

Tercer Informe tarea 4 Keras

Fernando López Soriano – Redes neuronales

(c) De la mejor red que hayas entrenado del inciso anterior. Continúa entrenando hasta que detectes sobre ajuste. Si no lo logras, puedes reducir el número de datos de entrenamiento para que sea mas fácil sobre-ajustar. Recuerda que si tu modelo es sencillo y tienes muchos datos, es posible que no se presente el problema de sobre-ajuste. Posteriormente entrena la misma red con los mismos datos de entrenamiento pero usando regularizaciones:

- Primero: regularización L1
- Segundo: regularización L2
- Tercero: regularización L1-L2
- Cuarto: Dropout
- Quinto: Dropout y L1 - L2

Haz commit a cada caso y sube tu repositorio a git-hub. En el reporte comenta el resultado de cada caso. Es decir, ¿la regularización ayudó a mejorar la eficiencia antes de haber sobreajuste?

Cambié un poco la red que usé debido a que comprendí un poco más el cómo funcionan las capas.

La red usada fue Keras Sobreajuste, donde se puede ver este comportamiento:

```
CA\Windows\system32\cmd.exe
Epoch 1/50
WARNING:tensorflow:From C:\Users\User\AppData\Local\Programs\Python\Python310\lib\site-packages\keras\src\utils\tf_utils.py:492: The name tf.
ragged.RaggedTensorValue is deprecated. Please use tf.compat.v1.ragged.RaggedTensorValue instead.
WARNING:tensorflow:From C:\Users\User\AppData\Local\Programs\Python\Python310\lib\site-packages\keras\src\engine\base_layer_utils.py:384: The
name tf.executing_eagerly_outside_functions is deprecated. Please use tf.compat.v1.executing_eagerly_outside_functions instead.
8/8 [=====] - 8s 201ms/step - loss: 2.4179 - accuracy: 0.1160 - val_loss: 2.3555 - val_accuracy: 0.1040
Epoch 2/50
8/8 [=====] - 1s 92ms/step - loss: 2.3302 - accuracy: 0.1250 - val_loss: 2.3078 - val_accuracy: 0.1070
Epoch 3/50
8/8 [=====] - 1s 92ms/step - loss: 2.3004 - accuracy: 0.1170 - val_loss: 2.2889 - val_accuracy: 0.1070
Epoch 4/50
8/8 [=====] - 1s 87ms/step - loss: 2.2824 - accuracy: 0.1130 - val_loss: 2.2728 - val_accuracy: 0.1750
Epoch 5/50
8/8 [=====] - 1s 92ms/step - loss: 2.2651 - accuracy: 0.1820 - val_loss: 2.2548 - val_accuracy: 0.2060
Epoch 6/50
8/8 [=====] - 1s 88ms/step - loss: 2.2444 - accuracy: 0.2240 - val_loss: 2.2349 - val_accuracy: 0.2070
Epoch 7/50
8/8 [=====] - 1s 89ms/step - loss: 2.2245 - accuracy: 0.2290 - val_loss: 2.2164 - val_accuracy: 0.2060
Epoch 8/50
8/8 [=====] - 1s 87ms/step - loss: 2.2033 - accuracy: 0.2370 - val_loss: 2.1973 - val_accuracy: 0.2960
Epoch 9/50
8/8 [=====] - 1s 89ms/step - loss: 2.1821 - accuracy: 0.2920 - val_loss: 2.1773 - val_accuracy: 0.2960
Epoch 10/50
8/8 [=====] - 1s 89ms/step - loss: 2.1632 - accuracy: 0.2980 - val_loss: 2.1597 - val_accuracy: 0.2970
Epoch 11/50
8/8 [=====] - 1s 94ms/step - loss: 2.1433 - accuracy: 0.2750 - val_loss: 2.1434 - val_accuracy: 0.2950
Epoch 12/50
8/8 [=====] - 1s 87ms/step - loss: 2.1218 - accuracy: 0.3220 - val_loss: 2.1249 - val_accuracy: 0.2930
Epoch 13/50
8/8 [=====] - 1s 87ms/step - loss: 2.1001 - accuracy: 0.3260 - val_loss: 2.1040 - val_accuracy: 0.2970
Epoch 14/50
8/8 [=====] - 1s 90ms/step - loss: 2.0801 - accuracy: 0.3030 - val_loss: 2.0856 - val_accuracy: 0.2930
Epoch 15/50
8/8 [=====] - 1s 90ms/step - loss: 2.0583 - accuracy: 0.3230 - val_loss: 2.0679 - val_accuracy: 0.2950
Epoch 16/50
8/8 [=====] - 1s 103ms/step - loss: 2.0350 - accuracy: 0.3250 - val_loss: 2.0447 - val_accuracy: 0.2960
Epoch 17/50
```

