# keras_tensorboard

December 7, 2018

```
In [1]: !wget https://bin.equinox.io/c/4VmDzA7iaHb/ngrok-stable-linux-amd64.zip
        !unzip ngrok-stable-linux-amd64.zip
```

```
--2018-12-05 06:33:12--  https://bin.equinox.io/c/4VmDzA7iaHb/ngrok-stable-linux-amd64.zip
Resolving bin.equinox.io (bin.equinox.io)... 54.152.127.232, 52.44.92.122, 54.165.51.142, ...
Connecting to bin.equinox.io (bin.equinox.io)|54.152.127.232|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 5363700 (5.1M) [application/octet-stream]
Saving to: ngrok-stable-linux-amd64.zip

ngrok-stable-linux- 100%[===================>]   5.11M  3.44MB/s    in 1.5s

2018-12-05 06:33:14 (3.44 MB/s) - ngrok-stable-linux-amd64.zip saved [5363700/5363700]

Archive:  ngrok-stable-linux-amd64.zip
  inflating: ngrok
```

## 0.1 Run TensorBoard

```
In [0]: LOG_DIR = './log'
        get_ipython().system_raw(
            'tensorboard --logdir {} --host 0.0.0.0 --port 6006 &'
            .format(LOG_DIR)
        )
```

## 0.2 Run ngrok

```
In [0]: get_ipython().system_raw('./ngrok http 6006 &')
```

## 0.3 Get URL

Run the next cell to start the training before open the url.

```
In [4]: ! curl -s http://localhost:4040/api/tunnels | python3 -c \
            "import sys, json; print(json.load(sys.stdin)['tunnels'][0]['public_url'])"
```

```
http://b403ebe9.ngrok.io
```

```
In [5]: !unzip Daily.zip
        !unzip Weekly.zip
        !unzip FourHour.zip
        !unzip OneHour.zip
        !unzip ThirtyMin.zip
        !unzip FifteenMin.zip
```

```
Archive:  Daily.zip
   creating: Daily/
   creating: Daily/Correction/
  inflating: Daily/Correction/XAUUSD_Correction0000.png
  inflating: Daily/Correction/XAUUSD_Correction0001.png
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inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0071.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0072.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0073.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0074.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0075.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0076.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0077.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0078.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0079.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0080.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0081.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0082.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0083.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0084.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0085.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0086.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0087.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0088.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0089.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0090.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0091.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0092.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0093.png
inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0094.png
```

```
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0095.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0096.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0097.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0098.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0099.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0100.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0101.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0102.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0103.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0104.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0105.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0106.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0107.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0108.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0109.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0110.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0111.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0112.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0113.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0114.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0115.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0116.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0117.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0118.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0119.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0120.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0121.png
  inflating: ThirtyMin/UpTrend/XAUUSD_30m_Up0122.png
Archive:  FifteenMin.zip
   creating: FifteenMin/
   creating: FifteenMin/Correction/
   creating: FifteenMin/DownTrend/
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0000.png
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0001.png
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0002.png
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0003.png
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0004.png
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0005.png
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0006.png
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0007.png
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0008.png
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0009.png
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0010.png
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0011.png
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0012.png
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0013.png
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0014.png
  inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0015.png
```

```
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0016.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0017.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0018.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0019.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0020.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0021.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0022.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0023.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0024.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0025.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0026.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0027.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0028.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0029.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0030.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0031.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0032.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0033.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0034.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0035.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0036.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0037.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0038.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0039.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0040.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0041.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0042.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0043.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0044.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0045.png
inflating: FifteenMin/DownTrend/XAUUSD_15m_Down0046.png
 creating: FifteenMin/UpTrend/
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0000.png
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0001.png
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0002.png
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0003.png
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0004.png
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0005.png
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0006.png
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0007.png
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0008.png
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0009.png
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0010.png
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0011.png
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0012.png
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0013.png
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0014.png
inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0015.png
```

```
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0016.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0017.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0018.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0019.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0020.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0021.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0022.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0023.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0024.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0025.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0026.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0027.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0028.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0029.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0030.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0031.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0032.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0033.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0034.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0035.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0036.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0037.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0038.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0039.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0040.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0041.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0042.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0043.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0044.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0045.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0046.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0047.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0048.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0049.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0050.png
  inflating: FifteenMin/UpTrend/XAUUSD_15m_Up0051.png
```

