Análisis de Datos y Aprendizaje Máquina con Tensorflow 2.0: Perceptrón Multicapa

2019/09/30

1 Dropout

Objetivo: Conocer Dropout, sus parámetros y como afecta los entrenamientos de una red neuronal para clasificación de imágenes

- Referencia: https://dl.acm.org/doi/abs/10.5555/2627435.2670313
- Dropout ignora algunas neuronas durante el entrenamiento, de forma que se puede decir que se entrenan sub-ensambles de redes
- La probabilidad de que cada neurona se desconecte se indica por 'tasa de dropout'
- Dropout ha sido empleado tambien para RNN con el método de Zoneout

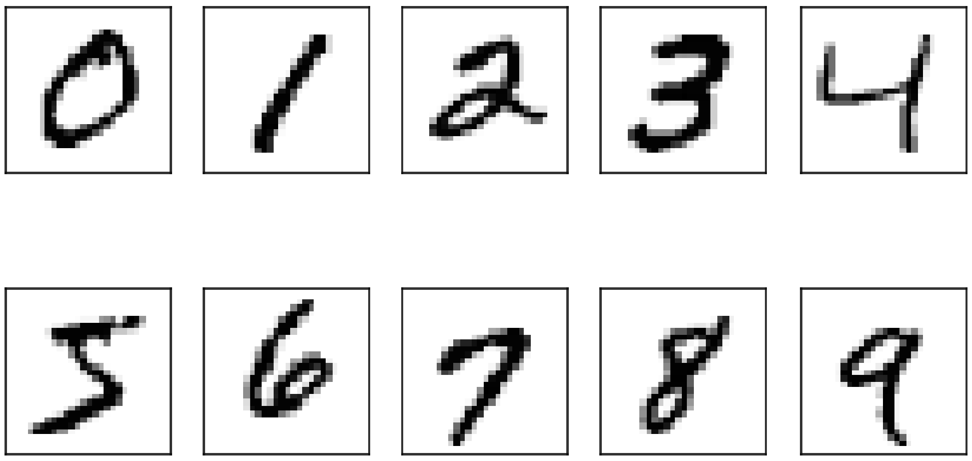
```
In [1]: import matplotlib.pyplot as plt
        import tensorflow as tf
        from tensorflow import keras
        from tensorflow.keras.models import Sequential
        from tensorflow.keras.layers import Dropout
        from tensorflow.keras.layers import Dense
        from tensorflow.keras import backend as K
        K.clear_session()

        mnist = keras.datasets.mnist

        (x_train, y_train), (x_test, y_test) = mnist.load_data()
```

```
In [2]: print(x_train.shape)
        print(y_train.shape)
        print(x_test.shape)
        print(y_test.shape)
```

```
(60000, 28, 28)
(60000,)
(10000, 28, 28)
(10000,)
```

1.1 Leer Dataset

```
In [3]: fig, ax = plt.subplots(nrows=2, ncols=5, sharex=True, sharey=True,)
        ax = ax.flatten()
        for i in range(10):
            img = x_train[y_train == i][0].reshape(28, 28)
            ax[i].imshow(img, cmap='Greys', interpolation='nearest')

        ax[0].set_xticks([])
        ax[0].set_yticks([])
        plt.tight_layout()
        plt.show()
```