Aquí es posible ver el sobre ajuste, ya que no evoluciona la red y solo oscila a lo largo del 30%.

Sin embargo, creo no haber entendido bien el cómo funciona la regulación de L1 y L2, ya que, en vez de mejorar, solo hace peor la exactitud.

```
CA\Windows\system32\cmd.exe
Epoch 1/30
WARNING:tensorflow:From C:\Users\User\AppData\Local\Programs\Python\Python310\lib\site-packages\keras\src\utils\tf_utils.py:492: The name tf.
ragged.RaggedTensorValue is deprecated. Please use tf.compat.v1.ragged.RaggedTensorValue instead.
WARNING:tensorflow:From C:\Users\User\AppData\Local\Programs\Python\Python310\lib\site-packages\keras\src\engine\base_layer_utils.py:384: The
name tf.executing_eagerly_outside_functions is deprecated. Please use tf.compat.v1.executing_eagerly_outside_functions instead.
8/8 [=====] - 8s 203ms/step - loss: 55.4787 - accuracy: 0.1160 - val_loss: 51.5192 - val_accuracy: 0.1040
Epoch 2/30
8/8 [=====] - 1s 92ms/step - loss: 48.3288 - accuracy: 0.1120 - val_loss: 43.9713 - val_accuracy: 0.1070
Epoch 3/30
8/8 [=====] - 1s 92ms/step - loss: 40.7191 - accuracy: 0.1170 - val_loss: 36.4163 - val_accuracy: 0.1070
Epoch 4/30
8/8 [=====] - 1s 93ms/step - loss: 33.3401 - accuracy: 0.1170 - val_loss: 29.3365 - val_accuracy: 0.1070
Epoch 5/30
8/8 [=====] - 1s 93ms/step - loss: 26.5541 - accuracy: 0.1060 - val_loss: 22.9710 - val_accuracy: 0.1040
Epoch 6/30
8/8 [=====] - 1s 96ms/step - loss: 20.5339 - accuracy: 0.1190 - val_loss: 17.4269 - val_accuracy: 0.1040
Epoch 7/30
8/8 [=====] - 1s 92ms/step - loss: 15.3559 - accuracy: 0.1430 - val_loss: 12.7475 - val_accuracy: 0.1510
Epoch 8/30
8/8 [=====] - 1s 92ms/step - loss: 11.0521 - accuracy: 0.1680 - val_loss: 8.9527 - val_accuracy: 0.1910
Epoch 9/30
8/8 [=====] - 1s 92ms/step - loss: 7.6465 - accuracy: 0.1320 - val_loss: 6.0677 - val_accuracy: 0.1040
Epoch 10/30
8/8 [=====] - 1s 92ms/step - loss: 5.1324 - accuracy: 0.1260 - val_loss: 4.0556 - val_accuracy: 0.1520
Epoch 11/30
8/8 [=====] - 1s 92ms/step - loss: 3.5027 - accuracy: 0.1370 - val_loss: 2.9266 - val_accuracy: 0.1200
Epoch 12/30
8/8 [=====] - 1s 92ms/step - loss: 2.7504 - accuracy: 0.1140 - val_loss: 2.6492 - val_accuracy: 0.1040
Epoch 13/30
8/8 [=====] - 1s 92ms/step - loss: 2.5732 - accuracy: 0.1160 - val_loss: 2.4666 - val_accuracy: 0.1040
Epoch 14/30
8/8 [=====] - 1s 95ms/step - loss: 2.4433 - accuracy: 0.1090 - val_loss: 2.4229 - val_accuracy: 0.1070
Epoch 15/30
8/8 [=====] - 1s 94ms/step - loss: 2.4180 - accuracy: 0.1120 - val_loss: 2.4173 - val_accuracy: 0.1530
Epoch 16/30
8/8 [=====] - 1s 92ms/step - loss: 2.4146 - accuracy: 0.1250 - val_loss: 2.4137 - val_accuracy: 0.1070
Epoch 17/30
```

