

# Análisis de Datos y Aprendizaje Máquina con Tensorflow 2.0: Redes neuronales convolucionales

2019/09/30

## Red convolucional Imperative/Training loop

- Objetivo: Programar una CNN en notación orientada a objetos con Tensorflow 2.0
- Los modelos son más personalizables para tareas como investigación

```
In [1]: import numpy as np
import matplotlib.pyplot as plt

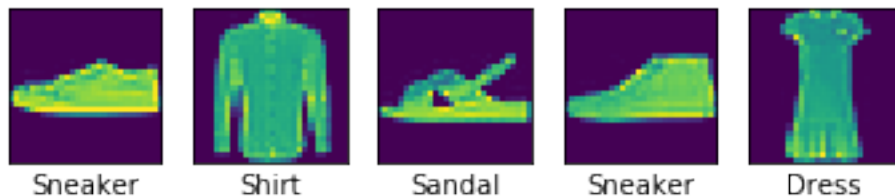
import tensorflow as tf
from tensorflow import keras

fashion_mnist = keras.datasets.fashion_mnist

(x_train, y_train), (x_test, y_test) = fashion_mnist.load_data()

In [2]: class_names = ['T-shirt/top', 'Trouser', 'Pullover', 'Dress',
                        'Coat', 'Sandal', 'Shirt', 'Sneaker', 'Bag', 'Ankle boot']

In [3]: for i in range(5):
    rand_image_idx = np.random.randint(0, y_train.shape[0])
    plt.subplot(1, 5, i+1)
    plt.xticks([])
    plt.yticks([])
    plt.grid('off')
    plt.imshow(x_train[rand_image_idx])
    plt.xlabel(class_names[y_train[rand_image_idx]])
plt.show()
```



```
In [4]: # escalar entre 0 y 1
x_train = x_train.reshape(x_train.shape[0], 28, 28, 1).astype('float32') / 255
x_test = x_test.reshape(x_test.shape[0], 28, 28, 1).astype('float32') / 255
```

```
In [5]: print(x_train.shape) # (60000, 28, 28, 1)
        print(x_test.shape)  # (10000, 28, 28, 1)
```

```
(60000, 28, 28, 1)
(10000, 28, 28, 1)
```

```
In [6]: batch_size = 50
```

```
train_ds = tf.data.Dataset.from_tensor_slices(
    (x_train, y_train)).shuffle(10000).batch(batch_size)
```

```
In [7]: from tensorflow.keras.layers import Dense, Flatten, Conv2D, MaxPooling2D
        from tensorflow.keras import Model
```

## Crear modelo

- Se tienen que asignar las funciones de activación como 'softmax' en la salida para 'Sparse-CategoricalCrossentropy'

```
In [8]: class CNN(Model):
        def __init__(self):
            super(CNN, self).__init__()
            self.conv = Conv2D(30, 3, activation='relu', name='conv')
            self.pool = MaxPooling2D(2, name='pool')
            self.f = Flatten(name='flatten')
            self.d = Dense(10, activation='softmax', name='dense')

        def call(self, x): # método call que pasa 'x' por capa
            x = self.conv(x)
            x = self.pool(x)
            x = self.f(x)
            return self.d(x)
```

```
In [9]: model = CNN()
        model.build(input_shape=(None, 28, 28, 1))
        model.summary()
```

Model: "cnn"

Layer (type)	Output Shape	Param #
conv (Conv2D)	multiple	300

```

-----
pool (MaxPooling2D)           multiple           0
-----
flatten (Flatten)            multiple           0
-----
dense (Dense)                 multiple        50710
=====
Total params: 51,010
Trainable params: 51,010
Non-trainable params: 0
-----

```

- Optimizador y función de costo

```
In [10]: loss_fn = tf.keras.losses.SparseCategoricalCrossentropy()
optimizer = tf.keras.optimizers.Adam()
```

- Métricas

```
In [11]: train_loss = tf.keras.metrics.SparseCategoricalCrossentropy(name='train_loss')
train_accuracy = tf.keras.metrics.SparseCategoricalAccuracy(name='train_accuracy')
```

