```
In [1]:  # Install TensorFlow
         # !pip install -q tensorflow-gpu==2.0.0-beta1

         try:
           %tensorflow_version 2.x  # Colab only.
         except Exception:
           pass

         import tensorflow as tf
         print(tf.__version__)
```

```
Colab only includes TensorFlow 2.x; %tensorflow_version has no effect.
2.12.0
```

```
In [2]:  # More imports
         from tensorflow.keras.layers import Input, SimpleRNN, GRU, LSTM, Dense, Flatten, Gl
         from tensorflow.keras.models import Model
         from tensorflow.keras.optimizers import SGD, Adam

         import numpy as np
         import pandas as pd
         import matplotlib.pyplot as plt
```

```
In [3]:  ### build the dataset
         # This is a nonlinear AND long-distance dataset
         # (Actually, we will test long-distance vs. short-distance patterns)

         # Start with a small T and increase it later
         T = 10
         D = 1
         X = []
         Y = []

         def get_label(x, i1, i2, i3):
           # x = sequence
           if x[i1] < 0 and x[i2] < 0 and x[i3] < 0:
             return 1
           if x[i1] < 0 and x[i2] > 0 and x[i3] > 0:
             return 1
           if x[i1] > 0 and x[i2] < 0 and x[i3] > 0:
             return 1
           if x[i1] > 0 and x[i2] > 0 and x[i3] < 0:
             return 1
           return 0

         for t in range(5000):
           x = np.random.randn(T)
           X.append(x)
           y = get_label(x, -1, -2, -3) # short distance
         #   y = get_label(x, 0, 1, 2) # long distance
           Y.append(y)

         X = np.array(X)
```

```
Y = np.array(Y)
N = len(X)
```

In [4]:
```python
# Try a linear model first - note: it is classification now!
i = Input(shape=(T,))
x = Dense(1, activation='sigmoid')(i)
model = Model(i, x)
model.compile(
  loss='binary_crossentropy',
  optimizer=Adam(learning_rate=0.01),
  metrics=['accuracy'],
)

# train the network
r = model.fit(
  X, Y,
  epochs=100,
  validation_split=0.5,
)
```

```
Epoch 1/100
79/79 [==============================] - 8s 7ms/step - loss: 0.7663 - accuracy: 0.
4892 - val_loss: 0.7106 - val_accuracy: 0.4936
Epoch 2/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6930 - accuracy: 0.
5248 - val_loss: 0.7016 - val_accuracy: 0.4920
Epoch 3/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6903 - accuracy: 0.
5356 - val_loss: 0.6984 - val_accuracy: 0.4916
Epoch 4/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6896 - accuracy: 0.
5372 - val_loss: 0.7023 - val_accuracy: 0.4968
Epoch 5/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6889 - accuracy: 0.
5352 - val_loss: 0.7012 - val_accuracy: 0.4884
Epoch 6/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6901 - accuracy: 0.
5324 - val_loss: 0.7013 - val_accuracy: 0.4972
Epoch 7/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6889 - accuracy: 0.
5404 - val_loss: 0.6994 - val_accuracy: 0.4968
Epoch 8/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6901 - accuracy: 0.
5332 - val_loss: 0.7003 - val_accuracy: 0.4908
Epoch 9/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6891 - accuracy: 0.
5272 - val_loss: 0.6999 - val_accuracy: 0.4964
Epoch 10/100
79/79 [==============================] - 1s 6ms/step - loss: 0.6893 - accuracy: 0.
5292 - val_loss: 0.7027 - val_accuracy: 0.4892
Epoch 11/100
79/79 [==============================] - 1s 7ms/step - loss: 0.6895 - accuracy: 0.
5372 - val_loss: 0.7057 - val_accuracy: 0.4904
Epoch 12/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6897 - accuracy: 0.
5340 - val_loss: 0.7034 - val_accuracy: 0.4960
Epoch 13/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6899 - accuracy: 0.
5348 - val_loss: 0.7042 - val_accuracy: 0.4948
Epoch 14/100
79/79 [==============================] - 0s 6ms/step - loss: 0.6896 - accuracy: 0.
5316 - val_loss: 0.7036 - val_accuracy: 0.4896
Epoch 15/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6893 - accuracy: 0.
5304 - val_loss: 0.7004 - val_accuracy: 0.4912
Epoch 16/100
79/79 [==============================] - 0s 6ms/step - loss: 0.6896 - accuracy: 0.
5288 - val_loss: 0.7018 - val_accuracy: 0.4940
Epoch 17/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6896 - accuracy: 0.
5316 - val_loss: 0.7017 - val_accuracy: 0.4860
Epoch 18/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6895 - accuracy: 0.
5272 - val_loss: 0.7035 - val_accuracy: 0.4908
Epoch 19/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6903 - accuracy: 0.
```

```
5344 - val_loss: 0.6997 - val_accuracy: 0.4900
Epoch 20/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6895 - accuracy: 0.
5220 - val_loss: 0.7003 - val_accuracy: 0.4956
Epoch 21/100
79/79 [==============================] - 1s 7ms/step - loss: 0.6896 - accuracy: 0.
5356 - val_loss: 0.7002 - val_accuracy: 0.4856
Epoch 22/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6899 - accuracy: 0.
5172 - val_loss: 0.7019 - val_accuracy: 0.4900
Epoch 23/100
79/79 [==============================] - 1s 7ms/step - loss: 0.6899 - accuracy: 0.
5444 - val_loss: 0.7027 - val_accuracy: 0.5000
Epoch 24/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6891 - accuracy: 0.
5284 - val_loss: 0.7016 - val_accuracy: 0.4972
Epoch 25/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6900 - accuracy: 0.
5360 - val_loss: 0.7021 - val_accuracy: 0.4884
Epoch 26/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6899 - accuracy: 0.
5292 - val_loss: 0.7028 - val_accuracy: 0.4932
Epoch 27/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6903 - accuracy: 0.
5332 - val_loss: 0.7032 - val_accuracy: 0.4964
Epoch 28/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6890 - accuracy: 0.
5340 - val_loss: 0.7030 - val_accuracy: 0.4976
Epoch 29/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6893 - accuracy: 0.
5284 - val_loss: 0.7005 - val_accuracy: 0.4892
Epoch 30/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6895 - accuracy: 0.
5356 - val_loss: 0.7042 - val_accuracy: 0.4952
Epoch 31/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6905 - accuracy: 0.
5396 - val_loss: 0.7032 - val_accuracy: 0.4984
Epoch 32/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6897 - accuracy: 0.
5364 - val_loss: 0.7017 - val_accuracy: 0.4944
Epoch 33/100
79/79 [==============================] - 1s 7ms/step - loss: 0.6893 - accuracy: 0.
5284 - val_loss: 0.7019 - val_accuracy: 0.4900
Epoch 34/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6899 - accuracy: 0.
5188 - val_loss: 0.7022 - val_accuracy: 0.4916
Epoch 35/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6901 - accuracy: 0.
5312 - val_loss: 0.7017 - val_accuracy: 0.4984
Epoch 36/100
79/79 [==============================] - 1s 7ms/step - loss: 0.6899 - accuracy: 0.
5304 - val_loss: 0.7011 - val_accuracy: 0.4980
Epoch 37/100
79/79 [==============================] - 1s 7ms/step - loss: 0.6892 - accuracy: 0.
5292 - val_loss: 0.7014 - val_accuracy: 0.4912
Epoch 38/100
```

```
79/79 [==============================] - 1s 8ms/step - loss: 0.6896 - accuracy: 0.
5272 - val_loss: 0.7027 - val_accuracy: 0.4968
Epoch 39/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6896 - accuracy: 0.
5356 - val_loss: 0.7020 - val_accuracy: 0.5060
Epoch 40/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6891 - accuracy: 0.
5404 - val_loss: 0.7002 - val_accuracy: 0.4864
Epoch 41/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6893 - accuracy: 0.
5344 - val_loss: 0.7036 - val_accuracy: 0.4944
Epoch 42/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6897 - accuracy: 0.
5340 - val_loss: 0.7004 - val_accuracy: 0.4956
Epoch 43/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6895 - accuracy: 0.
5316 - val_loss: 0.7013 - val_accuracy: 0.4840
Epoch 44/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6897 - accuracy: 0.
5244 - val_loss: 0.7041 - val_accuracy: 0.4912
Epoch 45/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6896 - accuracy: 0.
5268 - val_loss: 0.7036 - val_accuracy: 0.4932
Epoch 46/100
79/79 [==============================] - 1s 7ms/step - loss: 0.6900 - accuracy: 0.
5384 - val_loss: 0.7040 - val_accuracy: 0.4916
Epoch 47/100
79/79 [==============================] - 0s 6ms/step - loss: 0.6897 - accuracy: 0.
5252 - val_loss: 0.7040 - val_accuracy: 0.4888
Epoch 48/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6893 - accuracy: 0.
5192 - val_loss: 0.7002 - val_accuracy: 0.4964
Epoch 49/100
79/79 [==============================] - 0s 6ms/step - loss: 0.6895 - accuracy: 0.
5328 - val_loss: 0.7007 - val_accuracy: 0.4912
Epoch 50/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6893 - accuracy: 0.
5420 - val_loss: 0.7013 - val_accuracy: 0.4924
Epoch 51/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6896 - accuracy: 0.
5264 - val_loss: 0.7014 - val_accuracy: 0.4916
Epoch 52/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6897 - accuracy: 0.
5392 - val_loss: 0.7008 - val_accuracy: 0.4916
Epoch 53/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6905 - accuracy: 0.
5256 - val_loss: 0.7021 - val_accuracy: 0.4876
Epoch 54/100
79/79 [==============================] - 0s 6ms/step - loss: 0.6898 - accuracy: 0.
5332 - val_loss: 0.7019 - val_accuracy: 0.4916
Epoch 55/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6901 - accuracy: 0.
5268 - val_loss: 0.7026 - val_accuracy: 0.4924
Epoch 56/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6899 - accuracy: 0.
5372 - val_loss: 0.7024 - val_accuracy: 0.4936
```

```
Epoch 57/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6898 - accuracy: 0.
5344 - val_loss: 0.7011 - val_accuracy: 0.4920
Epoch 58/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6897 - accuracy: 0.
5296 - val_loss: 0.7003 - val_accuracy: 0.4872
Epoch 59/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6898 - accuracy: 0.
5384 - val_loss: 0.7024 - val_accuracy: 0.4976
Epoch 60/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6900 - accuracy: 0.
5332 - val_loss: 0.7009 - val_accuracy: 0.4988
Epoch 61/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6890 - accuracy: 0.
5300 - val_loss: 0.7023 - val_accuracy: 0.4988
Epoch 62/100
79/79 [==============================] - 0s 6ms/step - loss: 0.6889 - accuracy: 0.
5416 - val_loss: 0.7009 - val_accuracy: 0.4920
Epoch 63/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6901 - accuracy: 0.
5360 - val_loss: 0.7016 - val_accuracy: 0.4936
Epoch 64/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6894 - accuracy: 0.
5348 - val_loss: 0.7035 - val_accuracy: 0.4888
Epoch 65/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6903 - accuracy: 0.
5344 - val_loss: 0.7016 - val_accuracy: 0.4852
Epoch 66/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6895 - accuracy: 0.
5356 - val_loss: 0.7003 - val_accuracy: 0.4888
Epoch 67/100
79/79 [==============================] - 1s 7ms/step - loss: 0.6899 - accuracy: 0.
5392 - val_loss: 0.6999 - val_accuracy: 0.4928
Epoch 68/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6896 - accuracy: 0.
5352 - val_loss: 0.7004 - val_accuracy: 0.4928
Epoch 69/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6896 - accuracy: 0.
5356 - val_loss: 0.7004 - val_accuracy: 0.4864
Epoch 70/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6890 - accuracy: 0.
5296 - val_loss: 0.7024 - val_accuracy: 0.4924
Epoch 71/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6893 - accuracy: 0.
5344 - val_loss: 0.6995 - val_accuracy: 0.5008
Epoch 72/100
79/79 [==============================] - 1s 7ms/step - loss: 0.6900 - accuracy: 0.
5388 - val_loss: 0.7038 - val_accuracy: 0.4880
Epoch 73/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6906 - accuracy: 0.
5336 - val_loss: 0.7038 - val_accuracy: 0.4892
Epoch 74/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6897 - accuracy: 0.
5356 - val_loss: 0.7000 - val_accuracy: 0.4928
Epoch 75/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6895 - accuracy: 0.
```

```
5284 - val_loss: 0.7013 - val_accuracy: 0.4908
Epoch 76/100
79/79 [==============================] - 1s 7ms/step - loss: 0.6899 - accuracy: 0.
5296 - val_loss: 0.7019 - val_accuracy: 0.4860
Epoch 77/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6901 - accuracy: 0.
5296 - val_loss: 0.7029 - val_accuracy: 0.4968
Epoch 78/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6902 - accuracy: 0.
5292 - val_loss: 0.7008 - val_accuracy: 0.4868
Epoch 79/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6902 - accuracy: 0.
5324 - val_loss: 0.7008 - val_accuracy: 0.5000
Epoch 80/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6891 - accuracy: 0.
5344 - val_loss: 0.7012 - val_accuracy: 0.4892
Epoch 81/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6890 - accuracy: 0.
5316 - val_loss: 0.7026 - val_accuracy: 0.4920
Epoch 82/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6899 - accuracy: 0.
5340 - val_loss: 0.7020 - val_accuracy: 0.4876
Epoch 83/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6896 - accuracy: 0.
5340 - val_loss: 0.7015 - val_accuracy: 0.4956
Epoch 84/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6904 - accuracy: 0.
5336 - val_loss: 0.7011 - val_accuracy: 0.4924
Epoch 85/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6894 - accuracy: 0.
5264 - val_loss: 0.7018 - val_accuracy: 0.5008
Epoch 86/100
79/79 [==============================] - 1s 7ms/step - loss: 0.6898 - accuracy: 0.
5232 - val_loss: 0.7024 - val_accuracy: 0.4956
Epoch 87/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6894 - accuracy: 0.
5264 - val_loss: 0.7010 - val_accuracy: 0.4968
Epoch 88/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6893 - accuracy: 0.
5312 - val_loss: 0.7022 - val_accuracy: 0.4904
Epoch 89/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6893 - accuracy: 0.
5288 - val_loss: 0.7030 - val_accuracy: 0.4880
Epoch 90/100
79/79 [==============================] - 1s 7ms/step - loss: 0.6898 - accuracy: 0.
5332 - val_loss: 0.7027 - val_accuracy: 0.4916
Epoch 91/100
79/79 [==============================] - 1s 7ms/step - loss: 0.6898 - accuracy: 0.
5312 - val_loss: 0.7044 - val_accuracy: 0.4900
Epoch 92/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6900 - accuracy: 0.
5304 - val_loss: 0.7020 - val_accuracy: 0.4932
Epoch 93/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6904 - accuracy: 0.
5268 - val_loss: 0.7025 - val_accuracy: 0.5032
Epoch 94/100
```

```
79/79 [==============================] - 0s 6ms/step - loss: 0.6895 - accuracy: 0.
5380 - val_loss: 0.7031 - val_accuracy: 0.4956
Epoch 95/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6896 - accuracy: 0.
5284 - val_loss: 0.7012 - val_accuracy: 0.4888
Epoch 96/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6900 - accuracy: 0.
5280 - val_loss: 0.6995 - val_accuracy: 0.4932
Epoch 97/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6890 - accuracy: 0.
5368 - val_loss: 0.7024 - val_accuracy: 0.4924
Epoch 98/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6888 - accuracy: 0.
5312 - val_loss: 0.7023 - val_accuracy: 0.4896
Epoch 99/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6897 - accuracy: 0.
5308 - val_loss: 0.7016 - val_accuracy: 0.4864
Epoch 100/100
79/79 [==============================] - 0s 5ms/step - loss: 0.6898 - accuracy: 0.
5232 - val_loss: 0.7023 - val_accuracy: 0.4932
```
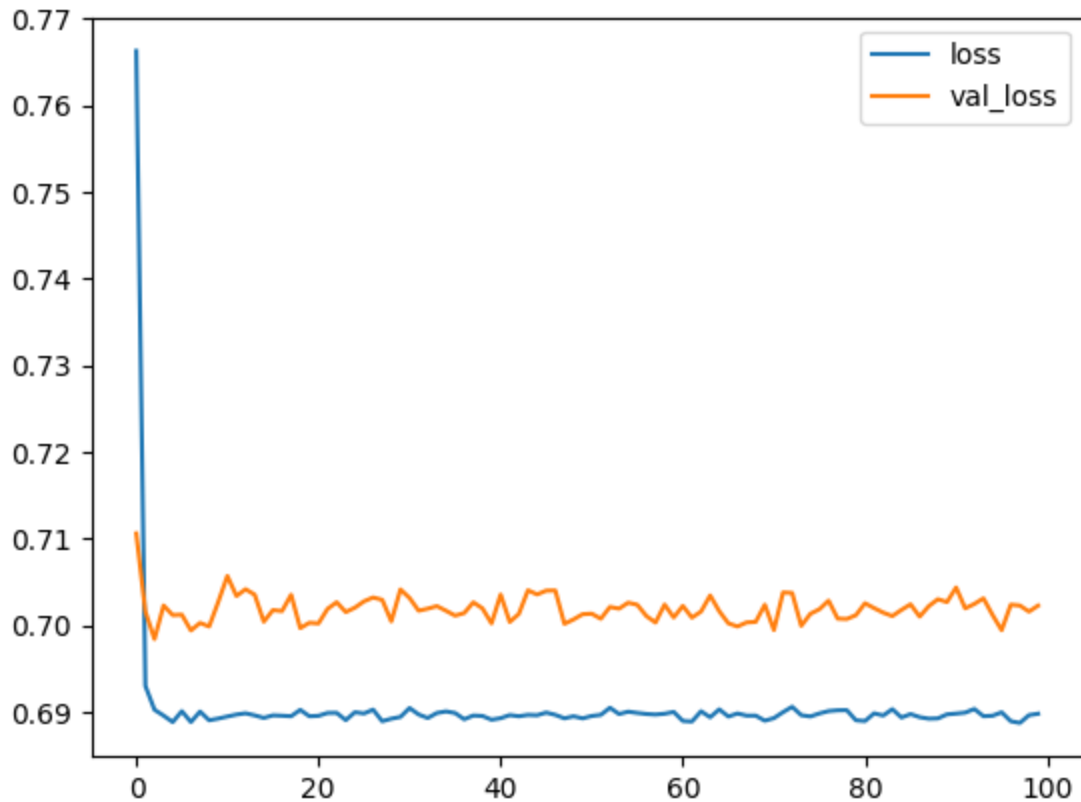
In [5]:
```python
# Plot the loss
plt.plot(r.history['loss'], label='loss')
plt.plot(r.history['val_loss'], label='val_loss')
plt.legend()
```

Out[5]: `<matplotlib.legend.Legend at 0x7f8c67e9a980>`
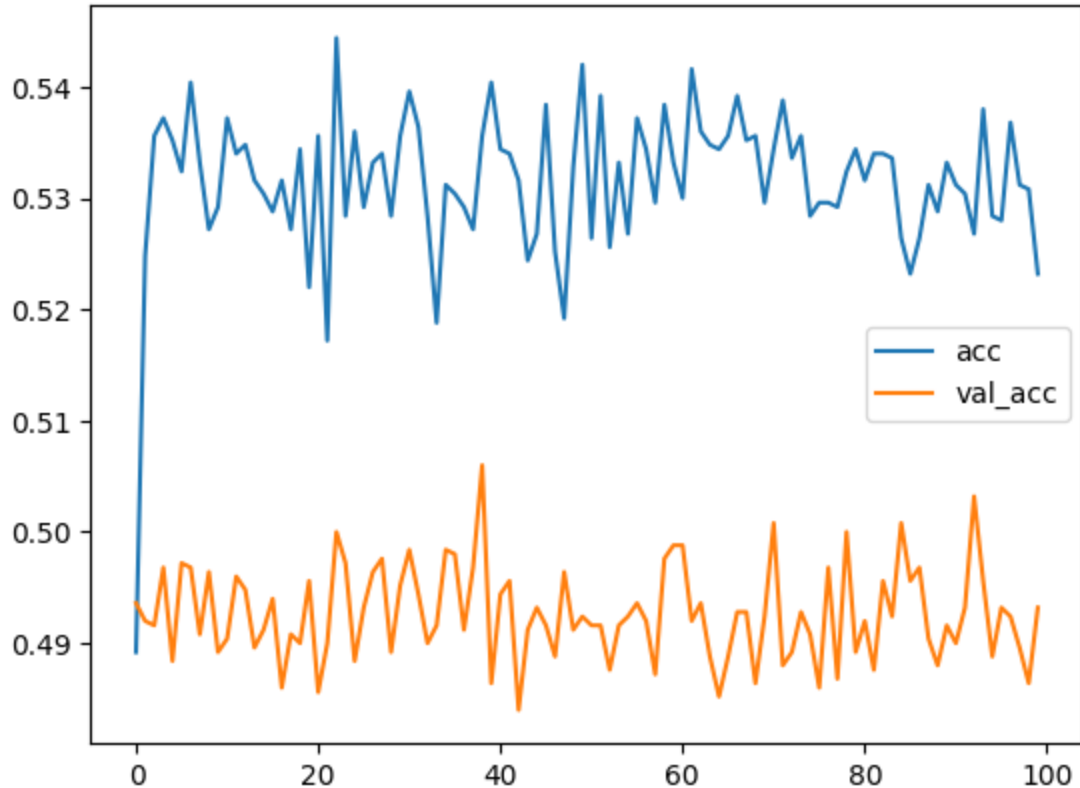

