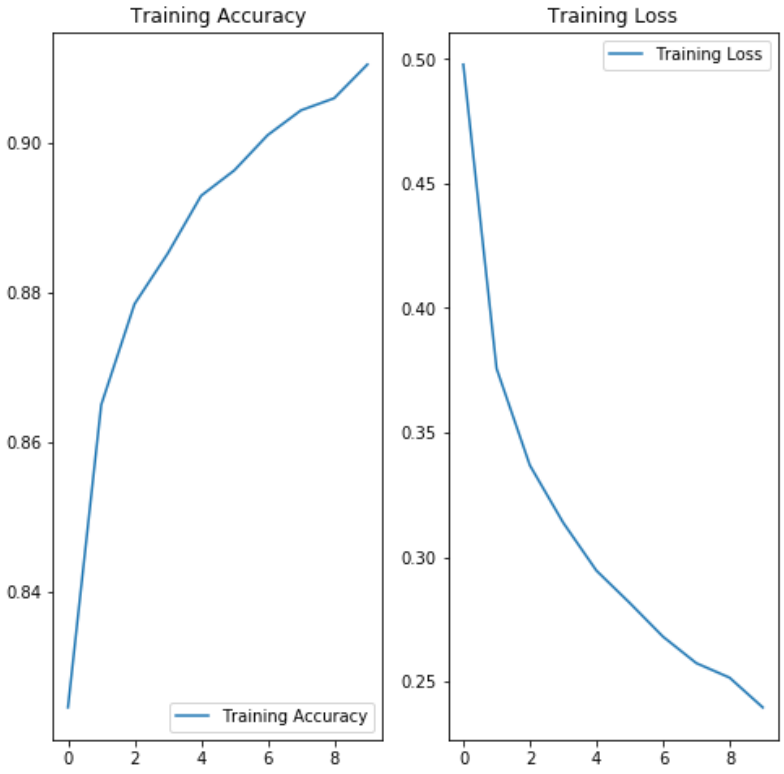
2) Basic Classification

```
  model = keras.Sequential([
      keras.layers.Flatten(input_shape=(28, 28,1)),
      keras.layers.Dense(128, activation='relu'),
      keras.layers.Dense(10)
  ])
```

```
Total params: 101,770
Trainable params: 101,770
Non-trainable params: 0
```

Results:

Test Accuracy: 86.39 %



```
[105] history = model.fit_generator(train_gen, steps_per_epoch=steps_per_epoch, epochs=epochs)
```

```
WARNING:tensorflow:sample_weight modes were coerced from
  ...
    to
  ['...']
Train for 1875 steps
Epoch 1/10
1875/1875 [==============================] - 5s 3ms/step - loss: 0.4978 - accuracy: 0.8245
Epoch 2/10
1875/1875 [==============================] - 5s 3ms/step - loss: 0.3757 - accuracy: 0.8650
Epoch 3/10
1875/1875 [==============================] - 5s 3ms/step - loss: 0.3368 - accuracy: 0.8784
Epoch 4/10
1875/1875 [==============================] - 5s 3ms/step - loss: 0.3139 - accuracy: 0.8852
Epoch 5/10
1875/1875 [==============================] - 5s 3ms/step - loss: 0.2946 - accuracy: 0.8929
Epoch 6/10
1875/1875 [==============================] - 5s 3ms/step - loss: 0.2816 - accuracy: 0.8963
Epoch 7/10
1875/1875 [==============================] - 5s 3ms/step - loss: 0.2681 - accuracy: 0.9010
Epoch 8/10
1875/1875 [==============================] - 5s 3ms/step - loss: 0.2574 - accuracy: 0.9043
Epoch 9/10
1875/1875 [==============================] - 5s 3ms/step - loss: 0.2516 - accuracy: 0.9059
Epoch 10/10
1875/1875 [==============================] - 5s 3ms/step - loss: 0.2396 - accuracy: 0.9104
```

Evaluate accuracy

```
[106] test_loss, test_acc = model.evaluate(test_images,  test_labels, verbose=2)
      print('\nTest accuracy:', test_acc)
```

```
10000/10000 - 1s - loss: 0.3820 - accuracy: 0.8639

Test accuracy: 0.8639
```