- Listas para plot

```
In [12]: hist_loss = []
hist_acc = []
```

## Entrenamiento

- Se hace un ciclo por épocas en donde se itera por cada época sobre cada par de datos y etiquetas de entrenamiento
- *Nota: El entrenamiento con 'tf.function decorator' tiene un mejor desempeño al compilarse en grafo. Para simplificar el ejemplo, también se omite el entrenamiento en conjunto de prueba*

```
In [13]: EPOCH = 20
for epoch in range(EPOCH):
    #entrenamiento
    for data, target in train_ds:
        with tf.GradientTape() as tape:
            predictions = model(data) # predicciones
            loss = loss_fn(target, predictions) # target y predicciones para obtener acc
            gradients = tape.gradient(loss, model.trainable_variables) # gradiente sobre variables
            optimizer.apply_gradients(zip(gradients, model.trainable_variables))
            # se guardan metricas
            train_loss(target, predictions)
            train_accuracy(target, predictions)
```

```

template = 'Epoch {}/{} \n - loss: {} - accuracy: {}'
print(template.format(epoch+1, EPOCH,
                      train_loss.result(), train_accuracy.result()))

# lista para plot
hist_loss.append(train_loss.result())
hist_acc.append(train_accuracy.result())
# reinicia las metricas para la siguiente epoca
train_loss.reset_states()
train_accuracy.reset_states()

```

Epoch 1/20  
- loss: 0.4680822789669037 - accuracy: 0.8371999859809875

Epoch 2/20  
- loss: 0.32173648476600647 - accuracy: 0.887066662311554

Epoch 3/20  
- loss: 0.28852158784866333 - accuracy: 0.8992833495140076

Epoch 4/20  
- loss: 0.26711592078208923 - accuracy: 0.9056000113487244

Epoch 5/20  
- loss: 0.25134652853012085 - accuracy: 0.9107666611671448

Epoch 6/20  
- loss: 0.23804430663585663 - accuracy: 0.9157999753952026

Epoch 7/20  
- loss: 0.22623147070407867 - accuracy: 0.9202166795730591

Epoch 8/20  
- loss: 0.21565188467502594 - accuracy: 0.9245166778564453

Epoch 9/20  
- loss: 0.2054499387741089 - accuracy: 0.9273499846458435

Epoch 10/20  
- loss: 0.1977359801530838 - accuracy: 0.9306333065032959

Epoch 11/20  
- loss: 0.18901444971561432 - accuracy: 0.9334333539009094

Epoch 12/20  
- loss: 0.18020057678222656 - accuracy: 0.9372166395187378

Epoch 13/20  
- loss: 0.17478816211223602 - accuracy: 0.9377833604812622

Epoch 14/20  
- loss: 0.16748106479644775 - accuracy: 0.9415500164031982

Epoch 15/20  
- loss: 0.16133031249046326 - accuracy: 0.9436666369438171

Epoch 16/20  
- loss: 0.15665766596794128 - accuracy: 0.9449999928474426

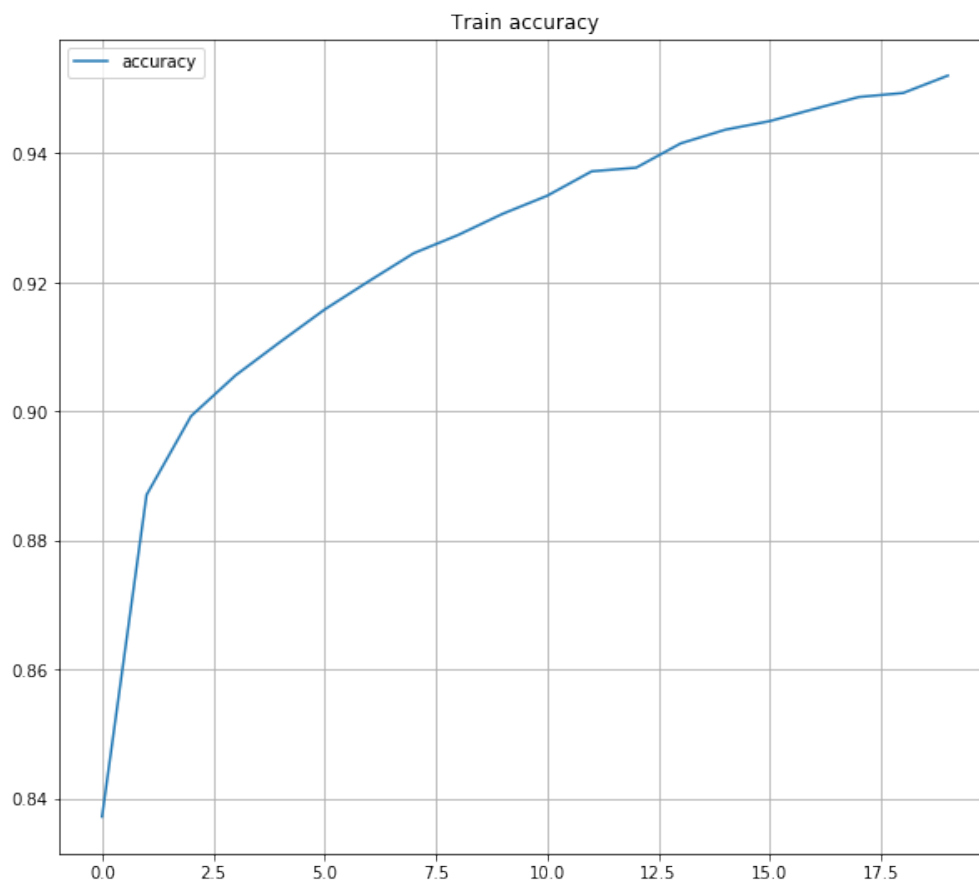
Epoch 17/20  
- loss: 0.1508084088563919 - accuracy: 0.9468833208084106

