

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

2019/09/30

Función de activación y costo / Inicialización del modelo

Objetivo: Conocer los diferentes inicializadores, funciones de costo y activación.

- La inicialización de pesos tiene efecto en el tiempo de entrenamiento
- Las funciones de costo dependen de el número de clases o si es clasificación o regresión
- Las funciones no lineales tienen diferentes comportamientos en los tipos de redes, estas proyectan los datos a un diferente espacio

Leer conjunto de datos

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

from sklearn.datasets import load_breast_cancer
from sklearn.model_selection import train_test_split

data = load_breast_cancer()

X_data = data.data
y_data = data.target

x_train, x_test, y_train, y_test = train_test_split(X_data, y_data, test_size = 0.33, ran

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

(381, 30)
(381,)
```

```
(188, 30)
(188,)
```

Modelo MLP simple, se aplica optimizador ‘rmsprp’

- En el ejemplo anterior ‘SGD’ tiene un desempeño bajo

```
In [3]: epoch = 50
        verbose = 0
        batch = 50
```

```
In [4]: from tensorflow.keras.models import Sequential
        from tensorflow.keras.layers import Dense
```

Funcion costo

- Se mide que tan lejos esta \hat{y}_i de y_i

$$MSE = \frac{1}{n} \sum^n (y_i - \hat{y}_i)^2$$

- Para más de 2 clases se usa ‘sparse_categorical_crossentropy’
- Para más de 2 clases con ‘one hot’ se aplica ‘categorical_crossentropy’
- Para 2 clases ‘binary_crossentropy’

```
In [5]: def make_model():
        model = Sequential()

        model.add(Dense(16, input_shape = (30, ), activation = 'sigmoid'))
        model.add(Dense(1, activation = 'sigmoid'))

        model.compile(optimizer='rmsprop', loss='binary_crossentropy',
                      metrics=['accuracy'])

        return model
```

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

```
model.summary()
```

Model: "sequential"

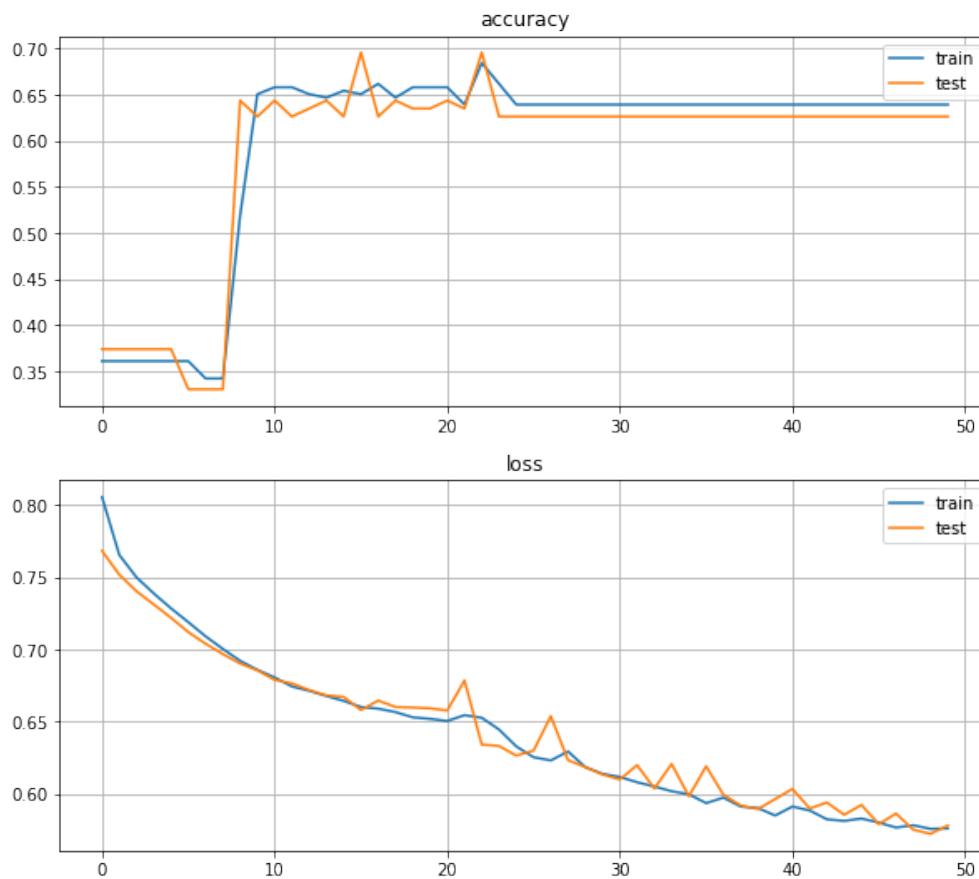
Layer (type)	Output Shape	Param #
dense (Dense)	(None, 16)	496
dense_1 (Dense)	(None, 1)	17

