```
Imagenes entrenamiento originales: 10000
Imagenes entrenamiento con augmentation: 10000
Entrenamiento: Imágenes con tatuajes: 5745  sin: 4255  total imágenes de train: 10000
Validación: Imágenes con tatuajes:    1451  sin: 1076  total imágenes de validate: 2527
Arquitectura MobileNetv2-ft
Model: "sequential_1"
_____
Layer (type)                 Output Shape              Param #
=================================================================
mobilenetv2_1.00_224 (Model) (None, 7, 7, 1280)        2257984
_____
global_average_pooling2d_1 ( (None, 1280)              0
_____
dense_3 (Dense)              (None, 320)               409920
_____
dropout_2 (Dropout)          (None, 320)               0
_____
dense_4 (Dense)              (None, 320)               102720
_____
dropout_3 (Dropout)          (None, 320)               0
_____
dense_5 (Dense)              (None, 1)                 321
=================================================================
Total params: 2,770,945
Trainable params: 2,736,833
Non-trainable params: 34,112
_____
lr actual: tf.Tensor(0.005, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: tf.Tensor(0.005, shape=(), dtype=float32)
lr nuevo: tf.Tensor(0.005, shape=(), dtype=float32)
Epoch 1/40
312/312 [==============================] - 97s 310ms/step - loss: 0.2447 - accuracy: 0.8936 - val_loss: 0.4039 - val_accuracy: 0.8615 - lr: 0.0050
lr actual: tf.Tensor(0.005, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: tf.Tensor(0.005, shape=(), dtype=float32)
lr nuevo: tf.Tensor(0.005, shape=(), dtype=float32)
Epoch 2/40
312/312 [==============================] - 96s 308ms/step - loss: 0.1493 - accuracy: 0.9413 - val_loss: 0.4121 - val_accuracy: 0.8761 - lr: 0.0050
lr actual: tf.Tensor(0.005, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.004267766952966369
lr nuevo: tf.Tensor(0.004267767, shape=(), dtype=float32)
Epoch 3/40
312/312 [==============================] - 96s 307ms/step - loss: 0.1145 - accuracy: 0.9574 - val_loss: 0.4355 - val_accuracy: 0.8793 - lr: 0.0043
lr actual: tf.Tensor(0.004267767, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.003456708580912725
lr nuevo: tf.Tensor(0.0034567085, shape=(), dtype=float32)
Epoch 4/40
312/312 [==============================] - 96s 308ms/step - loss: 0.0851 - accuracy: 0.9675 - val_loss: 0.1570 - val_accuracy: 0.9497 - lr: 0.0035
lr actual: tf.Tensor(0.0034567085, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.0025
lr nuevo: tf.Tensor(0.0025, shape=(), dtype=float32)
Epoch 5/40
312/312 [==============================] - 96s 308ms/step - loss: 0.0669 - accuracy: 0.9773 - val_loss: 0.2821 - val_accuracy: 0.9165 - lr: 0.0025
```

```
lr actual: tf.Tensor(0.0025, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.00154329141908722758
lr nuevo: tf.Tensor(0.0015432914, shape=(), dtype=float32)
Epoch 6/40
312/312 [==============================] - 97s 310ms/step - loss: 0.0571 - accuracy: 0.9802 - val_loss: 0.1387 - val_accuracy: 0.9632 - lr: 0.0015
lr actual: tf.Tensor(0.0015432914, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.0007322330470336313
lr nuevo: tf.Tensor(0.00073223305, shape=(), dtype=float32)
Epoch 7/40
312/312 [==============================] - 96s 308ms/step - loss: 0.0443 - accuracy: 0.9849 - val_loss: 0.1087 - val_accuracy: 0.9668 - lr: 7.3223e-04