### 0.4 Run a Keras model with TenorBoard

CNN

In [1]:
```
# DATA FEED IN AND PRE-PROCESSING -- CNN

import numpy as np
import cv2

height = 389
```

```
# weekly, daily, 4H, 1H, 30M, 15M
num_up = [6, 40, 97, 67, 123, 52]
num_down = [6, 40, 108, 62, 122, 47]
num_co = [84, 345, 0, 0, 0, 0]
timeframe = ['Weekly', 'Daily', 'FourHour', 'OneHour', 'ThirtyMin', 'FifteenMin']
TF = ['_weekly', '', '_4H', '_1H', '_30m', '_15m']
numbers = sum(num_up) + sum(num_down) + sum(num_co) #num_up + num_down + num_co #40+97
fresize = 0.4
height = int(height*fresize)+1

batch_size = 128
num_classes = 3

# input image dimensions
img_rows, img_cols = height, height

x_data = np.zeros((numbers, height, height, 1))
y_data = np.zeros(numbers)

count = 0
for i in range(len(num_up)):
  # up trend
  for j in range(num_up[i]):
    if i == 1 and j == 0:# Daily
        path = timeframe[i] + '/UpTrend/XAUUSD'+ TF[i] + '_Up' + '%04d'% j + '.PNG'
    else:
        path = timeframe[i] + '/UpTrend/XAUUSD'+ TF[i] + '_Up' + '%04d'% j + '.png'

    img = cv2.imread(path,0)
    if i < 2: # Weekly, Daily
        img = img[50:439, 1136-389:1136].astype('float32')
    else:
        img = img[50:439, 1178-389:1178].astype('float32')

    img = img/255
    img = cv2.resize(img, (0,0), fx=fresize, fy=fresize)

    x_data[count,:,:,0] = img
    y_data[count] = y_data[count]
    count += 1

  # down trend
  for j in range(num_down[i]):
    if i == 1 and j == 0:# Daily
        path = timeframe[i] + '/DownTrend/XAUUSD'+ TF[i] + '_Down' + '%04d'% j + '.PNG
    else:
        path = timeframe[i] + '/DownTrend/XAUUSD'+ TF[i] + '_Down' + '%04d'% j + '.png
```

```
        img = cv2.imread(path,0)
        if i < 2: # Weekly, Daily
            img = img[50:439, 1136-389:1136].astype('float32')
        else:
            img = img[50:439, 1178-389:1178].astype('float32')

        img = img/255
        img = cv2.resize(img, (0,0), fx=fresize, fy=fresize)

        x_data[count,:,:,0] = img
        y_data[count] = 1
        count += 1

      # correction
      for j in range(num_co[i]):
        path = timeframe[i] + '/Correction/XAUUSD'+ TF[i] + '_Correction' + '%04d'% j + '.p

        img = cv2.imread(path,0)
        if i < 2: # Weekly, Daily
            img = img[50:439, 1136-389:1136].astype('float32')
        else:
            img = img[50:439, 1178-389:1178].astype('float32')

        img = img/255
        img = cv2.resize(img, (0,0), fx=fresize, fy=fresize)

        x_data[count,:,:,0] = img
        y_data[count] = 2
        count += 1


    # SHUFFLE TRAINING AND TESTING DATA

    from sklearn import model_selection
    import keras
    x_train, x_test, y_train, y_test = model_selection.train_test_split(x_data, y_data, tes
    y_train = keras.utils.to_categorical(y_train, num_classes)
    y_test = keras.utils.to_categorical(y_test, num_classes)
```

```
Using TensorFlow backend.
```

```
In [2]: # CNN


        from __future__ import print_function
        import keras
        from keras.datasets import mnist
```

```python
from keras.models import Sequential
from keras.layers import Dense, Dropout, Flatten
from keras.layers import Conv2D, MaxPooling2D
from keras import backend as K
from keras.callbacks import TensorBoard

epochs = 100

input_shape = (img_rows, img_cols, 1)
model = Sequential()
model.add(Conv2D(32, kernel_size=(3, 3),
                 activation='relu',
                 input_shape=input_shape))
model.add(Conv2D(64, (3, 3), activation='relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.25))
model.add(Flatten())
model.add(Dense(128, activation='relu'))
model.add(Dropout(0.5))
model.add(Dense(num_classes, activation='softmax'))

model.compile(loss=keras.losses.categorical_crossentropy,
              optimizer=keras.optimizers.SGD(lr=0.001),
              metrics=['accuracy'])


tbCallBack = TensorBoard(log_dir='./log', histogram_freq=1,
                         write_graph=True,
                         write_grads=True,
                         batch_size=batch_size,
                         write_images=True)

model.fit(x_train, y_train,
          batch_size=batch_size,
          epochs=epochs,
          verbose=1,
          validation_data=(x_test, y_test),
          callbacks=[tbCallBack])
score = model.evaluate(x_test, y_test, verbose=0)
print('Test loss:', score[0])
print('Test accuracy:', score[1])
```

```
Train on 1079 samples, validate on 120 samples
Epoch 1/100
1079/1079 [==============================] - 9s 8ms/step - loss: 2.7219 - acc: 0.3207 - val_los
Epoch 2/100
1079/1079 [==============================] - 4s 4ms/step - loss: 1.0961 - acc: 0.3503 - val_los
Epoch 3/100
```

```
1079/1079 [==============================] - 4s 4ms/step - loss: 1.0776 - acc: 0.4282 - val_los
Epoch 4/100
1079/1079 [==============================] - 4s 4ms/step - loss: 1.0643 - acc: 0.4384 - val_los
Epoch 5/100
1079/1079 [==============================] - 4s 4ms/step - loss: 1.0427 - acc: 0.4949 - val_los
Epoch 6/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.8950 - acc: 0.5941 - val_los
Epoch 7/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.8307 - acc: 0.6321 - val_los
Epoch 8/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.7485 - acc: 0.7006 - val_los
Epoch 9/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.5281 - acc: 0.8109 - val_los
Epoch 10/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.3978 - acc: 0.8591 - val_los
Epoch 11/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.2597 - acc: 0.9351 - val_los
Epoch 12/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.2184 - acc: 0.9286 - val_los
Epoch 13/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.1464 - acc: 0.9620 - val_los
Epoch 14/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0981 - acc: 0.9787 - val_los
Epoch 15/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0931 - acc: 0.9759 - val_los
Epoch 16/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0618 - acc: 0.9852 - val_los
Epoch 17/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0598 - acc: 0.9852 - val_los
Epoch 18/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0478 - acc: 0.9907 - val_los
Epoch 19/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0374 - acc: 0.9898 - val_los
Epoch 20/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0314 - acc: 0.9926 - val_los
Epoch 21/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0224 - acc: 0.9972 - val_los
Epoch 22/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0170 - acc: 0.9972 - val_los
Epoch 23/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0202 - acc: 0.9963 - val_los
Epoch 24/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0211 - acc: 0.9944 - val_los
Epoch 25/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0110 - acc: 1.0000 - val_los
Epoch 26/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0166 - acc: 0.9972 - val_los
Epoch 27/100
```

```
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0151 - acc: 0.9972 - val_los