```
Total params: 513
Trainable params: 513
Non-trainable params: 0
```

```
In [7]: history = model.fit(x_train, y_train, batch_size = batch, validation_split = 0.3,
                             epochs = epoch, verbose = verbose)
```

```
In [8]: #plot
plt.figure(figsize=(10,9))

plt.subplot(211)
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.title('accuracy')
plt.legend(['train', 'test'])
plt.grid()
plt.subplot(212)
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('loss')
plt.legend(['train', 'test'])
plt.grid()
```



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

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

```
188/1 - 0s - loss: 0.5833 - accuracy: 0.6117
```

```
Test accuracy: 0.61170214
```

Función de activación

- Las funciones no-lineales son necesarias en los perceptrones multicapa, estas mapean las salidas de las multiplicaciones por las matrices a un espacio no lineal en donde los datos pueden ser clasificados.
- Existen muchas funciones de activación como:
 - Relu $\max(0, 1)$ que trabaja bien con imágenes y muestra una rápida convergencia que las demás funciones

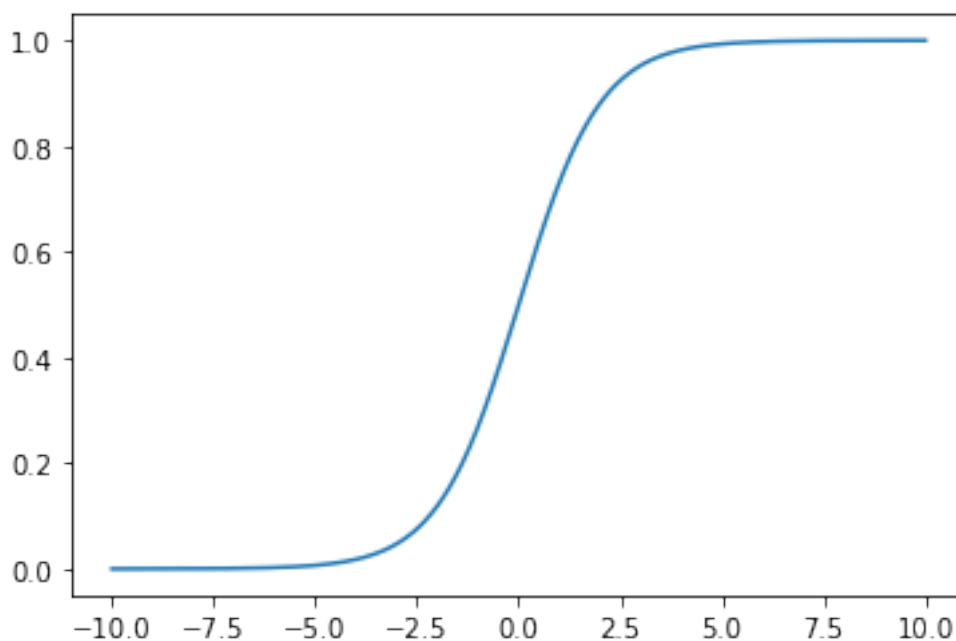
- Tanh $\tanh(x)$ que tiene una salida de un rango de -1 a 1, a diferencia de la sigmoide
- Investigar el problema del gradiente y el efecto de las funciones de activación