lr actual: tf.Tensor(0.00073223305, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.00019030116872178316
lr nuevo: tf.Tensor(0.00019030117, shape=(), dtype=float32)
Epoch 8/40
312/312 [==============================] - ETA: 0s - loss: 0.0365 - accuracy: 0.9869>saved snapshot /content/drive/My Drive/MAIR-Master/08MAIR-TFM/modelos/ensemble/mobilenet2
312/312 [==============================] - 96s 308ms/step - loss: 0.0365 - accuracy: 0.9869 - val_loss: 0.0879 - val_accuracy: 0.9727 - lr: 1.9030e-04
lr actual: tf.Tensor(0.00019030117, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.005
lr nuevo: tf.Tensor(0.005, shape=(), dtype=float32)
Epoch 9/40
312/312 [==============================] - 96s 309ms/step - loss: 0.0835 - accuracy: 0.9701 - val_loss: 0.1419 - val_accuracy: 0.9608 - lr: 0.0050
lr actual: tf.Tensor(0.005, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.004809698831278217
lr nuevo: tf.Tensor(0.004809699, shape=(), dtype=float32)
Epoch 10/40
312/312 [==============================] - 96s 306ms/step - loss: 0.0873 - accuracy: 0.9680 - val_loss: 0.0585 - val_accuracy: 0.9826 - lr: 0.0048
lr actual: tf.Tensor(0.004809699, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.004267766952966369
lr nuevo: tf.Tensor(0.004267767, shape=(), dtype=float32)
Epoch 11/40
312/312 [==============================] - 96s 308ms/step - loss: 0.0675 - accuracy: 0.9763 - val_loss: 0.1736 - val_accuracy: 0.9486 - lr: 0.0043
lr actual: tf.Tensor(0.004267767, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.003456708580912725
lr nuevo: tf.Tensor(0.0034567085, shape=(), dtype=float32)
Epoch 12/40
312/312 [==============================] - 96s 308ms/step - loss: 0.0551 - accuracy: 0.9797 - val_loss: 0.1567 - val_accuracy: 0.9478 - lr: 0.0035
lr actual: tf.Tensor(0.0034567085, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.0025
lr nuevo: tf.Tensor(0.0025, shape=(), dtype=float32)
Epoch 13/40
312/312 [==============================] - ETA: 0s - loss: 0.0432 - accuracy: 0.9862
Epoch 00013: ReduceLROnPlateau reducing learning rate to 0.0006249999860301614.
312/312 [==============================] - 96s 308ms/step - loss: 0.0432 - accuracy: 0.9862 - val_loss: 0.1236 - val_accuracy: 0.9679 - lr: 0.0025
lr actual: tf.Tensor(0.000625, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.00154329141908722758
lr nuevo: tf.Tensor(0.0015432914, shape=(), dtype=float32)
Epoch 14/40
312/312 [==============================] - 96s 307ms/step - loss: 0.0376 - accuracy: 0.9873 - val_loss: 0.1154 - val_accuracy: 0.9683 - lr: 0.0015
lr actual: tf.Tensor(0.0015432914, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.0007322330470336313
lr nuevo: tf.Tensor(0.00073223305, shape=(), dtype=float32)
Epoch 15/40
312/312 [==============================] - 96s 307ms/step - loss: 0.0291 - accuracy: 0.9911 - val_loss: 0.0786 - val_accuracy: 0.9810 - lr: 7.3223e-04
```

```
lr actual: tf.Tensor(0.00073223305, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.00019030116872178316
lr nuevo: tf.Tensor(0.00019030117, shape=(), dtype=float32)
Epoch 16/40
312/312 [==============================] - ETA: 0s - loss: 0.0240 - accuracy: 0.9920>saved snapshot /content/drive/My Drive/MAIR-Master/08MAIR-TFM/modelos/ensemble/mobilenet2

Epoch 00016: ReduceLROnPlateau reducing learning rate to 4.7575293137924746e-05.