- Se modifica la forma de los datos de 2-d (n, 28, 28) a 1-d (n, 784)

```
In [4]: x_train = x_train.reshape(x_train.shape[0], -1)
        x_test = x_test.reshape(x_test.shape[0], -1)


        print(x_train.shape) # (60000, 784)
        print(y_train.shape) # (60000,)
        print(x_test.shape)  # (10000, 784)
        print(y_test.shape)  # (10000,)
```

```
(60000, 784)
(60000,)
(10000, 784)
(10000,)
```

```
In [5]: epoch = 50
        verbose = 0
        batch = 50
```

```
In [6]: def make_model():
            model = Sequential()

            model.add(Dense(40, input_shape = (784, ), activation = 'relu'))
            model.add(Dropout(0.2))                             # capa Dropout
            model.add(Dense(40, activation = 'relu'))
            model.add(Dropout(0.2))                             # capa Dropout
            model.add(Dense(40, activation = 'relu'))
            model.add(Dropout(0.2))                             # capa Dropout
            model.add(Dense(10, activation = 'softmax'))


            model.compile(optimizer='adam', loss='sparse_categorical_crossentropy',
                          metrics=['accuracy'])
            return model
```

```
In [7]: model = make_model()

        model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense (Dense)                (None, 40)                31400
_________________________________________________________________
dropout (Dropout)            (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 40)                1640
_________________________________________________________________
dropout_1 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_2 (Dense)              (None, 40)                1640
_________________________________________________________________
dropout_2 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_3 (Dense)              (None, 10)                410
=================================================================
Total params: 35,090
Trainable params: 35,090
Non-trainable params: 0
_________________________________________________________________
```

```
In [8]: history1 = model.fit(x_train, y_train, batch_size = batch, validation_split = 0.3,
                             epochs = epoch, verbose = verbose)
```

```
In [9]: test_loss, test_acc = model.evaluate(x_test,  y_test, verbose=2)

        print('\nTest acccuracy:', test_acc)
```

```
10000/1 - 1s - loss: 0.3316 - accuracy: 0.8815

Test acccuracy: 0.8815
```

```
In [10]: def make_model():
             model = Sequential()

             model.add(Dense(40, input_shape = (784, ), activation = 'relu'))
             model.add(Dropout(0.5))                             # capa Dropout
             model.add(Dense(40, activation = 'relu'))
             model.add(Dropout(0.5))                             # capa Dropout
             model.add(Dense(40, activation = 'relu'))
             model.add(Dropout(0.5))                             # capa Dropout
             model.add(Dense(10, activation = 'softmax'))


             model.compile(optimizer='adam', loss='sparse_categorical_crossentropy',
                           metrics=['accuracy'])
             return model
```

```
In [11]: model = make_model()

         model.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_4 (Dense)              (None, 40)                31400
_________________________________________________________________
dropout_3 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_5 (Dense)              (None, 40)                1640
_________________________________________________________________
dropout_4 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_6 (Dense)              (None, 40)                1640
_________________________________________________________________
dropout_5 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_7 (Dense)              (None, 10)                410
=================================================================
Total params: 35,090
Trainable params: 35,090
Non-trainable params: 0
_________________________________________________________________
```

```
In [12]: history2 = model.fit(x_train, y_train, batch_size = batch, validation_split = 0.3,
                              epochs = epoch, verbose = verbose)
```

```
In [13]: test_loss, test_acc = model.evaluate(x_test,  y_test, verbose=2)

         print('\nTest acccuracy:', test_acc)

10000/1 - 1s - loss: 2.3022 - accuracy: 0.1135

Test acccuracy: 0.1135
```

```
In [14]: def make_model():
             model = Sequential()

             model.add(Dense(40, input_shape = (784, ), activation = 'relu'))
             model.add(Dropout(0.1))                        # capa Dropout
             model.add(Dense(40, activation = 'relu'))
             model.add(Dropout(0.1))                        # capa Dropout
             model.add(Dense(40, activation = 'relu'))
             model.add(Dropout(0.1))                        # capa Dropout
             model.add(Dense(10, activation = 'softmax'))


             model.compile(optimizer='adam', loss='sparse_categorical_crossentropy',
                           metrics=['accuracy'])
             return model
```

```
In [15]: model = make_model()

         model.summary()

Model: "sequential_2"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_8 (Dense)              (None, 40)                31400
_________________________________________________________________
dropout_6 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_9 (Dense)              (None, 40)                1640
_________________________________________________________________
dropout_7 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_10 (Dense)             (None, 40)                1640
_________________________________________________________________
dropout_8 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_11 (Dense)             (None, 10)                410
=================================================================
Total params: 35,090
Trainable params: 35,090
Non-trainable params: 0
```