Epoch 28/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0109 - acc: 0.9981 - val_los
Epoch 29/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0167 - acc: 0.9935 - val_los
Epoch 30/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0088 - acc: 0.9991 - val_los
Epoch 31/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0064 - acc: 1.0000 - val_los
Epoch 32/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0076 - acc: 0.9991 - val_los
Epoch 33/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0108 - acc: 0.9963 - val_los
Epoch 34/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0092 - acc: 0.9981 - val_los
Epoch 35/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0095 - acc: 0.9972 - val_los
Epoch 36/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0053 - acc: 0.9991 - val_los
Epoch 37/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0092 - acc: 0.9963 - val_los
Epoch 38/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0070 - acc: 0.9991 - val_los
Epoch 39/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0044 - acc: 0.9991 - val_los
Epoch 40/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0059 - acc: 0.9972 - val_los
Epoch 41/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0038 - acc: 1.0000 - val_los
Epoch 42/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0047 - acc: 1.0000 - val_los
Epoch 43/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0038 - acc: 0.9981 - val_los
Epoch 44/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0049 - acc: 0.9991 - val_los
Epoch 45/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0095 - acc: 0.9963 - val_los
Epoch 46/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0107 - acc: 0.9972 - val_los
Epoch 47/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0076 - acc: 0.9991 - val_los
Epoch 48/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0049 - acc: 0.9991 - val_los
Epoch 49/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0053 - acc: 0.9981 - val_los
Epoch 50/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0042 - acc: 0.9991 - val_los
Epoch 51/100
```

```
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0060 - acc: 0.9991 - val_los
Epoch 52/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0034 - acc: 1.0000 - val_los
Epoch 53/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0027 - acc: 1.0000 - val_los
Epoch 54/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0047 - acc: 0.9981 - val_los
Epoch 55/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0065 - acc: 0.9981 - val_los
Epoch 56/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0030 - acc: 0.9991 - val_los
Epoch 57/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0048 - acc: 0.9991 - val_los
Epoch 58/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0051 - acc: 0.9963 - val_los
Epoch 59/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0047 - acc: 0.9991 - val_los
Epoch 60/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0021 - acc: 0.9991 - val_los
Epoch 61/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0038 - acc: 0.9991 - val_los
Epoch 62/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0030 - acc: 1.0000 - val_los
Epoch 63/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0025 - acc: 1.0000 - val_los
Epoch 64/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0021 - acc: 1.0000 - val_los
Epoch 65/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0022 - acc: 0.9991 - val_los
Epoch 66/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0046 - acc: 0.9981 - val_los
Epoch 67/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0026 - acc: 0.9991 - val_los
Epoch 68/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0031 - acc: 0.9991 - val_los
Epoch 69/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0018 - acc: 1.0000 - val_los
Epoch 70/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0036 - acc: 0.9981 - val_los
Epoch 71/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0058 - acc: 0.9991 - val_los
Epoch 72/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0031 - acc: 0.9991 - val_los
Epoch 73/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0029 - acc: 0.9981 - val_los
Epoch 74/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0030 - acc: 0.9981 - val_los
Epoch 75/100
```

```
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0013 - acc: 1.0000 - val_los
Epoch 76/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0017 - acc: 1.0000 - val_los
Epoch 77/100
1079/1079 [==============================] - 4s 4ms/step - loss: 6.5148e-04 - acc: 1.0000 - val
Epoch 78/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0027 - acc: 0.9981 - val_los
Epoch 79/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0012 - acc: 1.0000 - val_los
Epoch 80/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0020 - acc: 0.9991 - val_los
Epoch 81/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0013 - acc: 1.0000 - val_los
Epoch 82/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0010 - acc: 1.0000 - val_los
Epoch 83/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0020 - acc: 0.9991 - val_los
Epoch 84/100
1079/1079 [==============================] - 4s 4ms/step - loss: 6.4434e-04 - acc: 1.0000 - val
Epoch 85/100
1079/1079 [==============================] - 4s 4ms/step - loss: 4.3183e-04 - acc: 1.0000 - val
Epoch 86/100
1079/1079 [==============================] - 4s 4ms/step - loss: 9.1556e-04 - acc: 1.0000 - val
Epoch 87/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0051 - acc: 0.9972 - val_los
Epoch 88/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0015 - acc: 1.0000 - val_los
Epoch 89/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0017 - acc: 1.0000 - val_los
Epoch 90/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0042 - acc: 0.9991 - val_los
Epoch 91/100
1079/1079 [==============================] - 4s 4ms/step - loss: 3.0085e-04 - acc: 1.0000 - val
Epoch 92/100
1079/1079 [==============================] - 4s 4ms/step - loss: 7.6595e-04 - acc: 1.0000 - val
Epoch 93/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0016 - acc: 1.0000 - val_los
Epoch 94/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0011 - acc: 1.0000 - val_los
Epoch 95/100
1079/1079 [==============================] - 4s 4ms/step - loss: 4.4306e-04 - acc: 1.0000 - val
Epoch 96/100
1079/1079 [==============================] - 4s 4ms/step - loss: 5.9857e-04 - acc: 1.0000 - val
Epoch 97/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0036 - acc: 0.9972 - val_los
Epoch 98/100
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0019 - acc: 0.9991 - val_los
Epoch 99/100
```

```
1079/1079 [==============================] - 4s 4ms/step - loss: 0.0012 - acc: 1.0000 - val_lo
Epoch 100/100
1079/1079 [==============================] - 4s 4ms/step - loss: 4.4988e-04 - acc: 1.0000 - va
Test loss: 3.8888094425201416
Test accuracy: 0.5333333373069763
```