```
In [75]: import math
         def sigmoid(x):
             return 1 / (1 + math.exp(-x))
```

```
In [76]: def relu(x):
         return max(0,x)
```

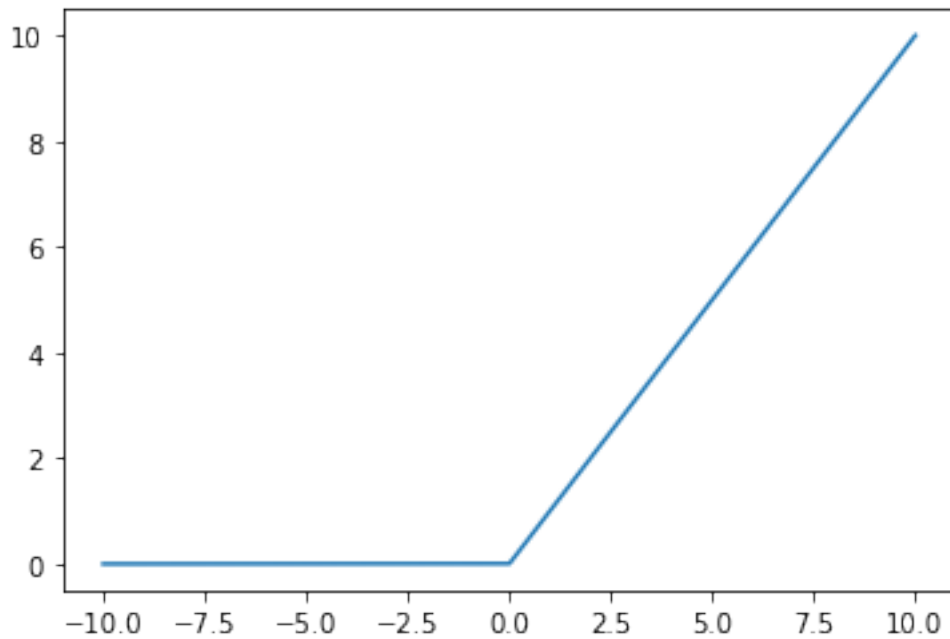
```
In [78]: import numpy as np
         x = np.linspace(-10, 10, 100000)
         y = list(map(sigmoid, x))

         plt.plot(x, y)
         plt.show()
```



```
In [80]: x = np.linspace(-10, 10, 100000)
         y = list(map(relu, x))

         plt.plot(x, y )
         plt.show()
```



tanh

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

         model.add(Dense(16, input_shape = (30, ), activation = 'tanh'))
         model.add(Dense(1, activation = 'sigmoid'))

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

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

