Ingeniería en Robótica y Sistemas Digitales

TE3002B.501

Clasificación de imágenes con redes neuronales convolucionales

Actividad

Entrenamiento de redes neuronales

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Ejercicio 1

```
# Fit model
model.fit(x_train, y_train_categorical, validation_data = (x_test, y_test_categorical), epochs=50, batch_size=128, verbose=1)
```

```
Epoch 1/50
469/469 [==============================] - 112s 236ms/step - loss: 0.5396 - accuracy: 0.8084 - val_loss: 0.3504 - val_accuracy: 0.8709
Epoch 2/50
469/469 [==============================] - 108s 230ms/step - loss: 0.3502 - accuracy: 0.8754 - val_loss: 0.2932 - val_accuracy: 0.8921
Epoch 3/50
469/469 [==============================] - 107s 229ms/step - loss: 0.3016 - accuracy: 0.8919 - val_loss: 0.2580 - val_accuracy: 0.9036
Epoch 4/50
469/469 [==============================] - 107s 229ms/step - loss: 0.2654 - accuracy: 0.9029 - val_loss: 0.2500 - val_accuracy: 0.9060
Epoch 5/50
469/469 [==============================] - 107s 228ms/step - loss: 0.2439 - accuracy: 0.9107 - val_loss: 0.2375 - val_accuracy: 0.9149
Epoch 6/50
469/469 [==============================] - 107s 228ms/step - loss: 0.2218 - accuracy: 0.9186 - val_loss: 0.2262 - val_accuracy: 0.9179
Epoch 7/50
469/469 [==============================] - 115s 244ms/step - loss: 0.2052 - accuracy: 0.9230 - val_loss: 0.2223 - val_accuracy: 0.9195
Epoch 8/50
469/469 [==============================] - 107s 228ms/step - loss: 0.1939 - accuracy: 0.9292 - val_loss: 0.2143 - val_accuracy: 0.9214
Epoch 9/50
469/469 [==============================] - 106s 227ms/step - loss: 0.1806 - accuracy: 0.9322 - val_loss: 0.2238 - val_accuracy: 0.9173
Epoch 10/50
469/469 [==============================] - 106s 226ms/step - loss: 0.1688 - accuracy: 0.9368 - val_loss: 0.2259 - val_accuracy: 0.9240
Epoch 11/50
469/469 [==============================] - 107s 228ms/step - loss: 0.1587 - accuracy: 0.9396 - val_loss: 0.2149 - val_accuracy: 0.9252
Epoch 12/50
469/469 [==============================] - 107s 228ms/step - loss: 0.1514 - accuracy: 0.9433 - val_loss: 0.2201 - val_accuracy: 0.9255
Epoch 13/50
469/469 [==============================] - 108s 229ms/step - loss: 0.1383 - accuracy: 0.9480 - val_loss: 0.2218 - val_accuracy: 0.9262
Epoch 14/50
469/469 [==============================] - 107s 229ms/step - loss: 0.1305 - accuracy: 0.9500 - val_loss: 0.2178 - val_accuracy: 0.9266
Epoch 15/50
469/469 [==============================] - 108s 230ms/step - loss: 0.1246 - accuracy: 0.9535 - val_loss: 0.2205 - val_accuracy: 0.9273
Epoch 16/50
469/469 [==============================] - 107s 229ms/step - loss: 0.1192 - accuracy: 0.9544 - val_loss: 0.2269 - val_accuracy: 0.9272
Epoch 17/50
469/469 [==============================] - 107s 229ms/step - loss: 0.1150 - accuracy: 0.9559 - val_loss: 0.2280 - val_accuracy: 0.9289
Epoch 18/50
469/469 [==============================] - 107s 228ms/step - loss: 0.1084 - accuracy: 0.9587 - val_loss: 0.2337 - val_accuracy: 0.9255
Epoch 19/50
 77/469 [===>..........................] - ETA: 1:28 - loss: 0.0967 - accuracy: 0.9615
```

```
Epoch 20/50
469/469 [==============================] - 108s 231ms/step - loss: 0.0984 - accuracy: 0.9624 - val_loss: 0.2336 - val_accuracy: 0.9291
Epoch 21/50
469/469 [==============================] - 108s 230ms/step - loss: 0.0939 - accuracy: 0.9632 - val_loss: 0.2561 - val_accuracy: 0.9260
Epoch 22/50
469/469 [==============================] - 107s 229ms/step - loss: 0.0918 - accuracy: 0.9651 - val_loss: 0.2487 - val_accuracy: 0.9296
Epoch 23/50
469/469 [==============================] - 107s 228ms/step - loss: 0.0896 - accuracy: 0.9651 - val_loss: 0.2363 - val_accuracy: 0.9324
Epoch 24/50
469/469 [==============================] - 107s 227ms/step - loss: 0.0865 - accuracy: 0.9662 - val_loss: 0.2574 - val_accuracy: 0.9312
Epoch 25/50
469/469 [==============================] - 107s 228ms/step - loss: 0.0837 - accuracy: 0.9674 - val_loss: 0.2622 - val_accuracy: 0.9300
Epoch 26/50
469/469 [==============================] - 107s 228ms/step - loss: 0.0835 - accuracy: 0.9680 - val_loss: 0.2695 - val_accuracy: 0.9304
Epoch 27/50
469/469 [==============================] - 108s 230ms/step - loss: 0.0785 - accuracy: 0.9705 - val_loss: 0.2635 - val_accuracy: 0.9334
Epoch 28/50
469/469 [==============================] - 107s 228ms/step - loss: 0.0774 - accuracy: 0.9702 - val_loss: 0.2718 - val_accuracy: 0.9295
Epoch 29/50
469/469 [==============================] - 107s 228ms/step - loss: 0.0744 - accuracy: 0.9717 - val_loss: 0.2668 - val_accuracy: 0.9315
Epoch 30/50
469/469 [==============================] - 107s 228ms/step - loss: 0.0697 - accuracy: 0.9732 - val_loss: 0.2899 - val_accuracy: 0.9295
Epoch 31/50
469/469 [==============================] - 108s 229ms/step - loss: 0.0694 - accuracy: 0.9730 - val_loss: 0.2925 - val_accuracy: 0.9294
Epoch 32/50
469/469 [==============================] - 106s 227ms/step - loss: 0.0699 - accuracy: 0.9725 - val_loss: 0.2863 - val_accuracy: 0.9322
Epoch 33/50
469/469 [==============================] - 106s 226ms/step - loss: 0.0662 - accuracy: 0.9742 - val_loss: 0.2984 - val_accuracy: 0.9321
Epoch 34/50
271/469 [================>.............] - ETA: 43s - loss: 0.0665 - accuracy: 0.9745
```

```
# Evaluate model using test data
y_pred = np.argmax(model.predict(x_test), axis=-1)
print(classification_report(y_test, y_pred, target_names=['0', '1', '2', '3', '4', '5', '6', '7', '8', '9']))

#----------------------------------------------------------------------------------------------------
#   End of file
#----------------------------------------------------------------------------------------------------
```

```
313/313 [==============================] - 5s 15ms/step
              precision    recall  f1-score   support

           0       0.89      0.89      0.89      1000
           1       1.00      0.98      0.99      1000
           2       0.91      0.87      0.89      1000
           3       0.93      0.93      0.93      1000
           4       0.85      0.93      0.89      1000
           5       0.99      0.99      0.99      1000
           6       0.81      0.80      0.80      1000
           7       0.96      0.98      0.97      1000
           8       0.99      0.99      0.99      1000
           9       0.98      0.96      0.97      1000

    accuracy                           0.93     10000
   macro avg       0.93      0.93      0.93     10000
weighted avg       0.93      0.93      0.93     10000
```