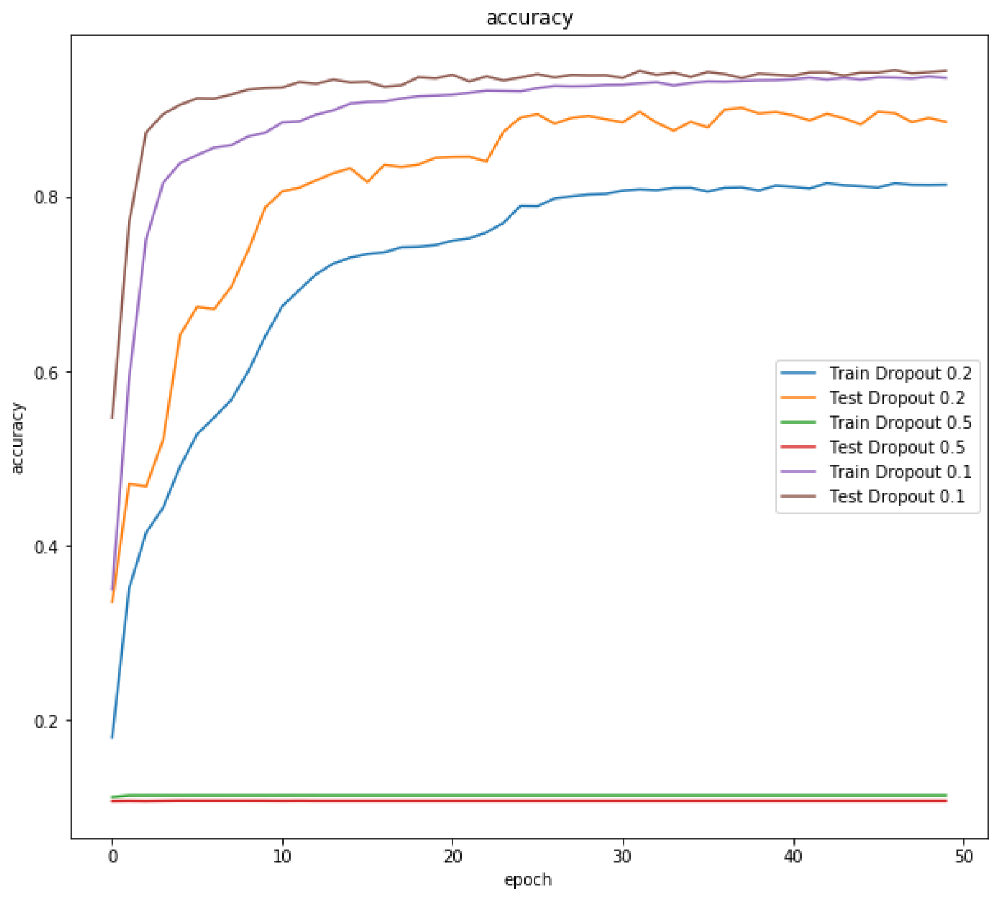
```
-----------------------------------------------------------------
```

```
In [16]: history3 = model.fit(x_train, y_train, batch_size = batch, validation_split = 0.3,
                              epochs = epoch, verbose = verbose)
```

```
In [17]: test_loss, test_acc = model.evaluate(x_test,  y_test, verbose=2)

         print('\nTest acccuracy:', test_acc)
```

```
10000/1 - 1s - loss: 0.1365 - accuracy: 0.9436

Test acccuracy: 0.9436
```

```
In [18]: #plot
         plt.figure(figsize=(10,9))
         plt.plot(history1.history['accuracy'])
         plt.plot(history1.history['val_accuracy'])


         plt.plot(history2.history['accuracy'])
         plt.plot(history2.history['val_accuracy'])

         plt.plot(history3.history['accuracy'])
         plt.plot(history3.history['val_accuracy'])


         plt.legend(['Train Dropout 0.2', 'Test Dropout 0.2',
                     'Train Dropout 0.5', 'Test Dropout 0.5',
                     'Train Dropout 0.1', 'Test Dropout 0.1'])

         plt.title('accuracy')
         plt.ylabel('accuracy')
         plt.xlabel('epoch')

         plt.show()
```



- Experimentar los demás parámetros de dropout
- Describir el comportamiento de Dropout con diferentes funciones de costo, capas y optimizadores.
- Comparar y combinar con otros métodos de regularización