IE 345 - K “Introduction to Deep Learning: Fundamentals Concepts”

Prof. Yuzo

Case Studies with Real Data

pg. 106 - 110

In [1]:

```
# Importing the libraries
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
```

In [2]:

```
# Load the dataset
dataset = pd.read_csv('C:/Users/pablo/Desktop/IE345_DeepLearning/PythonMachineLearningfromScratch/
Dataset/Churn_Modelling.csv')
dataset.head()
```

Out[2]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCr
0	1	15634602	Hargrave	619	France	Female	42	2	0.00	1	
1	2	15647311	Hill	608	Spain	Female	41	1	83807.86	1	
2	3	15619304	Onio	502	France	Female	42	8	159660.80	3	
3	4	15701354	Boni	699	France	Female	39	1	0.00	2	
4	5	15737888	Mitchell	850	Spain	Female	43	2	125510.82	1	

In [3]:

```
X = dataset.iloc[:, 3:13].values
y = dataset.iloc[:, 13].values
```

In [4]:

```
# encoding categorical data
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
labelencoder_X_1 = LabelEncoder()
X[:, 1] = labelencoder_X_1.fit_transform(X[:, 1])
labelencoder_X_2 = LabelEncoder()
X[:, 2] = labelencoder_X_2.fit_transform(X[:, 2])
onehotencoder = OneHotEncoder(categorical_features = [1])
X = onehotencoder.fit_transform(X).toarray()
X = X[:, 1:]
```

```
C:\Users\pablo\Python\envs\DAVID\lib\site-packages\sklearn\preprocessing\_encoders.py:371: FutureW
arning: The handling of integer data will change in version 0.22. Currently, the categories are de
termined based on the range [0, max(values)], while in the future they will be determined based on
the unique values.
If you want the future behaviour and silence this warning, you can specify "categories='auto'".
In case you used a LabelEncoder before this OneHotEncoder to convert the categories to integers, t
hen you can now use the OneHotEncoder directly.
  warnings.warn(msg, FutureWarning)
C:\Users\pablo\Python\envs\DAVID\lib\site-packages\sklearn\preprocessing\_encoders.py:392: Depreca
tionWarning: The 'categorical_features' keyword is deprecated in version 0.20 and will be removed
in 0.22. You can use the ColumnTransformer instead.
  "use the ColumnTransformer instead.", DeprecationWarning)
```

In [5]:

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2, random_state = 0)
```

In [6]:

```
# feature scaling
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

In [8]:

```
# Building the Artificial Neural Network ANN layer by layer
import keras
from keras.models import Sequential
from keras.layers import Dense
```

In [9]:

```
net = Sequential()
net.add(Dense(output_dim=6, init = 'uniform', activation = 'relu', input_dim = 11))
net.add(Dense(output_dim = 6, init = 'uniform', activation = 'relu'))
net.add(Dense(output_dim = 1, init = 'uniform', activation = 'sigmoid'))

net.compile(optimizer = 'adam', loss = 'binary_crossentropy', metrics = ['accuracy'])
```

```
WARNING:tensorflow:From C:\Users\pablo\AppData\Roaming\Python\Python36\site-packages\tensorflow\py
thon\framework\op_def_library.py:263: colocate_with (from tensorflow.python.framework.ops) is depr
ecated and will be removed in a future version.
Instructions for updating:
Colocations handled automatically by placer.

C:\Users\pablo\Python\envs\DAVID\lib\site-packages\ipykernel_launcher.py:2: UserWarning: Update yo
ur `Dense` call to the Keras 2 API: `Dense(activation="relu", input_dim=11, units=6, kernel_initia
lizer="uniform")`


C:\Users\pablo\Python\envs\DAVID\lib\site-packages\ipykernel_launcher.py:3: UserWarning: Update yo
ur `Dense` call to the Keras 2 API: `Dense(activation="relu", units=6, kernel_initializer="unifor
m")`
  This is separate from the ipykernel package so we can avoid doing imports until
C:\Users\pablo\Python\envs\DAVID\lib\site-packages\ipykernel_launcher.py:4: UserWarning: Update yo
ur `Dense` call to the Keras 2 API: `Dense(activation="sigmoid", units=1, kernel_initializer="unif
orm")`
  after removing the cwd from sys.path.
```