In [6]:
```python
# Plot the accuracy too - should be around 50%
plt.plot(r.history['accuracy'], label='acc')
```

```python
plt.plot(r.history['val_accuracy'], label='val_acc')
plt.legend()
```

Out[6]: <matplotlib.legend.Legend at 0x7f8c50417790>

In [7]:
```python
# Now try a simple RNN
inputs = np.expand_dims(X, -1)

# make the RNN
i = Input(shape=(T, D))

# method 1
# x = LSTM(5)(i)
x = SimpleRNN(5)(i)
# x = GRU(5)(i)

# method 2
# x = LSTM(5, return_sequences=True)(i)
# x = GlobalMaxPool1D()(x)

x = Dense(1, activation='sigmoid')(x)
model = Model(i, x)
model.compile(
  loss='binary_crossentropy',
  # optimizer='rmsprop',
#   optimizer='adam',
  optimizer=Adam(learning_rate=0.01),
  # optimizer=SGD(learning_rate=0.1, momentum=0.9),
  metrics=['accuracy'],
)
```

```
In [8]:  # train the RNN
         r = model.fit(
           inputs, Y,
           epochs=200,
           validation_split=0.5,
         )
```

```
Epoch 1/200
79/79 [==============================] - 4s 16ms/step - loss: 0.6912 - accuracy:
0.5452 - val_loss: 0.6845 - val_accuracy: 0.5752
Epoch 2/200
79/79 [==============================] - 1s 15ms/step - loss: 0.6682 - accuracy:
0.6184 - val_loss: 0.6533 - val_accuracy: 0.6576
Epoch 3/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6208 - accuracy:
0.7124 - val_loss: 0.5903 - val_accuracy: 0.7244
Epoch 4/200
79/79 [==============================] - 1s 15ms/step - loss: 0.5327 - accuracy:
0.7920 - val_loss: 0.4871 - val_accuracy: 0.8120
Epoch 5/200
79/79 [==============================] - 1s 14ms/step - loss: 0.4155 - accuracy:
0.8636 - val_loss: 0.3724 - val_accuracy: 0.8740
Epoch 6/200
79/79 [==============================] - 1s 14ms/step - loss: 0.3224 - accuracy:
0.8940 - val_loss: 0.2948 - val_accuracy: 0.9072
Epoch 7/200
79/79 [==============================] - 1s 15ms/step - loss: 0.2648 - accuracy:
0.9200 - val_loss: 0.2447 - val_accuracy: 0.9220
Epoch 8/200
79/79 [==============================] - 1s 13ms/step - loss: 0.2291 - accuracy:
0.9220 - val_loss: 0.2123 - val_accuracy: 0.9288
Epoch 9/200
79/79 [==============================] - 2s 20ms/step - loss: 0.2026 - accuracy:
0.9368 - val_loss: 0.2001 - val_accuracy: 0.9300
Epoch 10/200
79/79 [==============================] - 2s 20ms/step - loss: 0.1902 - accuracy:
0.9384 - val_loss: 0.1836 - val_accuracy: 0.9356
Epoch 11/200
79/79 [==============================] - 1s 13ms/step - loss: 0.1730 - accuracy:
0.9440 - val_loss: 0.1623 - val_accuracy: 0.9508
Epoch 12/200
79/79 [==============================] - 1s 15ms/step - loss: 0.1605 - accuracy:
0.9496 - val_loss: 0.1553 - val_accuracy: 0.9508
Epoch 13/200
79/79 [==============================] - 1s 14ms/step - loss: 0.1537 - accuracy:
0.9508 - val_loss: 0.1481 - val_accuracy: 0.9572
Epoch 14/200
79/79 [==============================] - 1s 14ms/step - loss: 0.1449 - accuracy:
0.9544 - val_loss: 0.1455 - val_accuracy: 0.9536
Epoch 15/200
79/79 [==============================] - 1s 14ms/step - loss: 0.1422 - accuracy:
0.9564 - val_loss: 0.1302 - val_accuracy: 0.9576
Epoch 16/200
79/79 [==============================] - 1s 15ms/step - loss: 0.1370 - accuracy:
0.9556 - val_loss: 0.1344 - val_accuracy: 0.9640
Epoch 17/200
79/79 [==============================] - 1s 13ms/step - loss: 0.1347 - accuracy:
0.9624 - val_loss: 0.1187 - val_accuracy: 0.9652
Epoch 18/200
79/79 [==============================] - 1s 13ms/step - loss: 0.1277 - accuracy:
0.9640 - val_loss: 0.1250 - val_accuracy: 0.9616
Epoch 19/200
79/79 [==============================] - 1s 14ms/step - loss: 0.1253 - accuracy:
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0.9624 - val_loss: 0.1151 - val_accuracy: 0.9660
Epoch 20/200
79/79 [==============================] - 2s 23ms/step - loss: 0.1247 - accuracy:
0.9620 - val_loss: 0.1291 - val_accuracy: 0.9544
Epoch 21/200
79/79 [==============================] - 1s 16ms/step - loss: 0.1411 - accuracy:
0.9544 - val_loss: 0.1326 - val_accuracy: 0.9564
Epoch 22/200
79/79 [==============================] - 1s 13ms/step - loss: 0.1171 - accuracy:
0.9624 - val_loss: 0.1212 - val_accuracy: 0.9692
Epoch 23/200
79/79 [==============================] - 1s 14ms/step - loss: 0.1099 - accuracy:
0.9668 - val_loss: 0.1154 - val_accuracy: 0.9652
Epoch 24/200
79/79 [==============================] - 1s 14ms/step - loss: 0.1095 - accuracy:
0.9652 - val_loss: 0.1042 - val_accuracy: 0.9724
Epoch 25/200
79/79 [==============================] - 1s 13ms/step - loss: 0.1009 - accuracy:
0.9720 - val_loss: 0.1124 - val_accuracy: 0.9680
Epoch 26/200
79/79 [==============================] - 1s 14ms/step - loss: 0.1050 - accuracy:
0.9712 - val_loss: 0.0981 - val_accuracy: 0.9700
Epoch 27/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0975 - accuracy:
0.9724 - val_loss: 0.1124 - val_accuracy: 0.9644
Epoch 28/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0954 - accuracy:
0.9740 - val_loss: 0.1004 - val_accuracy: 0.9736
Epoch 29/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0928 - accuracy:
0.9732 - val_loss: 0.1080 - val_accuracy: 0.9640
Epoch 30/200
79/79 [==============================] - 1s 17ms/step - loss: 0.0946 - accuracy:
0.9756 - val_loss: 0.1024 - val_accuracy: 0.9692
Epoch 31/200
79/79 [==============================] - 2s 22ms/step - loss: 0.0920 - accuracy:
0.9768 - val_loss: 0.1012 - val_accuracy: 0.9712
Epoch 32/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0877 - accuracy:
0.9784 - val_loss: 0.0937 - val_accuracy: 0.9732
Epoch 33/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0841 - accuracy:
0.9764 - val_loss: 0.0969 - val_accuracy: 0.9704
Epoch 34/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0834 - accuracy:
0.9756 - val_loss: 0.0980 - val_accuracy: 0.9676
Epoch 35/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0909 - accuracy:
0.9696 - val_loss: 0.1064 - val_accuracy: 0.9668
Epoch 36/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0815 - accuracy:
0.9744 - val_loss: 0.1016 - val_accuracy: 0.9664
Epoch 37/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0812 - accuracy:
0.9720 - val_loss: 0.0988 - val_accuracy: 0.9748
Epoch 38/200
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79/79 [==============================] - 1s 14ms/step - loss: 0.0746 - accuracy:
0.9796 - val_loss: 0.1072 - val_accuracy: 0.9644
Epoch 39/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0764 - accuracy:
0.9780 - val_loss: 0.1050 - val_accuracy: 0.9704
Epoch 40/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0966 - accuracy:
0.9720 - val_loss: 0.0924 - val_accuracy: 0.9724
Epoch 41/200
79/79 [==============================] - 2s 19ms/step - loss: 0.0792 - accuracy:
0.9776 - val_loss: 0.0920 - val_accuracy: 0.9740
Epoch 42/200
79/79 [==============================] - 2s 20ms/step - loss: 0.0702 - accuracy:
0.9808 - val_loss: 0.0947 - val_accuracy: 0.9724
Epoch 43/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0718 - accuracy:
0.9804 - val_loss: 0.0930 - val_accuracy: 0.9736
Epoch 44/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0726 - accuracy:
0.9756 - val_loss: 0.0931 - val_accuracy: 0.9724
Epoch 45/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0702 - accuracy:
0.9828 - val_loss: 0.0904 - val_accuracy: 0.9740
Epoch 46/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0710 - accuracy:
0.9784 - val_loss: 0.0957 - val_accuracy: 0.9704
Epoch 47/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0681 - accuracy:
0.9812 - val_loss: 0.0889 - val_accuracy: 0.9772
Epoch 48/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0634 - accuracy:
0.9840 - val_loss: 0.0854 - val_accuracy: 0.9788
Epoch 49/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0648 - accuracy:
0.9800 - val_loss: 0.0895 - val_accuracy: 0.9788
Epoch 50/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0629 - accuracy:
0.9804 - val_loss: 0.0971 - val_accuracy: 0.9724
Epoch 51/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0649 - accuracy:
0.9804 - val_loss: 0.0902 - val_accuracy: 0.9784
Epoch 52/200
79/79 [==============================] - 2s 26ms/step - loss: 0.0662 - accuracy:
0.9808 - val_loss: 0.0967 - val_accuracy: 0.9692
Epoch 53/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0641 - accuracy:
0.9796 - val_loss: 0.0877 - val_accuracy: 0.9776
Epoch 54/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0637 - accuracy:
0.9816 - val_loss: 0.0839 - val_accuracy: 0.9816
Epoch 55/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0575 - accuracy:
0.9840 - val_loss: 0.0876 - val_accuracy: 0.9804
Epoch 56/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0623 - accuracy:
0.9824 - val_loss: 0.0833 - val_accuracy: 0.9780
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Epoch 57/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0574 - accuracy:
0.9848 - val_loss: 0.0764 - val_accuracy: 0.9800
Epoch 58/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0604 - accuracy:
0.9840 - val_loss: 0.0885 - val_accuracy: 0.9780
Epoch 59/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0607 - accuracy:
0.9804 - val_loss: 0.0794 - val_accuracy: 0.9832
Epoch 60/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0565 - accuracy:
0.9852 - val_loss: 0.0898 - val_accuracy: 0.9752
Epoch 61/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0540 - accuracy:
0.9812 - val_loss: 0.0877 - val_accuracy: 0.9772
Epoch 62/200
79/79 [==============================] - 2s 20ms/step - loss: 0.0648 - accuracy:
0.9784 - val_loss: 0.1025 - val_accuracy: 0.9728
Epoch 63/200
79/79 [==============================] - 2s 22ms/step - loss: 0.0722 - accuracy:
0.9816 - val_loss: 0.0763 - val_accuracy: 0.9824
Epoch 64/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0580 - accuracy:
0.9832 - val_loss: 0.0872 - val_accuracy: 0.9792
Epoch 65/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0564 - accuracy:
0.9824 - val_loss: 0.0837 - val_accuracy: 0.9800
Epoch 66/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0530 - accuracy:
0.9868 - val_loss: 0.0781 - val_accuracy: 0.9824
Epoch 67/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0539 - accuracy:
0.9848 - val_loss: 0.0808 - val_accuracy: 0.9820
Epoch 68/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0538 - accuracy:
0.9840 - val_loss: 0.0790 - val_accuracy: 0.9796
Epoch 69/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0484 - accuracy:
0.9868 - val_loss: 0.0736 - val_accuracy: 0.9828
Epoch 70/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0496 - accuracy:
0.9864 - val_loss: 0.0904 - val_accuracy: 0.9768
Epoch 71/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0513 - accuracy:
0.9828 - val_loss: 0.0729 - val_accuracy: 0.9812
Epoch 72/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0520 - accuracy:
0.9856 - val_loss: 0.1090 - val_accuracy: 0.9704
Epoch 73/200
79/79 [==============================] - 2s 22ms/step - loss: 0.0729 - accuracy:
0.9816 - val_loss: 0.0712 - val_accuracy: 0.9844
Epoch 74/200
79/79 [==============================] - 1s 18ms/step - loss: 0.0528 - accuracy:
0.9880 - val_loss: 0.0742 - val_accuracy: 0.9816
Epoch 75/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0515 - accuracy:
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                 0.9860 - val_loss: 0.0708 - val_accuracy: 0.9776
                 Epoch 76/200
                 79/79 [==============================] - 1s 15ms/step - loss: 0.0502 - accuracy:
                 0.9872 - val_loss: 0.0746 - val_accuracy: 0.9832
                 Epoch 77/200
                 79/79 [==============================] - 1s 14ms/step - loss: 0.0494 - accuracy:
                 0.9876 - val_loss: 0.0711 - val_accuracy: 0.9836
                 Epoch 78/200
                 79/79 [==============================] - 1s 13ms/step - loss: 0.0572 - accuracy:
                 0.9848 - val_loss: 0.0701 - val_accuracy: 0.9832
                 Epoch 79/200
                 79/79 [==============================] - 1s 15ms/step - loss: 0.0494 - accuracy:
                 0.9868 - val_loss: 0.0629 - val_accuracy: 0.9872
                 Epoch 80/200
                 79/79 [==============================] - 1s 13ms/step - loss: 0.0436 - accuracy:
                 0.9888 - val_loss: 0.0814 - val_accuracy: 0.9816
                 Epoch 81/200
                 79/79 [==============================] - 1s 14ms/step - loss: 0.0475 - accuracy:
                 0.9848 - val_loss: 0.0806 - val_accuracy: 0.9812
                 Epoch 82/200
                 79/79 [==============================] - 1s 12ms/step - loss: 0.0512 - accuracy:
                 0.9848 - val_loss: 0.0667 - val_accuracy: 0.9840
                 Epoch 83/200
                 79/79 [==============================] - 1s 16ms/step - loss: 0.0468 - accuracy:
                 0.9872 - val_loss: 0.0688 - val_accuracy: 0.9804
                 Epoch 84/200
                 79/79 [==============================] - 2s 23ms/step - loss: 0.0443 - accuracy:
                 0.9876 - val_loss: 0.0793 - val_accuracy: 0.9820
                 Epoch 85/200
                 79/79 [==============================] - 1s 13ms/step - loss: 0.0498 - accuracy:
                 0.9832 - val_loss: 0.0700 - val_accuracy: 0.9824
                 Epoch 86/200
                 79/79 [==============================] - 1s 13ms/step - loss: 0.0426 - accuracy:
                 0.9880 - val_loss: 0.0747 - val_accuracy: 0.9800
                 Epoch 87/200
                 79/79 [==============================] - 1s 15ms/step - loss: 0.0509 - accuracy:
                 0.9848 - val_loss: 0.0568 - val_accuracy: 0.9884
                 Epoch 88/200
                 79/79 [==============================] - 1s 14ms/step - loss: 0.0457 - accuracy:
                 0.9888 - val_loss: 0.0708 - val_accuracy: 0.9836
                 Epoch 89/200
                 79/79 [==============================] - 1s 15ms/step - loss: 0.0538 - accuracy:
                 0.9864 - val_loss: 0.0734 - val_accuracy: 0.9832
                 Epoch 90/200
                 79/79 [==============================] - 1s 14ms/step - loss: 0.0419 - accuracy:
                 0.9868 - val_loss: 0.0716 - val_accuracy: 0.9828
                 Epoch 91/200
                 79/79 [==============================] - 1s 14ms/step - loss: 0.0473 - accuracy:
                 0.9836 - val_loss: 0.0609 - val_accuracy: 0.9832
                 Epoch 92/200
                 79/79 [==============================] - 1s 13ms/step - loss: 0.0417 - accuracy:
                 0.9872 - val_loss: 0.0595 - val_accuracy: 0.9864
                 Epoch 93/200
                 79/79 [==============================] - 1s 14ms/step - loss: 0.0439 - accuracy:
                 0.9868 - val_loss: 0.0575 - val_accuracy: 0.9832
                 Epoch 94/200
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79/79 [==============================] - 2s 21ms/step - loss: 0.0500 - accuracy:
0.9868 - val_loss: 0.0620 - val_accuracy: 0.9808
Epoch 95/200
79/79 [==============================] - 1s 19ms/step - loss: 0.0436 - accuracy:
0.9868 - val_loss: 0.0675 - val_accuracy: 0.9844
Epoch 96/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0466 - accuracy:
0.9864 - val_loss: 0.0701 - val_accuracy: 0.9804
Epoch 97/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0560 - accuracy:
0.9848 - val_loss: 0.1064 - val_accuracy: 0.9748
Epoch 98/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0523 - accuracy:
0.9852 - val_loss: 0.0566 - val_accuracy: 0.9876
Epoch 99/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0419 - accuracy:
0.9872 - val_loss: 0.0708 - val_accuracy: 0.9840
Epoch 100/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0457 - accuracy:
0.9892 - val_loss: 0.0652 - val_accuracy: 0.9832
Epoch 101/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0431 - accuracy:
0.9864 - val_loss: 0.0624 - val_accuracy: 0.9864
Epoch 102/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0399 - accuracy:
0.9884 - val_loss: 0.0545 - val_accuracy: 0.9888
Epoch 103/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0372 - accuracy:
0.9908 - val_loss: 0.0768 - val_accuracy: 0.9812
Epoch 104/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0529 - accuracy:
0.9888 - val_loss: 0.0676 - val_accuracy: 0.9844
Epoch 105/200
79/79 [==============================] - 2s 22ms/step - loss: 0.0387 - accuracy:
0.9908 - val_loss: 0.0534 - val_accuracy: 0.9880
Epoch 106/200
79/79 [==============================] - 1s 18ms/step - loss: 0.0362 - accuracy:
0.9900 - val_loss: 0.0498 - val_accuracy: 0.9900
Epoch 107/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0414 - accuracy:
0.9896 - val_loss: 0.0554 - val_accuracy: 0.9872
Epoch 108/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0381 - accuracy:
0.9904 - val_loss: 0.0557 - val_accuracy: 0.9876
Epoch 109/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0431 - accuracy:
0.9876 - val_loss: 0.0639 - val_accuracy: 0.9856
Epoch 110/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0482 - accuracy:
0.9856 - val_loss: 0.0692 - val_accuracy: 0.9836
Epoch 111/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0481 - accuracy:
0.9856 - val_loss: 0.0593 - val_accuracy: 0.9856
Epoch 112/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0470 - accuracy:
0.9868 - val_loss: 0.0620 - val_accuracy: 0.9864
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Epoch 113/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0443 - accuracy:
0.9884 - val_loss: 0.0484 - val_accuracy: 0.9900
Epoch 114/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0370 - accuracy:
0.9892 - val_loss: 0.0459 - val_accuracy: 0.9896
Epoch 115/200
79/79 [==============================] - 2s 20ms/step - loss: 0.0361 - accuracy:
0.9904 - val_loss: 0.0479 - val_accuracy: 0.9892
Epoch 116/200
79/79 [==============================] - 2s 20ms/step - loss: 0.0414 - accuracy:
0.9888 - val_loss: 0.0579 - val_accuracy: 0.9864
Epoch 117/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0404 - accuracy:
0.9868 - val_loss: 0.0591 - val_accuracy: 0.9848
Epoch 118/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0337 - accuracy:
0.9876 - val_loss: 0.0616 - val_accuracy: 0.9848
Epoch 119/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0403 - accuracy:
0.9888 - val_loss: 0.0558 - val_accuracy: 0.9844
Epoch 120/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0371 - accuracy:
0.9880 - val_loss: 0.0581 - val_accuracy: 0.9864
Epoch 121/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0427 - accuracy:
0.9876 - val_loss: 0.0584 - val_accuracy: 0.9872
Epoch 122/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0352 - accuracy:
0.9888 - val_loss: 0.0573 - val_accuracy: 0.9864
Epoch 123/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0341 - accuracy:
0.9892 - val_loss: 0.0525 - val_accuracy: 0.9868
Epoch 124/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0338 - accuracy:
0.9888 - val_loss: 0.0488 - val_accuracy: 0.9896
Epoch 125/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0443 - accuracy:
0.9896 - val_loss: 0.0572 - val_accuracy: 0.9876
Epoch 126/200
79/79 [==============================] - 2s 22ms/step - loss: 0.0425 - accuracy:
0.9884 - val_loss: 0.0642 - val_accuracy: 0.9848
Epoch 127/200
79/79 [==============================] - 2s 19ms/step - loss: 0.0464 - accuracy:
0.9872 - val_loss: 0.0547 - val_accuracy: 0.9872
Epoch 128/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0357 - accuracy:
0.9912 - val_loss: 0.0444 - val_accuracy: 0.9908
Epoch 129/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0404 - accuracy:
0.9888 - val_loss: 0.0366 - val_accuracy: 0.9916
Epoch 130/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0465 - accuracy:
0.9884 - val_loss: 0.0456 - val_accuracy: 0.9900
Epoch 131/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0410 - accuracy:
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0.9900 - val_loss: 0.0511 - val_accuracy: 0.9880
Epoch 132/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0403 - accuracy:
0.9872 - val_loss: 0.0439 - val_accuracy: 0.9916
Epoch 133/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0377 - accuracy:
0.9908 - val_loss: 0.0469 - val_accuracy: 0.9900
Epoch 134/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0377 - accuracy:
0.9892 - val_loss: 0.0419 - val_accuracy: 0.9904
Epoch 135/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0367 - accuracy:
0.9892 - val_loss: 0.0424 - val_accuracy: 0.9904
Epoch 136/200
79/79 [==============================] - 1s 18ms/step - loss: 0.0537 - accuracy:
0.9828 - val_loss: 0.0697 - val_accuracy: 0.9820
Epoch 137/200
79/79 [==============================] - 2s 22ms/step - loss: 0.0362 - accuracy:
0.9868 - val_loss: 0.0552 - val_accuracy: 0.9888
Epoch 138/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0416 - accuracy:
0.9876 - val_loss: 0.0634 - val_accuracy: 0.9832
Epoch 139/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0373 - accuracy:
0.9892 - val_loss: 0.0574 - val_accuracy: 0.9856
Epoch 140/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0380 - accuracy:
0.9912 - val_loss: 0.0534 - val_accuracy: 0.9888
Epoch 141/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0373 - accuracy:
0.9900 - val_loss: 0.0493 - val_accuracy: 0.9892
Epoch 142/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0335 - accuracy:
0.9916 - val_loss: 0.0524 - val_accuracy: 0.9904
Epoch 143/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0362 - accuracy:
0.9920 - val_loss: 0.0531 - val_accuracy: 0.9876
Epoch 144/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0338 - accuracy:
0.9912 - val_loss: 0.0487 - val_accuracy: 0.9884
Epoch 145/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0320 - accuracy:
0.9920 - val_loss: 0.0503 - val_accuracy: 0.9896
Epoch 146/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0335 - accuracy:
0.9904 - val_loss: 0.0442 - val_accuracy: 0.9904
Epoch 147/200
79/79 [==============================] - 2s 24ms/step - loss: 0.0317 - accuracy:
0.9924 - val_loss: 0.0500 - val_accuracy: 0.9896
Epoch 148/200
79/79 [==============================] - 1s 17ms/step - loss: 0.0352 - accuracy:
0.9896 - val_loss: 0.0378 - val_accuracy: 0.9912
Epoch 149/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0380 - accuracy:
0.9912 - val_loss: 0.0437 - val_accuracy: 0.9896
Epoch 150/200
```