Epoch 18/20  
- loss: 0.14629878103733063 - accuracy: 0.9487333297729492

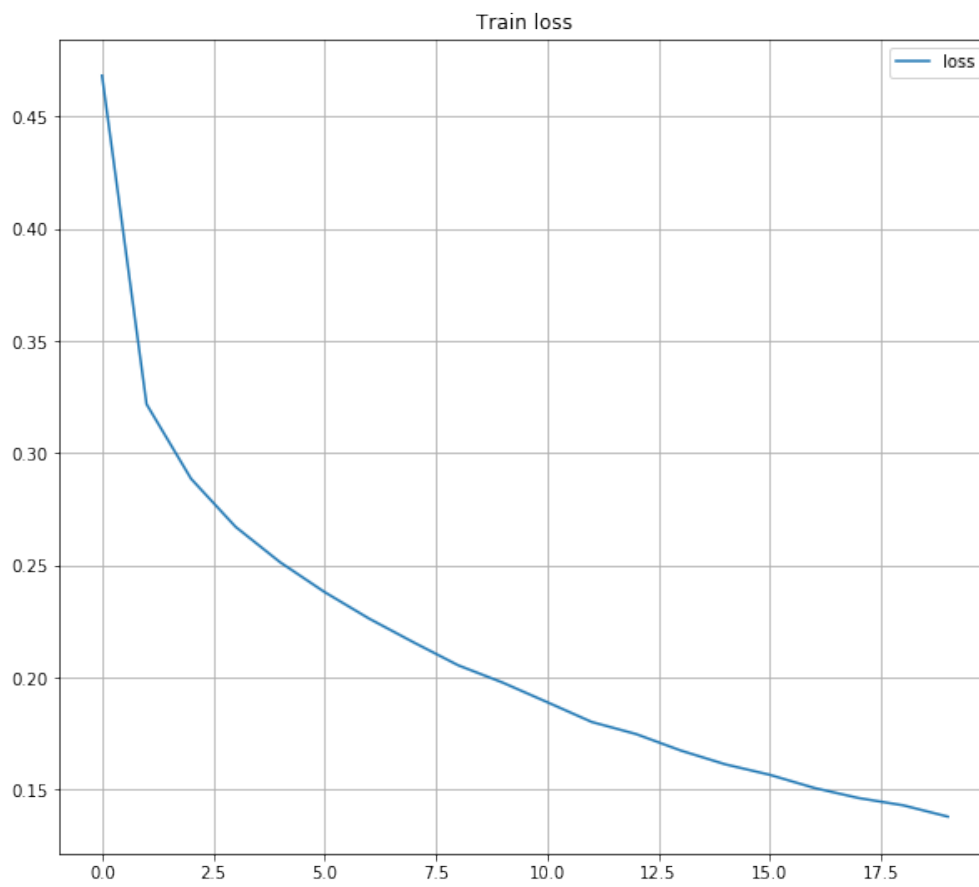
Epoch 19/20  
- loss: 0.1430559605360031 - accuracy: 0.9493666887283325

Epoch 20/20  
- loss: 0.13802675902843475 - accuracy: 0.952049970626831

```
In [14]: plt.figure(figsize=(10,9))
plt.plot(np.arange(len(hist_acc)), hist_acc)
plt.title('Train accuracy')
plt.legend(['accuracy'])
plt.grid()
```



```
In [15]: plt.figure(figsize=(10,9))
plt.plot(np.arange(len(hist_loss)), hist_loss)
plt.title('Train loss')
plt.legend(['loss'])
plt.grid()
```



- Mejorar la arquitectura
- Personalizar modelo
- Probar con otro dataset