312/312 [==============================] - 96s 307ms/step - loss: 0.0240 - accuracy: 0.9920 - val_loss: 0.0799 - val_accuracy: 0.9802 - lr: 1.9030e-04
lr actual: tf.Tensor(4.7575293e-05, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.005
lr nuevo: tf.Tensor(0.005, shape=(), dtype=float32)
Epoch 17/40
312/312 [==============================] - 96s 307ms/step - loss: 0.0504 - accuracy: 0.9822 - val_loss: 0.1370 - val_accuracy: 0.9664 - lr: 0.0050
lr actual: tf.Tensor(0.005, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.004809698831278217
lr nuevo: tf.Tensor(0.004809699, shape=(), dtype=float32)
Epoch 18/40
312/312 [==============================] - 96s 309ms/step - loss: 0.0608 - accuracy: 0.9791 - val_loss: 0.5226 - val_accuracy: 0.9070 - lr: 0.0048
lr actual: tf.Tensor(0.004809699, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.004267766952966369
lr nuevo: tf.Tensor(0.004267767, shape=(), dtype=float32)
Epoch 19/40
312/312 [==============================] - ETA: 0s - loss: 0.0521 - accuracy: 0.9815
Epoch 00019: ReduceLROnPlateau reducing learning rate to 0.0010669417679309845.
312/312 [==============================] - 97s 310ms/step - loss: 0.0521 - accuracy: 0.9815 - val_loss: 0.2746 - val_accuracy: 0.9351 - lr: 0.0043
lr actual: tf.Tensor(0.0010669418, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.003456708580912725
lr nuevo: tf.Tensor(0.0034567085, shape=(), dtype=float32)
Epoch 20/40
312/312 [==============================] - 96s 309ms/step - loss: 0.0433 - accuracy: 0.9846 - val_loss: 0.1281 - val_accuracy: 0.9668 - lr: 0.0035
lr actual: tf.Tensor(0.0034567085, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.0025
lr nuevo: tf.Tensor(0.0025, shape=(), dtype=float32)
Epoch 21/40
312/312 [==============================] - 96s 309ms/step - loss: 0.0328 - accuracy: 0.9883 - val_loss: 0.0755 - val_accuracy: 0.9822 - lr: 0.0025
lr actual: tf.Tensor(0.0025, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.0015432914190872758
lr nuevo: tf.Tensor(0.0015432914, shape=(), dtype=float32)
Epoch 22/40
312/312 [==============================] - ETA: 0s - loss: 0.0240 - accuracy: 0.9927
Epoch 00022: ReduceLROnPlateau reducing learning rate to 0.0003858228446915746.
312/312 [==============================] - 97s 310ms/step - loss: 0.0240 - accuracy: 0.9927 - val_loss: 0.0930 - val_accuracy: 0.9778 - lr: 0.0015
lr actual: tf.Tensor(0.00038582284, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.0007322330470336313
lr nuevo: tf.Tensor(0.00073223305, shape=(), dtype=float32)
Epoch 23/40
312/312 [==============================] - 96s 309ms/step - loss: 0.0164 - accuracy: 0.9942 - val_loss: 0.0850 - val_accuracy: 0.9794 - lr: 7.3223e-04
lr actual: tf.Tensor(0.00073223305, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.00019030116872178316
lr nuevo: tf.Tensor(0.00019030117, shape=(), dtype=float32)
Epoch 24/40
312/312 [==============================] - ETA: 0s - loss: 0.0180 - accuracy: 0.9932>saved snapshot /content/drive/My Drive/MAIR-Master/08MAIR-TFM/modelos/ensemble/mobilenet2
312/312 [==============================] - 97s 312ms/step - loss: 0.0180 - accuracy: 0.9932 - val_loss: 0.0792 - val_accuracy: 0.9802 - lr: 1.9030e-04
```
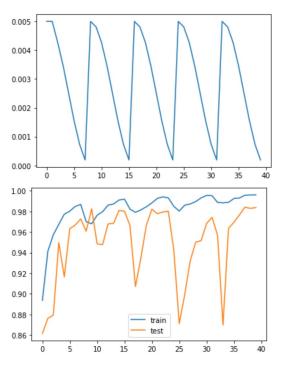
```
lr actual: tf.Tensor(0.00019030117, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.005
lr nuevo: tf.Tensor(0.005, shape=(), dtype=float32)
Epoch 25/40
312/312 [==============================] - ETA: 0s - loss: 0.0444 - accuracy: 0.9851
Epoch 00025: ReduceLROnPlateau reducing learning rate to 0.0012499999720603228.