```
model.summary()
```

Model: "sequential_1"

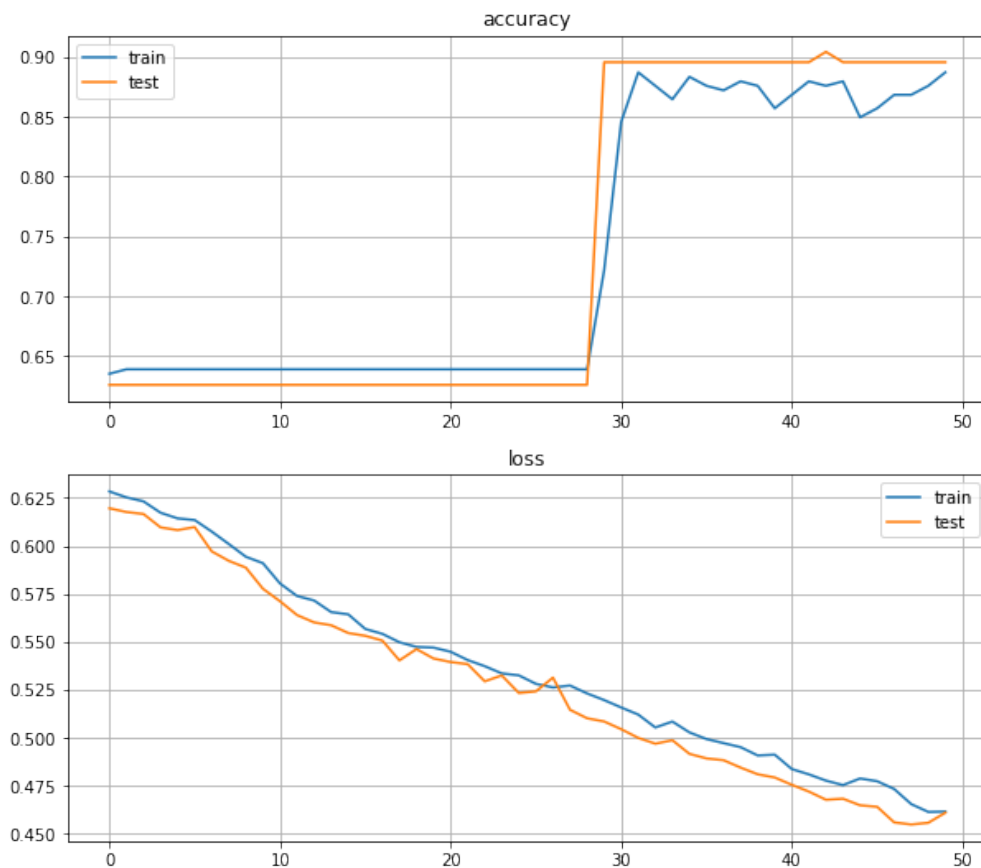
Layer (type)	Output Shape	Param #
dense_2 (Dense)	(None, 16)	496
dense_3 (Dense)	(None, 1)	17

```
Total params: 513
Trainable params: 513
Non-trainable params: 0
```

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

```
In [13]: #plot
plt.figure(figsize=(10,9))

plt.subplot(211)
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.title('accuracy')
plt.legend(['train', 'test'])
plt.grid()
plt.subplot(212)
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('loss')
plt.legend(['train', 'test'])
plt.grid()
```



```
In [14]: test_loss, test_acc = model.evaluate(x_test, y_test, verbose=2)
```

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

