Insights on Developing Neural Network With Keras using python 3.7

April 8, 2019

This is an insight on Jason Brownlee's Develop Your First Neural Network in Python With Keras Step-By-Step https://machinelearningmastery.com/tutorial-first-neural-network-python-keras/. Note that I do not own the original code. Some coding parts are modified.

Python 3.7 Jupyter Notebook

IreneToo 7/4/2019

1 initialize the random number generator with any seed preferred.

The seed value is important in terms of computer security to pseudorandomly generate a strong secret encryption key.

```
In [12]: from keras.models import Sequential
         from keras.layers import Dense
         import numpy
         # fix random seed for reproducibility
         numpy.random.seed(7)
```

1.1 import data from website link into jupyter notebook (csv format)

```
In [13]: import requests # This library is used to make requests to internet

         #  url // We are storing url of dataset
         url = 'https://raw.githubusercontent.com/jbrownlee/Datasets/master/pima-indians-diabet
         #  requests  // We are creating a requests variable with the above url
         r = requests.get(url, allow_redirects=True)
         # request dataset.url'  //
         # We are writing the content of above request to 'dataset.url' file
         open('pima-indians-diabetes.data.csv', 'wb').write(r.content)

         # Now, we have our files downloaded
         ds = open('pima-indians-diabetes.data.csv','r')
```

```
In [14]: # LOAD DATASET
         dataset = numpy.loadtxt("pima-indians-diabetes.data.csv", delimiter=",")
```

```
# split into input (X) and output (Y) variables
X = dataset[:,0:8]
Y = dataset[:,8]
```

2 Keras Sequential model

The Sequential model is a linear stack of layers. You can add layers via the model.add() method

3 First layer

The first layer in the network here is technically a hidden layer, hence it has an activation function ----Jason Brownlee

- input_dim=8 : input layer have 8 inputs.
- Dense(12, activation='relu'): a hidden layer with 12 neurons, connected to the input layer that use relu activation function. It initializes all weights using a sample of uniform random numbers.

after that add in 2nd layer and then 3rd layer. activate sigmoid function

In [15]:
```
# create model
model = Sequential()
model.add(Dense(12, input_dim=8, activation='relu'))
model.add(Dense(8, activation='relu'))
model.add(Dense(1, activation='sigmoid'))
```

4 compile model

5 why use binary_crossentropy

in this case we are executing multi-labels classification task, each label corresponds to a binary classification problem, so one comment could have multiple labels ----bangda, Kaggle

- metrics=['accuracy'] A metric function is similar to a loss function, except that the results from evaluating a metric are not used when training the model. You may use any of the loss functions as a metric function.

In [16]:
```
# compile model
model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])
```