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79/79 [==============================] - 1s 14ms/step - loss: 0.0367 - accuracy:
0.9900 - val_loss: 0.0393 - val_accuracy: 0.9908
Epoch 151/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0322 - accuracy:
0.9916 - val_loss: 0.0430 - val_accuracy: 0.9896
Epoch 152/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0442 - accuracy:
0.9900 - val_loss: 0.0495 - val_accuracy: 0.9904
Epoch 153/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0362 - accuracy:
0.9904 - val_loss: 0.0469 - val_accuracy: 0.9904
Epoch 154/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0373 - accuracy:
0.9900 - val_loss: 0.0393 - val_accuracy: 0.9916
Epoch 155/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0370 - accuracy:
0.9904 - val_loss: 0.0420 - val_accuracy: 0.9896
Epoch 156/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0338 - accuracy:
0.9908 - val_loss: 0.0482 - val_accuracy: 0.9916
Epoch 157/200
79/79 [==============================] - 1s 19ms/step - loss: 0.0373 - accuracy:
0.9904 - val_loss: 0.0384 - val_accuracy: 0.9908
Epoch 158/200
79/79 [==============================] - 2s 21ms/step - loss: 0.0365 - accuracy:
0.9900 - val_loss: 0.0441 - val_accuracy: 0.9892
Epoch 159/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0343 - accuracy:
0.9908 - val_loss: 0.0628 - val_accuracy: 0.9844
Epoch 160/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0385 - accuracy:
0.9868 - val_loss: 0.0534 - val_accuracy: 0.9876
Epoch 161/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0358 - accuracy:
0.9916 - val_loss: 0.0573 - val_accuracy: 0.9892
Epoch 162/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0275 - accuracy:
0.9924 - val_loss: 0.0619 - val_accuracy: 0.9872
Epoch 163/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0354 - accuracy:
0.9904 - val_loss: 0.0641 - val_accuracy: 0.9832
Epoch 164/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0376 - accuracy:
0.9892 - val_loss: 0.0364 - val_accuracy: 0.9896
Epoch 165/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0423 - accuracy:
0.9896 - val_loss: 0.0376 - val_accuracy: 0.9896
Epoch 166/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0356 - accuracy:
0.9900 - val_loss: 0.0524 - val_accuracy: 0.9896
Epoch 167/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0382 - accuracy:
0.9896 - val_loss: 0.0410 - val_accuracy: 0.9932
Epoch 168/200
79/79 [==============================] - 2s 21ms/step - loss: 0.0316 - accuracy:
0.9928 - val_loss: 0.0379 - val_accuracy: 0.9912
```

```
Epoch 169/200
79/79 [==============================] - 2s 20ms/step - loss: 0.0312 - accuracy:
0.9916 - val_loss: 0.0361 - val_accuracy: 0.9900
Epoch 170/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0290 - accuracy:
0.9900 - val_loss: 0.0535 - val_accuracy: 0.9888
Epoch 171/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0335 - accuracy:
0.9888 - val_loss: 0.0352 - val_accuracy: 0.9920
Epoch 172/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0297 - accuracy:
0.9916 - val_loss: 0.0366 - val_accuracy: 0.9896
Epoch 173/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0384 - accuracy:
0.9872 - val_loss: 0.0542 - val_accuracy: 0.9868
Epoch 174/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0371 - accuracy:
0.9904 - val_loss: 0.0423 - val_accuracy: 0.9888
Epoch 175/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0352 - accuracy:
0.9888 - val_loss: 0.0413 - val_accuracy: 0.9900
Epoch 176/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0322 - accuracy:
0.9892 - val_loss: 0.0517 - val_accuracy: 0.9880
Epoch 177/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0311 - accuracy:
0.9920 - val_loss: 0.0375 - val_accuracy: 0.9884
Epoch 178/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0275 - accuracy:
0.9916 - val_loss: 0.0383 - val_accuracy: 0.9912
Epoch 179/200
79/79 [==============================] - 2s 22ms/step - loss: 0.0347 - accuracy:
0.9868 - val_loss: 0.0579 - val_accuracy: 0.9864
Epoch 180/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0322 - accuracy:
0.9880 - val_loss: 0.0362 - val_accuracy: 0.9924
Epoch 181/200
79/79 [==============================] - 1s 16ms/step - loss: 0.0315 - accuracy:
0.9940 - val_loss: 0.0355 - val_accuracy: 0.9920
Epoch 182/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0349 - accuracy:
0.9892 - val_loss: 0.0329 - val_accuracy: 0.9912
Epoch 183/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0277 - accuracy:
0.9916 - val_loss: 0.0345 - val_accuracy: 0.9940
Epoch 184/200
79/79 [==============================] - 1s 14ms/step - loss: 0.0240 - accuracy:
0.9928 - val_loss: 0.0323 - val_accuracy: 0.9920
Epoch 185/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0342 - accuracy:
0.9896 - val_loss: 0.0566 - val_accuracy: 0.9904
Epoch 186/200
79/79 [==============================] - 1s 15ms/step - loss: 0.0243 - accuracy:
0.9924 - val_loss: 0.0590 - val_accuracy: 0.9896
Epoch 187/200
79/79 [==============================] - 1s 13ms/step - loss: 0.0287 - accuracy:
```

```
        0.9912 - val_loss: 0.0611 - val_accuracy: 0.9884
        Epoch 188/200
        79/79 [==============================] - 1s 15ms/step - loss: 0.0274 - accuracy:
        0.9912 - val_loss: 0.0541 - val_accuracy: 0.9896
        Epoch 189/200
        79/79 [==============================] - 2s 21ms/step - loss: 0.0242 - accuracy:
        0.9940 - val_loss: 0.0511 - val_accuracy: 0.9904
        Epoch 190/200
        79/79 [==============================] - 2s 19ms/step - loss: 0.0327 - accuracy:
        0.9908 - val_loss: 0.0487 - val_accuracy: 0.9900
        Epoch 191/200
        79/79 [==============================] - 1s 14ms/step - loss: 0.0250 - accuracy:
        0.9908 - val_loss: 0.0522 - val_accuracy: 0.9876
        Epoch 192/200
        79/79 [==============================] - 1s 15ms/step - loss: 0.0252 - accuracy:
        0.9932 - val_loss: 0.0470 - val_accuracy: 0.9900
        Epoch 193/200
        79/79 [==============================] - 1s 13ms/step - loss: 0.0225 - accuracy:
        0.9924 - val_loss: 0.0665 - val_accuracy: 0.9888
        Epoch 194/200
        79/79 [==============================] - 1s 14ms/step - loss: 0.0416 - accuracy:
        0.9896 - val_loss: 0.0689 - val_accuracy: 0.9884
        Epoch 195/200
        79/79 [==============================] - 1s 14ms/step - loss: 0.0257 - accuracy:
        0.9936 - val_loss: 0.0432 - val_accuracy: 0.9908
        Epoch 196/200
        79/79 [==============================] - 1s 15ms/step - loss: 0.0356 - accuracy:
        0.9904 - val_loss: 0.0422 - val_accuracy: 0.9896
        Epoch 197/200
        79/79 [==============================] - 1s 14ms/step - loss: 0.0281 - accuracy:
        0.9920 - val_loss: 0.0296 - val_accuracy: 0.9940
        Epoch 198/200
        79/79 [==============================] - 1s 14ms/step - loss: 0.0262 - accuracy:
        0.9928 - val_loss: 0.0405 - val_accuracy: 0.9912
        Epoch 199/200
        79/79 [==============================] - 1s 17ms/step - loss: 0.0244 - accuracy:
        0.9928 - val_loss: 0.0452 - val_accuracy: 0.9884
        Epoch 200/200
        79/79 [==============================] - 2s 26ms/step - loss: 0.0338 - accuracy:
        0.9904 - val_loss: 0.0385 - val_accuracy: 0.9920
```

```python
In [9]:  # Plot the loss
         plt.plot(r.history['loss'], label='loss')
         plt.plot(r.history['val_loss'], label='val_loss')
         plt.legend()
```
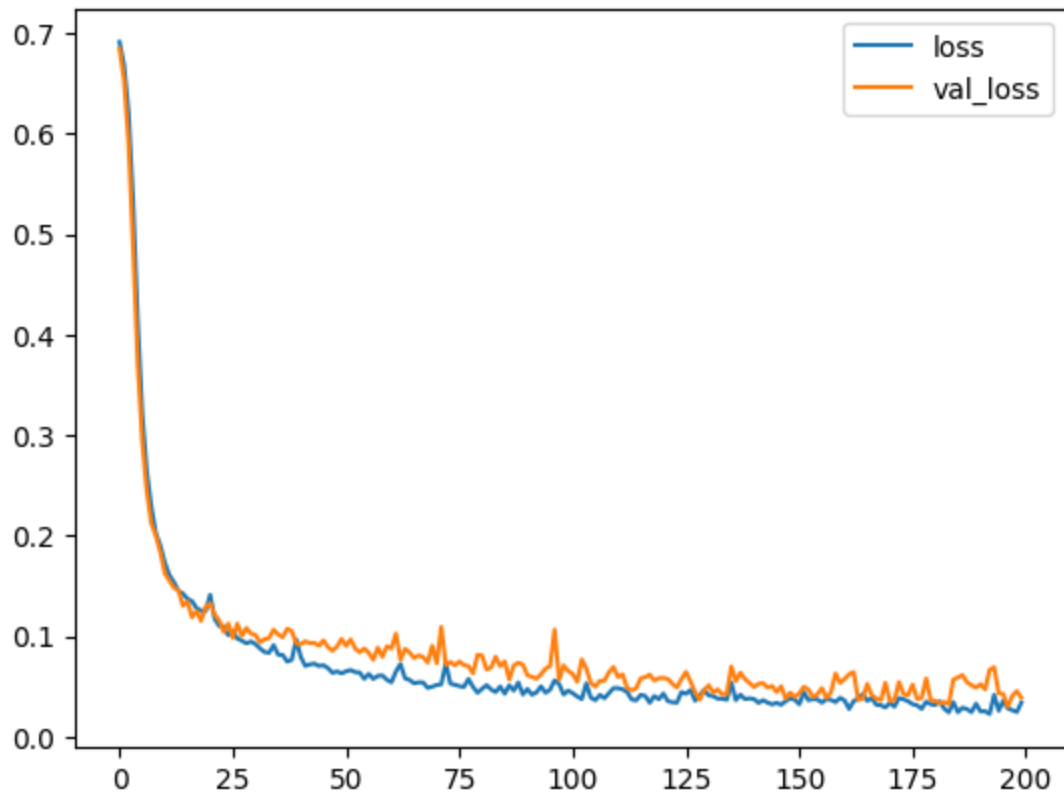
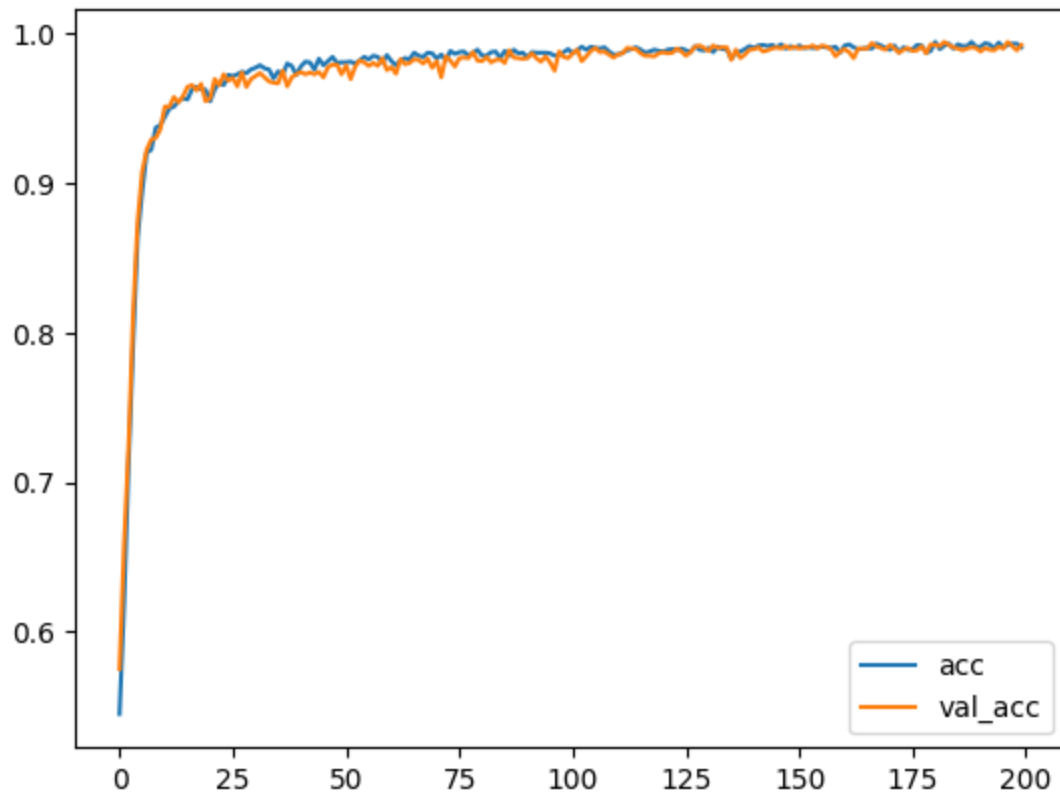Out[9]: <matplotlib.legend.Legend at 0x7f8c50513550>

```
In [10]:   # Plot the accuracy too
           plt.plot(r.history['accuracy'], label='acc')
           plt.plot(r.history['val_accuracy'], label='val_acc')
           plt.legend()
```

Out[10]:   <matplotlib.legend.Legend at 0x7f8be01871f0>

```
In [11]:  # Now change to the long distance problem

          # Start with a small T and increase it later
          T = 10
          D = 1
          X = []
          Y = []

          for t in range(5000):
            x = np.random.randn(T)
            X.append(x)
            y = get_label(x, 0, 1, 2) # long distance
            Y.append(y)

          X = np.array(X)
          Y = np.array(Y)
          N = len(X)
```

```
In [12]:  # Now test our Simple RNN again
          inputs = np.expand_dims(X, -1)

          # make the RNN
          i = Input(shape=(T, D))

          # method 1
          x = SimpleRNN(5)(i)

          x = Dense(1, activation='sigmoid')(x)
          model = Model(i, x)
          model.compile(
```

```python
  loss='binary_crossentropy',
  optimizer=Adam(learning_rate=0.01),
  metrics=['accuracy'],
)

# train the RNN
r = model.fit(
  inputs, Y,
  epochs=200,
  validation_split=0.5,
)
```

```
Epoch 1/200
79/79 [==============================] - 3s 15ms/step - loss: 0.7010 - accuracy:
0.5128 - val_loss: 0.6983 - val_accuracy: 0.4968
Epoch 2/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6946 - accuracy:
0.5092 - val_loss: 0.6956 - val_accuracy: 0.4996
Epoch 3/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6935 - accuracy:
0.5164 - val_loss: 0.6974 - val_accuracy: 0.5104
Epoch 4/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6935 - accuracy:
0.5164 - val_loss: 0.6968 - val_accuracy: 0.5144
Epoch 5/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6935 - accuracy:
0.5184 - val_loss: 0.6951 - val_accuracy: 0.5032
Epoch 6/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6934 - accuracy:
0.5132 - val_loss: 0.6962 - val_accuracy: 0.5000
Epoch 7/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6925 - accuracy:
0.5084 - val_loss: 0.6953 - val_accuracy: 0.5024
Epoch 8/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6926 - accuracy:
0.5248 - val_loss: 0.6984 - val_accuracy: 0.5064
Epoch 9/200
79/79 [==============================] - 1s 18ms/step - loss: 0.6920 - accuracy:
0.5132 - val_loss: 0.6947 - val_accuracy: 0.5116
Epoch 10/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6923 - accuracy:
0.5116 - val_loss: 0.6959 - val_accuracy: 0.4996
Epoch 11/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6924 - accuracy:
0.5304 - val_loss: 0.6974 - val_accuracy: 0.5028
Epoch 12/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6924 - accuracy:
0.5124 - val_loss: 0.6953 - val_accuracy: 0.5092
Epoch 13/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6919 - accuracy:
0.5064 - val_loss: 0.6952 - val_accuracy: 0.5168
Epoch 14/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6918 - accuracy:
0.5212 - val_loss: 0.6965 - val_accuracy: 0.5012
Epoch 15/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6910 - accuracy:
0.5264 - val_loss: 0.6960 - val_accuracy: 0.5096
Epoch 16/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6914 - accuracy:
0.5228 - val_loss: 0.6979 - val_accuracy: 0.4956
Epoch 17/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6908 - accuracy:
0.5208 - val_loss: 0.6972 - val_accuracy: 0.5192
Epoch 18/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6931 - accuracy:
0.5204 - val_loss: 0.6960 - val_accuracy: 0.5144
Epoch 19/200
79/79 [==============================] - 2s 22ms/step - loss: 0.6901 - accuracy:
```

```
0.5216 - val_loss: 0.6961 - val_accuracy: 0.5032
Epoch 20/200
79/79 [==============================] - 1s 18ms/step - loss: 0.6894 - accuracy:
0.5336 - val_loss: 0.6980 - val_accuracy: 0.5084
Epoch 21/200
79/79 [==============================] - 1s 15ms/step - loss: 0.6907 - accuracy:
0.5272 - val_loss: 0.6998 - val_accuracy: 0.5132
Epoch 22/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6904 - accuracy:
0.5368 - val_loss: 0.6968 - val_accuracy: 0.5004
Epoch 23/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6891 - accuracy:
0.5380 - val_loss: 0.6960 - val_accuracy: 0.5088
Epoch 24/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6898 - accuracy:
0.5400 - val_loss: 0.6987 - val_accuracy: 0.4948
Epoch 25/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6901 - accuracy:
0.5356 - val_loss: 0.6960 - val_accuracy: 0.5092
Epoch 26/200
79/79 [==============================] - 1s 15ms/step - loss: 0.6884 - accuracy:
0.5400 - val_loss: 0.6976 - val_accuracy: 0.5140
Epoch 27/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6882 - accuracy:
0.5320 - val_loss: 0.6971 - val_accuracy: 0.5176
Epoch 28/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6874 - accuracy:
0.5384 - val_loss: 0.6973 - val_accuracy: 0.5080
Epoch 29/200
79/79 [==============================] - 1s 15ms/step - loss: 0.6886 - accuracy:
0.5408 - val_loss: 0.6969 - val_accuracy: 0.5064
Epoch 30/200
79/79 [==============================] - 2s 26ms/step - loss: 0.6871 - accuracy:
0.5288 - val_loss: 0.6970 - val_accuracy: 0.5072
Epoch 31/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6869 - accuracy:
0.5424 - val_loss: 0.6986 - val_accuracy: 0.4984
Epoch 32/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6879 - accuracy:
0.5352 - val_loss: 0.6994 - val_accuracy: 0.5080
Epoch 33/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6866 - accuracy:
0.5400 - val_loss: 0.7006 - val_accuracy: 0.5116
Epoch 34/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6875 - accuracy:
0.5368 - val_loss: 0.6989 - val_accuracy: 0.5148
Epoch 35/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6880 - accuracy:
0.5376 - val_loss: 0.6968 - val_accuracy: 0.5080
Epoch 36/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6853 - accuracy:
0.5476 - val_loss: 0.6998 - val_accuracy: 0.5240
Epoch 37/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6854 - accuracy:
0.5456 - val_loss: 0.6982 - val_accuracy: 0.5068
Epoch 38/200
```