In [10]:

```
net.fit(X_train, y_train, batch_size = 10, nb_epoch = 100)
```

```
WARNING:tensorflow:From C:\Users\pablo\AppData\Roaming\Python\Python36\site-packages\tensorflow\py
thon\ops\math_ops.py:3066: to_int32 (from tensorflow.python.ops.math_ops) is deprecated and will b
e removed in a future version.
Instructions for updating:
Use tf.cast instead.

C:\Users\pablo\Python\envs\DAVID\lib\site-packages\ipykernel_launcher.py:1: UserWarning: The `nb_e
poch` argument in `fit` has been renamed `epochs`.
  """Entry point for launching an IPython kernel.
```

```
Epoch 1/100
8000/8000 [==============================] - 1s 98us/step - loss: 0.4840 - acc: 0.7956
Epoch 2/100
8000/8000 [==============================] - 1s 73us/step - loss: 0.4275 - acc: 0.7960
Epoch 3/100
8000/8000 [==============================] - 1s 75us/step - loss: 0.4213 - acc: 0.7975
Epoch 4/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4173 - acc: 0.8246
Epoch 5/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4147 - acc: 0.8281
Epoch 6/100
8000/8000 [==============================] - 1s 70us/step - loss: 0.4134 - acc: 0.8304
Epoch 7/100
8000/8000 [==============================] - 1s 71us/step - loss: 0.4123 - acc: 0.8326
Epoch 8/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4110 - acc: 0.8325
Epoch 9/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4101 - acc: 0.8331
Epoch 10/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4091 - acc: 0.8337
Epoch 11/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4080 - acc: 0.8326
Epoch 12/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4077 - acc: 0.8362
Epoch 13/100
8000/8000 [==============================] - 1s 70us/step - loss: 0.4073 - acc: 0.8320
Epoch 14/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4064 - acc: 0.8345
Epoch 15/100
8000/8000 [==============================] - 1s 71us/step - loss: 0.4059 - acc: 0.8345
Epoch 16/100
8000/8000 [==============================] - 1s 70us/step - loss: 0.4054 - acc: 0.8342
Epoch 17/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4051 - acc: 0.8357
Epoch 18/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4045 - acc: 0.8354
Epoch 19/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4040 - acc: 0.8351
Epoch 20/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4045 - acc: 0.8346: 0s - loss:
0.4050 - acc
Epoch 21/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4038 - acc: 0.8346
Epoch 22/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4029 - acc: 0.8340
Epoch 23/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4031 - acc: 0.8352
Epoch 24/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4031 - acc: 0.8349
Epoch 25/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4023 - acc: 0.8351
Epoch 26/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4030 - acc: 0.8339
Epoch 27/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4029 - acc: 0.8339
Epoch 28/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4023 - acc: 0.8331
Epoch 29/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4022 - acc: 0.8357: 0s - loss:
0.4308 - a
Epoch 30/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4020 - acc: 0.8345
Epoch 31/100
8000/8000 [==============================] - 1s 70us/step - loss: 0.4022 - acc: 0.8354
Epoch 32/100
8000/8000 [==============================] - 1s 69us/step - loss: 0.4020 - acc: 0.8350
Epoch 33/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4021 - acc: 0.8356
Epoch 34/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4022 - acc: 0.8355
Epoch 35/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4016 - acc: 0.8340
Epoch 36/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4019 - acc: 0.8336
Epoch 37/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4015 - acc: 0.8347
```

```
Epoch 38/100
8000/8000 [==============================] - 1s 69us/step - loss: 0.4015 - acc: 0.8350
Epoch 39/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4016 - acc: 0.8354
Epoch 40/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4018 - acc: 0.8347
Epoch 41/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4018 - acc: 0.8346
Epoch 42/100
8000/8000 [==============================] - 1s 69us/step - loss: 0.4013 - acc: 0.8342
Epoch 43/100
8000/8000 [==============================] - 1s 70us/step - loss: 0.4015 - acc: 0.8339
Epoch 44/100
8000/8000 [==============================] - 1s 69us/step - loss: 0.4012 - acc: 0.8340
Epoch 45/100
8000/8000 [==============================] - 1s 72us/step - loss: 0.4015 - acc: 0.8365
Epoch 46/100
8000/8000 [==============================] - 1s 70us/step - loss: 0.4011 - acc: 0.8335
Epoch 47/100
8000/8000 [==============================] - 1s 72us/step - loss: 0.4009 - acc: 0.8366
Epoch 48/100
8000/8000 [==============================] - 1s 70us/step - loss: 0.4012 - acc: 0.8340
Epoch 49/100
8000/8000 [==============================] - 1s 79us/step - loss: 0.4015 - acc: 0.8352
Epoch 50/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4005 - acc: 0.8357
Epoch 51/100
8000/8000 [==============================] - 1s 69us/step - loss: 0.4012 - acc: 0.8364
Epoch 52/100
8000/8000 [==============================] - 1s 76us/step - loss: 0.4010 - acc: 0.8339
Epoch 53/100