312/312 [==============================] - 97s 312ms/step - loss: 0.0444 - accuracy: 0.9851 - val_loss: 0.2072 - val_accuracy: 0.9430 - lr: 0.0050
lr actual: tf.Tensor(0.00125, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.004809698831278217
lr nuevo: tf.Tensor(0.004809699, shape=(), dtype=float32)
Epoch 26/40
312/312 [==============================] - 98s 314ms/step - loss: 0.0514 - accuracy: 0.9803 - val_loss: 0.3978 - val_accuracy: 0.8710 - lr: 0.0048
lr actual: tf.Tensor(0.004809699, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.004267766952966369
lr nuevo: tf.Tensor(0.004267767, shape=(), dtype=float32)
Epoch 27/40
312/312 [==============================] - 97s 312ms/step - loss: 0.0420 - accuracy: 0.9861 - val_loss: 0.2888 - val_accuracy: 0.8991 - lr: 0.0043
lr actual: tf.Tensor(0.004267767, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.003456708580912725
lr nuevo: tf.Tensor(0.0034567085, shape=(), dtype=float32)
Epoch 28/40
312/312 [==============================] - ETA: 0s - loss: 0.0349 - accuracy: 0.9873
Epoch 00028: ReduceLROnPlateau reducing learning rate to 0.0008641771273687482.
312/312 [==============================] - 97s 311ms/step - loss: 0.0349 - accuracy: 0.9873 - val_loss: 0.2146 - val_accuracy: 0.9319 - lr: 0.0035
lr actual: tf.Tensor(0.0008641771, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.0025
lr nuevo: tf.Tensor(0.0025, shape=(), dtype=float32)
Epoch 29/40
312/312 [==============================] - 97s 312ms/step - loss: 0.0278 - accuracy: 0.9896 - val_loss: 0.1760 - val_accuracy: 0.9501 - lr: 0.0025
lr actual: tf.Tensor(0.0025, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.0015432914190872758
lr nuevo: tf.Tensor(0.0015432914, shape=(), dtype=float32)
Epoch 30/40
312/312 [==============================] - 97s 310ms/step - loss: 0.0197 - accuracy: 0.9932 - val_loss: 0.1728 - val_accuracy: 0.9517 - lr: 0.0015
lr actual: tf.Tensor(0.0015432914, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.0007322330470336313
lr nuevo: tf.Tensor(0.00073223305, shape=(), dtype=float32)
Epoch 31/40
312/312 [==============================] - ETA: 0s - loss: 0.0139 - accuracy: 0.9956
Epoch 00031: ReduceLROnPlateau reducing learning rate to 0.00018305826233699918.
