable(tf.random_normal([n_hidden_1, n_hidden_2])),
    'out': tf.Variable(tf.random_normal([n_hidden_2, num_classes]))
}

biases = {
    'b1': tf.Variable(tf.random_normal([n_hidden_1])),
    'b2': tf.Variable(tf.random_normal([n_hidden_2])),
    'out': tf.Variable(tf.random_normal([num_classes]))
}
```

In [8]:
```
# Create Model
def neural_net(x):
    # Hidden fully connected layer with 10 neurons
    layer_1 = tf.add(tf.matmul(x, weights['h1']), biases['b1'])
    # Hidden fully connected layer with 10 neurons
    layer_2 = tf.add(tf.matmul(layer_1, weights['h2']), biases['b2'])
    # Output fully connected layer with a neuron for each class
    out_layer = tf.matmul(layer_2, weights['out']) + biases['out']
    return out_layer
```

In [9]:
```
# Construct model
logits = neural_net(X)
```

In [10]:
```
# Define loss and optimizer
loss_op = tf.reduce_mean(tf.nn.softmax_cross_entropy_with_logits_v2(logits=logits, la
bels=Y))
optimizer = tf.train.AdamOptimizer(learning_rate=learning_rate)
train_op = optimizer.minimize(loss_op)
```

Recommendation from TensorFlow

Future major versions of TensorFlow will allow gradients to flow into the labels input on backprop by default.

See `tf.nn.softmax_cross_entropy_with_logits_v2` .

In [11]:
```
# Evaluate model (with test logits, for dropout to be disabled)
correct_pred = tf.equal(tf.arg_max(logits, 1), tf.arg_max(Y, 1))
accuracy = tf.reduce_mean(tf.cast(correct_pred, tf.float32))
```

```
WARNING:tensorflow:From <ipython-input-11-025b50ff9787>:2: arg_max (from tensorflow.p
ython.ops.gen_math_ops) is deprecated and will be removed in a future version.
Instructions for updating:
Use `argmax` instead
```

In [12]:
```
# Initialize the variables (i.e. assign their default value)
init = tf.global_variables_initializer()
sess = tf.Session()
```

In [28]:

```
# Start training
with tf.Session() as sess:
    # Run the initializer
    sess.run(init)

    for step in range(1, num_steps+1):
        batch_x, batch_y = mnist.train.next_batch(batch_size)
        # Run optimization op (backprop)
        sess.run(train_op, feed_dict={X: batch_x, Y:batch_y})
        if step % display_step == 0 or step == 1:
            # Calculate batch loss and accuracy
            loss, acc = sess.run([loss_op, accuracy], feed_dict={X: batch_x, Y:batch_
y})
            print("Step " + str(step) + ", Minibatch Loss= " + \
                  "{:.4f}".format(loss) + ", Training  Accuracy= " +\
                  "{:.3f}".format(acc))

    print("Optimization Finished!!")

    # Calculate accuracy for MNIST test images
    print("\nTesting Accuracy:", \
        sess.run(accuracy, feed_dict={X: mnist.test.images,
                                      Y: mnist.test.labels}))
```

```
Step 1, Minibatch Loss= 156.1856, Training  Accuracy= 0.125
Step 100, Minibatch Loss= 0.8100, Training  Accuracy= 0.750
Step 200, Minibatch Loss= 0.7834, Training  Accuracy= 0.773
Step 300, Minibatch Loss= 0.5642, Training  Accuracy= 0.820
Step 400, Minibatch Loss= 0.3817, Training  Accuracy= 0.891
Step 500, Minibatch Loss= 0.4415, Training  Accuracy= 0.898
Optimization Finished!!

Testing Accuracy: 0.8828
```

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