In [33]:
```
[sum(num_up),  sum(num_down),  sum(num_no)]
```

Out[33]:
```
[385, 385, 429]
```

In [42]:
```
np.shape(x_train), np.shape(x_test), np.shape(y_train), np.shape(y_test)
```

Out[42]:
```
((1079, 156, 156), (120, 156, 156), (1079,), (120,))
```

RNN

In [0]:
```
# DATA FEED IN AND PRE-PROCESSING -- RNN

import numpy as np
import cv2

height = 389
# weekly, daily, 4H, 1H, 30M, 15M
num_up = [6, 40, 97, 67, 123, 52]
num_down = [6, 40, 108, 62, 122, 47]
num_co = [84, 345, 0, 0, 0, 0]
timeframe = ['Weekly', 'Daily', 'FourHour', 'OneHour', 'ThirtyMin', 'FifteenMin']
TF = ['_weekly', '', '_4H', '_1H', '_30m', '_15m']
numbers = sum(num_up) + sum(num_down) + sum(num_co) #num_up + num_down + num_co #40+97
fresize = 0.4
height = int(height*fresize)+1

batch_size = 128
num_classes = 3

# input image dimensions
img_rows, img_cols = height, height

x_data = np.zeros((numbers, height, height))
y_data = np.zeros(numbers)

count = 0
for i in range(len(num_up)):
  # up trend
  for j in range(num_up[i]):
    if i == 1 and j == 0:# Daily
        path = timeframe[i] + '/UpTrend/XAUUSD'+ TF[i] + '_Up' + '%04d'% j + '.PNG'
    else:
```

```
        path = timeframe[i] + '/UpTrend/XAUUSD'+ TF[i] + '_Up' + '%04d'% j + '.png'

    img = cv2.imread(path,0)
    if i < 2: # Weekly, Daily
        img = img[50:439, 1136-389:1136].astype('float32')
    else:
        img = img[50:439, 1178-389:1178].astype('float32')

    img = img/255
    img = cv2.resize(img, (0,0), fx=fresize, fy=fresize)

    x_data[count,:,:] = img
    y_data[count] = y_data[count]
    count += 1

  # down trend
  for j in range(num_down[i]):
    if i == 1 and j == 0:# Daily
        path = timeframe[i] + '/DownTrend/XAUUSD'+ TF[i] + '_Down' + '%04d'% j + '.PNG
    else:
        path = timeframe[i] + '/DownTrend/XAUUSD'+ TF[i] + '_Down' + '%04d'% j + '.png

    img = cv2.imread(path,0)
    if i < 2: # Weekly, Daily
        img = img[50:439, 1136-389:1136].astype('float32')
    else:
        img = img[50:439, 1178-389:1178].astype('float32')

    img = img/255
    img = cv2.resize(img, (0,0), fx=fresize, fy=fresize)

    x_data[count,:,:] = img
    y_data[count] = 1
    count += 1

  # correction
  for j in range(num_co[i]):
    path = timeframe[i] + '/Correction/XAUUSD'+ TF[i] + '_Correction' + '%04d'% j + '.j

    img = cv2.imread(path,0)
    if i < 2: # Weekly, Daily
        img = img[50:439, 1136-389:1136].astype('float32')
    else:
        img = img[50:439, 1178-389:1178].astype('float32')

    img = img/255
    img = cv2.resize(img, (0,0), fx=fresize, fy=fresize)
```

```
            x_data[count,:,:] = img
            y_data[count] = 2
            count += 1


    # SHUFFLE TRAINING AND TESTING DATA

    from sklearn import model_selection
    import keras
    x_train, x_test, y_train, y_test = model_selection.train_test_split(x_data, y_data, tes
    y_train = keras.utils.to_categorical(y_train, num_classes)
    y_test = keras.utils.to_categorical(y_test, num_classes)
```

```
In [0]: import tensorflow as tf
        import os
        from tensorflow.python.ops import rnn, rnn_cell
```

```
In [7]: # LSTM

        learning_rate = 0.001
        training_steps = 10000
        batch_size = 128
        display_step = 200
        test_step = 1000

        nInput = height
        nSteps = height
        nHidden = 128
        nClasses = 3
        result_dir = './results_LSTM/'

        x = tf.placeholder('float', [None, nSteps, nInput])
        y = tf.placeholder('float', [None, nClasses])

        weights = {
            'out': tf.Variable(tf.random_normal([nHidden, nClasses]))
        }

        biases = {
            'out': tf.Variable(tf.random_normal([nClasses]))
        }


        def RNN(x, weights, biases):
            x = tf.transpose(x, [1, 0, 2])
            x = tf.reshape(x, [-1, nInput])
            x = tf.split(x, nSteps, 0)
            lstm_cell = tf.nn.rnn_cell.LSTMCell(nHidden, forget_bias=1.0)#, reuse=True)
```

```
    outputs, states = rnn.static_rnn(lstm_cell, x, dtype=tf.float32)
    return tf.matmul(outputs[-1], weights['out']) + biases['out']


def unfoldRNN(x):
    return tf.unstack(x, nSteps, 1)


pred = RNN(x, weights, biases)
prediction = tf.nn.softmax(pred)

# Define loss and optimizer
cost = tf.reduce_mean(tf.nn.softmax_cross_entropy_with_logits(logits=pred, labels=y))
optimizer = tf.train.GradientDescentOptimizer(learning_rate=learning_rate).minimize(cos

# Evaluate model (with test logits, for dropout to be disabled)
correctPred = tf.equal(tf.argmax(prediction, 1), tf.argmax(y, 1))
accuracy = tf.reduce_mean(tf.cast(correctPred, tf.float32))

loss_summary = tf.summary.scalar("loss", cost)
accuracy_summary = tf.summary.scalar("accuracy", accuracy)
test_accuracy_summary = tf.summary.scalar("test_accuracy", accuracy)

# Initialize the variables (i.e. assign their default value)
init = tf.initialize_all_variables()

# Start training

with tf.Session() as sess:
    saver = tf.train.Saver()

    summary_writer = tf.summary.FileWriter(result_dir, sess.graph)
    sess.run(init)

    for step in range(1, training_steps + 1):
        shuffles_train = list(range(len(x_train)))
        np.random.shuffle(shuffles_train)
        batchX = x_train[shuffles_train[:batch_size],:,:]
        batchY = y_train[shuffles_train[:batch_size]]
        sess.run(optimizer, feed_dict={x: batchX, y: batchY})

        if step % display_step == 0 or step == 1:
            # Calculate batch loss and accuracy
            loss, acc, loss_summ, accuracy_summ = sess.run([cost, accuracy, loss_summa
                                                          feed_dict={x: batchX,
                                                                     y: batchY})
            summary_writer.add_summary(loss_summ, step)
            summary_writer.add_summary(accuracy_summ, step)
```

```
                summary_writer.flush()

                print("Training Step " + str(step) + ", Minibatch Loss= " +
                      "{:.6f}".format(loss) + ", Training Accuracy= " +