In [17]:
```
# fit the model
model.fit(X, Y, epochs=150, batch_size=10)
```

```
Epoch 1/150
768/768 [==============================] - 6s 8ms/step - loss: 3.7105 - acc: 0.5990
Epoch 2/150
768/768 [==============================] - 0s 150us/step - loss: 0.9358 - acc: 0.5938
```

```
Epoch 3/150
768/768 [==============================] - 0s 157us/step - loss: 0.7471 - acc: 0.6406
Epoch 4/150
768/768 [==============================] - 0s 165us/step - loss: 0.7115 - acc: 0.6576
Epoch 5/150
768/768 [==============================] - 0s 238us/step - loss: 0.6824 - acc: 0.6745
Epoch 6/150
768/768 [==============================] - 0s 237us/step - loss: 0.6512 - acc: 0.6836
Epoch 7/150
768/768 [==============================] - 0s 163us/step - loss: 0.6493 - acc: 0.6732
Epoch 8/150
768/768 [==============================] - 0s 164us/step - loss: 0.6366 - acc: 0.6901
Epoch 9/150
768/768 [==============================] - 0s 129us/step - loss: 0.6241 - acc: 0.6875
Epoch 10/150
768/768 [==============================] - 0s 124us/step - loss: 0.6297 - acc: 0.6784
Epoch 11/150
768/768 [==============================] - 0s 151us/step - loss: 0.6479 - acc: 0.6758
Epoch 12/150
768/768 [==============================] - 0s 135us/step - loss: 0.6392 - acc: 0.6758
Epoch 13/150
768/768 [==============================] - 0s 226us/step - loss: 0.6252 - acc: 0.6758
Epoch 14/150
768/768 [==============================] - 0s 133us/step - loss: 0.6173 - acc: 0.7018
Epoch 15/150
768/768 [==============================] - 0s 124us/step - loss: 0.6014 - acc: 0.6953
Epoch 16/150
768/768 [==============================] - 0s 129us/step - loss: 0.5874 - acc: 0.7005
Epoch 17/150
768/768 [==============================] - 0s 162us/step - loss: 0.5836 - acc: 0.6953
Epoch 18/150
768/768 [==============================] - 0s 152us/step - loss: 0.5994 - acc: 0.6836
Epoch 19/150
768/768 [==============================] - 0s 155us/step - loss: 0.5795 - acc: 0.7109
Epoch 20/150
768/768 [==============================] - 0s 155us/step - loss: 0.5783 - acc: 0.7214
Epoch 21/150
768/768 [==============================] - 0s 154us/step - loss: 0.5702 - acc: 0.7161
Epoch 22/150
768/768 [==============================] - 0s 164us/step - loss: 0.5822 - acc: 0.6992
Epoch 23/150
768/768 [==============================] - 0s 155us/step - loss: 0.5749 - acc: 0.7109
Epoch 24/150
768/768 [==============================] - ETA: 0s - loss: 0.5729 - acc: 0.728 - 0s 152us/step
Epoch 25/150
768/768 [==============================] - 0s 150us/step - loss: 0.5581 - acc: 0.7357
Epoch 26/150
768/768 [==============================] - 0s 131us/step - loss: 0.5705 - acc: 0.7070
```

```
Epoch 27/150
768/768 [==============================] - 0s 154us/step - loss: 0.5555 - acc: 0.7201
Epoch 28/150
768/768 [==============================] - 0s 148us/step - loss: 0.5549 - acc: 0.7292
Epoch 29/150
768/768 [==============================] - 0s 126us/step - loss: 0.5742 - acc: 0.7174
Epoch 30/150
768/768 [==============================] - 0s 123us/step - loss: 0.5611 - acc: 0.7201
Epoch 31/150
768/768 [==============================] - 0s 130us/step - loss: 0.5691 - acc: 0.7135
Epoch 32/150
768/768 [==============================] - 0s 124us/step - loss: 0.5641 - acc: 0.7122
Epoch 33/150
768/768 [==============================] - 0s 141us/step - loss: 0.5532 - acc: 0.7214
Epoch 34/150
768/768 [==============================] - 0s 169us/step - loss: 0.5522 - acc: 0.7279
Epoch 35/150
768/768 [==============================] - 0s 173us/step - loss: 0.5550 - acc: 0.7161
Epoch 36/150
768/768 [==============================] - 0s 143us/step - loss: 0.5627 - acc: 0.7109
Epoch 37/150
768/768 [==============================] - 0s 142us/step - loss: 0.5354 - acc: 0.7357
Epoch 38/150
768/768 [==============================] - 0s 143us/step - loss: 0.5456 - acc: 0.7122
Epoch 39/150
768/768 [==============================] - 0s 144us/step - loss: 0.5491 - acc: 0.7253
Epoch 40/150
768/768 [==============================] - 0s 160us/step - loss: 0.5486 - acc: 0.7201
Epoch 41/150
768/768 [==============================] - 0s 134us/step - loss: 0.5445 - acc: 0.7318
Epoch 42/150
768/768 [==============================] - 0s 141us/step - loss: 0.5379 - acc: 0.7409
Epoch 43/150
768/768 [==============================] - 0s 189us/step - loss: 0.5345 - acc: 0.7435
Epoch 44/150
768/768 [==============================] - 0s 318us/step - loss: 0.5351 - acc: 0.7448
Epoch 45/150
768/768 [==============================] - 0s 259us/step - loss: 0.5330 - acc: 0.7578
Epoch 46/150
768/768 [==============================] - 0s 223us/step - loss: 0.5298 - acc: 0.7604
Epoch 47/150
768/768 [==============================] - 0s 239us/step - loss: 0.5320 - acc: 0.7383
Epoch 48/150
768/768 [==============================] - 0s 246us/step - loss: 0.5346 - acc: 0.7396
Epoch 49/150
768/768 [==============================] - 0s 200us/step - loss: 0.5349 - acc: 0.7526
Epoch 50/150
768/768 [==============================] - 0s 238us/step - loss: 0.5270 - acc: 0.7422
```