Épocas de L1

```
C:\Windows\system32\cmd.exe
Epoch 1/50
WARNING:tensorflow:From C:\Users\User\AppData\Local\Programs\Python\Python310\lib\site-packages\keras\src\utils\tf_utils.py:492: The name tf.
ragged.RaggedTensorValue is deprecated. Please use tf.compat.v1.ragged.RaggedTensorValue instead.
WARNING:tensorflow:From C:\Users\User\AppData\Local\Programs\Python\Python310\lib\site-packages\keras\src\engine\base_layer_utils.py:384: The
name tf.executing_eagerly_outside_functions is deprecated. Please use tf.compat.v1.executing_eagerly_outside_functions instead.
8/8 [=====] - 8s 201ms/step - loss: 2.4262 - accuracy: 0.0990 - val_loss: 2.3681 - val_accuracy: 0.0990
Epoch 2/50
8/8 [=====] - 1s 92ms/step - loss: 2.3421 - accuracy: 0.0940 - val_loss: 2.3268 - val_accuracy: 0.1070
Epoch 3/50
8/8 [=====] - 1s 85ms/step - loss: 2.3181 - accuracy: 0.1100 - val_loss: 2.3143 - val_accuracy: 0.1670
Epoch 4/50
8/8 [=====] - 1s 87ms/step - loss: 2.3119 - accuracy: 0.1330 - val_loss: 2.3025 - val_accuracy: 0.1690
Epoch 5/50
8/8 [=====] - 1s 85ms/step - loss: 2.2992 - accuracy: 0.1790 - val_loss: 2.2894 - val_accuracy: 0.2040
Epoch 6/50
8/8 [=====] - 1s 85ms/step - loss: 2.2829 - accuracy: 0.2220 - val_loss: 2.2740 - val_accuracy: 0.2040
Epoch 7/50
8/8 [=====] - 1s 83ms/step - loss: 2.2651 - accuracy: 0.2220 - val_loss: 2.2582 - val_accuracy: 0.2010
Epoch 8/50
8/8 [=====] - 1s 84ms/step - loss: 2.2462 - accuracy: 0.2250 - val_loss: 2.2402 - val_accuracy: 0.2040
Epoch 9/50
8/8 [=====] - 1s 85ms/step - loss: 2.2297 - accuracy: 0.2240 - val_loss: 2.2239 - val_accuracy: 0.2040
Epoch 10/50
8/8 [=====] - 1s 85ms/step - loss: 2.2132 - accuracy: 0.2250 - val_loss: 2.2083 - val_accuracy: 0.2040
Epoch 11/50
8/8 [=====] - 1s 89ms/step - loss: 2.1967 - accuracy: 0.2260 - val_loss: 2.1943 - val_accuracy: 0.2060
Epoch 12/50
8/8 [=====] - 1s 89ms/step - loss: 2.1804 - accuracy: 0.2270 - val_loss: 2.1807 - val_accuracy: 0.2050
Epoch 13/50
8/8 [=====] - 1s 83ms/step - loss: 2.1650 - accuracy: 0.2270 - val_loss: 2.1656 - val_accuracy: 0.2060
Epoch 14/50
8/8 [=====] - 1s 83ms/step - loss: 2.1473 - accuracy: 0.2270 - val_loss: 2.1517 - val_accuracy: 0.2060
Epoch 15/50
8/8 [=====] - 1s 83ms/step - loss: 2.1332 - accuracy: 0.2270 - val_loss: 2.1372 - val_accuracy: 0.2060
Epoch 16/50
8/8 [=====] - 1s 85ms/step - loss: 2.1149 - accuracy: 0.2280 - val_loss: 2.1234 - val_accuracy: 0.2040
Epoch 17/50
```