                      "{:.5f}".format(acc))

            if step % test_step == 0 or step == 1:
                shuffles_test = list(range(len(x_test)))
                np.random.shuffle(shuffles_test)
                loss, acc, loss_summ, test_accuracy_summ = sess.run([cost, accuracy, loss_s
                                                                    feed_dict={
                                                                        x: (x_test[shuffles
                                                                        y: y_test[shuffles_
                summary_writer.add_summary(test_accuracy_summ, step)
                checkpoint_file = os.path.join(result_dir, 'checkpoint')
                saver.save(sess, checkpoint_file, global_step=step)
                summary_writer.flush()

                print("Test Step " + str(step) + ", Minibatch Loss= " +
                      "{:.6f}".format(loss) + ", Testing Accuracy= " +
                      "{:.5f}".format(acc))

        print("Optimization Finished!")

        testData = x_test[:,:,:]
        testLabel = y_test[:]
        print("Testing Accuracy:", sess.run(accuracy, feed_dict={x: testData, y: testLabel]

WARNING:tensorflow:From <ipython-input-7-dd99a244cfa7>:45: softmax_cross_entropy_with_logits (
Instructions for updating:

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`.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/tensorflow/python/util/tf_should
Instructions for updating:
Use `tf.global_variables_initializer` instead.
Training Step 1, Minibatch Loss= 1.136090, Training Accuracy= 0.39062
Test Step 1, Minibatch Loss= 1.198355, Testing Accuracy= 0.30000
Training Step 200, Minibatch Loss= 1.023054, Training Accuracy= 0.59375
Training Step 400, Minibatch Loss= 0.958115, Training Accuracy= 0.57031
Training Step 600, Minibatch Loss= 0.873392, Training Accuracy= 0.64844
Training Step 800, Minibatch Loss= 0.889890, Training Accuracy= 0.61719
Training Step 1000, Minibatch Loss= 0.851353, Training Accuracy= 0.61719
Test Step 1000, Minibatch Loss= 0.838344, Testing Accuracy= 0.64167
Training Step 1200, Minibatch Loss= 0.885591, Training Accuracy= 0.53125
```

```
Training Step 1400, Minibatch Loss= 0.880929, Training Accuracy= 0.58594
Training Step 1600, Minibatch Loss= 0.850149, Training Accuracy= 0.61719
Training Step 1800, Minibatch Loss= 0.807798, Training Accuracy= 0.62500
Training Step 2000, Minibatch Loss= 0.810977, Training Accuracy= 0.67188
Test Step 2000, Minibatch Loss= 0.780578, Testing Accuracy= 0.61667
Training Step 2200, Minibatch Loss= 0.809776, Training Accuracy= 0.64062
Training Step 2400, Minibatch Loss= 0.796908, Training Accuracy= 0.64062
Training Step 2600, Minibatch Loss= 0.793176, Training Accuracy= 0.62500
Training Step 2800, Minibatch Loss= 0.799109, Training Accuracy= 0.55469
Training Step 3000, Minibatch Loss= 0.799601, Training Accuracy= 0.62500
Test Step 3000, Minibatch Loss= 0.757349, Testing Accuracy= 0.64167
Training Step 3200, Minibatch Loss= 0.809814, Training Accuracy= 0.60156
Training Step 3400, Minibatch Loss= 0.805528, Training Accuracy= 0.59375
Training Step 3600, Minibatch Loss= 0.784021, Training Accuracy= 0.59375
Training Step 3800, Minibatch Loss= 0.823637, Training Accuracy= 0.59375
Training Step 4000, Minibatch Loss= 0.674243, Training Accuracy= 0.69531
Test Step 4000, Minibatch Loss= 0.784947, Testing Accuracy= 0.56667
Training Step 4200, Minibatch Loss= 0.791027, Training Accuracy= 0.62500
Training Step 4400, Minibatch Loss= 0.801137, Training Accuracy= 0.60938
Training Step 4600, Minibatch Loss= 0.766801, Training Accuracy= 0.60938
Training Step 4800, Minibatch Loss= 0.774743, Training Accuracy= 0.58594
Training Step 5000, Minibatch Loss= 0.797688, Training Accuracy= 0.57812
Test Step 5000, Minibatch Loss= 0.734200, Testing Accuracy= 0.63333
Training Step 5200, Minibatch Loss= 0.832948, Training Accuracy= 0.59375
Training Step 5400, Minibatch Loss= 0.842136, Training Accuracy= 0.53906
Training Step 5600, Minibatch Loss= 0.776487, Training Accuracy= 0.61719
Training Step 5800, Minibatch Loss= 0.764684, Training Accuracy= 0.67188
Training Step 6000, Minibatch Loss= 0.731066, Training Accuracy= 0.67969
Test Step 6000, Minibatch Loss= 0.794630, Testing Accuracy= 0.58333
Training Step 6200, Minibatch Loss= 0.749039, Training Accuracy= 0.60156
Training Step 6400, Minibatch Loss= 0.704722, Training Accuracy= 0.71094
Training Step 6600, Minibatch Loss= 0.763979, Training Accuracy= 0.60938
Training Step 6800, Minibatch Loss= 0.735037, Training Accuracy= 0.64062
Training Step 7000, Minibatch Loss= 0.719457, Training Accuracy= 0.65625
Test Step 7000, Minibatch Loss= 0.651994, Testing Accuracy= 0.75000
Training Step 7200, Minibatch Loss= 0.759959, Training Accuracy= 0.60938
Training Step 7400, Minibatch Loss= 0.789176, Training Accuracy= 0.57031
Training Step 7600, Minibatch Loss= 0.811686, Training Accuracy= 0.56250
Training Step 7800, Minibatch Loss= 0.736548, Training Accuracy= 0.64844
Training Step 8000, Minibatch Loss= 0.795470, Training Accuracy= 0.57812
Test Step 8000, Minibatch Loss= 0.736963, Testing Accuracy= 0.64167
Training Step 8200, Minibatch Loss= 0.714448, Training Accuracy= 0.62500
Training Step 8400, Minibatch Loss= 0.770266, Training Accuracy= 0.60156
Training Step 8600, Minibatch Loss= 0.655017, Training Accuracy= 0.72656
Training Step 8800, Minibatch Loss= 0.672425, Training Accuracy= 0.72656
Training Step 9000, Minibatch Loss= 0.717358, Training Accuracy= 0.69531
Test Step 9000, Minibatch Loss= 0.731063, Testing Accuracy= 0.60000
Training Step 9200, Minibatch Loss= 0.777558, Training Accuracy= 0.66406
```

```
Training Step 9400, Minibatch Loss= 0.819457, Training Accuracy= 0.63281
Training Step 9600, Minibatch Loss= 0.786526, Training Accuracy= 0.57812
Training Step 9800, Minibatch Loss= 0.751578, Training Accuracy= 0.65625
Training Step 10000, Minibatch Loss= 0.679598, Training Accuracy= 0.71094
Test Step 10000, Minibatch Loss= 0.720752, Testing Accuracy= 0.62500
Optimization Finished!
Testing Accuracy: 0.625
```