```
79/79 [==============================] - 1s 14ms/step - loss: 0.6862 - accuracy:
0.5516 - val_loss: 0.6990 - val_accuracy: 0.5192
Epoch 39/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6838 - accuracy:
0.5548 - val_loss: 0.7039 - val_accuracy: 0.4964
Epoch 40/200
79/79 [==============================] - 2s 24ms/step - loss: 0.6874 - accuracy:
0.5372 - val_loss: 0.7009 - val_accuracy: 0.4928
Epoch 41/200
79/79 [==============================] - 1s 18ms/step - loss: 0.6834 - accuracy:
0.5472 - val_loss: 0.7020 - val_accuracy: 0.4988
Epoch 42/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6823 - accuracy:
0.5564 - val_loss: 0.7022 - val_accuracy: 0.5116
Epoch 43/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6831 - accuracy:
0.5572 - val_loss: 0.7015 - val_accuracy: 0.5056
Epoch 44/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6843 - accuracy:
0.5636 - val_loss: 0.7031 - val_accuracy: 0.5068
Epoch 45/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6830 - accuracy:
0.5588 - val_loss: 0.7043 - val_accuracy: 0.5004
Epoch 46/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6815 - accuracy:
0.5568 - val_loss: 0.7024 - val_accuracy: 0.5076
Epoch 47/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6809 - accuracy:
0.5664 - val_loss: 0.7020 - val_accuracy: 0.5116
Epoch 48/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6808 - accuracy:
0.5660 - val_loss: 0.7045 - val_accuracy: 0.5012
Epoch 49/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6812 - accuracy:
0.5584 - val_loss: 0.7041 - val_accuracy: 0.5112
Epoch 50/200
79/79 [==============================] - 1s 17ms/step - loss: 0.6796 - accuracy:
0.5616 - val_loss: 0.7016 - val_accuracy: 0.5192
Epoch 51/200
79/79 [==============================] - 2s 25ms/step - loss: 0.6811 - accuracy:
0.5532 - val_loss: 0.7020 - val_accuracy: 0.4996
Epoch 52/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6776 - accuracy:
0.5728 - val_loss: 0.7035 - val_accuracy: 0.5040
Epoch 53/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6792 - accuracy:
0.5732 - val_loss: 0.7044 - val_accuracy: 0.5140
Epoch 54/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6781 - accuracy:
0.5692 - val_loss: 0.7024 - val_accuracy: 0.5072
Epoch 55/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6806 - accuracy:
0.5672 - val_loss: 0.7017 - val_accuracy: 0.5136
Epoch 56/200
79/79 [==============================] - 1s 12ms/step - loss: 0.6807 - accuracy:
0.5540 - val_loss: 0.7024 - val_accuracy: 0.5148
```

```
Epoch 57/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6801 - accuracy:
0.5652 - val_loss: 0.7018 - val_accuracy: 0.5116
Epoch 58/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6800 - accuracy:
0.5596 - val_loss: 0.7034 - val_accuracy: 0.5024
Epoch 59/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6800 - accuracy:
0.5648 - val_loss: 0.7071 - val_accuracy: 0.4924
Epoch 60/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6777 - accuracy:
0.5620 - val_loss: 0.7065 - val_accuracy: 0.4988
Epoch 61/200
79/79 [==============================] - 2s 22ms/step - loss: 0.6785 - accuracy:
0.5696 - val_loss: 0.7082 - val_accuracy: 0.5088
Epoch 62/200
79/79 [==============================] - 1s 19ms/step - loss: 0.6810 - accuracy:
0.5680 - val_loss: 0.7045 - val_accuracy: 0.5180
Epoch 63/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6784 - accuracy:
0.5740 - val_loss: 0.7035 - val_accuracy: 0.5172
Epoch 64/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6810 - accuracy:
0.5660 - val_loss: 0.7049 - val_accuracy: 0.5172
Epoch 65/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6790 - accuracy:
0.5632 - val_loss: 0.7053 - val_accuracy: 0.5024
Epoch 66/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6794 - accuracy:
0.5700 - val_loss: 0.7017 - val_accuracy: 0.5040
Epoch 67/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6802 - accuracy:
0.5640 - val_loss: 0.7031 - val_accuracy: 0.5116
Epoch 68/200
79/79 [==============================] - 1s 15ms/step - loss: 0.6777 - accuracy:
0.5668 - val_loss: 0.7038 - val_accuracy: 0.5116
Epoch 69/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6768 - accuracy:
0.5736 - val_loss: 0.7057 - val_accuracy: 0.5088
Epoch 70/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6793 - accuracy:
0.5716 - val_loss: 0.7064 - val_accuracy: 0.5132
Epoch 71/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6784 - accuracy:
0.5728 - val_loss: 0.7056 - val_accuracy: 0.5008
Epoch 72/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6805 - accuracy:
0.5696 - val_loss: 0.7068 - val_accuracy: 0.5068
Epoch 73/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6788 - accuracy:
0.5676 - val_loss: 0.7047 - val_accuracy: 0.5056
Epoch 74/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6808 - accuracy:
0.5684 - val_loss: 0.7044 - val_accuracy: 0.4984
Epoch 75/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6778 - accuracy:
```

```
0.5772 - val_loss: 0.7073 - val_accuracy: 0.5000
Epoch 76/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6794 - accuracy:
0.5632 - val_loss: 0.7043 - val_accuracy: 0.5128
Epoch 77/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6780 - accuracy:
0.5676 - val_loss: 0.7054 - val_accuracy: 0.4936
Epoch 78/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6766 - accuracy:
0.5744 - val_loss: 0.7083 - val_accuracy: 0.5044
Epoch 79/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6796 - accuracy:
0.5660 - val_loss: 0.7074 - val_accuracy: 0.5100
Epoch 80/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6796 - accuracy:
0.5656 - val_loss: 0.7060 - val_accuracy: 0.5112
Epoch 81/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6781 - accuracy:
0.5720 - val_loss: 0.7069 - val_accuracy: 0.5016
Epoch 82/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6770 - accuracy:
0.5764 - val_loss: 0.7051 - val_accuracy: 0.5072
Epoch 83/200
79/79 [==============================] - 2s 22ms/step - loss: 0.6783 - accuracy:
0.5716 - val_loss: 0.7047 - val_accuracy: 0.5024
Epoch 84/200
79/79 [==============================] - 1s 12ms/step - loss: 0.6779 - accuracy:
0.5628 - val_loss: 0.7083 - val_accuracy: 0.5040
Epoch 85/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6765 - accuracy:
0.5708 - val_loss: 0.7074 - val_accuracy: 0.5060
Epoch 86/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6801 - accuracy:
0.5708 - val_loss: 0.7080 - val_accuracy: 0.5088
Epoch 87/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6787 - accuracy:
0.5768 - val_loss: 0.7080 - val_accuracy: 0.5072
Epoch 88/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6777 - accuracy:
0.5716 - val_loss: 0.7048 - val_accuracy: 0.5092
Epoch 89/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6802 - accuracy:
0.5596 - val_loss: 0.7074 - val_accuracy: 0.5024
Epoch 90/200
79/79 [==============================] - 1s 15ms/step - loss: 0.6830 - accuracy:
0.5592 - val_loss: 0.7062 - val_accuracy: 0.5080
Epoch 91/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6784 - accuracy:
0.5772 - val_loss: 0.7054 - val_accuracy: 0.5148
Epoch 92/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6790 - accuracy:
0.5696 - val_loss: 0.7052 - val_accuracy: 0.5072
Epoch 93/200
79/79 [==============================] - 2s 25ms/step - loss: 0.6837 - accuracy:
0.5696 - val_loss: 0.7061 - val_accuracy: 0.5080
Epoch 94/200
```

```
79/79 [==============================] - 1s 17ms/step - loss: 0.6827 - accuracy:
0.5588 - val_loss: 0.7057 - val_accuracy: 0.4976
Epoch 95/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6799 - accuracy:
0.5612 - val_loss: 0.7040 - val_accuracy: 0.5040
Epoch 96/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6772 - accuracy:
0.5692 - val_loss: 0.7067 - val_accuracy: 0.5024
Epoch 97/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6789 - accuracy:
0.5756 - val_loss: 0.7043 - val_accuracy: 0.5072
Epoch 98/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6773 - accuracy:
0.5672 - val_loss: 0.7060 - val_accuracy: 0.5072
Epoch 99/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6758 - accuracy:
0.5784 - val_loss: 0.7052 - val_accuracy: 0.5084
Epoch 100/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6763 - accuracy:
0.5736 - val_loss: 0.7090 - val_accuracy: 0.5028
Epoch 101/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6789 - accuracy:
0.5680 - val_loss: 0.7057 - val_accuracy: 0.5056
Epoch 102/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6771 - accuracy:
0.5732 - val_loss: 0.7064 - val_accuracy: 0.5008
Epoch 103/200
79/79 [==============================] - 1s 18ms/step - loss: 0.6762 - accuracy:
0.5720 - val_loss: 0.7068 - val_accuracy: 0.5028
Epoch 104/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6776 - accuracy:
0.5660 - val_loss: 0.7102 - val_accuracy: 0.4976
Epoch 105/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6807 - accuracy:
0.5636 - val_loss: 0.7067 - val_accuracy: 0.5012
Epoch 106/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6776 - accuracy:
0.5596 - val_loss: 0.7115 - val_accuracy: 0.4976
Epoch 107/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6762 - accuracy:
0.5744 - val_loss: 0.7134 - val_accuracy: 0.5112
Epoch 108/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6768 - accuracy:
0.5724 - val_loss: 0.7106 - val_accuracy: 0.4924
Epoch 109/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6798 - accuracy:
0.5716 - val_loss: 0.7079 - val_accuracy: 0.5024
Epoch 110/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6773 - accuracy:
0.5752 - val_loss: 0.7094 - val_accuracy: 0.5024
Epoch 111/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6752 - accuracy:
0.5784 - val_loss: 0.7082 - val_accuracy: 0.5060
Epoch 112/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6760 - accuracy:
0.5728 - val_loss: 0.7089 - val_accuracy: 0.4972
```

```
Epoch 113/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6770 - accuracy:
0.5748 - val_loss: 0.7092 - val_accuracy: 0.5008
Epoch 114/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6759 - accuracy:
0.5748 - val_loss: 0.7135 - val_accuracy: 0.5000
Epoch 115/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6789 - accuracy:
0.5760 - val_loss: 0.7073 - val_accuracy: 0.5072
Epoch 116/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6782 - accuracy:
0.5724 - val_loss: 0.7142 - val_accuracy: 0.5036
Epoch 117/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6812 - accuracy:
0.5700 - val_loss: 0.7085 - val_accuracy: 0.4896
Epoch 118/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6768 - accuracy:
0.5784 - val_loss: 0.7116 - val_accuracy: 0.4948
Epoch 119/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6783 - accuracy:
0.5800 - val_loss: 0.7090 - val_accuracy: 0.4956
Epoch 120/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6759 - accuracy:
0.5780 - val_loss: 0.7128 - val_accuracy: 0.4832
Epoch 121/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6768 - accuracy:
0.5748 - val_loss: 0.7094 - val_accuracy: 0.4912
Epoch 122/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6806 - accuracy:
0.5668 - val_loss: 0.7065 - val_accuracy: 0.5032
Epoch 123/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6768 - accuracy:
0.5692 - val_loss: 0.7067 - val_accuracy: 0.4972
Epoch 124/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6779 - accuracy:
0.5764 - val_loss: 0.7102 - val_accuracy: 0.4912
Epoch 125/200
79/79 [==============================] - 2s 23ms/step - loss: 0.6758 - accuracy:
0.5744 - val_loss: 0.7132 - val_accuracy: 0.4912
Epoch 126/200
79/79 [==============================] - 1s 17ms/step - loss: 0.6770 - accuracy:
0.5704 - val_loss: 0.7117 - val_accuracy: 0.5040
Epoch 127/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6756 - accuracy:
0.5760 - val_loss: 0.7140 - val_accuracy: 0.5000
Epoch 128/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6768 - accuracy:
0.5700 - val_loss: 0.7103 - val_accuracy: 0.4972
Epoch 129/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6746 - accuracy:
0.5704 - val_loss: 0.7115 - val_accuracy: 0.4968
Epoch 130/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6769 - accuracy:
0.5788 - val_loss: 0.7113 - val_accuracy: 0.4948
Epoch 131/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6762 - accuracy:
```

```
0.5760 - val_loss: 0.7101 - val_accuracy: 0.4988
Epoch 132/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6746 - accuracy:
0.5768 - val_loss: 0.7085 - val_accuracy: 0.5056
Epoch 133/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6765 - accuracy:
0.5736 - val_loss: 0.7092 - val_accuracy: 0.4964
Epoch 134/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6769 - accuracy:
0.5756 - val_loss: 0.7083 - val_accuracy: 0.5024
Epoch 135/200
79/79 [==============================] - 1s 15ms/step - loss: 0.6765 - accuracy:
0.5792 - val_loss: 0.7141 - val_accuracy: 0.4948
Epoch 136/200
79/79 [==============================] - 2s 22ms/step - loss: 0.6802 - accuracy:
0.5664 - val_loss: 0.7093 - val_accuracy: 0.4996
Epoch 137/200
79/79 [==============================] - 1s 15ms/step - loss: 0.6789 - accuracy:
0.5660 - val_loss: 0.7104 - val_accuracy: 0.5008
Epoch 138/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6768 - accuracy:
0.5752 - val_loss: 0.7106 - val_accuracy: 0.4956
Epoch 139/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6748 - accuracy:
0.5816 - val_loss: 0.7132 - val_accuracy: 0.4856
Epoch 140/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6745 - accuracy:
0.5788 - val_loss: 0.7117 - val_accuracy: 0.4988
Epoch 141/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6755 - accuracy:
0.5880 - val_loss: 0.7121 - val_accuracy: 0.4956
Epoch 142/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6777 - accuracy:
0.5660 - val_loss: 0.7106 - val_accuracy: 0.4944
Epoch 143/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6821 - accuracy:
0.5660 - val_loss: 0.7069 - val_accuracy: 0.5056
Epoch 144/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6753 - accuracy:
0.5860 - val_loss: 0.7108 - val_accuracy: 0.4992
Epoch 145/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6742 - accuracy:
0.5780 - val_loss: 0.7097 - val_accuracy: 0.5044
Epoch 146/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6781 - accuracy:
0.5712 - val_loss: 0.7119 - val_accuracy: 0.5056
Epoch 147/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6765 - accuracy:
0.5748 - val_loss: 0.7106 - val_accuracy: 0.4944
Epoch 148/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6811 - accuracy:
0.5620 - val_loss: 0.7101 - val_accuracy: 0.5112
Epoch 149/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6789 - accuracy:
0.5732 - val_loss: 0.7075 - val_accuracy: 0.5004
Epoch 150/200
```

```
79/79 [==============================] - 1s 13ms/step - loss: 0.6756 - accuracy:
0.5664 - val_loss: 0.7145 - val_accuracy: 0.4884
Epoch 151/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6783 - accuracy:
0.5676 - val_loss: 0.7082 - val_accuracy: 0.4968
Epoch 152/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6765 - accuracy:
0.5748 - val_loss: 0.7108 - val_accuracy: 0.5032
Epoch 153/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6779 - accuracy:
0.5672 - val_loss: 0.7082 - val_accuracy: 0.4976
Epoch 154/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6798 - accuracy:
0.5640 - val_loss: 0.7086 - val_accuracy: 0.4944
Epoch 155/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6740 - accuracy:
0.5764 - val_loss: 0.7107 - val_accuracy: 0.5008
Epoch 156/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6805 - accuracy:
0.5676 - val_loss: 0.7099 - val_accuracy: 0.4964
Epoch 157/200
79/79 [==============================] - 2s 23ms/step - loss: 0.6783 - accuracy:
0.5668 - val_loss: 0.7065 - val_accuracy: 0.5040
Epoch 158/200
79/79 [==============================] - 1s 17ms/step - loss: 0.6760 - accuracy:
0.5680 - val_loss: 0.7103 - val_accuracy: 0.5012
Epoch 159/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6760 - accuracy:
0.5744 - val_loss: 0.7116 - val_accuracy: 0.5028
Epoch 160/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6749 - accuracy:
0.5788 - val_loss: 0.7127 - val_accuracy: 0.4944
Epoch 161/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6755 - accuracy:
0.5788 - val_loss: 0.7178 - val_accuracy: 0.4972
Epoch 162/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6836 - accuracy:
0.5620 - val_loss: 0.7100 - val_accuracy: 0.4944
Epoch 163/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6782 - accuracy:
0.5676 - val_loss: 0.7095 - val_accuracy: 0.4996
Epoch 164/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6765 - accuracy:
0.5764 - val_loss: 0.7104 - val_accuracy: 0.4984
Epoch 165/200
79/79 [==============================] - 1s 15ms/step - loss: 0.6738 - accuracy:
0.5844 - val_loss: 0.7126 - val_accuracy: 0.4888
Epoch 166/200
79/79 [==============================] - 1s 15ms/step - loss: 0.6765 - accuracy:
0.5744 - val_loss: 0.7110 - val_accuracy: 0.4908
Epoch 167/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6741 - accuracy:
0.5856 - val_loss: 0.7141 - val_accuracy: 0.4904
Epoch 168/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6756 - accuracy:
0.5692 - val_loss: 0.7164 - val_accuracy: 0.4884
```

```
Epoch 169/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6791 - accuracy:
0.5728 - val_loss: 0.7115 - val_accuracy: 0.4996
Epoch 170/200
79/79 [==============================] - 1s 15ms/step - loss: 0.6778 - accuracy:
0.5692 - val_loss: 0.7094 - val_accuracy: 0.4904
Epoch 171/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6763 - accuracy:
0.5732 - val_loss: 0.7125 - val_accuracy: 0.5032
Epoch 172/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6774 - accuracy:
0.5652 - val_loss: 0.7099 - val_accuracy: 0.5056
Epoch 173/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6780 - accuracy:
0.5764 - val_loss: 0.7094 - val_accuracy: 0.4992
Epoch 174/200
79/79 [==============================] - 1s 15ms/step - loss: 0.6752 - accuracy:
0.5836 - val_loss: 0.7108 - val_accuracy: 0.4972
Epoch 175/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6788 - accuracy:
0.5656 - val_loss: 0.7107 - val_accuracy: 0.4960
Epoch 176/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6762 - accuracy:
0.5836 - val_loss: 0.7118 - val_accuracy: 0.4948
Epoch 177/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6776 - accuracy:
0.5684 - val_loss: 0.7117 - val_accuracy: 0.4988
Epoch 178/200
79/79 [==============================] - 2s 25ms/step - loss: 0.6765 - accuracy:
0.5772 - val_loss: 0.7099 - val_accuracy: 0.5040
Epoch 179/200
79/79 [==============================] - 1s 15ms/step - loss: 0.6766 - accuracy:
0.5756 - val_loss: 0.7129 - val_accuracy: 0.4900
Epoch 180/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6780 - accuracy:
0.5776 - val_loss: 0.7125 - val_accuracy: 0.4920
Epoch 181/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6775 - accuracy:
0.5776 - val_loss: 0.7091 - val_accuracy: 0.4996
Epoch 182/200
79/79 [==============================] - 1s 14ms/step - loss: 0.6808 - accuracy:
0.5668 - val_loss: 0.7078 - val_accuracy: 0.5008
Epoch 183/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6809 - accuracy:
0.5648 - val_loss: 0.7088 - val_accuracy: 0.4952
Epoch 184/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6790 - accuracy:
0.5668 - val_loss: 0.7060 - val_accuracy: 0.5056
Epoch 185/200
79/79 [==============================] - 1s 15ms/step - loss: 0.6756 - accuracy:
0.5788 - val_loss: 0.7106 - val_accuracy: 0.5032
Epoch 186/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6790 - accuracy:
0.5664 - val_loss: 0.7107 - val_accuracy: 0.4952
Epoch 187/200
79/79 [==============================] - 1s 13ms/step - loss: 0.6773 - accuracy:
```