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Epoch 51/150
768/768 [==============================] - 0s 180us/step - loss: 0.5280 - acc: 0.7500
Epoch 52/150
768/768 [==============================] - 0s 174us/step - loss: 0.5304 - acc: 0.7422
Epoch 53/150
768/768 [==============================] - 0s 169us/step - loss: 0.5391 - acc: 0.7448
Epoch 54/150
768/768 [==============================] - 0s 163us/step - loss: 0.5378 - acc: 0.7266
Epoch 55/150
768/768 [==============================] - 0s 164us/step - loss: 0.5218 - acc: 0.7500
Epoch 56/150
768/768 [==============================] - 0s 246us/step - loss: 0.5302 - acc: 0.7435
Epoch 57/150
768/768 [==============================] - 0s 252us/step - loss: 0.5324 - acc: 0.7383
Epoch 58/150
768/768 [==============================] - 0s 213us/step - loss: 0.5225 - acc: 0.7526
Epoch 59/150
768/768 [==============================] - 0s 200us/step - loss: 0.5134 - acc: 0.7617
Epoch 60/150
768/768 [==============================] - 0s 164us/step - loss: 0.5355 - acc: 0.7357
Epoch 61/150
768/768 [==============================] - 0s 159us/step - loss: 0.5268 - acc: 0.7318
Epoch 62/150
768/768 [==============================] - 0s 185us/step - loss: 0.5172 - acc: 0.7500 0s - loss
Epoch 63/150
768/768 [==============================] - 0s 168us/step - loss: 0.5436 - acc: 0.7305
Epoch 64/150
768/768 [==============================] - 0s 276us/step - loss: 0.5337 - acc: 0.7370
Epoch 65/150
768/768 [==============================] - 0s 237us/step - loss: 0.5197 - acc: 0.7448
Epoch 66/150
768/768 [==============================] - 0s 260us/step - loss: 0.5067 - acc: 0.7500
Epoch 67/150
768/768 [==============================] - 0s 195us/step - loss: 0.5170 - acc: 0.7383
Epoch 68/150
768/768 [==============================] - 0s 182us/step - loss: 0.5126 - acc: 0.7487
Epoch 69/150
768/768 [==============================] - 0s 189us/step - loss: 0.5131 - acc: 0.7513
Epoch 70/150
768/768 [==============================] - 0s 190us/step - loss: 0.5348 - acc: 0.7201
Epoch 71/150
768/768 [==============================] - 0s 174us/step - loss: 0.5207 - acc: 0.7396
Epoch 72/150
768/768 [==============================] - 0s 172us/step - loss: 0.5169 - acc: 0.7474
Epoch 73/150
768/768 [==============================] - 0s 181us/step - loss: 0.5160 - acc: 0.7474
Epoch 74/150
768/768 [==============================] - 0s 168us/step - loss: 0.5102 - acc: 0.7591
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Epoch 75/150
768/768 [==============================] - 0s 169us/step - loss: 0.5113 - acc: 0.7591
Epoch 76/150
768/768 [==============================] - 0s 155us/step - loss: 0.5134 - acc: 0.7513
Epoch 77/150
768/768 [==============================] - 0s 172us/step - loss: 0.5161 - acc: 0.7578
Epoch 78/150
768/768 [==============================] - 0s 169us/step - loss: 0.5141 - acc: 0.7448
Epoch 79/150
768/768 [==============================] - 0s 170us/step - loss: 0.5153 - acc: 0.7344
Epoch 80/150
768/768 [==============================] - 0s 168us/step - loss: 0.5103 - acc: 0.7591
Epoch 81/150
768/768 [==============================] - 0s 175us/step - loss: 0.5067 - acc: 0.7708
Epoch 82/150
768/768 [==============================] - 0s 224us/step - loss: 0.5037 - acc: 0.7474
Epoch 83/150
768/768 [==============================] - 0s 217us/step - loss: 0.5022 - acc: 0.7578
Epoch 84/150
768/768 [==============================] - 0s 181us/step - loss: 0.4983 - acc: 0.7513
Epoch 85/150
768/768 [==============================] - 0s 206us/step - loss: 0.5074 - acc: 0.7461
Epoch 86/150
768/768 [==============================] - 0s 219us/step - loss: 0.5093 - acc: 0.7513