Épocas de L2

L2 tiene un comportamiento diferente en al inicio, pero no estoy seguro de que mejore, ya que también termina oscilando en cierto punto.

En cuanto a la mezcla del regularizador L1 y L2 unidos, obtengo que...

```
C:\Windows\system32\cmd.exe
Epoch 33/50
8/8 [=====] - 1s 129ms/step - loss: 1.7040 - accuracy: 0.3340 - val_loss: 1.7486 - val_accuracy: 0.3040
Epoch 34/50
8/8 [=====] - 1s 127ms/step - loss: 1.6866 - accuracy: 0.3340 - val_loss: 1.7351 - val_accuracy: 0.3040
Epoch 35/50
8/8 [=====] - 1s 129ms/step - loss: 1.6725 - accuracy: 0.3340 - val_loss: 1.7241 - val_accuracy: 0.3020
Epoch 36/50
8/8 [=====] - 1s 132ms/step - loss: 1.6563 - accuracy: 0.3340 - val_loss: 1.7104 - val_accuracy: 0.3060
Epoch 37/50
8/8 [=====] - 1s 125ms/step - loss: 1.6407 - accuracy: 0.3340 - val_loss: 1.6994 - val_accuracy: 0.3050
Epoch 38/50
8/8 [=====] - 1s 129ms/step - loss: 1.6277 - accuracy: 0.3340 - val_loss: 1.6920 - val_accuracy: 0.3050
Epoch 39/50
8/8 [=====] - 1s 123ms/step - loss: 1.6149 - accuracy: 0.3220 - val_loss: 1.6776 - val_accuracy: 0.3040
Epoch 40/50
8/8 [=====] - 1s 125ms/step - loss: 1.6049 - accuracy: 0.3340 - val_loss: 1.6690 - val_accuracy: 0.3040
Epoch 41/50
8/8 [=====] - 1s 123ms/step - loss: 1.5929 - accuracy: 0.3350 - val_loss: 1.6605 - val_accuracy: 0.2960
Epoch 42/50
8/8 [=====] - 1s 123ms/step - loss: 1.5840 - accuracy: 0.3340 - val_loss: 1.6517 - val_accuracy: 0.3050
Epoch 43/50
8/8 [=====] - 1s 125ms/step - loss: 1.5753 - accuracy: 0.3220 - val_loss: 1.6499 - val_accuracy: 0.3050
Epoch 44/50
8/8 [=====] - 1s 127ms/step - loss: 1.5666 - accuracy: 0.3340 - val_loss: 1.6436 - val_accuracy: 0.3030
Epoch 45/50
8/8 [=====] - 1s 125ms/step - loss: 1.5562 - accuracy: 0.3360 - val_loss: 1.6373 - val_accuracy: 0.3020
Epoch 46/50
8/8 [=====] - 1s 123ms/step - loss: 1.5488 - accuracy: 0.3360 - val_loss: 1.6304 - val_accuracy: 0.2990
Epoch 47/50
8/8 [=====] - 1s 123ms/step - loss: 1.5427 - accuracy: 0.3090 - val_loss: 1.6343 - val_accuracy: 0.2990
Epoch 48/50
8/8 [=====] - 1s 127ms/step - loss: 1.5474 - accuracy: 0.3370 - val_loss: 1.6317 - val_accuracy: 0.3040
Epoch 49/50
8/8 [=====] - 1s 125ms/step - loss: 1.5315 - accuracy: 0.3350 - val_loss: 1.6232 - val_accuracy: 0.3030
Epoch 50/50
8/8 [=====] - 1s 127ms/step - loss: 1.5235 - accuracy: 0.3370 - val_loss: 1.6173 - val_accuracy: 0.2960
C:\Users\User\RN Fer>
```