```
              0.5708 - val_loss: 0.7099 - val_accuracy: 0.5044
              Epoch 188/200
              79/79 [==============================] - 2s 20ms/step - loss: 0.6744 - accuracy:
              0.5812 - val_loss: 0.7120 - val_accuracy: 0.4908
              Epoch 189/200
              79/79 [==============================] - 2s 21ms/step - loss: 0.6755 - accuracy:
              0.5804 - val_loss: 0.7112 - val_accuracy: 0.5056
              Epoch 190/200
              79/79 [==============================] - 1s 14ms/step - loss: 0.6736 - accuracy:
              0.5820 - val_loss: 0.7114 - val_accuracy: 0.4976
              Epoch 191/200
              79/79 [==============================] - 1s 14ms/step - loss: 0.6727 - accuracy:
              0.5868 - val_loss: 0.7135 - val_accuracy: 0.4988
              Epoch 192/200
              79/79 [==============================] - 1s 13ms/step - loss: 0.6785 - accuracy:
              0.5752 - val_loss: 0.7132 - val_accuracy: 0.5064
              Epoch 193/200
              79/79 [==============================] - 1s 15ms/step - loss: 0.6765 - accuracy:
              0.5852 - val_loss: 0.7175 - val_accuracy: 0.4948
              Epoch 194/200
              79/79 [==============================] - 1s 13ms/step - loss: 0.6762 - accuracy:
              0.5832 - val_loss: 0.7160 - val_accuracy: 0.4976
              Epoch 195/200
              79/79 [==============================] - 1s 14ms/step - loss: 0.6776 - accuracy:
              0.5764 - val_loss: 0.7110 - val_accuracy: 0.4928
              Epoch 196/200
              79/79 [==============================] - 1s 15ms/step - loss: 0.6778 - accuracy:
              0.5736 - val_loss: 0.7127 - val_accuracy: 0.4960
              Epoch 197/200
              79/79 [==============================] - 1s 15ms/step - loss: 0.6759 - accuracy:
              0.5704 - val_loss: 0.7126 - val_accuracy: 0.4908
              Epoch 198/200
              79/79 [==============================] - 1s 14ms/step - loss: 0.6748 - accuracy:
              0.5748 - val_loss: 0.7118 - val_accuracy: 0.4976
              Epoch 199/200
              79/79 [==============================] - 2s 21ms/step - loss: 0.6727 - accuracy:
              0.5796 - val_loss: 0.7137 - val_accuracy: 0.4828
              Epoch 200/200
              79/79 [==============================] - 1s 18ms/step - loss: 0.6758 - accuracy:
              0.5756 - val_loss: 0.7128 - val_accuracy: 0.4936
```
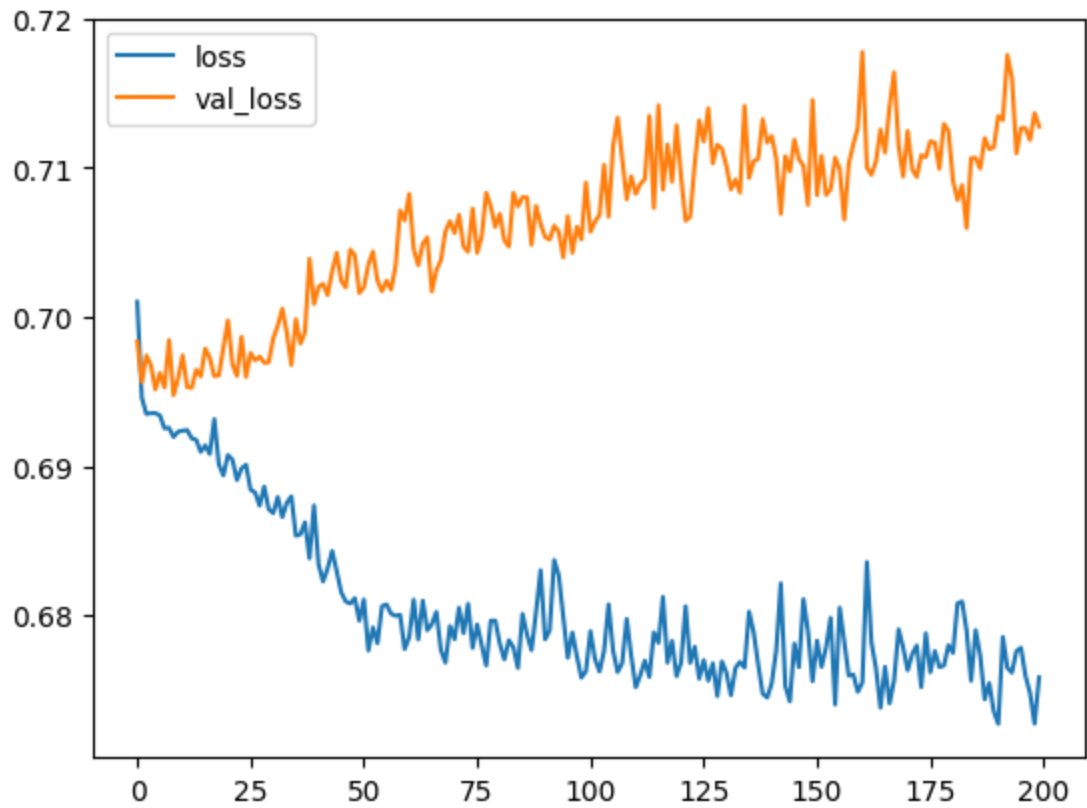
In [13]:
```python
# Plot the loss
plt.plot(r.history['loss'], label='loss')
plt.plot(r.history['val_loss'], label='val_loss')
plt.legend()
```

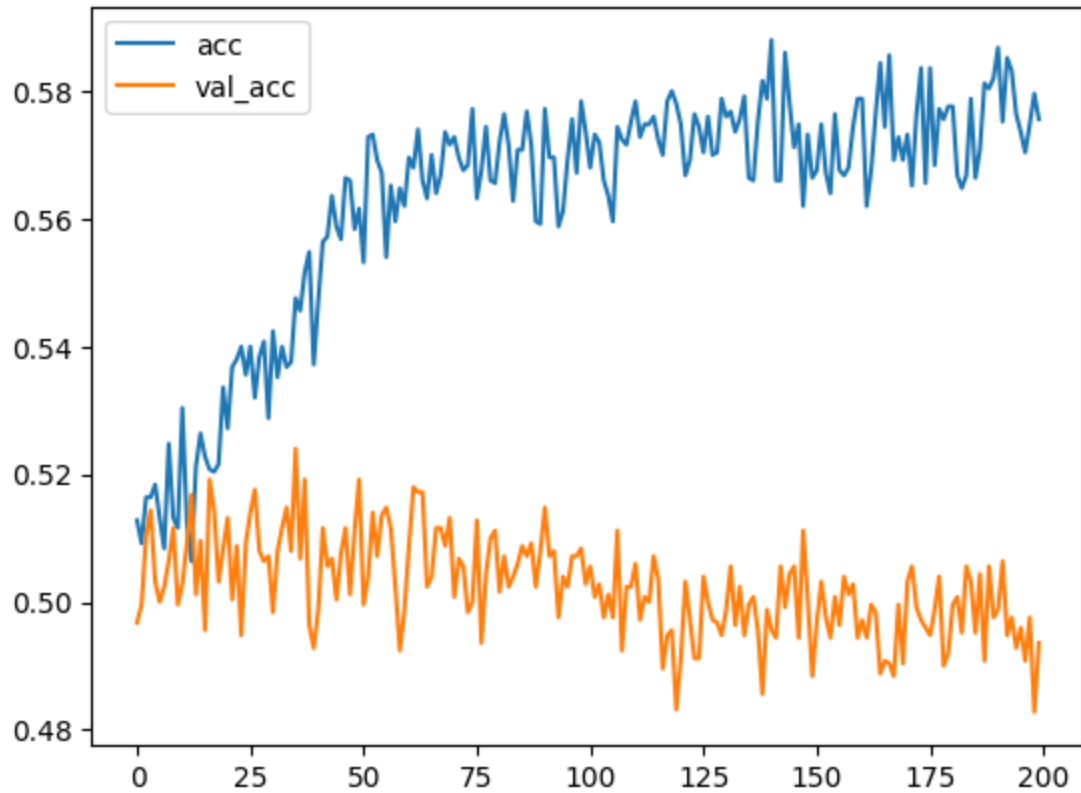Out[13]: <matplotlib.legend.Legend at 0x7f8bd86be650>

```
In [14]:  # Plot the accuracy too
          plt.plot(r.history['accuracy'], label='acc')
          plt.plot(r.history['val_accuracy'], label='val_acc')
          plt.legend()
```

Out[14]: <matplotlib.legend.Legend at 0x7f8bd8f279d0>

```
In [15]: # Now test our LSTM
         inputs = np.expand_dims(X, -1)

         # make the RNN
         i = Input(shape=(T, D))

         # method 1
         x = LSTM(5)(i)

         x = Dense(1, activation='sigmoid')(x)
         model = Model(i, x)
         model.compile(
           loss='binary_crossentropy',
           optimizer=Adam(learning_rate=0.01),
           metrics=['accuracy'],
         )

         # train the RNN
         r = model.fit(
           inputs, Y,
           epochs=200,
           validation_split=0.5,
         )
```

```
Epoch 1/200
79/79 [==============================] - 4s 14ms/step - loss: 0.6945 - accuracy:
0.5036 - val_loss: 0.6936 - val_accuracy: 0.5008
Epoch 2/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6934 - accuracy: 0.
5048 - val_loss: 0.6936 - val_accuracy: 0.5036
Epoch 3/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6946 - accuracy: 0.
5040 - val_loss: 0.6934 - val_accuracy: 0.5004
Epoch 4/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6934 - accuracy: 0.
4940 - val_loss: 0.6933 - val_accuracy: 0.4960
Epoch 5/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6933 - accuracy: 0.
5032 - val_loss: 0.6934 - val_accuracy: 0.5064
Epoch 6/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6931 - accuracy: 0.
5048 - val_loss: 0.6936 - val_accuracy: 0.4948
Epoch 7/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6928 - accuracy: 0.
5088 - val_loss: 0.6940 - val_accuracy: 0.4940
Epoch 8/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6930 - accuracy: 0.
4968 - val_loss: 0.6942 - val_accuracy: 0.4936
Epoch 9/200
79/79 [==============================] - 1s 11ms/step - loss: 0.6925 - accuracy:
0.5140 - val_loss: 0.6954 - val_accuracy: 0.4920
Epoch 10/200
79/79 [==============================] - 1s 10ms/step - loss: 0.6925 - accuracy:
0.5080 - val_loss: 0.6947 - val_accuracy: 0.4940
Epoch 11/200
79/79 [==============================] - 1s 11ms/step - loss: 0.6918 - accuracy:
0.5184 - val_loss: 0.6954 - val_accuracy: 0.5092
Epoch 12/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6889 - accuracy: 0.
5480 - val_loss: 0.6819 - val_accuracy: 0.5720
Epoch 13/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6727 - accuracy: 0.
5856 - val_loss: 0.6565 - val_accuracy: 0.6152
Epoch 14/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6521 - accuracy: 0.
6188 - val_loss: 0.6507 - val_accuracy: 0.6052
Epoch 15/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6495 - accuracy: 0.
6240 - val_loss: 0.6588 - val_accuracy: 0.6212
Epoch 16/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6246 - accuracy: 0.
6540 - val_loss: 0.6181 - val_accuracy: 0.6584
Epoch 17/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5954 - accuracy: 0.
6792 - val_loss: 0.5859 - val_accuracy: 0.6812
Epoch 18/200
79/79 [==============================] - 1s 7ms/step - loss: 0.5814 - accuracy: 0.
6868 - val_loss: 0.5760 - val_accuracy: 0.6800
Epoch 19/200
79/79 [==============================] - 1s 9ms/step - loss: 0.5464 - accuracy: 0.
```

```
7068 - val_loss: 0.5693 - val_accuracy: 0.7100
Epoch 20/200
79/79 [==============================] - 1s 7ms/step - loss: 0.5551 - accuracy: 0.
7032 - val_loss: 0.5463 - val_accuracy: 0.7136
Epoch 21/200
79/79 [==============================] - 1s 7ms/step - loss: 0.5054 - accuracy: 0.
7428 - val_loss: 0.5270 - val_accuracy: 0.7296
Epoch 22/200
79/79 [==============================] - 1s 7ms/step - loss: 0.4742 - accuracy: 0.
7648 - val_loss: 0.4869 - val_accuracy: 0.7704
Epoch 23/200
79/79 [==============================] - 1s 9ms/step - loss: 0.4332 - accuracy: 0.
8016 - val_loss: 0.4548 - val_accuracy: 0.7904
Epoch 24/200
79/79 [==============================] - 1s 7ms/step - loss: 0.4059 - accuracy: 0.
8248 - val_loss: 0.4108 - val_accuracy: 0.8336
Epoch 25/200
79/79 [==============================] - 1s 7ms/step - loss: 0.3629 - accuracy: 0.
8604 - val_loss: 0.3685 - val_accuracy: 0.8636
Epoch 26/200
79/79 [==============================] - 1s 9ms/step - loss: 0.3430 - accuracy: 0.
8620 - val_loss: 0.3119 - val_accuracy: 0.8812
Epoch 27/200
79/79 [==============================] - 1s 9ms/step - loss: 0.2945 - accuracy: 0.
8960 - val_loss: 0.3140 - val_accuracy: 0.8960
Epoch 28/200
79/79 [==============================] - 1s 10ms/step - loss: 0.2683 - accuracy:
0.9036 - val_loss: 0.2693 - val_accuracy: 0.9080
Epoch 29/200
79/79 [==============================] - 1s 11ms/step - loss: 0.2476 - accuracy:
0.9120 - val_loss: 0.2285 - val_accuracy: 0.9208
Epoch 30/200
79/79 [==============================] - 1s 10ms/step - loss: 0.1959 - accuracy:
0.9364 - val_loss: 0.2022 - val_accuracy: 0.9324
Epoch 31/200
79/79 [==============================] - 1s 7ms/step - loss: 0.1840 - accuracy: 0.
9444 - val_loss: 0.2298 - val_accuracy: 0.9276
Epoch 32/200
79/79 [==============================] - 1s 9ms/step - loss: 0.1693 - accuracy: 0.
9460 - val_loss: 0.2079 - val_accuracy: 0.9312
Epoch 33/200
79/79 [==============================] - 1s 9ms/step - loss: 0.1535 - accuracy: 0.
9512 - val_loss: 0.1831 - val_accuracy: 0.9400
Epoch 34/200
79/79 [==============================] - 1s 9ms/step - loss: 0.1626 - accuracy: 0.
9460 - val_loss: 0.1324 - val_accuracy: 0.9552
Epoch 35/200
79/79 [==============================] - 1s 8ms/step - loss: 0.1393 - accuracy: 0.
9536 - val_loss: 0.1468 - val_accuracy: 0.9496
Epoch 36/200
79/79 [==============================] - 1s 9ms/step - loss: 0.1264 - accuracy: 0.
9604 - val_loss: 0.1699 - val_accuracy: 0.9456
Epoch 37/200
79/79 [==============================] - 1s 7ms/step - loss: 0.1385 - accuracy: 0.
9524 - val_loss: 0.1591 - val_accuracy: 0.9468
Epoch 38/200
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79/79 [==============================] - 1s 9ms/step - loss: 0.1117 - accuracy: 0.
9616 - val_loss: 0.1168 - val_accuracy: 0.9604
Epoch 39/200
79/79 [==============================] - 1s 7ms/step - loss: 0.1070 - accuracy: 0.
9624 - val_loss: 0.1172 - val_accuracy: 0.9544
Epoch 40/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0979 - accuracy: 0.
9672 - val_loss: 0.1007 - val_accuracy: 0.9652
Epoch 41/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0840 - accuracy: 0.
9704 - val_loss: 0.1040 - val_accuracy: 0.9632
Epoch 42/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0868 - accuracy: 0.
9672 - val_loss: 0.0902 - val_accuracy: 0.9672
Epoch 43/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0829 - accuracy: 0.
9700 - val_loss: 0.0894 - val_accuracy: 0.9700
Epoch 44/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0962 - accuracy: 0.
9644 - val_loss: 0.0781 - val_accuracy: 0.9720
Epoch 45/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0822 - accuracy: 0.
9688 - val_loss: 0.0807 - val_accuracy: 0.9688
Epoch 46/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0652 - accuracy:
0.9756 - val_loss: 0.0873 - val_accuracy: 0.9696
Epoch 47/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0817 - accuracy:
0.9696 - val_loss: 0.0829 - val_accuracy: 0.9712
Epoch 48/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0725 - accuracy: 0.
9716 - val_loss: 0.0870 - val_accuracy: 0.9688
Epoch 49/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0644 - accuracy: 0.
9752 - val_loss: 0.0670 - val_accuracy: 0.9748
Epoch 50/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0619 - accuracy: 0.
9756 - val_loss: 0.0864 - val_accuracy: 0.9724
Epoch 51/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0627 - accuracy: 0.
9760 - val_loss: 0.0733 - val_accuracy: 0.9732
Epoch 52/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0603 - accuracy: 0.
9756 - val_loss: 0.0970 - val_accuracy: 0.9668
Epoch 53/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0597 - accuracy: 0.
9804 - val_loss: 0.0711 - val_accuracy: 0.9764
Epoch 54/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0570 - accuracy: 0.
9800 - val_loss: 0.0686 - val_accuracy: 0.9728
Epoch 55/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0550 - accuracy: 0.
9796 - val_loss: 0.0860 - val_accuracy: 0.9664
Epoch 56/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0537 - accuracy: 0.
9792 - val_loss: 0.0719 - val_accuracy: 0.9752
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Epoch 57/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0554 - accuracy: 0.
9792 - val_loss: 0.0611 - val_accuracy: 0.9776
Epoch 58/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0614 - accuracy: 0.
9788 - val_loss: 0.0576 - val_accuracy: 0.9796
Epoch 59/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0536 - accuracy: 0.
9804 - val_loss: 0.0565 - val_accuracy: 0.9820
Epoch 60/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0473 - accuracy: 0.
9828 - val_loss: 0.0637 - val_accuracy: 0.9780
Epoch 61/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0477 - accuracy: 0.
9828 - val_loss: 0.0610 - val_accuracy: 0.9792
Epoch 62/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0484 - accuracy: 0.
9828 - val_loss: 0.0502 - val_accuracy: 0.9816
Epoch 63/200
79/79 [==============================] - 1s 10ms/step - loss: 0.0483 - accuracy:
0.9816 - val_loss: 0.0563 - val_accuracy: 0.9804
Epoch 64/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0470 - accuracy:
0.9796 - val_loss: 0.0534 - val_accuracy: 0.9800
Epoch 65/200
79/79 [==============================] - 1s 10ms/step - loss: 0.0450 - accuracy:
0.9844 - val_loss: 0.0564 - val_accuracy: 0.9776
Epoch 66/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0404 - accuracy: 0.
9868 - val_loss: 0.0645 - val_accuracy: 0.9740
Epoch 67/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0455 - accuracy: 0.
9832 - val_loss: 0.0571 - val_accuracy: 0.9784
Epoch 68/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0493 - accuracy: 0.
9812 - val_loss: 0.0477 - val_accuracy: 0.9836
Epoch 69/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0441 - accuracy: 0.
9832 - val_loss: 0.0525 - val_accuracy: 0.9832
Epoch 70/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0407 - accuracy: 0.
9852 - val_loss: 0.0741 - val_accuracy: 0.9756
Epoch 71/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0423 - accuracy: 0.
9812 - val_loss: 0.0725 - val_accuracy: 0.9740
Epoch 72/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0377 - accuracy: 0.
9852 - val_loss: 0.0409 - val_accuracy: 0.9852
Epoch 73/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0441 - accuracy: 0.
9820 - val_loss: 0.0444 - val_accuracy: 0.9824
Epoch 74/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0395 - accuracy: 0.
9868 - val_loss: 0.0401 - val_accuracy: 0.9832
Epoch 75/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0360 - accuracy: 0.
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9872 - val_loss: 0.0418 - val_accuracy: 0.9836
Epoch 76/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0341 - accuracy: 0.
9876 - val_loss: 0.0604 - val_accuracy: 0.9776
Epoch 77/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0386 - accuracy: 0.
9848 - val_loss: 0.0388 - val_accuracy: 0.9820
Epoch 78/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0317 - accuracy: 0.
9884 - val_loss: 0.0582 - val_accuracy: 0.9816
Epoch 79/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0554 - accuracy: 0.
9816 - val_loss: 0.0593 - val_accuracy: 0.9772
Epoch 80/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0376 - accuracy: 0.
9856 - val_loss: 0.0402 - val_accuracy: 0.9856
Epoch 81/200
79/79 [==============================] - 1s 10ms/step - loss: 0.0332 - accuracy:
0.9880 - val_loss: 0.0337 - val_accuracy: 0.9864
Epoch 82/200
79/79 [==============================] - 1s 10ms/step - loss: 0.0519 - accuracy:
0.9812 - val_loss: 0.0502 - val_accuracy: 0.9824
Epoch 83/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0334 - accuracy:
0.9868 - val_loss: 0.0377 - val_accuracy: 0.9852
Epoch 84/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0279 - accuracy: 0.
9908 - val_loss: 0.0578 - val_accuracy: 0.9800
Epoch 85/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0294 - accuracy: 0.
9888 - val_loss: 0.0325 - val_accuracy: 0.9872
Epoch 86/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0327 - accuracy: 0.
9900 - val_loss: 0.0384 - val_accuracy: 0.9860
Epoch 87/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0295 - accuracy: 0.
9896 - val_loss: 0.0352 - val_accuracy: 0.9864
Epoch 88/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0296 - accuracy: 0.
9896 - val_loss: 0.0338 - val_accuracy: 0.9872
Epoch 89/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0245 - accuracy: 0.
9908 - val_loss: 0.0360 - val_accuracy: 0.9868
Epoch 90/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0255 - accuracy: 0.
9916 - val_loss: 0.0427 - val_accuracy: 0.9860
Epoch 91/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0283 - accuracy: 0.
9904 - val_loss: 0.0373 - val_accuracy: 0.9864
Epoch 92/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0273 - accuracy: 0.
9880 - val_loss: 0.0298 - val_accuracy: 0.9892
Epoch 93/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0248 - accuracy: 0.
9908 - val_loss: 0.0321 - val_accuracy: 0.9856
Epoch 94/200
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79/79 [==============================] - 1s 9ms/step - loss: 0.0281 - accuracy: 0.
9900 - val_loss: 0.0433 - val_accuracy: 0.9872
Epoch 95/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0306 - accuracy: 0.
9872 - val_loss: 0.0602 - val_accuracy: 0.9808
Epoch 96/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0348 - accuracy: 0.
9872 - val_loss: 0.0373 - val_accuracy: 0.9868
Epoch 97/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0302 - accuracy: 0.
9896 - val_loss: 0.0442 - val_accuracy: 0.9844
Epoch 98/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0243 - accuracy: 0.
9924 - val_loss: 0.0307 - val_accuracy: 0.9892
Epoch 99/200
79/79 [==============================] - 1s 10ms/step - loss: 0.0274 - accuracy:
0.9920 - val_loss: 0.0584 - val_accuracy: 0.9840
Epoch 100/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0348 - accuracy:
0.9876 - val_loss: 0.0505 - val_accuracy: 0.9812
Epoch 101/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0271 - accuracy:
0.9912 - val_loss: 0.0319 - val_accuracy: 0.9884
Epoch 102/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0249 - accuracy: 0.
9924 - val_loss: 0.0340 - val_accuracy: 0.9876
Epoch 103/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0204 - accuracy: 0.
9924 - val_loss: 0.0315 - val_accuracy: 0.9872
Epoch 104/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0230 - accuracy: 0.
9916 - val_loss: 0.0329 - val_accuracy: 0.9876
Epoch 105/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0268 - accuracy: 0.
9912 - val_loss: 0.0497 - val_accuracy: 0.9828
Epoch 106/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0324 - accuracy: 0.
9884 - val_loss: 0.0265 - val_accuracy: 0.9896
Epoch 107/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0206 - accuracy: 0.
9944 - val_loss: 0.0415 - val_accuracy: 0.9856
Epoch 108/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0218 - accuracy: 0.
9916 - val_loss: 0.0258 - val_accuracy: 0.9908
Epoch 109/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0218 - accuracy: 0.
9924 - val_loss: 0.0300 - val_accuracy: 0.9896
Epoch 110/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0245 - accuracy: 0.
9916 - val_loss: 0.0376 - val_accuracy: 0.9872
Epoch 111/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0215 - accuracy: 0.
9912 - val_loss: 0.0405 - val_accuracy: 0.9876
Epoch 112/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0325 - accuracy: 0.
9868 - val_loss: 0.0387 - val_accuracy: 0.9864
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Epoch 113/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0208 - accuracy: 0.
9912 - val_loss: 0.0313 - val_accuracy: 0.9880
Epoch 114/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0210 - accuracy: 0.
9896 - val_loss: 0.0419 - val_accuracy: 0.9820
Epoch 115/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0221 - accuracy: 0.
9912 - val_loss: 0.0382 - val_accuracy: 0.9856
Epoch 116/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0148 - accuracy: 0.
9952 - val_loss: 0.0347 - val_accuracy: 0.9888
Epoch 117/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0196 - accuracy:
0.9916 - val_loss: 0.0363 - val_accuracy: 0.9888
Epoch 118/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0203 - accuracy:
0.9936 - val_loss: 0.0369 - val_accuracy: 0.9880
Epoch 119/200
79/79 [==============================] - 1s 10ms/step - loss: 0.0129 - accuracy:
0.9948 - val_loss: 0.0342 - val_accuracy: 0.9896
Epoch 120/200
79/79 [==============================] - 1s 10ms/step - loss: 0.0170 - accuracy:
0.9944 - val_loss: 0.0313 - val_accuracy: 0.9892
Epoch 121/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0169 - accuracy: 0.
9940 - val_loss: 0.0338 - val_accuracy: 0.9880
Epoch 122/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0171 - accuracy: 0.
9928 - val_loss: 0.0348 - val_accuracy: 0.9872
Epoch 123/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0160 - accuracy: 0.
9940 - val_loss: 0.0326 - val_accuracy: 0.9892
Epoch 124/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0240 - accuracy: 0.
9920 - val_loss: 0.0608 - val_accuracy: 0.9804
Epoch 125/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0290 - accuracy: 0.
9896 - val_loss: 0.0348 - val_accuracy: 0.9888
Epoch 126/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0240 - accuracy: 0.
9904 - val_loss: 0.0341 - val_accuracy: 0.9872
Epoch 127/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0201 - accuracy: 0.
9928 - val_loss: 0.0413 - val_accuracy: 0.9880
Epoch 128/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0164 - accuracy: 0.
9920 - val_loss: 0.0300 - val_accuracy: 0.9892
Epoch 129/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0137 - accuracy: 0.
9932 - val_loss: 0.0346 - val_accuracy: 0.9872
Epoch 130/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0153 - accuracy: 0.
9940 - val_loss: 0.0233 - val_accuracy: 0.9924
Epoch 131/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0326 - accuracy: 0.
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                          9920 - val_loss: 0.0317 - val_accuracy: 0.9900
                          Epoch 132/200
                          79/79 [==============================] - 1s 7ms/step - loss: 0.0520 - accuracy: 0.
                          9836 - val_loss: 0.0544 - val_accuracy: 0.9820
                          Epoch 133/200
                          79/79 [==============================] - 1s 9ms/step - loss: 0.0373 - accuracy: 0.
                          9876 - val_loss: 0.0490 - val_accuracy: 0.9820
                          Epoch 134/200
                          79/79 [==============================] - 1s 9ms/step - loss: 0.0221 - accuracy: 0.
                          9904 - val_loss: 0.0304 - val_accuracy: 0.9880
                          Epoch 135/200
                          79/79 [==============================] - 1s 10ms/step - loss: 0.0162 - accuracy:
                          0.9940 - val_loss: 0.0243 - val_accuracy: 0.9904
                          Epoch 136/200
                          79/79 [==============================] - 1s 10ms/step - loss: 0.0149 - accuracy:
                          0.9936 - val_loss: 0.0282 - val_accuracy: 0.9904
                          Epoch 137/200
                          79/79 [==============================] - 1s 11ms/step - loss: 0.0222 - accuracy:
                          0.9912 - val_loss: 0.0438 - val_accuracy: 0.9852
                          Epoch 138/200
                          79/79 [==============================] - 1s 9ms/step - loss: 0.0197 - accuracy: 0.
                          9936 - val_loss: 0.0266 - val_accuracy: 0.9912
                          Epoch 139/200
                          79/79 [==============================] - 1s 8ms/step - loss: 0.0134 - accuracy: 0.
                          9944 - val_loss: 0.0283 - val_accuracy: 0.9884
                          Epoch 140/200
                          79/79 [==============================] - 1s 8ms/step - loss: 0.0116 - accuracy: 0.
                          9956 - val_loss: 0.0357 - val_accuracy: 0.9872
                          Epoch 141/200
                          79/79 [==============================] - 1s 8ms/step - loss: 0.0121 - accuracy: 0.
                          9964 - val_loss: 0.0287 - val_accuracy: 0.9904
                          Epoch 142/200
                          79/79 [==============================] - 1s 9ms/step - loss: 0.0154 - accuracy: 0.
                          9928 - val_loss: 0.0235 - val_accuracy: 0.9920
                          Epoch 143/200
                          79/79 [==============================] - 1s 8ms/step - loss: 0.0119 - accuracy: 0.
                          9940 - val_loss: 0.0382 - val_accuracy: 0.9884
                          Epoch 144/200
                          79/79 [==============================] - 1s 7ms/step - loss: 0.0115 - accuracy: 0.
                          9968 - val_loss: 0.0285 - val_accuracy: 0.9896
                          Epoch 145/200
                          79/79 [==============================] - 1s 9ms/step - loss: 0.0100 - accuracy: 0.
                          9960 - val_loss: 0.0297 - val_accuracy: 0.9892
                          Epoch 146/200
                          79/79 [==============================] - 1s 8ms/step - loss: 0.0148 - accuracy: 0.
                          9940 - val_loss: 0.0333 - val_accuracy: 0.9880
                          Epoch 147/200
                          79/79 [==============================] - 1s 9ms/step - loss: 0.0114 - accuracy: 0.
                          9944 - val_loss: 0.0306 - val_accuracy: 0.9904
                          Epoch 148/200
                          79/79 [==============================] - 1s 8ms/step - loss: 0.0145 - accuracy: 0.
                          9936 - val_loss: 0.0297 - val_accuracy: 0.9904
                          Epoch 149/200
                          79/79 [==============================] - 1s 9ms/step - loss: 0.0134 - accuracy: 0.
                          9952 - val_loss: 0.0368 - val_accuracy: 0.9904
                          Epoch 150/200
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79/79 [==============================] - 1s 7ms/step - loss: 0.0110 - accuracy: 0.
9960 - val_loss: 0.0336 - val_accuracy: 0.9904
Epoch 151/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0090 - accuracy: 0.
9960 - val_loss: 0.0415 - val_accuracy: 0.9900
Epoch 152/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0102 - accuracy: 0.
9964 - val_loss: 0.0535 - val_accuracy: 0.9872
Epoch 153/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0212 - accuracy: 0.
9924 - val_loss: 0.0251 - val_accuracy: 0.9908
Epoch 154/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0119 - accuracy:
0.9964 - val_loss: 0.0389 - val_accuracy: 0.9876
Epoch 155/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0094 - accuracy:
0.9968 - val_loss: 0.0271 - val_accuracy: 0.9916
Epoch 156/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0088 - accuracy:
0.9964 - val_loss: 0.0379 - val_accuracy: 0.9888
Epoch 157/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0094 - accuracy: 0.
9960 - val_loss: 0.0307 - val_accuracy: 0.9900
Epoch 158/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0098 - accuracy: 0.
9972 - val_loss: 0.0311 - val_accuracy: 0.9896
Epoch 159/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0153 - accuracy: 0.
9964 - val_loss: 0.0268 - val_accuracy: 0.9912
Epoch 160/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0160 - accuracy: 0.
9952 - val_loss: 0.0405 - val_accuracy: 0.9872
Epoch 161/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0425 - accuracy: 0.
9860 - val_loss: 0.0443 - val_accuracy: 0.9876
Epoch 162/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0287 - accuracy: 0.
9916 - val_loss: 0.0346 - val_accuracy: 0.9900
Epoch 163/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0231 - accuracy: 0.
9884 - val_loss: 0.0335 - val_accuracy: 0.9908
Epoch 164/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0193 - accuracy: 0.
9920 - val_loss: 0.0337 - val_accuracy: 0.9908
Epoch 165/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0324 - accuracy: 0.
9916 - val_loss: 0.0377 - val_accuracy: 0.9876
Epoch 166/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0213 - accuracy: 0.
9940 - val_loss: 0.0273 - val_accuracy: 0.9916
Epoch 167/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0140 - accuracy: 0.
9944 - val_loss: 0.0226 - val_accuracy: 0.9916
Epoch 168/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0108 - accuracy: 0.
9936 - val_loss: 0.0233 - val_accuracy: 0.9904
```