In [5]:
```
import numpy as np
np.shape(batchX)
```

Out[5]: (128, 156, 156)

In [8]:
```
# GRU


learning_rate = 0.001
training_steps = 10000
batch_size = 128
display_step = 200
test_step = 1000

nInput = height
nSteps = height
nHidden = 128
nClasses = 3
result_dir = './results_GRU/'

x = tf.placeholder('float', [None, nSteps, nInput])
y = tf.placeholder('float', [None, nClasses])

weights = {
    'out': tf.Variable(tf.random_normal([nHidden, nClasses]))
}

biases = {
    'out': tf.Variable(tf.random_normal([nClasses]))
}


def RNN(x, weights, biases):
    x = tf.transpose(x, [1, 0, 2])
    x = tf.reshape(x, [-1, nInput])
    x = tf.split(x, nSteps, 0)
    gru_cell = rnn_cell.GRUCell(nHidden)
    outputs, states = rnn.static_rnn(gru_cell, x, dtype=tf.float32)
    return tf.matmul(outputs[-1], weights['out']) + biases['out']
```

```python
def unfoldRNN(x):
    return tf.unstack(x, nSteps, 1)


pred = RNN(x, weights, biases)
prediction = tf.nn.softmax(pred)

# Define loss and optimizer
cost = tf.reduce_mean(tf.nn.softmax_cross_entropy_with_logits(logits=pred, labels=y))
optimizer = tf.train.GradientDescentOptimizer(learning_rate=learning_rate).minimize(cos

# Evaluate model (with test logits, for dropout to be disabled)
correctPred = tf.equal(tf.argmax(prediction, 1), tf.argmax(y, 1))
accuracy = tf.reduce_mean(tf.cast(correctPred, tf.float32))

loss_summary = tf.summary.scalar("loss", cost)
accuracy_summary = tf.summary.scalar("accuracy", accuracy)
test_accuracy_summary = tf.summary.scalar("test_accuracy", accuracy)

# Initialize the variables (i.e. assign their default value)
init = tf.initialize_all_variables()

# Start training

with tf.Session() as sess:
    saver = tf.train.Saver()

    summary_writer = tf.summary.FileWriter(result_dir, sess.graph)
    sess.run(init)

    for step in range(1, training_steps + 1):
        shuffles_train = list(range(len(x_train)))
        np.random.shuffle(shuffles_train)
        batchX = x_train[shuffles_train[:batch_size],:,:]
        batchY = y_train[shuffles_train[:batch_size]]
        sess.run(optimizer, feed_dict={x: batchX, y: batchY})

        if step % display_step == 0 or step == 1:
            # Calculate batch loss and accuracy
            loss, acc, loss_summ, accuracy_summ = sess.run([cost, accuracy, loss_summa
                                                             feed_dict={x: batchX,
                                                                        y: batchY})
            summary_writer.add_summary(loss_summ, step)
            summary_writer.add_summary(accuracy_summ, step)
            summary_writer.flush()
```

```
                print("Training Step " + str(step) + ", Minibatch Loss= " +
                      "{:.6f}".format(loss) + ", Training Accuracy= " +
                      "{:.5f}".format(acc))

            if step % test_step == 0 or step == 1:
                shuffles_test = list(range(len(x_test)))
                np.random.shuffle(shuffles_test)
                loss, acc, loss_summ, test_accuracy_summ = sess.run([cost, accuracy, loss_s
                                                                    feed_dict={
                                                                        x: (x_test[shuffle
                                                                        y: y_test[shuffles_
                summary_writer.add_summary(test_accuracy_summ, step)
                checkpoint_file = os.path.join(result_dir, 'checkpoint')
                saver.save(sess, checkpoint_file, global_step=step)
                summary_writer.flush()

                print("Test Step " + str(step) + ", Minibatch Loss= " +
                      "{:.6f}".format(loss) + ", Testing Accuracy= " +
                      "{:.5f}".format(acc))

        print("Optimization Finished!")

        testData = x_test[:,:,:]
        testLabel = y_test[:]
        print("Testing Accuracy:", sess.run(accuracy, feed_dict={x: testData, y: testLabel
```

```
Training Step 1, Minibatch Loss= 1.570676, Training Accuracy= 0.36719
Test Step 1, Minibatch Loss= 1.579638, Testing Accuracy= 0.32500
Training Step 200, Minibatch Loss= 1.003041, Training Accuracy= 0.56250
Training Step 400, Minibatch Loss= 0.940247, Training Accuracy= 0.40625
Training Step 600, Minibatch Loss= 0.906239, Training Accuracy= 0.53125
Training Step 800, Minibatch Loss= 0.858382, Training Accuracy= 0.54688
Training Step 1000, Minibatch Loss= 0.835003, Training Accuracy= 0.64844
Test Step 1000, Minibatch Loss= 0.856358, Testing Accuracy= 0.56667
Training Step 1200, Minibatch Loss= 0.823104, Training Accuracy= 0.63281
Training Step 1400, Minibatch Loss= 0.820316, Training Accuracy= 0.59375
Training Step 1600, Minibatch Loss= 0.857112, Training Accuracy= 0.48438
Training Step 1800, Minibatch Loss= 0.811211, Training Accuracy= 0.58594
Training Step 2000, Minibatch Loss= 0.778678, Training Accuracy= 0.59375
Test Step 2000, Minibatch Loss= 0.765318, Testing Accuracy= 0.57500
Training Step 2200, Minibatch Loss= 0.767689, Training Accuracy= 0.62500
Training Step 2400, Minibatch Loss= 0.766688, Training Accuracy= 0.66406
Training Step 2600, Minibatch Loss= 0.768704, Training Accuracy= 0.61719
Training Step 2800, Minibatch Loss= 0.744701, Training Accuracy= 0.63281
Training Step 3000, Minibatch Loss= 0.803975, Training Accuracy= 0.58594
Test Step 3000, Minibatch Loss= 0.770192, Testing Accuracy= 0.56667
Training Step 3200, Minibatch Loss= 0.795215, Training Accuracy= 0.60156
Training Step 3400, Minibatch Loss= 0.779612, Training Accuracy= 0.63281
```

```
Training Step 3600, Minibatch Loss= 0.798270, Training Accuracy= 0.64062
Training Step 3800, Minibatch Loss= 0.739011, Training Accuracy= 0.63281
Training Step 4000, Minibatch Loss= 0.780882, Training Accuracy= 0.63281
Test Step 4000, Minibatch Loss= 0.741624, Testing Accuracy= 0.58333
Training Step 4200, Minibatch Loss= 0.770610, Training Accuracy= 0.60938
Training Step 4400, Minibatch Loss= 0.751995, Training Accuracy= 0.63281
Training Step 4600, Minibatch Loss= 0.817887, Training Accuracy= 0.57812
Training Step 4800, Minibatch Loss= 0.655933, Training Accuracy= 0.74219
Training Step 5000, Minibatch Loss= 0.736431, Training Accuracy= 0.61719
Test Step 5000, Minibatch Loss= 0.711407, Testing Accuracy= 0.65833
Training Step 5200, Minibatch Loss= 0.721221, Training Accuracy= 0.64844
Training Step 5400, Minibatch Loss= 0.724449, Training Accuracy= 0.63281
Training Step 5600, Minibatch Loss= 0.749507, Training Accuracy= 0.70312
Training Step 5800, Minibatch Loss= 0.658545, Training Accuracy= 0.69531
Training Step 6000, Minibatch Loss= 0.792793, Training Accuracy= 0.67188
Test Step 6000, Minibatch Loss= 0.716316, Testing Accuracy= 0.63333
Training Step 6200, Minibatch Loss= 0.678683, Training Accuracy= 0.72656
Training Step 6400, Minibatch Loss= 0.766437, Training Accuracy= 0.60156
Training Step 6600, Minibatch Loss= 0.729647, Training Accuracy= 0.60938
Training Step 6800, Minibatch Loss= 0.809131, Training Accuracy= 0.57812
Training Step 7000, Minibatch Loss= 0.878530, Training Accuracy= 0.57812
Test Step 7000, Minibatch Loss= 0.800367, Testing Accuracy= 0.65000
Training Step 7200, Minibatch Loss= 0.689825, Training Accuracy= 0.63281
Training Step 7400, Minibatch Loss= 0.680479, Training Accuracy= 0.72656
Training Step 7600, Minibatch Loss= 0.757906, Training Accuracy= 0.68750
Training Step 7800, Minibatch Loss= 0.699099, Training Accuracy= 0.64844
Training Step 8000, Minibatch Loss= 0.670865, Training Accuracy= 0.67188
Test Step 8000, Minibatch Loss= 0.623632, Testing Accuracy= 0.70000
Training Step 8200, Minibatch Loss= 0.777869, Training Accuracy= 0.64062
Training Step 8400, Minibatch Loss= 0.699819, Training Accuracy= 0.66406
Training Step 8600, Minibatch Loss= 0.727844, Training Accuracy= 0.61719
Training Step 8800, Minibatch Loss= 0.634063, Training Accuracy= 0.69531
Training Step 9000, Minibatch Loss= 0.821023, Training Accuracy= 0.57812
Test Step 9000, Minibatch Loss= 0.811850, Testing Accuracy= 0.60000
Training Step 9200, Minibatch Loss= 0.574032, Training Accuracy= 0.71094
Training Step 9400, Minibatch Loss= 0.686132, Training Accuracy= 0.70312
Training Step 9600, Minibatch Loss= 0.935042, Training Accuracy= 0.62500
Training Step 9800, Minibatch Loss= 0.586413, Training Accuracy= 0.69531
Training Step 10000, Minibatch Loss= 0.948805, Training Accuracy= 0.63281
Test Step 10000, Minibatch Loss= 1.056789, Testing Accuracy= 0.56667
Optimization Finished!
Testing Accuracy: 0.56666666
```