312/312 [==============================] - 98s 313ms/step - loss: 0.0139 - accuracy: 0.9956 - val_loss: 0.1259 - val_accuracy: 0.9683 - lr: 7.3223e-04
lr actual: tf.Tensor(0.00018305826, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.00019030116872178316
lr nuevo: tf.Tensor(0.00019030117, shape=(), dtype=float32)
Epoch 32/40
312/312 [==============================] - ETA: 0s - loss: 0.0133 - accuracy: 0.9953>saved snapshot /content/drive/My Drive/MAIR-Master/08MAIR-TFM/modelos/ensemble/mobilenet2
312/312 [==============================] - 98s 314ms/step - loss: 0.0133 - accuracy: 0.9953 - val_loss: 0.1125 - val_accuracy: 0.9743 - lr: 1.9030e-04
lr actual: tf.Tensor(0.00019030117, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.005
lr nuevo: tf.Tensor(0.005, shape=(), dtype=float32)
Epoch 33/40
312/312 [==============================] - 97s 311ms/step - loss: 0.0350 - accuracy: 0.9888 - val_loss: 0.1376 - val_accuracy: 0.9569 - lr: 0.0050
lr actual: tf.Tensor(0.005, shape=(), dtype=float32)
```

```
lr maximo: 0.005 propuesto: 0.004809698831278217
lr nuevo: tf.Tensor(0.004809699, shape=(), dtype=float32)
Epoch 34/40
312/312 [==============================] - ETA: 0s - loss: 0.0315 - accuracy: 0.9884
Epoch 00034: ReduceLROnPlateau reducing learning rate to 0.001202424755319953.
312/312 [==============================] - 96s 309ms/step - loss: 0.0315 - accuracy: 0.9884 - val_loss: 0.4514 - val_accuracy: 0.8698 - lr: 0.0048
lr actual: tf.Tensor(0.0012024248, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.004267766952966369
lr nuevo: tf.Tensor(0.004267767, shape=(), dtype=float32)
Epoch 35/40
312/312 [==============================] - 97s 309ms/step - loss: 0.0317 - accuracy: 0.9889 - val_loss: 0.2008 - val_accuracy: 0.9636 - lr: 0.0043
lr actual: tf.Tensor(0.004267767, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.003456708580912725
lr nuevo: tf.Tensor(0.0034567085, shape=(), dtype=float32)
Epoch 36/40
312/312 [==============================] - 96s 309ms/step - loss: 0.0223 - accuracy: 0.9926 - val_loss: 0.1580 - val_accuracy: 0.9695 - lr: 0.0035
lr actual: tf.Tensor(0.0034567085, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.0025
lr nuevo: tf.Tensor(0.0025, shape=(), dtype=float32)
Epoch 37/40
312/312 [==============================] - ETA: 0s - loss: 0.0208 - accuracy: 0.9931
Epoch 00037: ReduceLROnPlateau reducing learning rate to 0.0006249999860301614.
312/312 [==============================] - 96s 309ms/step - loss: 0.0208 - accuracy: 0.9931 - val_loss: 0.1410 - val_accuracy: 0.9767 - lr: 0.0025
lr actual: tf.Tensor(0.000625, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.0015432914190872758
lr nuevo: tf.Tensor(0.0015432914, shape=(), dtype=float32)
Epoch 38/40
312/312 [==============================] - 96s 309ms/step - loss: 0.0142 - accuracy: 0.9958 - val_loss: 0.0829 - val_accuracy: 0.9842 - lr: 0.0015
lr actual: tf.Tensor(0.0015432914, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.0007322330470336313
lr nuevo: tf.Tensor(0.00073223305, shape=(), dtype=float32)
Epoch 39/40
312/312 [==============================] - 96s 309ms/step - loss: 0.0134 - accuracy: 0.9960 - val_loss: 0.0900 - val_accuracy: 0.9830 - lr: 7.3223e-04
lr actual: tf.Tensor(0.00073223305, shape=(), dtype=float32)
lr maximo: 0.005 propuesto: 0.00019030116872178316
lr nuevo: tf.Tensor(0.00019030117, shape=(), dtype=float32)
Epoch 40/40
312/312 [==============================] - ETA: 0s - loss: 0.0114 - accuracy: 0.9961>saved snapshot /content/drive/My Drive/MAIR-Master/08MAIR-TFM/modelos/ensemble/mobilenet2

Epoch 00040: ReduceLROnPlateau reducing learning rate to 4.7575293137924746e-05.
312/312 [==============================] - 98s 313ms/step - loss: 0.0114 - accuracy: 0.9961 - val_loss: 0.0902 - val_accuracy: 0.9838 - lr: 1.9030e-04
Train: 1.000, Test: 0.984
```