```
Epoch 169/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0146 - accuracy: 0.
9932 - val_loss: 0.0239 - val_accuracy: 0.9928
Epoch 170/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0113 - accuracy: 0.
9948 - val_loss: 0.0295 - val_accuracy: 0.9904
Epoch 171/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0115 - accuracy:
0.9956 - val_loss: 0.0245 - val_accuracy: 0.9932
Epoch 172/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0088 - accuracy:
0.9956 - val_loss: 0.0260 - val_accuracy: 0.9928
Epoch 173/200
79/79 [==============================] - 1s 10ms/step - loss: 0.0064 - accuracy:
0.9976 - val_loss: 0.0212 - val_accuracy: 0.9932
Epoch 174/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0070 - accuracy: 0.
9968 - val_loss: 0.0353 - val_accuracy: 0.9908
Epoch 175/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0128 - accuracy: 0.
9952 - val_loss: 0.0248 - val_accuracy: 0.9920
Epoch 176/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0072 - accuracy: 0.
9988 - val_loss: 0.0331 - val_accuracy: 0.9900
Epoch 177/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0130 - accuracy: 0.
9972 - val_loss: 0.0210 - val_accuracy: 0.9924
Epoch 178/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0063 - accuracy: 0.
9976 - val_loss: 0.0309 - val_accuracy: 0.9908
Epoch 179/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0055 - accuracy: 0.
9980 - val_loss: 0.0317 - val_accuracy: 0.9924
Epoch 180/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0207 - accuracy: 0.
9932 - val_loss: 0.0409 - val_accuracy: 0.9888
Epoch 181/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0160 - accuracy: 0.
9944 - val_loss: 0.0241 - val_accuracy: 0.9928
Epoch 182/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0074 - accuracy: 0.
9972 - val_loss: 0.0300 - val_accuracy: 0.9900
Epoch 183/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0224 - accuracy: 0.
9944 - val_loss: 0.0306 - val_accuracy: 0.9900
Epoch 184/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0156 - accuracy: 0.
9948 - val_loss: 0.0335 - val_accuracy: 0.9884
Epoch 185/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0235 - accuracy: 0.
9916 - val_loss: 0.0392 - val_accuracy: 0.9892
Epoch 186/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0132 - accuracy: 0.
9948 - val_loss: 0.0276 - val_accuracy: 0.9932
Epoch 187/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0085 - accuracy: 0.
```

```
9968 - val_loss: 0.0222 - val_accuracy: 0.9924
Epoch 188/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0061 - accuracy: 0.
9980 - val_loss: 0.0337 - val_accuracy: 0.9892
Epoch 189/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0064 - accuracy:
0.9980 - val_loss: 0.0280 - val_accuracy: 0.9920
Epoch 190/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0055 - accuracy:
0.9988 - val_loss: 0.0265 - val_accuracy: 0.9920
Epoch 191/200
79/79 [==============================] - 1s 11ms/step - loss: 0.0066 - accuracy:
0.9968 - val_loss: 0.0285 - val_accuracy: 0.9912
Epoch 192/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0049 - accuracy: 0.
9984 - val_loss: 0.0372 - val_accuracy: 0.9896
Epoch 193/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0158 - accuracy: 0.
9936 - val_loss: 0.0472 - val_accuracy: 0.9864
Epoch 194/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0160 - accuracy: 0.
9948 - val_loss: 0.0267 - val_accuracy: 0.9916
Epoch 195/200
79/79 [==============================] - 1s 7ms/step - loss: 0.0153 - accuracy: 0.
9948 - val_loss: 0.0296 - val_accuracy: 0.9920
Epoch 196/200
79/79 [==============================] - 1s 9ms/step - loss: 0.0110 - accuracy: 0.
9952 - val_loss: 0.0267 - val_accuracy: 0.9932
Epoch 197/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0099 - accuracy: 0.
9968 - val_loss: 0.0229 - val_accuracy: 0.9928
Epoch 198/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0068 - accuracy: 0.
9976 - val_loss: 0.0249 - val_accuracy: 0.9928
Epoch 199/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0050 - accuracy: 0.
9980 - val_loss: 0.0208 - val_accuracy: 0.9940
Epoch 200/200
79/79 [==============================] - 1s 8ms/step - loss: 0.0049 - accuracy: 0.
9984 - val_loss: 0.0204 - val_accuracy: 0.9936
```
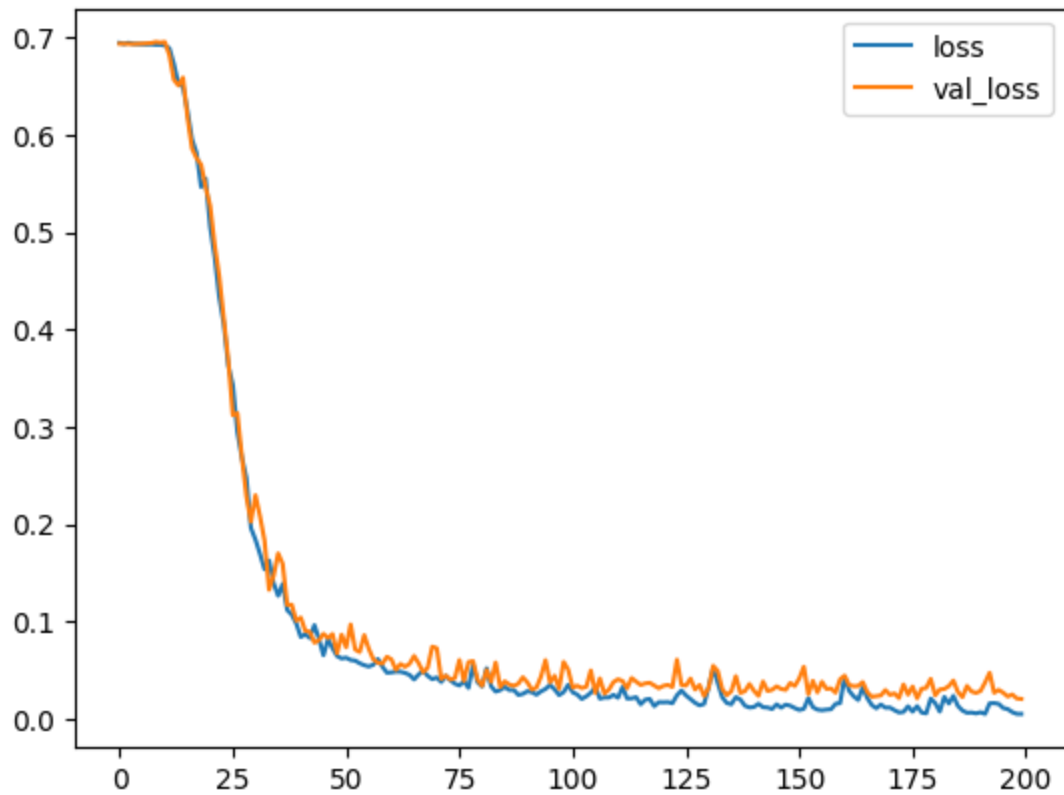
In [16]:
```python
# Plot the loss
plt.plot(r.history['loss'], label='loss')
plt.plot(r.history['val_loss'], label='val_loss')
plt.legend()
```

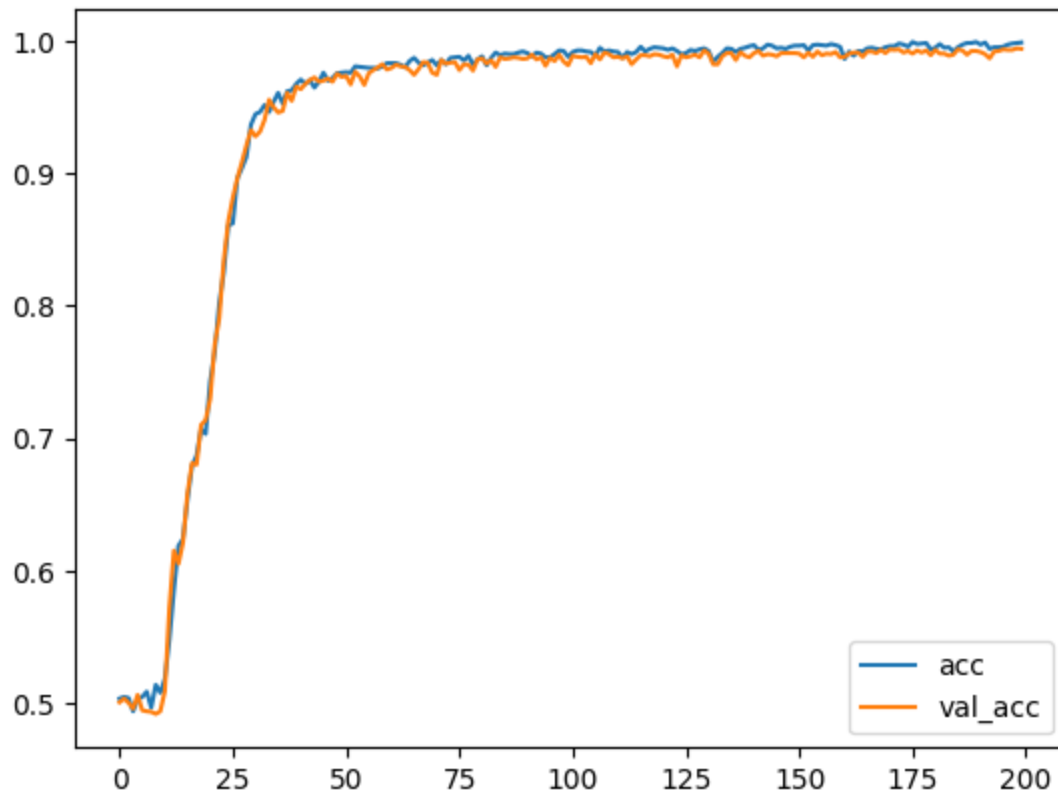Out[16]: <matplotlib.legend.Legend at 0x7f8bd8dc5de0>

```
In [17]:  # Plot the accuracy too
          plt.plot(r.history['accuracy'], label='acc')
          plt.plot(r.history['val_accuracy'], label='val_acc')
          plt.legend()
```

Out[17]: <matplotlib.legend.Legend at 0x7f8bd9f4e770>

```python
In [18]:  # Make the problem harder by making T larger
          T = 20
          D = 1
          X = []
          Y = []

          for t in range(5000):
            x = np.random.randn(T)
            X.append(x)
            y = get_label(x, 0, 1, 2) # long distance
            Y.append(y)

          X = np.array(X)
          Y = np.array(Y)
          N = len(X)
```

```python
In [19]:  # Now test our Simple RNN again
          inputs = np.expand_dims(X, -1)

          # make the RNN
          i = Input(shape=(T, D))

          # method 1
          x = SimpleRNN(5)(i)

          x = Dense(1, activation='sigmoid')(x)
          model = Model(i, x)
          model.compile(
            loss='binary_crossentropy',
            optimizer=Adam(learning_rate=0.01),
```

```
  metrics=['accuracy'],
)