In [9]:
```
# RNN


learning_rate = 0.001
```

```
training_steps = 10000
batch_size = 128
display_step = 200
test_step = 1000

nInput = height
nSteps = height
nHidden = 128
nClasses = 3
result_dir = './results_RNN/'

x = tf.placeholder('float', [None, nSteps, nInput])
y = tf.placeholder('float', [None, nClasses])

weights = {
    'out': tf.Variable(tf.random_normal([nHidden, nClasses]))
}

biases = {
    'out': tf.Variable(tf.random_normal([nClasses]))
}


def RNN(x, weights, biases):
    x = tf.transpose(x, [1, 0, 2])
    x = tf.reshape(x, [-1, nInput])
    x = tf.split(x, nSteps, 0)
    RNN_cell = rnn_cell.BasicRNNCell(nHidden)
    outputs, states = rnn.static_rnn(RNN_cell, x, dtype=tf.float32)
    return tf.matmul(outputs[-1], weights['out']) + biases['out']


def unfoldRNN(x):
    return tf.unstack(x, nSteps, 1)


pred = RNN(x, weights, biases)
prediction = tf.nn.softmax(pred)

# Define loss and optimizer
cost = tf.reduce_mean(tf.nn.softmax_cross_entropy_with_logits(logits=pred, labels=y))
optimizer = tf.train.GradientDescentOptimizer(learning_rate=learning_rate).minimize(cos

# Evaluate model (with test logits, for dropout to be disabled)
correctPred = tf.equal(tf.argmax(prediction, 1), tf.argmax(y, 1))
accuracy = tf.reduce_mean(tf.cast(correctPred, tf.float32))

loss_summary = tf.summary.scalar("loss", cost)
```

```
accuracy_summary = tf.summary.scalar("accuracy", accuracy)
test_accuracy_summary = tf.summary.scalar("test_accuracy", accuracy)

# Initialize the variables (i.e. assign their default value)
init = tf.initialize_all_variables()

# Start training

with tf.Session() as sess:
    saver = tf.train.Saver()

    summary_writer = tf.summary.FileWriter(result_dir, sess.graph)
    sess.run(init)

    for step in range(1, training_steps + 1):
        shuffles_train = list(range(len(x_train)))
        np.random.shuffle(shuffles_train)
        batchX = x_train[shuffles_train[:batch_size],:,:]
        batchY = y_train[shuffles_train[:batch_size]]
        sess.run(optimizer, feed_dict={x: batchX, y: batchY})

        if step % display_step == 0 or step == 1:
            # Calculate batch loss and accuracy
            loss, acc, loss_summ, accuracy_summ = sess.run([cost, accuracy, loss_summa
                                                            feed_dict={x: batchX,
                                                                       y: batchY})
            summary_writer.add_summary(loss_summ, step)
            summary_writer.add_summary(accuracy_summ, step)
            summary_writer.flush()

            print("Training Step " + str(step) + ", Minibatch Loss= " +
                  "{:.6f}".format(loss) + ", Training Accuracy= " +
                  "{:.5f}".format(acc))

        if step % test_step == 0 or step == 1:
            shuffles_test = list(range(len(x_test)))
            np.random.shuffle(shuffles_test)
            loss, acc, loss_summ, test_accuracy_summ = sess.run([cost, accuracy, loss_s
                                                                  feed_dict={
                                                                      x: (x_test[shuffle
                                                                      y: y_test[shuffles_
            summary_writer.add_summary(test_accuracy_summ, step)
            checkpoint_file = os.path.join(result_dir, 'checkpoint')
            saver.save(sess, checkpoint_file, global_step=step)
            summary_writer.flush()

            print("Test Step " + str(step) + ", Minibatch Loss= " +
                  "{:.6f}".format(loss) + ", Testing Accuracy= " +
```

```
                "{:.5f}".format(acc))

    print("Optimization Finished!")

    testData = x_test[:,:,:]
    testLabel = y_test[:]
    print("Testing Accuracy:", sess.run(accuracy, feed_dict={x: testData, y: testLabel]
```

```
WARNING:tensorflow:From <ipython-input-9-f3461eb02c6b>:33: BasicRNNCell.__init__ (from tensorf
Instructions for updating:
This class is equivalent as tf.keras.layers.SimpleRNNCell, and will be replaced by that in Tens
Training Step 1, Minibatch Loss= 2.844236, Training Accuracy= 0.31250
Test Step 1, Minibatch Loss= 2.542162, Testing Accuracy= 0.37500
Training Step 200, Minibatch Loss= 0.926534, Training Accuracy= 0.53906