Que es una mejora significativa a los L1 y L2 por separado, aunque se encuentre oscilando, puedo ver una mejora que llega hasta el 30%

En cuanto al dropout:

```
C:\Windows\system32\cmd.exe
Epoch 33/50
8/8 [=====] - 1s 94ms/step - loss: 1.5600 - accuracy: 0.3930 - val_loss: 1.6533 - val_accuracy: 0.3440
Epoch 34/50
8/8 [=====] - 1s 92ms/step - loss: 1.5336 - accuracy: 0.3940 - val_loss: 1.6283 - val_accuracy: 0.3480
Epoch 35/50
8/8 [=====] - 1s 89ms/step - loss: 1.5094 - accuracy: 0.3980 - val_loss: 1.6089 - val_accuracy: 0.3520
Epoch 36/50
8/8 [=====] - 1s 89ms/step - loss: 1.4807 - accuracy: 0.4030 - val_loss: 1.5911 - val_accuracy: 0.3470
Epoch 37/50
8/8 [=====] - 1s 92ms/step - loss: 1.4593 - accuracy: 0.3950 - val_loss: 1.5665 - val_accuracy: 0.3500
Epoch 38/50
8/8 [=====] - 1s 89ms/step - loss: 1.4354 - accuracy: 0.4060 - val_loss: 1.5554 - val_accuracy: 0.3530
Epoch 39/50
8/8 [=====] - 1s 92ms/step - loss: 1.4139 - accuracy: 0.4000 - val_loss: 1.5353 - val_accuracy: 0.3470
Epoch 40/50
8/8 [=====] - 1s 92ms/step - loss: 1.3901 - accuracy: 0.4000 - val_loss: 1.5371 - val_accuracy: 0.3540
Epoch 41/50
8/8 [=====] - 1s 92ms/step - loss: 1.3749 - accuracy: 0.4030 - val_loss: 1.5186 - val_accuracy: 0.3540
Epoch 42/50
8/8 [=====] - 1s 89ms/step - loss: 1.3541 - accuracy: 0.4050 - val_loss: 1.5017 - val_accuracy: 0.3590
Epoch 43/50
8/8 [=====] - 1s 94ms/step - loss: 1.3354 - accuracy: 0.4120 - val_loss: 1.5008 - val_accuracy: 0.3590
Epoch 44/50
8/8 [=====] - 1s 94ms/step - loss: 1.3153 - accuracy: 0.4010 - val_loss: 1.5045 - val_accuracy: 0.3480
Epoch 45/50
8/8 [=====] - 1s 96ms/step - loss: 1.2998 - accuracy: 0.4030 - val_loss: 1.4770 - val_accuracy: 0.3570
Epoch 46/50
8/8 [=====] - 1s 94ms/step - loss: 1.2845 - accuracy: 0.4150 - val_loss: 1.4762 - val_accuracy: 0.3560
Epoch 47/50
8/8 [=====] - 1s 89ms/step - loss: 1.2717 - accuracy: 0.4090 - val_loss: 1.4661 - val_accuracy: 0.3530
Epoch 48/50
8/8 [=====] - 1s 89ms/step - loss: 1.2581 - accuracy: 0.4120 - val_loss: 1.4656 - val_accuracy: 0.3510
Epoch 49/50
8/8 [=====] - 1s 89ms/step - loss: 1.2471 - accuracy: 0.3980 - val_loss: 1.4537 - val_accuracy: 0.3700
Epoch 50/50
8/8 [=====] - 1s 92ms/step - loss: 1.2394 - accuracy: 0.4130 - val_loss: 1.4607 - val_accuracy: 0.3580
C:\Users\User\RN Fer>
```

Logro hacer que el sobreajuste apareciera mucho después, y teniendo una exactitud del 40%, mucho mejor que el obtenido en cualquiera de los anteriores.