# train the RNN
r = model.fit(
  inputs, Y,
  epochs=200,
  validation_split=0.5,
)
```

```
Epoch 1/200
79/79 [==============================] - 3s 23ms/step - loss: 0.6999 - accuracy:
0.4904 - val_loss: 0.6951 - val_accuracy: 0.4988
Epoch 2/200
79/79 [==============================] - 2s 30ms/step - loss: 0.6955 - accuracy:
0.5068 - val_loss: 0.7017 - val_accuracy: 0.4888
Epoch 3/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6937 - accuracy:
0.5184 - val_loss: 0.6980 - val_accuracy: 0.4756
Epoch 4/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6941 - accuracy:
0.5132 - val_loss: 0.6945 - val_accuracy: 0.5024
Epoch 5/200
79/79 [==============================] - 1s 18ms/step - loss: 0.6936 - accuracy:
0.5180 - val_loss: 0.6962 - val_accuracy: 0.5052
Epoch 6/200
79/79 [==============================] - 1s 19ms/step - loss: 0.6931 - accuracy:
0.5112 - val_loss: 0.6944 - val_accuracy: 0.4960
Epoch 7/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6920 - accuracy:
0.5064 - val_loss: 0.6984 - val_accuracy: 0.4820
Epoch 8/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6926 - accuracy:
0.5156 - val_loss: 0.6941 - val_accuracy: 0.5068
Epoch 9/200
79/79 [==============================] - 2s 28ms/step - loss: 0.6923 - accuracy:
0.5284 - val_loss: 0.6980 - val_accuracy: 0.4892
Epoch 10/200
79/79 [==============================] - 2s 24ms/step - loss: 0.6919 - accuracy:
0.5200 - val_loss: 0.6972 - val_accuracy: 0.4880
Epoch 11/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6920 - accuracy:
0.5216 - val_loss: 0.6984 - val_accuracy: 0.4988
Epoch 12/200
79/79 [==============================] - 1s 19ms/step - loss: 0.6906 - accuracy:
0.5352 - val_loss: 0.7025 - val_accuracy: 0.4976
Epoch 13/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6911 - accuracy:
0.5332 - val_loss: 0.6953 - val_accuracy: 0.4988
Epoch 14/200
79/79 [==============================] - 1s 19ms/step - loss: 0.6904 - accuracy:
0.5320 - val_loss: 0.6962 - val_accuracy: 0.4988
Epoch 15/200
79/79 [==============================] - 1s 19ms/step - loss: 0.6904 - accuracy:
0.5368 - val_loss: 0.6989 - val_accuracy: 0.4972
Epoch 16/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6905 - accuracy:
0.5368 - val_loss: 0.6958 - val_accuracy: 0.5088
Epoch 17/200
79/79 [==============================] - 3s 36ms/step - loss: 0.6884 - accuracy:
0.5424 - val_loss: 0.6984 - val_accuracy: 0.4944
Epoch 18/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6902 - accuracy:
0.5336 - val_loss: 0.6978 - val_accuracy: 0.5192
Epoch 19/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6883 - accuracy:
```

```
0.5500 - val_loss: 0.7015 - val_accuracy: 0.4992
Epoch 20/200
79/79 [==============================] - 1s 19ms/step - loss: 0.6897 - accuracy:
0.5392 - val_loss: 0.6953 - val_accuracy: 0.5128
Epoch 21/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6938 - accuracy:
0.5124 - val_loss: 0.6924 - val_accuracy: 0.5264
Epoch 22/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6948 - accuracy:
0.5052 - val_loss: 0.6912 - val_accuracy: 0.5268
Epoch 23/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6921 - accuracy:
0.5272 - val_loss: 0.6880 - val_accuracy: 0.5492
Epoch 24/200
79/79 [==============================] - 3s 33ms/step - loss: 0.6926 - accuracy:
0.5336 - val_loss: 0.6921 - val_accuracy: 0.5208
Epoch 25/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6941 - accuracy:
0.5084 - val_loss: 0.6920 - val_accuracy: 0.5204
Epoch 26/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6941 - accuracy:
0.5128 - val_loss: 0.6934 - val_accuracy: 0.5196
Epoch 27/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6937 - accuracy:
0.5196 - val_loss: 0.6944 - val_accuracy: 0.5200
Epoch 28/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6941 - accuracy:
0.5196 - val_loss: 0.6929 - val_accuracy: 0.5192
Epoch 29/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6924 - accuracy:
0.5120 - val_loss: 0.6953 - val_accuracy: 0.5196
Epoch 30/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6933 - accuracy:
0.5232 - val_loss: 0.6937 - val_accuracy: 0.4996
Epoch 31/200
79/79 [==============================] - 2s 25ms/step - loss: 0.6924 - accuracy:
0.5152 - val_loss: 0.6934 - val_accuracy: 0.5192
Epoch 32/200
79/79 [==============================] - 2s 25ms/step - loss: 0.6943 - accuracy:
0.5064 - val_loss: 0.6927 - val_accuracy: 0.5220
Epoch 33/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6926 - accuracy:
0.5232 - val_loss: 0.6960 - val_accuracy: 0.4816
Epoch 34/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6933 - accuracy:
0.5156 - val_loss: 0.6934 - val_accuracy: 0.5200
Epoch 35/200
79/79 [==============================] - 1s 19ms/step - loss: 0.6923 - accuracy:
0.5208 - val_loss: 0.6931 - val_accuracy: 0.5148
Epoch 36/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6934 - accuracy:
0.5188 - val_loss: 0.6931 - val_accuracy: 0.5200
Epoch 37/200
79/79 [==============================] - 1s 19ms/step - loss: 0.6922 - accuracy:
0.5200 - val_loss: 0.6944 - val_accuracy: 0.5220
Epoch 38/200
```

```
79/79 [==============================] - 2s 21ms/step - loss: 0.6922 - accuracy:
0.5232 - val_loss: 0.6931 - val_accuracy: 0.5192
Epoch 39/200
79/79 [==============================] - 2s 31ms/step - loss: 0.6918 - accuracy:
0.5184 - val_loss: 0.6933 - val_accuracy: 0.5180
Epoch 40/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6911 - accuracy:
0.5236 - val_loss: 0.6954 - val_accuracy: 0.5032
Epoch 41/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6926 - accuracy:
0.5224 - val_loss: 0.6935 - val_accuracy: 0.5028
Epoch 42/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6911 - accuracy:
0.5292 - val_loss: 0.6943 - val_accuracy: 0.5196
Epoch 43/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6921 - accuracy:
0.5196 - val_loss: 0.6933 - val_accuracy: 0.5152
Epoch 44/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6924 - accuracy:
0.5384 - val_loss: 0.6947 - val_accuracy: 0.5220
Epoch 45/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6905 - accuracy:
0.5300 - val_loss: 0.6933 - val_accuracy: 0.5184
Epoch 46/200
79/79 [==============================] - 3s 33ms/step - loss: 0.6914 - accuracy:
0.5252 - val_loss: 0.6944 - val_accuracy: 0.5000
Epoch 47/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6908 - accuracy:
0.5252 - val_loss: 0.6932 - val_accuracy: 0.5188
Epoch 48/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6902 - accuracy:
0.5300 - val_loss: 0.6956 - val_accuracy: 0.4952
Epoch 49/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6908 - accuracy:
0.5288 - val_loss: 0.6925 - val_accuracy: 0.5184
Epoch 50/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6898 - accuracy:
0.5348 - val_loss: 0.6934 - val_accuracy: 0.5192
Epoch 51/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6908 - accuracy:
0.5340 - val_loss: 0.6972 - val_accuracy: 0.4788
Epoch 52/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6917 - accuracy:
0.5276 - val_loss: 0.6929 - val_accuracy: 0.5180
Epoch 53/200
79/79 [==============================] - 2s 26ms/step - loss: 0.6906 - accuracy:
0.5404 - val_loss: 0.6944 - val_accuracy: 0.5104
Epoch 54/200
79/79 [==============================] - 2s 24ms/step - loss: 0.6916 - accuracy:
0.5288 - val_loss: 0.6956 - val_accuracy: 0.5004
Epoch 55/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6912 - accuracy:
0.5392 - val_loss: 0.6952 - val_accuracy: 0.5340
Epoch 56/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6906 - accuracy:
0.5332 - val_loss: 0.6938 - val_accuracy: 0.5104
```

```
Epoch 57/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6903 - accuracy:
0.5332 - val_loss: 0.6936 - val_accuracy: 0.5192
Epoch 58/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6909 - accuracy:
0.5336 - val_loss: 0.6932 - val_accuracy: 0.5136
Epoch 59/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6920 - accuracy:
0.5364 - val_loss: 0.6950 - val_accuracy: 0.5064
Epoch 60/200
79/79 [==============================] - 2s 24ms/step - loss: 0.6911 - accuracy:
0.5344 - val_loss: 0.6949 - val_accuracy: 0.5180
Epoch 61/200
79/79 [==============================] - 2s 29ms/step - loss: 0.6913 - accuracy:
0.5264 - val_loss: 0.6949 - val_accuracy: 0.5092
Epoch 62/200
79/79 [==============================] - 1s 19ms/step - loss: 0.6911 - accuracy:
0.5368 - val_loss: 0.6951 - val_accuracy: 0.5092
Epoch 63/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6921 - accuracy:
0.5264 - val_loss: 0.6952 - val_accuracy: 0.5044
Epoch 64/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6909 - accuracy:
0.5336 - val_loss: 0.6940 - val_accuracy: 0.5080
Epoch 65/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6922 - accuracy:
0.5168 - val_loss: 0.6947 - val_accuracy: 0.5100
Epoch 66/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6910 - accuracy:
0.5268 - val_loss: 0.6968 - val_accuracy: 0.5016
Epoch 67/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6915 - accuracy:
0.5296 - val_loss: 0.6949 - val_accuracy: 0.5224
Epoch 68/200
79/79 [==============================] - 3s 36ms/step - loss: 0.6900 - accuracy:
0.5348 - val_loss: 0.6946 - val_accuracy: 0.5092
Epoch 69/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6908 - accuracy:
0.5236 - val_loss: 0.6936 - val_accuracy: 0.5136
Epoch 70/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6907 - accuracy:
0.5296 - val_loss: 0.6944 - val_accuracy: 0.5028
Epoch 71/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6903 - accuracy:
0.5356 - val_loss: 0.6989 - val_accuracy: 0.5168
Epoch 72/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6909 - accuracy:
0.5340 - val_loss: 0.6957 - val_accuracy: 0.5128
Epoch 73/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6886 - accuracy:
0.5412 - val_loss: 0.6922 - val_accuracy: 0.5220
Epoch 74/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6881 - accuracy:
0.5464 - val_loss: 0.6945 - val_accuracy: 0.5116
Epoch 75/200
79/79 [==============================] - 2s 29ms/step - loss: 0.6882 - accuracy:
```

```
0.5436 - val_loss: 0.6940 - val_accuracy: 0.5332
Epoch 76/200
79/79 [==============================] - 2s 23ms/step - loss: 0.6900 - accuracy:
0.5444 - val_loss: 0.6939 - val_accuracy: 0.5164
Epoch 77/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6896 - accuracy:
0.5388 - val_loss: 0.6927 - val_accuracy: 0.5096
Epoch 78/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6889 - accuracy:
0.5360 - val_loss: 0.6931 - val_accuracy: 0.5108
Epoch 79/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6893 - accuracy:
0.5368 - val_loss: 0.6957 - val_accuracy: 0.4964
Epoch 80/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6899 - accuracy:
0.5292 - val_loss: 0.6960 - val_accuracy: 0.4972
Epoch 81/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6899 - accuracy:
0.5376 - val_loss: 0.6940 - val_accuracy: 0.5108
Epoch 82/200
79/79 [==============================] - 2s 24ms/step - loss: 0.6909 - accuracy:
0.5360 - val_loss: 0.6955 - val_accuracy: 0.5112
Epoch 83/200
79/79 [==============================] - 2s 28ms/step - loss: 0.6890 - accuracy:
0.5324 - val_loss: 0.6939 - val_accuracy: 0.5020
Epoch 84/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6893 - accuracy:
0.5460 - val_loss: 0.6937 - val_accuracy: 0.5104
Epoch 85/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6900 - accuracy:
0.5364 - val_loss: 0.6933 - val_accuracy: 0.5168
Epoch 86/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6889 - accuracy:
0.5376 - val_loss: 0.6924 - val_accuracy: 0.5188
Epoch 87/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6865 - accuracy:
0.5600 - val_loss: 0.6916 - val_accuracy: 0.5476
Epoch 88/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6911 - accuracy:
0.5380 - val_loss: 0.6914 - val_accuracy: 0.5340
Epoch 89/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6909 - accuracy:
0.5344 - val_loss: 0.6953 - val_accuracy: 0.4988
Epoch 90/200
79/79 [==============================] - 3s 32ms/step - loss: 0.6912 - accuracy:
0.5300 - val_loss: 0.6979 - val_accuracy: 0.5184
Epoch 91/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6912 - accuracy:
0.5316 - val_loss: 0.6995 - val_accuracy: 0.4876
Epoch 92/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6916 - accuracy:
0.5348 - val_loss: 0.6982 - val_accuracy: 0.4848
Epoch 93/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6905 - accuracy:
0.5352 - val_loss: 0.6980 - val_accuracy: 0.4908
Epoch 94/200
```

```
79/79 [==============================] - 2s 20ms/step - loss: 0.6927 - accuracy:
0.5232 - val_loss: 0.6982 - val_accuracy: 0.4944
Epoch 95/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6917 - accuracy:
0.5392 - val_loss: 0.6994 - val_accuracy: 0.4860
Epoch 96/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6915 - accuracy:
0.5280 - val_loss: 0.6974 - val_accuracy: 0.4916
Epoch 97/200
79/79 [==============================] - 2s 24ms/step - loss: 0.6914 - accuracy:
0.5284 - val_loss: 0.6987 - val_accuracy: 0.4956
Epoch 98/200
79/79 [==============================] - 2s 27ms/step - loss: 0.6920 - accuracy:
0.5252 - val_loss: 0.6983 - val_accuracy: 0.4916
Epoch 99/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6912 - accuracy:
0.5356 - val_loss: 0.6964 - val_accuracy: 0.5004
Epoch 100/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6908 - accuracy:
0.5388 - val_loss: 0.6972 - val_accuracy: 0.4952
Epoch 101/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6910 - accuracy:
0.5308 - val_loss: 0.7011 - val_accuracy: 0.4976
Epoch 102/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6912 - accuracy:
0.5368 - val_loss: 0.6972 - val_accuracy: 0.4900
Epoch 103/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6917 - accuracy:
0.5200 - val_loss: 0.6955 - val_accuracy: 0.5060
Epoch 104/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6923 - accuracy:
0.5172 - val_loss: 0.6957 - val_accuracy: 0.5104
Epoch 105/200
79/79 [==============================] - 2s 31ms/step - loss: 0.6949 - accuracy:
0.5164 - val_loss: 0.6961 - val_accuracy: 0.4896
Epoch 106/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6947 - accuracy:
0.5064 - val_loss: 0.6940 - val_accuracy: 0.4956
Epoch 107/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6933 - accuracy:
0.5104 - val_loss: 0.6941 - val_accuracy: 0.4916
Epoch 108/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6940 - accuracy:
0.5060 - val_loss: 0.6930 - val_accuracy: 0.5152
Epoch 109/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6942 - accuracy:
0.5076 - val_loss: 0.6940 - val_accuracy: 0.5016
Epoch 110/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6920 - accuracy:
0.5076 - val_loss: 0.6949 - val_accuracy: 0.5032
Epoch 111/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6927 - accuracy:
0.5148 - val_loss: 0.6960 - val_accuracy: 0.5052
Epoch 112/200
79/79 [==============================] - 3s 33ms/step - loss: 0.6916 - accuracy:
0.5220 - val_loss: 0.6942 - val_accuracy: 0.5088
```

```
Epoch 113/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6914 - accuracy:
0.5272 - val_loss: 0.6971 - val_accuracy: 0.4972
Epoch 114/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6926 - accuracy:
0.5200 - val_loss: 0.6943 - val_accuracy: 0.5028
Epoch 115/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6920 - accuracy:
0.5240 - val_loss: 0.6957 - val_accuracy: 0.5060
Epoch 116/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6945 - accuracy:
0.4988 - val_loss: 0.6949 - val_accuracy: 0.5028
Epoch 117/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6912 - accuracy:
0.5288 - val_loss: 0.6981 - val_accuracy: 0.4944
Epoch 118/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6927 - accuracy:
0.5192 - val_loss: 0.6948 - val_accuracy: 0.5108
Epoch 119/200
79/79 [==============================] - 2s 26ms/step - loss: 0.6922 - accuracy:
0.5276 - val_loss: 0.6968 - val_accuracy: 0.5132
Epoch 120/200
79/79 [==============================] - 2s 26ms/step - loss: 0.6916 - accuracy:
0.5352 - val_loss: 0.6927 - val_accuracy: 0.5252
Epoch 121/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6913 - accuracy:
0.5384 - val_loss: 0.6911 - val_accuracy: 0.5340
Epoch 122/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6902 - accuracy:
0.5312 - val_loss: 0.6914 - val_accuracy: 0.5312
Epoch 123/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6902 - accuracy:
0.5368 - val_loss: 0.7022 - val_accuracy: 0.4844
Epoch 124/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6955 - accuracy:
0.5196 - val_loss: 0.6976 - val_accuracy: 0.5040
Epoch 125/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6944 - accuracy:
0.5156 - val_loss: 0.6963 - val_accuracy: 0.5032
Epoch 126/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6937 - accuracy:
0.5140 - val_loss: 0.6929 - val_accuracy: 0.5244
Epoch 127/200
79/79 [==============================] - 3s 36ms/step - loss: 0.6919 - accuracy:
0.5344 - val_loss: 0.6934 - val_accuracy: 0.5212
Epoch 128/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6935 - accuracy:
0.5248 - val_loss: 0.6963 - val_accuracy: 0.4964
Epoch 129/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6939 - accuracy:
0.5068 - val_loss: 0.6964 - val_accuracy: 0.5032
Epoch 130/200
79/79 [==============================] - 1s 19ms/step - loss: 0.6931 - accuracy:
0.5148 - val_loss: 0.6958 - val_accuracy: 0.4908
Epoch 131/200
79/79 [==============================] - 1s 19ms/step - loss: 0.6929 - accuracy:
```

```
                0.5108 - val_loss: 0.6951 - val_accuracy: 0.5100
                Epoch 132/200
                79/79 [==============================] - 2s 19ms/step - loss: 0.6929 - accuracy:
                0.5172 - val_loss: 0.6950 - val_accuracy: 0.4904
                Epoch 133/200
                79/79 [==============================] - 2s 20ms/step - loss: 0.6925 - accuracy:
                0.5240 - val_loss: 0.6952 - val_accuracy: 0.4928
                Epoch 134/200
                79/79 [==============================] - 2s 29ms/step - loss: 0.6925 - accuracy:
                0.5216 - val_loss: 0.6949 - val_accuracy: 0.5152
                Epoch 135/200
                79/79 [==============================] - 2s 23ms/step - loss: 0.6924 - accuracy:
                0.5168 - val_loss: 0.6952 - val_accuracy: 0.5096
                Epoch 136/200
                79/79 [==============================] - 2s 19ms/step - loss: 0.6911 - accuracy:
                0.5300 - val_loss: 0.6974 - val_accuracy: 0.5016
                Epoch 137/200
                79/79 [==============================] - 2s 19ms/step - loss: 0.6930 - accuracy:
                0.5216 - val_loss: 0.6970 - val_accuracy: 0.5044
                Epoch 138/200
                79/79 [==============================] - 2s 19ms/step - loss: 0.6920 - accuracy:
                0.5192 - val_loss: 0.6946 - val_accuracy: 0.5116
                Epoch 139/200
                79/79 [==============================] - 1s 19ms/step - loss: 0.6923 - accuracy:
                0.5224 - val_loss: 0.6956 - val_accuracy: 0.5052
                Epoch 140/200
                79/79 [==============================] - 2s 19ms/step - loss: 0.6921 - accuracy:
                0.5296 - val_loss: 0.6968 - val_accuracy: 0.5116
                Epoch 141/200
                79/79 [==============================] - 2s 25ms/step - loss: 0.6922 - accuracy:
                0.5280 - val_loss: 0.6959 - val_accuracy: 0.5096
                Epoch 142/200
                79/79 [==============================] - 2s 27ms/step - loss: 0.6930 - accuracy:
                0.5132 - val_loss: 0.6960 - val_accuracy: 0.5068
                Epoch 143/200
                79/79 [==============================] - 2s 20ms/step - loss: 0.6932 - accuracy:
                0.5104 - val_loss: 0.6948 - val_accuracy: 0.5028
                Epoch 144/200
                79/79 [==============================] - 2s 20ms/step - loss: 0.6927 - accuracy:
                0.5192 - val_loss: 0.6956 - val_accuracy: 0.5112
                Epoch 145/200
                79/79 [==============================] - 2s 20ms/step - loss: 0.6933 - accuracy:
                0.5088 - val_loss: 0.6948 - val_accuracy: 0.5168
                Epoch 146/200
                79/79 [==============================] - 2s 19ms/step - loss: 0.6920 - accuracy:
                0.5200 - val_loss: 0.6950 - val_accuracy: 0.5088
                Epoch 147/200
                79/79 [==============================] - 2s 20ms/step - loss: 0.6919 - accuracy:
                0.5224 - val_loss: 0.6962 - val_accuracy: 0.4900
                Epoch 148/200
                79/79 [==============================] - 2s 19ms/step - loss: 0.6917 - accuracy:
                0.5208 - val_loss: 0.6956 - val_accuracy: 0.4956
                Epoch 149/200
                79/79 [==============================] - 3s 33ms/step - loss: 0.6930 - accuracy:
                0.5176 - val_loss: 0.6952 - val_accuracy: 0.5032
                Epoch 150/200
```