Training Step 400, Minibatch Loss= 0.754711, Training Accuracy= 0.62500
Training Step 600, Minibatch Loss= 0.770410, Training Accuracy= 0.63281
Training Step 800, Minibatch Loss= 0.812265, Training Accuracy= 0.57031
Training Step 1000, Minibatch Loss= 0.784910, Training Accuracy= 0.63281
Test Step 1000, Minibatch Loss= 0.775242, Testing Accuracy= 0.56667
Training Step 1200, Minibatch Loss= 0.822709, Training Accuracy= 0.59375
Training Step 1400, Minibatch Loss= 0.793107, Training Accuracy= 0.58594
Training Step 1600, Minibatch Loss= 0.746164, Training Accuracy= 0.60938
Training Step 1800, Minibatch Loss= 0.814168, Training Accuracy= 0.57812
Training Step 2000, Minibatch Loss= 0.801162, Training Accuracy= 0.61719
Test Step 2000, Minibatch Loss= 0.727592, Testing Accuracy= 0.64167
Training Step 2200, Minibatch Loss= 0.769669, Training Accuracy= 0.62500
Training Step 2400, Minibatch Loss= 0.765233, Training Accuracy= 0.64062
Training Step 2600, Minibatch Loss= 0.702758, Training Accuracy= 0.62500
Training Step 2800, Minibatch Loss= 0.711439, Training Accuracy= 0.68750
Training Step 3000, Minibatch Loss= 0.778047, Training Accuracy= 0.60156
Test Step 3000, Minibatch Loss= 0.729107, Testing Accuracy= 0.55833
Training Step 3200, Minibatch Loss= 0.777623, Training Accuracy= 0.56250
Training Step 3400, Minibatch Loss= 0.736749, Training Accuracy= 0.60156
Training Step 3600, Minibatch Loss= 0.786515, Training Accuracy= 0.58594
Training Step 3800, Minibatch Loss= 0.768270, Training Accuracy= 0.59375
Training Step 4000, Minibatch Loss= 0.791910, Training Accuracy= 0.59375
Test Step 4000, Minibatch Loss= 0.743710, Testing Accuracy= 0.57500
Training Step 4200, Minibatch Loss= 0.801761, Training Accuracy= 0.60938
Training Step 4400, Minibatch Loss= 0.777831, Training Accuracy= 0.59375
Training Step 4600, Minibatch Loss= 0.710146, Training Accuracy= 0.64844
Training Step 4800, Minibatch Loss= 0.742600, Training Accuracy= 0.64844
Training Step 5000, Minibatch Loss= 0.724410, Training Accuracy= 0.65625
Test Step 5000, Minibatch Loss= 0.720775, Testing Accuracy= 0.64167
Training Step 5200, Minibatch Loss= 0.773124, Training Accuracy= 0.60938
Training Step 5400, Minibatch Loss= 0.827373, Training Accuracy= 0.57812
Training Step 5600, Minibatch Loss= 0.723832, Training Accuracy= 0.65625
Training Step 5800, Minibatch Loss= 0.731833, Training Accuracy= 0.60938
Training Step 6000, Minibatch Loss= 0.694421, Training Accuracy= 0.66406
```

```
Test Step 6000, Minibatch Loss= 0.724010, Testing Accuracy= 0.63333
Training Step 6200, Minibatch Loss= 0.752831, Training Accuracy= 0.61719
Training Step 6400, Minibatch Loss= 0.843409, Training Accuracy= 0.57812
Training Step 6600, Minibatch Loss= 0.809607, Training Accuracy= 0.56250
Training Step 6800, Minibatch Loss= 0.781896, Training Accuracy= 0.61719
Training Step 7000, Minibatch Loss= 0.728211, Training Accuracy= 0.67188
Test Step 7000, Minibatch Loss= 0.735121, Testing Accuracy= 0.56667
Training Step 7200, Minibatch Loss= 0.838670, Training Accuracy= 0.53906
Training Step 7400, Minibatch Loss= 0.772555, Training Accuracy= 0.57031
Training Step 7600, Minibatch Loss= 0.769768, Training Accuracy= 0.57031
Training Step 7800, Minibatch Loss= 0.815081, Training Accuracy= 0.54688
Training Step 8000, Minibatch Loss= 0.673418, Training Accuracy= 0.67188
Test Step 8000, Minibatch Loss= 0.739713, Testing Accuracy= 0.63333
Training Step 8200, Minibatch Loss= 0.699818, Training Accuracy= 0.66406
Training Step 8400, Minibatch Loss= 0.779752, Training Accuracy= 0.60938
Training Step 8600, Minibatch Loss= 0.730372, Training Accuracy= 0.64062
Training Step 8800, Minibatch Loss= 0.780510, Training Accuracy= 0.61719
Training Step 9000, Minibatch Loss= 0.718699, Training Accuracy= 0.62500
Test Step 9000, Minibatch Loss= 0.736560, Testing Accuracy= 0.57500
Training Step 9200, Minibatch Loss= 0.680613, Training Accuracy= 0.71094
Training Step 9400, Minibatch Loss= 0.787731, Training Accuracy= 0.60938
Training Step 9600, Minibatch Loss= 0.740950, Training Accuracy= 0.66406
Training Step 9800, Minibatch Loss= 0.796929, Training Accuracy= 0.59375
Training Step 10000, Minibatch Loss= 0.710793, Training Accuracy= 0.67188
Test Step 10000, Minibatch Loss= 0.723465, Testing Accuracy= 0.64167
Optimization Finished!
Testing Accuracy: 0.64166665
```