Por último, tenemos el dropout junto con L1 y L2.

```
C:\Windows\system32\cmd.exe
Epoch 33/50
8/8 [=====] - 2s 206ms/step - loss: 1.9542 - accuracy: 0.2300 - val_loss: 2.0296 - val_accuracy: 0.1960
Epoch 34/50
8/8 [=====] - 2s 237ms/step - loss: 1.9375 - accuracy: 0.2300 - val_loss: 2.0184 - val_accuracy: 0.2000
Epoch 35/50
8/8 [=====] - 2s 203ms/step - loss: 1.9230 - accuracy: 0.2300 - val_loss: 2.0043 - val_accuracy: 0.1980
Epoch 36/50
8/8 [=====] - 1s 174ms/step - loss: 1.9114 - accuracy: 0.2300 - val_loss: 2.0016 - val_accuracy: 0.1970
Epoch 37/50
8/8 [=====] - 1s 173ms/step - loss: 1.8968 - accuracy: 0.2300 - val_loss: 1.9976 - val_accuracy: 0.1960
Epoch 38/50
8/8 [=====] - 1s 178ms/step - loss: 1.8857 - accuracy: 0.2090 - val_loss: 1.9933 - val_accuracy: 0.1980
Epoch 39/50
8/8 [=====] - 1s 179ms/step - loss: 1.8726 - accuracy: 0.2300 - val_loss: 1.9840 - val_accuracy: 0.1960
Epoch 40/50
8/8 [=====] - 1s 176ms/step - loss: 1.8617 - accuracy: 0.2300 - val_loss: 1.9730 - val_accuracy: 0.1980
Epoch 41/50
8/8 [=====] - 1s 172ms/step - loss: 1.8516 - accuracy: 0.2130 - val_loss: 1.9616 - val_accuracy: 0.1990
Epoch 42/50
8/8 [=====] - 1s 192ms/step - loss: 1.8380 - accuracy: 0.2300 - val_loss: 1.9599 - val_accuracy: 0.2000
Epoch 43/50
8/8 [=====] - 2s 205ms/step - loss: 1.8336 - accuracy: 0.2300 - val_loss: 1.9570 - val_accuracy: 0.1990
Epoch 44/50
8/8 [=====] - 1s 187ms/step - loss: 1.8248 - accuracy: 0.2300 - val_loss: 1.9558 - val_accuracy: 0.1990
Epoch 45/50
8/8 [=====] - 1s 190ms/step - loss: 1.8163 - accuracy: 0.2300 - val_loss: 1.9508 - val_accuracy: 0.1990
Epoch 46/50
8/8 [=====] - 1s 187ms/step - loss: 1.8106 - accuracy: 0.2120 - val_loss: 1.9479 - val_accuracy: 0.2000
Epoch 47/50
8/8 [=====] - 1s 194ms/step - loss: 1.8032 - accuracy: 0.2300 - val_loss: 1.9484 - val_accuracy: 0.2010
Epoch 48/50
8/8 [=====] - 1s 185ms/step - loss: 1.7977 - accuracy: 0.2300 - val_loss: 1.9458 - val_accuracy: 0.1990
Epoch 49/50
8/8 [=====] - 1s 190ms/step - loss: 1.7928 - accuracy: 0.2300 - val_loss: 1.9424 - val_accuracy: 0.2000
Epoch 50/50
8/8 [=====] - 1s 181ms/step - loss: 1.7881 - accuracy: 0.2140 - val_loss: 1.9405 - val_accuracy: 0.2040
C:\Users\User\RN Fer>
```

Tengo la sensación de que mi problema es no saber cómo usar correctamente el L1 y L2, ya que en cualquier red que la implemento, simplemente empeora los datos.

Necesito retroalimentación de los datos.