```
188/1 - 0s - loss: 0.4765 - accuracy: 0.8777
```

```
Test accuracy: 0.87765956
```

relu

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

          model.add(Dense(16, input_shape = (30, ), activation = 'relu'))
          model.add(Dense(1, activation = 'sigmoid'))
```



```

        model.compile(optimizer='rmsprop', loss='binary_crossentropy',
                      metrics=['accuracy'])
    return model

In [16]: model = make_model()

        model.summary()

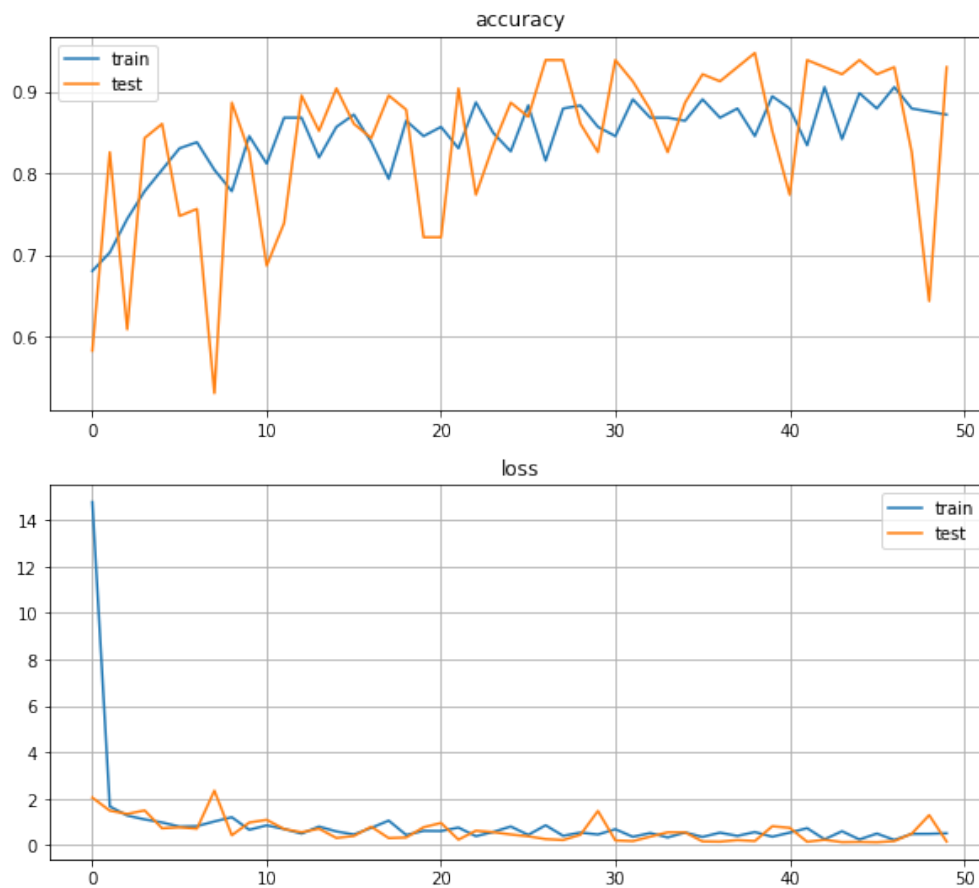
Model: "sequential_2"
-----
Layer (type)                 Output Shape              Param #
-----
dense_4 (Dense)              (None, 16)                496
-----
dense_5 (Dense)              (None, 1)                 17
-----
Total params: 513
Trainable params: 513
Non-trainable params: 0
-----

In [17]: history = model.fit(x_train, y_train, batch_size = batch, validation_split = 0.3,
                             epochs = epoch, verbose = verbose)

In [18]: #plot
        plt.figure(figsize=(10,9))

        plt.subplot(211)
        plt.plot(history.history['accuracy'])
        plt.plot(history.history['val_accuracy'])
        plt.title('accuracy')
        plt.legend(['train', 'test'])
        plt.grid()
        plt.subplot(212)
        plt.plot(history.history['loss'])
        plt.plot(history.history['val_loss'])
        plt.title('loss')
        plt.legend(['train', 'test'])
        plt.grid()

```



```
In [19]: test_loss, test_acc = model.evaluate(x_test, y_test, verbose=2)
```

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

```
188/1 - 0s - loss: 0.2331 - accuracy: 0.8989
```

```
Test accuracy: 0.89893615
```

Inicialización de pesos

he_normal

- he_normal muestrea de una distribución normal centrada con $\text{stddev} = \sqrt{2 / \text{fan_in}}$ donde fan_in es el número de entradas en el tensor de pesos.

```
In [20]: def make_model():
         model = Sequential()
```

```

model.add(Dense(16, input_shape = (30, ), activation = 'tanh', kernel_initializer='h
model.add(Dense(1, activation = 'sigmoid'))

model.compile(optimizer='rmsprop', loss='binary_crossentropy',
              metrics=['accuracy'])
return model

```

```
In [21]: model = make_model()
```

```
model.summary()
```

```
Model: "sequential_3"
```

Layer (type)	Output Shape	Param #
dense_6 (Dense)	(None, 16)	496
dense_7 (Dense)	(None, 1)	17

