**Embedding**

1. Single LSTM

**all\_files\_dir = '../data-d/'**

**saved\_model\_path = 'saved\_model/'**

**opcode\_to\_int\_path = "opcodeToInt.txt"**

**keep\_amt = 30**

**max\_opcode\_length = 2000**

**embed\_vector\_length = 128**

**num\_lstm\_unit = 64**

**dropout\_amt = 0.2**

**batch\_size = 32**

**num\_epochs = 20**

**test\_size= 0.15 # reserve for testing**

**shutdown = False**

train\_set shape: (5568, 2000)

test\_set shape: (960, 2000)

train\_labels shape: (5568, 1)

test\_labels shape: (960, 1)

def create\_model():

model = tf.keras.models.Sequential()

model.add(tf.keras.layers.Input(batch\_shape=(batch\_size, max\_opcode\_length), name="input"))

model.add(tf.keras.layers.Embedding(input\_dim=keep\_amt+1,

output\_dim=embed\_vector\_length,

input\_length=max\_opcode\_length, name="embedding"))

model.add(tf.keras.layers.Dropout(dropout\_amt, name="dropout\_1"))

model.add(tf.keras.layers.LSTM(num\_lstm\_unit,

input\_shape=(None, max\_opcode\_length),

#stateful=True,

#batch\_input\_shape=(batch\_size, max\_opcode\_length, 1),

name="lstm1"))

model.add(tf.keras.layers.Dropout(dropout\_amt, name="dropout2"))

model.add(tf.keras.layers.Dense(5, activation='softmax', name="dense"))

optimizer = tf.keras.optimizers.Adam()

model.compile(loss='sparse\_categorical\_crossentropy', optimizer=optimizer, metrics=['accuracy'])

model.summary()

return model

Epoch 1/20

87/87 [==============================] - 7s 85ms/step - loss: 1.4870 - accuracy: 0.3694

Epoch 2/20

87/87 [==============================] - 8s 86ms/step - loss: 1.2016 - accuracy: 0.5704

Epoch 3/20

87/87 [==============================] - 8s 86ms/step - loss: 1.0615 - accuracy: 0.6099

Epoch 4/20

87/87 [==============================] - 8s 91ms/step - loss: 0.9294 - accuracy: 0.6559

Epoch 5/20

87/87 [==============================] - 8s 87ms/step - loss: 0.8588 - accuracy: 0.6859

Epoch 6/20

87/87 [==============================] - 8s 86ms/step - loss: 0.8601 - accuracy: 0.6925

Epoch 7/20

87/87 [==============================] - 7s 85ms/step - loss: 0.8474 - accuracy: 0.6976

Epoch 8/20

87/87 [==============================] - 7s 85ms/step - loss: 0.7438 - accuracy: 0.7378

Epoch 9/20

87/87 [==============================] - 7s 84ms/step - loss: 0.7322 - accuracy: 0.7301

Epoch 10/20

87/87 [==============================] - 7s 84ms/step - loss: 0.6629 - accuracy: 0.7574

Epoch 11/20

87/87 [==============================] - 8s 89ms/step - loss: 0.7543 - accuracy: 0.7342

Epoch 12/20

87/87 [==============================] - 7s 85ms/step - loss: 0.6340 - accuracy: 0.7737

Epoch 13/20

87/87 [==============================] - 7s 84ms/step - loss: 0.7596 - accuracy: 0.7392

Epoch 14/20

87/87 [==============================] - 8s 89ms/step - loss: 0.6543 - accuracy: 0.7777

Epoch 15/20

87/87 [==============================] - 8s 90ms/step - loss: 0.6206 - accuracy: 0.7909

Epoch 16/20

87/87 [==============================] - 8s 89ms/step - loss: 0.7412 - accuracy: 0.7358 0s - loss: 0.7185

Epoch 17/20

87/87 [==============================] - 8s 90ms/step - loss: 0.7035 - accuracy: 0.7505

Epoch 18/20

87/87 [==============================] - 7s 85ms/step - loss: 0.5992 - accuracy: 0.7938

Epoch 19/20

87/87 [==============================] - 8s 87ms/step - loss: 0.6022 - accuracy: 0.7820

Epoch 20/20

87/87 [==============================] - 7s 86ms/step - loss: 0.5684 - accuracy: 0.8068

**Accuracy: 82.71%**

1. Stack LSTMS