Ejercicio 2

```
          12       0.89      0.94      0.91       282
          13       0.98      0.98      0.98       288
          14       0.99      0.96      0.98       108
          15       0.74      0.94      0.83        84
          16       1.00      0.87      0.93        60
          17       0.98      0.99      0.99       150
          18       0.77      0.97      0.86       162
          19       0.94      0.50      0.65        30
          31       0.91      0.90      0.90       108
          32       0.83      0.53      0.64        36
          33       0.91      1.00      0.96        96
          34       0.92      0.95      0.93        60
          35       0.99      0.99      0.99       162
          36       0.98      1.00      0.99        54
          37       1.00      0.77      0.87        30
          38       0.98      0.99      0.98       276
          39       1.00      0.98      0.99        42
          40       1.00      0.62      0.77        48
          41       0.80      0.92      0.86        36
          42       1.00      0.86      0.93        36

    accuracy                           0.90      5328
   macro avg       0.91      0.85      0.86      5328
weighted avg       0.91      0.90      0.90      5328

Epoch 1/3
188/188 [==============================] - 70s 361ms/step - loss: 2.0954 - val_loss: 19.4096
Epoch 2/3
188/188 [==============================] - 67s 356ms/step - loss: 0.4193 - val_loss: 20.9366
Epoch 3/3
188/188 [==============================] - 67s 357ms/step - loss: 0.2108 - val_loss: 22.6971
PS C:\Users\lpfa0\Documents\Tec\RoboticaInteligente\AprendizajeProfundo>
```