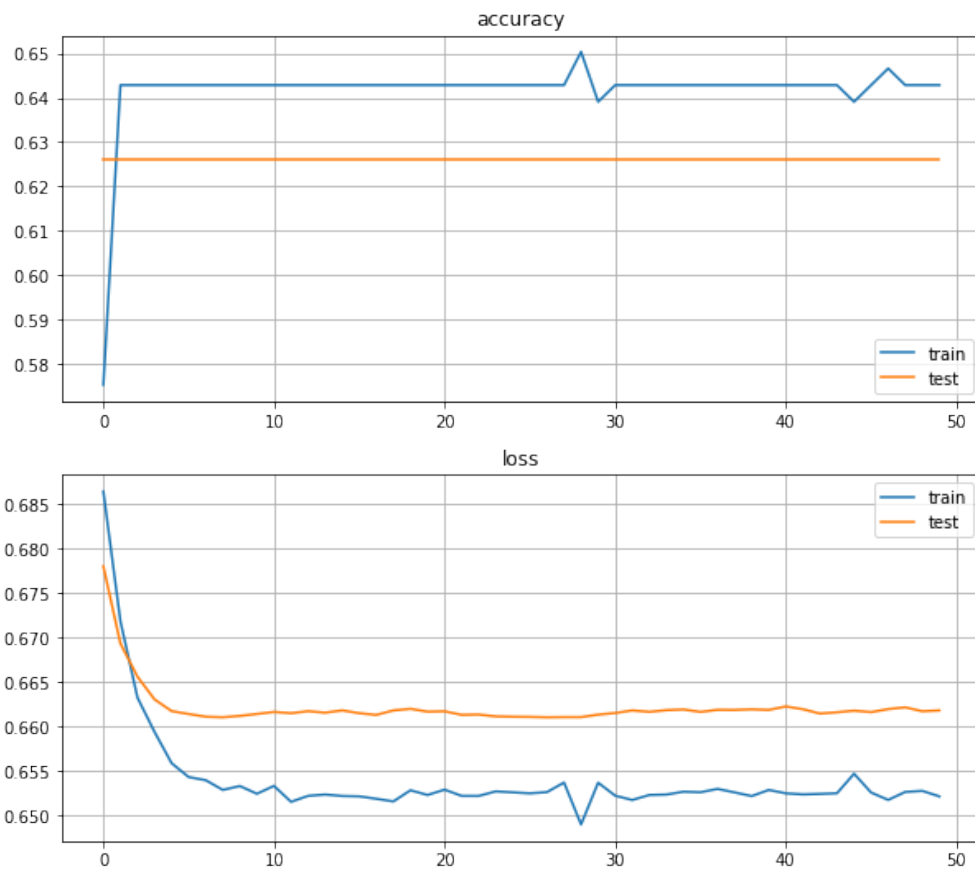
Total params: 513
 Trainable params: 513
 Non-trainable params: 0

```
In [22]: history = model.fit(x_train, y_train, batch_size = batch, validation_split = 0.3,
                             epochs = epoch, verbose = verbose)
```

```
In [23]: #plot
plt.figure(figsize=(10,9))

plt.subplot(211)
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.title('accuracy')
plt.legend(['train', 'test'])
plt.grid()
plt.subplot(212)
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('loss')
plt.legend(['train', 'test'])
plt.grid()

```



```
In [24]: test_loss, test_acc = model.evaluate(x_test, y_test, verbose=2)
```

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

```
188/1 - 0s - loss: 0.6600 - accuracy: 0.6170
```

```
Test accuracy: 0.61702126
```

orthogonal

```
In [25]: def make_model():
```

```
    model = Sequential()
```

```
    model.add(Dense(16, input_shape = (30, ), activation = 'tanh', kernel_initializer='c
```

```
    model.add(Dense(1, activation = 'sigmoid'))
```

```

        model.compile(optimizer='rmsprop', loss='binary_crossentropy',
                      metrics=['accuracy'])
    return model

```

```
In [26]: model = make_model()
```

```
        model.summary()
```

```
Model: "sequential_4"
```