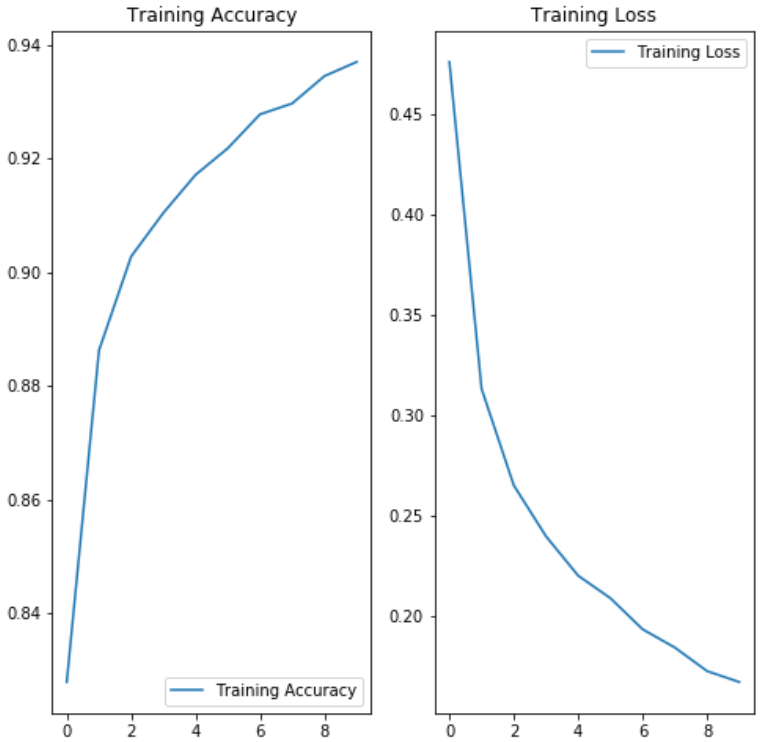
3) CNN:

```
model = keras.Sequential([
     keras.layers.Conv2D(32, 2, padding='same', activation='relu', input_shape=(28,
     28,1)),
    keras.layers.Dropout(0.3),

     keras.layers.Conv2D(32, 2, padding='same', activation='relu'),
    keras.layers.Dropout(0.3),

     keras.layers.Conv2D(64, 2, padding='same', activation='relu'),
    keras.layers.MaxPooling2D(),
    keras.layers.Dropout(0.5),

     keras.layers.Flatten(),
    keras.layers.Dense(64, activation='relu'),
    keras.layers.Dense(10)
])
```

```
Total params: 816,074
Trainable params: 816,074
Non-trainable params: 0
```

Results:

Test Accuracy: 92.38 %



```
[112] history = model.fit_generator(train_gen, steps_per_epoch=steps_per_epoch, epochs=epochs)
```

```
WARNING:tensorflow:sample_weight modes were coerced from
  ...
    to
  ['...']
Train for 1875 steps
Epoch 1/10
1875/1875 [==============================] - 9s 5ms/step - loss: 0.4757 - accuracy: 0.8279
Epoch 2/10
1875/1875 [==============================] - 8s 4ms/step - loss: 0.3130 - accuracy: 0.8862
Epoch 3/10
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2650 - accuracy: 0.9028
Epoch 4/10
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2396 - accuracy: 0.9104
Epoch 5/10
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2200 - accuracy: 0.9171
Epoch 6/10
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2088 - accuracy: 0.9218
Epoch 7/10
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1934 - accuracy: 0.9277
Epoch 8/10
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1843 - accuracy: 0.9297
Epoch 9/10
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1726 - accuracy: 0.9345
Epoch 10/10
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1671 - accuracy: 0.9370
```

Evaluate accuracy

```
[113] test_loss, test_acc = model.evaluate(test_images,  test_labels, verbose=2)
      print('\nTest accuracy:', test_acc)
```

```
10000/10000 - 1s - loss: 0.2187 - accuracy: 0.9238

Test accuracy: 0.9238
```