8000/8000 [==============================] - 1s 75us/step - loss: 0.4009 - acc: 0.8331
Epoch 54/100
8000/8000 [==============================] - 1s 74us/step - loss: 0.4010 - acc: 0.8344
Epoch 55/100
8000/8000 [==============================] - 1s 70us/step - loss: 0.4014 - acc: 0.8354
Epoch 56/100
8000/8000 [==============================] - 1s 70us/step - loss: 0.4004 - acc: 0.8357
Epoch 57/100
8000/8000 [==============================] - 1s 69us/step - loss: 0.4007 - acc: 0.8347
Epoch 58/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4009 - acc: 0.8352
Epoch 59/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4006 - acc: 0.8357
Epoch 60/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4006 - acc: 0.8335
Epoch 61/100
8000/8000 [==============================] - 1s 71us/step - loss: 0.4006 - acc: 0.8350
Epoch 62/100
8000/8000 [==============================] - 1s 74us/step - loss: 0.4011 - acc: 0.8344
Epoch 63/100
8000/8000 [==============================] - 1s 71us/step - loss: 0.4004 - acc: 0.8332
Epoch 64/100
8000/8000 [==============================] - 1s 75us/step - loss: 0.4006 - acc: 0.8365
Epoch 65/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4008 - acc: 0.8356
Epoch 66/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4008 - acc: 0.8346
Epoch 67/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4003 - acc: 0.8341
Epoch 68/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4007 - acc: 0.8361
Epoch 69/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4003 - acc: 0.8359
Epoch 70/100
8000/8000 [==============================] - 1s 70us/step - loss: 0.4005 - acc: 0.8347
Epoch 71/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4002 - acc: 0.8351
Epoch 72/100
8000/8000 [==============================] - 1s 69us/step - loss: 0.4004 - acc: 0.8350
Epoch 73/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4004 - acc: 0.8345
Epoch 74/100
8000/8000 [==============================] - 1s 69us/step - loss: 0.4004 - acc: 0.8352
Epoch 75/100
8000/8000 [==============================] - 1s 73us/step - loss: 0.4006 - acc: 0.8356
```

```
Epoch 76/100
8000/8000 [==============================] - 1s 76us/step - loss: 0.4004 - acc: 0.8341
Epoch 77/100
8000/8000 [==============================] - 1s 75us/step - loss: 0.4006 - acc: 0.8342
Epoch 78/100
8000/8000 [==============================] - 1s 77us/step - loss: 0.4001 - acc: 0.8357
Epoch 79/100
8000/8000 [==============================] - 1s 78us/step - loss: 0.3999 - acc: 0.8361
Epoch 80/100
8000/8000 [==============================] - 1s 72us/step - loss: 0.4000 - acc: 0.8339
Epoch 81/100
8000/8000 [==============================] - 1s 70us/step - loss: 0.4006 - acc: 0.8345
Epoch 82/100
8000/8000 [==============================] - 1s 71us/step - loss: 0.4000 - acc: 0.8350
Epoch 83/100
8000/8000 [==============================] - 1s 73us/step - loss: 0.3999 - acc: 0.8340
Epoch 84/100
8000/8000 [==============================] - 1s 70us/step - loss: 0.4001 - acc: 0.8359
Epoch 85/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.4000 - acc: 0.8344
Epoch 86/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.3996 - acc: 0.8361
Epoch 87/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4001 - acc: 0.8344
Epoch 88/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.4003 - acc: 0.8340
Epoch 89/100
8000/8000 [==============================] - 1s 67us/step - loss: 0.3998 - acc: 0.8356
Epoch 90/100
8000/8000 [==============================] - 1s 71us/step - loss: 0.3997 - acc: 0.8352
Epoch 91/100
8000/8000 [==============================] - 1s 70us/step - loss: 0.4001 - acc: 0.8351
Epoch 92/100
8000/8000 [==============================] - 1s 73us/step - loss: 0.3997 - acc: 0.8351
Epoch 93/100
8000/8000 [==============================] - 1s 72us/step - loss: 0.4000 - acc: 0.8359
Epoch 94/100
8000/8000 [==============================] - 1s 74us/step - loss: 0.4001 - acc: 0.8339
Epoch 95/100
8000/8000 [==============================] - 1s 74us/step - loss: 0.3995 - acc: 0.8356: 0s - loss:
0.3734 -
Epoch 96/100
8000/8000 [==============================] - 1s 75us/step - loss: 0.4001 - acc: 0.8352
Epoch 97/100
8000/8000 [==============================] - 1s 81us/step - loss: 0.4002 - acc: 0.8356
Epoch 98/100
8000/8000 [==============================] - ETA: 0s - loss: 0.4016 - acc: 0.832 - 1s 73us/step -
loss: 0.4000 - acc: 0.8339
Epoch 99/100
8000/8000 [==============================] - 1s 77us/step - loss: 0.4000 - acc: 0.8337
Epoch 100/100
8000/8000 [==============================] - 1s 68us/step - loss: 0.3999 - acc: 0.8366
```

Out[10]:

```
<keras.callbacks.History at 0x1d65963d748>
```

In [14]:

```
y_pred = net.predict(X_test)
y_pred = (y_pred > 0.5)
```

In [15]:

```
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
print(cm)
```

```
[[1546   49]
 [ 263  142]]
```

Code available on: https://towardsdatascience.com/building-your-own-artificial-neural-network-from-scratch-on-churn-modeling-dataset-using-keras-in-690782f7d051 (https://towardsdatascience.com/building-your-own-artificial-neural-network-from-scratch-on-churn-modeling-dataset-using-keras-in-690782f7d051)

Pablo David Minango Negrete

pablodavid218@gmail.com

Lisber Arana Hinostroza