Epoch 87/150
768/768 [==============================] - 0s 185us/step - loss: 0.5002 - acc: 0.7552
Epoch 88/150
768/768 [==============================] - 0s 216us/step - loss: 0.5035 - acc: 0.7643
Epoch 89/150
768/768 [==============================] - 0s 141us/step - loss: 0.5078 - acc: 0.7604
Epoch 90/150
768/768 [==============================] - 0s 143us/step - loss: 0.5104 - acc: 0.7487
Epoch 91/150
768/768 [==============================] - 0s 168us/step - loss: 0.5017 - acc: 0.7513
Epoch 92/150
768/768 [==============================] - 0s 160us/step - loss: 0.5061 - acc: 0.7422
Epoch 93/150
768/768 [==============================] - 0s 155us/step - loss: 0.4989 - acc: 0.7526
Epoch 94/150
768/768 [==============================] - 0s 163us/step - loss: 0.5000 - acc: 0.7578
Epoch 95/150
768/768 [==============================] - 0s 157us/step - loss: 0.5090 - acc: 0.7383
Epoch 96/150
768/768 [==============================] - 0s 145us/step - loss: 0.4949 - acc: 0.7578
Epoch 97/150
768/768 [==============================] - 0s 146us/step - loss: 0.4995 - acc: 0.7708
Epoch 98/150
768/768 [==============================] - 0s 143us/step - loss: 0.4923 - acc: 0.7578
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Epoch 99/150
768/768 [==============================] - 0s 147us/step - loss: 0.4928 - acc: 0.7591
Epoch 100/150
768/768 [==============================] - 0s 164us/step - loss: 0.4864 - acc: 0.7812
Epoch 101/150
768/768 [==============================] - 0s 269us/step - loss: 0.4913 - acc: 0.7656
Epoch 102/150
768/768 [==============================] - 0s 182us/step - loss: 0.4993 - acc: 0.7526
Epoch 103/150
768/768 [==============================] - 0s 150us/step - loss: 0.5025 - acc: 0.7552
Epoch 104/150
768/768 [==============================] - 0s 146us/step - loss: 0.4959 - acc: 0.7682
Epoch 105/150
768/768 [==============================] - 0s 143us/step - loss: 0.5291 - acc: 0.7396
Epoch 106/150
768/768 [==============================] - 0s 151us/step - loss: 0.4939 - acc: 0.7721
Epoch 107/150
768/768 [==============================] - 0s 148us/step - loss: 0.4915 - acc: 0.7695
Epoch 108/150
768/768 [==============================] - 0s 150us/step - loss: 0.5074 - acc: 0.7487
Epoch 109/150
768/768 [==============================] - 0s 150us/step - loss: 0.4898 - acc: 0.7539
Epoch 110/150
768/768 [==============================] - 0s 160us/step - loss: 0.4886 - acc: 0.7591
Epoch 111/150
768/768 [==============================] - 0s 148us/step - loss: 0.4846 - acc: 0.7721
Epoch 112/150
768/768 [==============================] - 0s 159us/step - loss: 0.4940 - acc: 0.7669
Epoch 113/150
768/768 [==============================] - 0s 150us/step - loss: 0.5034 - acc: 0.7526
Epoch 114/150
768/768 [==============================] - 0s 155us/step - loss: 0.4914 - acc: 0.7526
Epoch 115/150
768/768 [==============================] - 0s 152us/step - loss: 0.4941 - acc: 0.7669
Epoch 116/150
768/768 [==============================] - 0s 173us/step - loss: 0.4933 - acc: 0.7708
Epoch 117/150
768/768 [==============================] - 0s 159us/step - loss: 0.4924 - acc: 0.7630
Epoch 118/150
768/768 [==============================] - 0s 144us/step - loss: 0.4923 - acc: 0.7786
Epoch 119/150
768/768 [==============================] - 0s 169us/step - loss: 0.4867 - acc: 0.7630
Epoch 120/150
768/768 [==============================] - 0s 186us/step - loss: 0.4990 - acc: 0.7682
Epoch 121/150
768/768 [==============================] - 0s 154us/step - loss: 0.4958 - acc: 0.7747
Epoch 122/150
768/768 [==============================] - 0s 159us/step - loss: 0.4821 - acc: 0.7760
```