Layer (type)	Output Shape	Param #
dense_8 (Dense)	(None, 16)	496
dense_9 (Dense)	(None, 1)	17

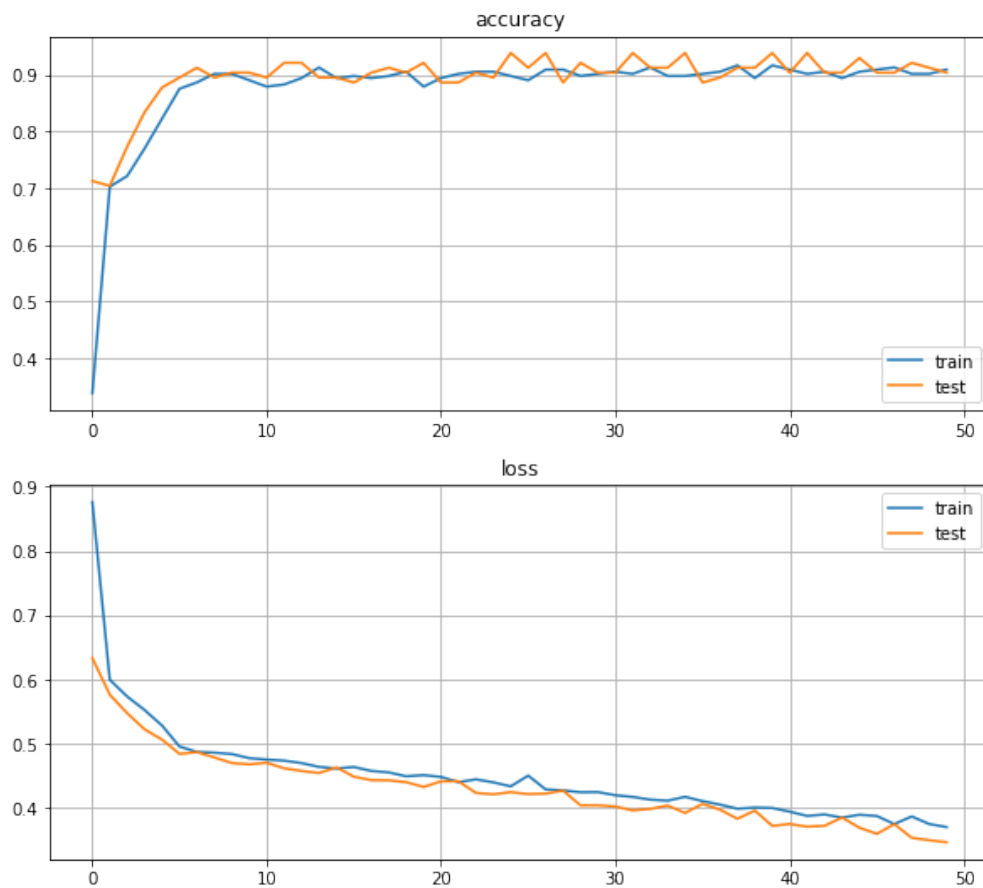
Total params: 513
 Trainable params: 513
 Non-trainable params: 0

```
In [27]: history = model.fit(x_train, y_train, batch_size = batch, validation_split = 0.3,
                             epochs = epoch, verbose = verbose)
```

```
In [28]: #plot
plt.figure(figsize=(10,9))

plt.subplot(211)
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.title('accuracy')
plt.legend(['train', 'test'])
plt.grid()
plt.subplot(212)
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('loss')
plt.legend(['train', 'test'])
plt.grid()

```



```
In [29]: test_loss, test_acc = model.evaluate(x_test, y_test, verbose=2)
```

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

```
188/1 - 0s - loss: 0.3409 - accuracy: 0.9255
```

```
Test accuracy: 0.9255319
```

- La red a mejorado el desempeño
- Probar con diferentes capas y funciones de activación
- Mejorar el tiempo de entrenamiento de la red y 'Test accuracy'