MNIST Multi-Layer Perceptron

Multi Layer Perceptron model to try to classify hand written digits using TensorFlow.

MNIST data set of handwritten digits.

The images are black and white images of size 28 x 28 pixels, or 784 pixels total. Features

In [22]:
```
# Import the libraries

# Numpy is the fundamental package for scientific computing with Python
import numpy as np

# Matplotlib is used for graphs
import matplotlib.pyplot as plt

# %matplotlib inline is magic command. This performs the necessary behi
%matplotlib inline
```

In [1]:
```
# Library to import MNIST Data
from tensorflow.examples.tutorials.mnist import input_data
```

In [2]:
```
# Reading the 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
```

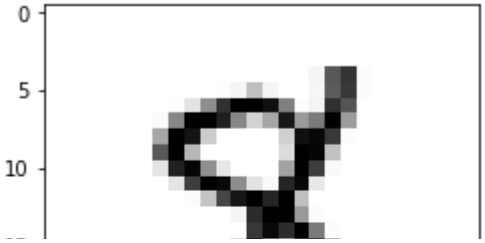
In [3]:
```
type(mnist)
```

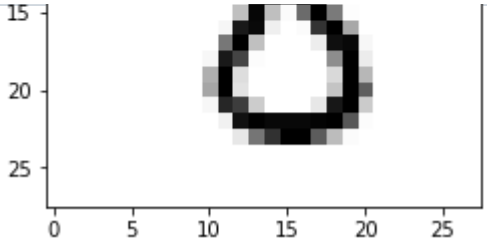
Out[3]:
```
tensorflow.contrib.learn.python.learn.datasets.base.Datasets
```

In [4]:
```
# To see our data
sample=mnist.train.images[1022].reshape(28,28)
```

In [7]:
```
plt.imshow(sample,cmap='Greys')
```

Out[7]:
```
<matplotlib.image.AxesImage at 0x1b832eee8d0>
```





In [8]:
```
# Parameters
# Learning Rate - How quickly to adjust the cost function.
# Training Epochs - How many training cycles to go through
# Batch Size - Size of the 'batches' of training data

learning_rate =0.01
training_epochs =15
batch_size =100
```

In [9]:
```
# Network Parameters
n_hidden_1 = 256 # 1st layer number of features
n_hidden_2 = 256 # 2nd layer number of features
n_input = 784 # MNIST data input (img shape: 28*28)
n_classes = 10 # MNIST total classes (0-9 digits)
n_samples = mnist.train.num_examples
```

In [14]:
```
def multilayer_perceptron(x, weights, biases):
    '''
    x : Place Holder for Data Input
    weights: Dictionary of weights
    biases: Dicitionary of biases
    '''

    # First Hidden layer with RELU activation
    layer_1 = tf.add(tf.matmul(x, weights['h1']), biases['b1'])
    layer_1 = tf.nn.relu(layer_1)

    # Second Hidden layer with RELU activation
    layer_2 = tf.add(tf.matmul(layer_1, weights['h2']), biases['b2'])
    layer_2 = tf.nn.relu(layer_2)

    # Last Output layer with linear activation
    out_layer = tf.matmul(layer_2, weights['out']) + biases['out']
    return out_layer
```

In [17]:
```
weights = {
    'h1': tf.Variable(tf.random_normal([n_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, n_classes]))
}
```

In [18]:
```
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([n_classes]))
}
```

```
}
```

In [19]:
```
x=tf.placeholder('float',[None,n_input])
y=tf.placeholder('float',[None,n_classes])
```

In [20]:
```
# Construct model
pred = multilayer_perceptron(x, weights, biases)
```

In [21]:
```
# Define loss and optimizer
cost =tf.reduce_mean(tf.nn.softmax_cross_entropy_with_logits(logits=pre
```

In [22]:
```
optimizer = tf.train.AdamOptimizer(learning_rate=learning_rate).minimiz
```

In [23]:
```
t=mnist.train.next_batch(10)
```

In [24]:
```
Xsamp,ysamp = mnist.train.next_batch(1)
```

In [25]:
```
# Launch the session
sess = tf.InteractiveSession()
init = tf.initialize_all_variables()
# Intialize all the variables
sess.run(init)

# Training Epochs
# Essentially the max amount of loops possible before we stop
# May stop earlier if cost/loss limit was set
for epoch in range(training_epochs):

    # Start with cost = 0.0
    avg_cost = 0.0

    # Convert total number of batches to integer
    total_batch = int(n_samples/batch_size)

    # Loop over all batches
    for i in range(total_batch):

        # Grab the next batch of training data and labels
        batch_x, batch_y = mnist.train.next_batch(batch_size)

        # Feed dictionary for optimization and loss value
        # Returns a tuple, but we only need 'c' the cost
        # So we set an underscore as a "throwaway"
        _, c = sess.run([optimizer, cost], feed_dict={x: batch_x, y: ba

        # Compute average loss
        avg_cost += c / total_batch

    print("Epoch: {} cost={:.4f}".format(epoch+1,avg_cost))

print("Model has completed {} Epochs of Training".format(training_epoch
```

```
WARNING:tensorflow:From C:\ProgramData\Anaconda3\lib\site-packages\tenso
Instructions for updating:
Use `tf.global_variables_initializer` instead.
Epoch: 1 cost=47.2376
Epoch: 2 cost=8.5407
Epoch: 3 cost=4.7683
Epoch: 4 cost=3.2909
Epoch: 5 cost=2.6277
Epoch: 6 cost=2.4564
Epoch: 7 cost=1.9550
Epoch: 8 cost=1.7337
Epoch: 9 cost=1.5574
Epoch: 10 cost=1.4798
Epoch: 11 cost=1.2893
Epoch: 12 cost=1.0913
Epoch: 13 cost=0.9235
Epoch: 14 cost=1.0144
Epoch: 15 cost=0.8712
Model has completed 15 Epochs of Training
```

In [73]:
```
# Test model
correct_predictions = tf.equal(tf.argmax(pred, 1), tf.argmax(y, 1))
```

In [74]:
```
print(correct_predictions[0])
```

```
Tensor("strided_slice:0", shape=(), dtype=bool)
```

In [75]:
```
correct_predictions = tf.cast(correct_predictions, "float")
```

In [76]:
```
accuracy = tf.reduce_mean(correct_predictions)
```

In [77]:
```
mnist.test.labels
```

Out[77]:
```
array([[ 0.,  0.,  0., ...,  1.,  0.,  0.],
       [ 0.,  0.,  1., ...,  0.,  0.,  0.],
       [ 0.,  1.,  0., ...,  0.,  0.,  0.],
       ...,
       [ 0.,  0.,  0., ...,  0.,  0.,  0.],
       [ 0.,  0.,  0., ...,  0.,  0.,  0.],
       [ 0.,  0.,  0., ...,  0.,  0.,  0.]])
```

In [78]:
```
mnist.test.images
```

Out[78]:
```
array([[ 0.,  0.,  0., ...,  0.,  0.,  0.],
       [ 0.,  0.,  0., ...,  0.,  0.,  0.],
       [ 0.,  0.,  0., ...,  0.,  0.,  0.],
       ...,
       [ 0.,  0.,  0., ...,  0.,  0.,  0.],
       [ 0.,  0.,  0., ...,  0.,  0.,  0.],
       [ 0.,  0.,  0., ...,  0.,  0.,  0.]], dtype=float32)
```

In [ ]:

In [79]:
```
print("Accuracy:", accuracy.eval({x: mnist.test.images, y: mnist.test.l
```

```
Accuracy: 0.963
```