```
Epoch 123/150
768/768 [==============================] - 0s 172us/step - loss: 0.4875 - acc: 0.7630
Epoch 124/150
768/768 [==============================] - 0s 157us/step - loss: 0.4861 - acc: 0.7760
Epoch 125/150
768/768 [==============================] - 0s 182us/step - loss: 0.4885 - acc: 0.7812
Epoch 126/150
768/768 [==============================] - 0s 181us/step - loss: 0.4807 - acc: 0.7708
Epoch 127/150
768/768 [==============================] - 0s 172us/step - loss: 0.4888 - acc: 0.7695
Epoch 128/150
768/768 [==============================] - 0s 185us/step - loss: 0.4716 - acc: 0.7786
Epoch 129/150
768/768 [==============================] - 0s 168us/step - loss: 0.4828 - acc: 0.7708
Epoch 130/150
768/768 [==============================] - 0s 168us/step - loss: 0.4733 - acc: 0.7852
Epoch 131/150
768/768 [==============================] - 0s 256us/step - loss: 0.4841 - acc: 0.7630
Epoch 132/150
768/768 [==============================] - 0s 224us/step - loss: 0.4815 - acc: 0.7734
Epoch 133/150
768/768 [==============================] - 0s 183us/step - loss: 0.4826 - acc: 0.7656
Epoch 134/150
768/768 [==============================] - 0s 165us/step - loss: 0.4860 - acc: 0.7682
Epoch 135/150
768/768 [==============================] - 0s 168us/step - loss: 0.4754 - acc: 0.7682
Epoch 136/150
768/768 [==============================] - 0s 230us/step - loss: 0.4724 - acc: 0.7721
Epoch 137/150
768/768 [==============================] - 0s 297us/step - loss: 0.4682 - acc: 0.7852
Epoch 138/150
768/768 [==============================] - 0s 203us/step - loss: 0.4794 - acc: 0.7826
Epoch 139/150
768/768 [==============================] - 0s 156us/step - loss: 0.4672 - acc: 0.7747
Epoch 140/150
768/768 [==============================] - 0s 129us/step - loss: 0.4804 - acc: 0.7799
Epoch 141/150
768/768 [==============================] - 0s 123us/step - loss: 0.4714 - acc: 0.7799
Epoch 142/150
768/768 [==============================] - 0s 130us/step - loss: 0.4830 - acc: 0.7708
Epoch 143/150
768/768 [==============================] - 0s 131us/step - loss: 0.4725 - acc: 0.7799
Epoch 144/150
768/768 [==============================] - 0s 156us/step - loss: 0.4733 - acc: 0.7826
Epoch 145/150
768/768 [==============================] - 0s 135us/step - loss: 0.4883 - acc: 0.7617
Epoch 146/150
768/768 [==============================] - 0s 156us/step - loss: 0.4929 - acc: 0.7721
```