```
79/79 [==============================] - 2s 20ms/step - loss: 0.6923 - accuracy:
0.5152 - val_loss: 0.6957 - val_accuracy: 0.5008
Epoch 151/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6924 - accuracy:
0.5132 - val_loss: 0.6962 - val_accuracy: 0.5108
Epoch 152/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6916 - accuracy:
0.5280 - val_loss: 0.6966 - val_accuracy: 0.5092
Epoch 153/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6914 - accuracy:
0.5220 - val_loss: 0.6960 - val_accuracy: 0.4952
Epoch 154/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6925 - accuracy:
0.5212 - val_loss: 0.6976 - val_accuracy: 0.4924
Epoch 155/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6929 - accuracy:
0.5212 - val_loss: 0.6963 - val_accuracy: 0.4992
Epoch 156/200
79/79 [==============================] - 2s 29ms/step - loss: 0.6929 - accuracy:
0.5208 - val_loss: 0.6955 - val_accuracy: 0.5064
Epoch 157/200
79/79 [==============================] - 2s 23ms/step - loss: 0.6918 - accuracy:
0.5288 - val_loss: 0.6977 - val_accuracy: 0.5096
Epoch 158/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6930 - accuracy:
0.5084 - val_loss: 0.6950 - val_accuracy: 0.5152
Epoch 159/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6924 - accuracy:
0.5232 - val_loss: 0.7005 - val_accuracy: 0.4904
Epoch 160/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6930 - accuracy:
0.5236 - val_loss: 0.6976 - val_accuracy: 0.4972
Epoch 161/200
79/79 [==============================] - 2s 21ms/step - loss: 0.6919 - accuracy:
0.5320 - val_loss: 0.6974 - val_accuracy: 0.4964
Epoch 162/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6923 - accuracy:
0.5332 - val_loss: 0.6958 - val_accuracy: 0.5004
Epoch 163/200
79/79 [==============================] - 2s 25ms/step - loss: 0.6914 - accuracy:
0.5368 - val_loss: 0.6963 - val_accuracy: 0.4988
Epoch 164/200
79/79 [==============================] - 2s 26ms/step - loss: 0.6919 - accuracy:
0.5252 - val_loss: 0.6954 - val_accuracy: 0.4872
Epoch 165/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6923 - accuracy:
0.5208 - val_loss: 0.6951 - val_accuracy: 0.5028
Epoch 166/200
79/79 [==============================] - 1s 19ms/step - loss: 0.6938 - accuracy:
0.5080 - val_loss: 0.6967 - val_accuracy: 0.4988
Epoch 167/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6915 - accuracy:
0.5016 - val_loss: 0.6945 - val_accuracy: 0.5096
Epoch 168/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6910 - accuracy:
0.5160 - val_loss: 0.6968 - val_accuracy: 0.5000
```

```
Epoch 169/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6922 - accuracy:
0.5172 - val_loss: 0.6967 - val_accuracy: 0.4848
Epoch 170/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6942 - accuracy:
0.5044 - val_loss: 0.6965 - val_accuracy: 0.4832
Epoch 171/200
79/79 [==============================] - 3s 35ms/step - loss: 0.6934 - accuracy:
0.4984 - val_loss: 0.6932 - val_accuracy: 0.5196
Epoch 172/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6940 - accuracy:
0.5048 - val_loss: 0.6936 - val_accuracy: 0.5096
Epoch 173/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6933 - accuracy:
0.5220 - val_loss: 0.6961 - val_accuracy: 0.4932
Epoch 174/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6932 - accuracy:
0.5088 - val_loss: 0.6940 - val_accuracy: 0.5084
Epoch 175/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6919 - accuracy:
0.5220 - val_loss: 0.6954 - val_accuracy: 0.4988
Epoch 176/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6928 - accuracy:
0.5128 - val_loss: 0.6951 - val_accuracy: 0.5000
Epoch 177/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6926 - accuracy:
0.5240 - val_loss: 0.6952 - val_accuracy: 0.5068
Epoch 178/200
79/79 [==============================] - 2s 30ms/step - loss: 0.6911 - accuracy:
0.5140 - val_loss: 0.6935 - val_accuracy: 0.5172
Epoch 179/200
79/79 [==============================] - 2s 22ms/step - loss: 0.6918 - accuracy:
0.5132 - val_loss: 0.6963 - val_accuracy: 0.5056
Epoch 180/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6903 - accuracy:
0.5216 - val_loss: 0.6945 - val_accuracy: 0.5204
Epoch 181/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6924 - accuracy:
0.5120 - val_loss: 0.6955 - val_accuracy: 0.5016
Epoch 182/200
79/79 [==============================] - 2s 19ms/step - loss: 0.6916 - accuracy:
0.5140 - val_loss: 0.6956 - val_accuracy: 0.5176
Epoch 183/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6903 - accuracy:
0.5232 - val_loss: 0.6945 - val_accuracy: 0.5120
Epoch 184/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6903 - accuracy:
0.5184 - val_loss: 0.6962 - val_accuracy: 0.5100
Epoch 185/200
79/79 [==============================] - 2s 27ms/step - loss: 0.6890 - accuracy:
0.5364 - val_loss: 0.6955 - val_accuracy: 0.5192
Epoch 186/200
79/79 [==============================] - 2s 27ms/step - loss: 0.6910 - accuracy:
0.5320 - val_loss: 0.6967 - val_accuracy: 0.5104
Epoch 187/200
79/79 [==============================] - 2s 20ms/step - loss: 0.6895 - accuracy:
```

```
     0.5224 - val_loss: 0.6980 - val_accuracy: 0.5140
     Epoch 188/200
     79/79 [==============================] - 2s 20ms/step - loss: 0.6882 - accuracy:
     0.5288 - val_loss: 0.6987 - val_accuracy: 0.5104
     Epoch 189/200
     79/79 [==============================] - 2s 20ms/step - loss: 0.6899 - accuracy:
     0.5224 - val_loss: 0.7004 - val_accuracy: 0.4964
     Epoch 190/200
     79/79 [==============================] - 2s 20ms/step - loss: 0.6886 - accuracy:
     0.5216 - val_loss: 0.6953 - val_accuracy: 0.5120
     Epoch 191/200
     79/79 [==============================] - 2s 19ms/step - loss: 0.6906 - accuracy:
     0.5224 - val_loss: 0.6971 - val_accuracy: 0.5180
     Epoch 192/200
     79/79 [==============================] - 2s 22ms/step - loss: 0.6895 - accuracy:
     0.5236 - val_loss: 0.6996 - val_accuracy: 0.5064
     Epoch 193/200
     79/79 [==============================] - 2s 31ms/step - loss: 0.6901 - accuracy:
     0.5168 - val_loss: 0.6970 - val_accuracy: 0.5076
     Epoch 194/200
     79/79 [==============================] - 2s 19ms/step - loss: 0.6875 - accuracy:
     0.5304 - val_loss: 0.7033 - val_accuracy: 0.4928
     Epoch 195/200
     79/79 [==============================] - 2s 20ms/step - loss: 0.6892 - accuracy:
     0.5312 - val_loss: 0.6986 - val_accuracy: 0.5060
     Epoch 196/200
     79/79 [==============================] - 2s 20ms/step - loss: 0.6874 - accuracy:
     0.5312 - val_loss: 0.7050 - val_accuracy: 0.5056
     Epoch 197/200
     79/79 [==============================] - 2s 20ms/step - loss: 0.6930 - accuracy:
     0.5132 - val_loss: 0.6982 - val_accuracy: 0.5024
     Epoch 198/200
     79/79 [==============================] - 2s 20ms/step - loss: 0.6909 - accuracy:
     0.5240 - val_loss: 0.6990 - val_accuracy: 0.5116
     Epoch 199/200
     79/79 [==============================] - 2s 20ms/step - loss: 0.6892 - accuracy:
     0.5328 - val_loss: 0.7052 - val_accuracy: 0.5108
     Epoch 200/200
     79/79 [==============================] - 2s 29ms/step - loss: 0.6984 - accuracy:
     0.5096 - val_loss: 0.7053 - val_accuracy: 0.4904
```
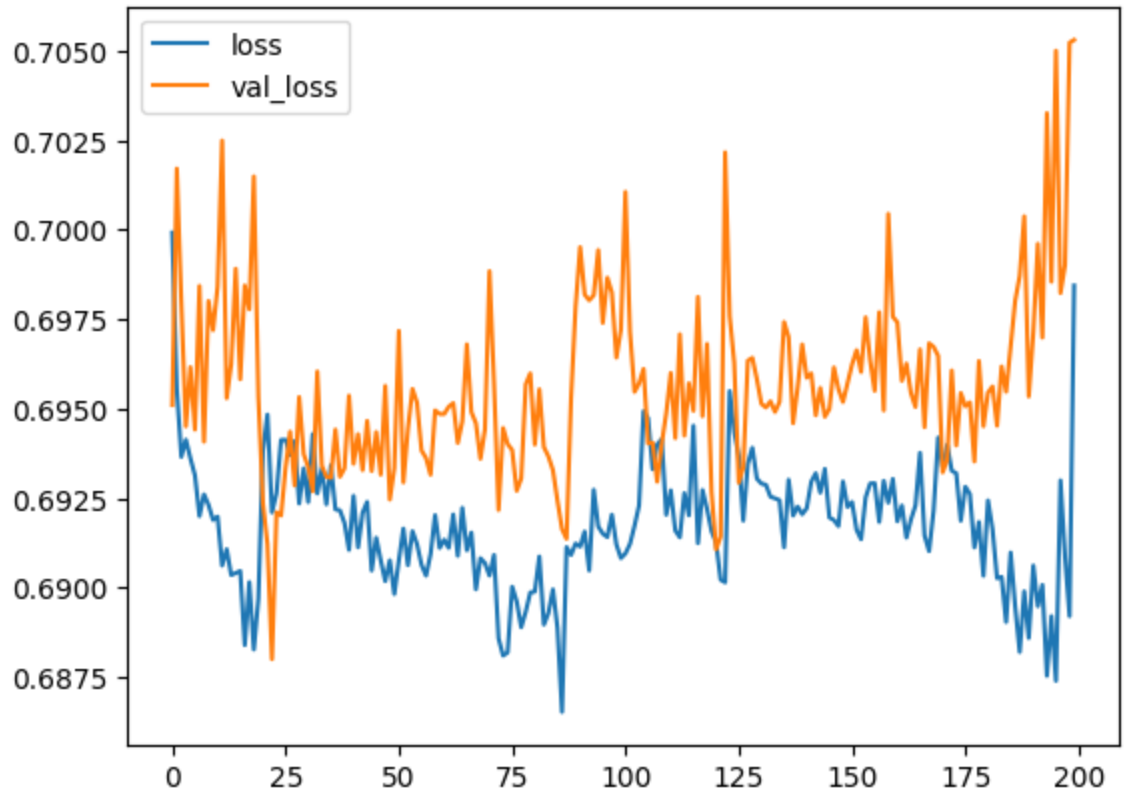
In [20]:
```python
# Plot the loss
plt.plot(r.history['loss'], label='loss')
plt.plot(r.history['val_loss'], label='val_loss')
plt.legend()
```

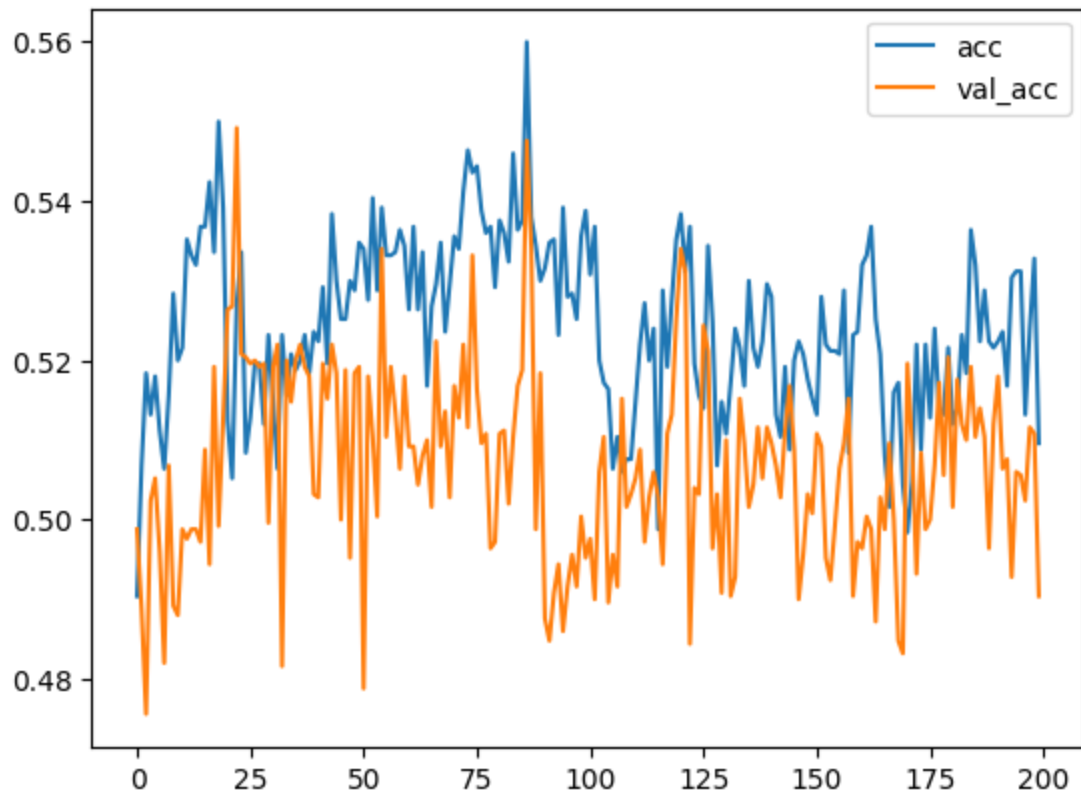Out[20]: <matplotlib.legend.Legend at 0x7f8bd9c134c0>

```
In [21]:  # Plot the accuracy too
          plt.plot(r.history['accuracy'], label='acc')
          plt.plot(r.history['val_accuracy'], label='val_acc')
          plt.legend()
```

Out[21]: <matplotlib.legend.Legend at 0x7f8bd9cef730>

```
In [22]:  # Now test our LSTM
          inputs = np.expand_dims(X, -1)

          # make the RNN
          i = Input(shape=(T, D))

          # method 1
          x = LSTM(5)(i)

          x = Dense(1, activation='sigmoid')(x)
          model = Model(i, x)
          model.compile(
            loss='binary_crossentropy',
            optimizer=Adam(learning_rate=0.01),
            metrics=['accuracy'],
          )

          # train the RNN
          r = model.fit(
            inputs, Y,
            epochs=200,
            validation_split=0.5,
          )
```

```
Epoch 1/200
79/79 [==============================] - 3s 13ms/step - loss: 0.6938 - accuracy:
0.4964 - val_loss: 0.6949 - val_accuracy: 0.4940
Epoch 2/200
79/79 [==============================] - 1s 10ms/step - loss: 0.6913 - accuracy:
0.5204 - val_loss: 0.6945 - val_accuracy: 0.5176
Epoch 3/200
79/79 [==============================] - 1s 11ms/step - loss: 0.6936 - accuracy:
0.4972 - val_loss: 0.6952 - val_accuracy: 0.4992
Epoch 4/200
79/79 [==============================] - 1s 11ms/step - loss: 0.6918 - accuracy:
0.5032 - val_loss: 0.6940 - val_accuracy: 0.5104
Epoch 5/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6923 - accuracy: 0.
5196 - val_loss: 0.6943 - val_accuracy: 0.5004
Epoch 6/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6928 - accuracy: 0.
5144 - val_loss: 0.6954 - val_accuracy: 0.4960
Epoch 7/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6918 - accuracy: 0.
5192 - val_loss: 0.6968 - val_accuracy: 0.4980
Epoch 8/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6913 - accuracy: 0.
5144 - val_loss: 0.6964 - val_accuracy: 0.4952
Epoch 9/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6919 - accuracy: 0.
5112 - val_loss: 0.6942 - val_accuracy: 0.5016
Epoch 10/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6916 - accuracy: 0.
5196 - val_loss: 0.6939 - val_accuracy: 0.5184
Epoch 11/200
79/79 [==============================] - 1s 10ms/step - loss: 0.6917 - accuracy:
0.5260 - val_loss: 0.6948 - val_accuracy: 0.5040
Epoch 12/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6917 - accuracy: 0.
5148 - val_loss: 0.6947 - val_accuracy: 0.5012
Epoch 13/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6907 - accuracy: 0.
5264 - val_loss: 0.6952 - val_accuracy: 0.4988
Epoch 14/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6907 - accuracy: 0.
5252 - val_loss: 0.6943 - val_accuracy: 0.5080
Epoch 15/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6904 - accuracy: 0.
5232 - val_loss: 0.6966 - val_accuracy: 0.5028
Epoch 16/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6914 - accuracy: 0.
5172 - val_loss: 0.6939 - val_accuracy: 0.5116
Epoch 17/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6904 - accuracy: 0.
5204 - val_loss: 0.7022 - val_accuracy: 0.4912
Epoch 18/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6896 - accuracy: 0.
5248 - val_loss: 0.6981 - val_accuracy: 0.5072
Epoch 19/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6891 - accuracy: 0.
```

```
5220 - val_loss: 0.6992 - val_accuracy: 0.5028
Epoch 20/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6875 - accuracy: 0.
5168 - val_loss: 0.6994 - val_accuracy: 0.4960
Epoch 21/200
79/79 [==============================] - 1s 11ms/step - loss: 0.6872 - accuracy:
0.5268 - val_loss: 0.7050 - val_accuracy: 0.5024
Epoch 22/200
79/79 [==============================] - 1s 11ms/step - loss: 0.6869 - accuracy:
0.5260 - val_loss: 0.7017 - val_accuracy: 0.5024
Epoch 23/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6867 - accuracy: 0.
5288 - val_loss: 0.6997 - val_accuracy: 0.5044
Epoch 24/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6867 - accuracy: 0.
5280 - val_loss: 0.7016 - val_accuracy: 0.5020
Epoch 25/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6860 - accuracy: 0.
5332 - val_loss: 0.6983 - val_accuracy: 0.5072
Epoch 26/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6868 - accuracy: 0.
5300 - val_loss: 0.7012 - val_accuracy: 0.5044
Epoch 27/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6841 - accuracy: 0.
5340 - val_loss: 0.7131 - val_accuracy: 0.5052
Epoch 28/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6859 - accuracy: 0.
5304 - val_loss: 0.7027 - val_accuracy: 0.5052
Epoch 29/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6828 - accuracy: 0.
5396 - val_loss: 0.7003 - val_accuracy: 0.5012
Epoch 30/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6825 - accuracy: 0.
5352 - val_loss: 0.7016 - val_accuracy: 0.5040
Epoch 31/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6796 - accuracy: 0.
5352 - val_loss: 0.7029 - val_accuracy: 0.5184
Epoch 32/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6823 - accuracy: 0.
5320 - val_loss: 0.6968 - val_accuracy: 0.4968
Epoch 33/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6864 - accuracy: 0.
5392 - val_loss: 0.7018 - val_accuracy: 0.4916
Epoch 34/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6849 - accuracy: 0.
5336 - val_loss: 0.7003 - val_accuracy: 0.5032
Epoch 35/200
79/79 [==============================] - 1s 10ms/step - loss: 0.6842 - accuracy:
0.5376 - val_loss: 0.7010 - val_accuracy: 0.4888
Epoch 36/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6798 - accuracy: 0.
5368 - val_loss: 0.6973 - val_accuracy: 0.5036
Epoch 37/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6825 - accuracy: 0.
5448 - val_loss: 0.6975 - val_accuracy: 0.4812
Epoch 38/200
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79/79 [==============================] - 1s 11ms/step - loss: 0.6849 - accuracy:
0.5344 - val_loss: 0.7005 - val_accuracy: 0.4924
Epoch 39/200
79/79 [==============================] - 1s 11ms/step - loss: 0.6836 - accuracy:
0.5264 - val_loss: 0.7030 - val_accuracy: 0.4940
Epoch 40/200
79/79 [==============================] - 1s 11ms/step - loss: 0.6818 - accuracy:
0.5444 - val_loss: 0.7000 - val_accuracy: 0.4916
Epoch 41/200
79/79 [==============================] - 1s 10ms/step - loss: 0.6810 - accuracy:
0.5368 - val_loss: 0.7044 - val_accuracy: 0.4956
Epoch 42/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6794 - accuracy: 0.
5440 - val_loss: 0.7251 - val_accuracy: 0.5196
Epoch 43/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6807 - accuracy: 0.
5416 - val_loss: 0.6822 - val_accuracy: 0.5108
Epoch 44/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6615 - accuracy: 0.
5696 - val_loss: 0.6792 - val_accuracy: 0.5660
Epoch 45/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6612 - accuracy: 0.
6024 - val_loss: 0.6571 - val_accuracy: 0.6248
Epoch 46/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6472 - accuracy: 0.
6344 - val_loss: 0.6513 - val_accuracy: 0.6184
Epoch 47/200
79/79 [==============================] - 1s 10ms/step - loss: 0.6575 - accuracy:
0.6204 - val_loss: 0.6613 - val_accuracy: 0.6244
Epoch 48/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6631 - accuracy: 0.
6152 - val_loss: 0.6834 - val_accuracy: 0.5612
Epoch 49/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6897 - accuracy: 0.
5228 - val_loss: 0.6834 - val_accuracy: 0.5480
Epoch 50/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6794 - accuracy: 0.
5532 - val_loss: 0.6721 - val_accuracy: 0.5808
Epoch 51/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6712 - accuracy: 0.
5572 - val_loss: 0.6732 - val_accuracy: 0.5692
Epoch 52/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6684 - accuracy: 0.
5652 - val_loss: 0.6624 - val_accuracy: 0.5948
Epoch 53/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6606 - accuracy: 0.
5924 - val_loss: 0.6605 - val_accuracy: 0.6036
Epoch 54/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6559 - accuracy: 0.
5960 - val_loss: 0.6548 - val_accuracy: 0.6036
Epoch 55/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6667 - accuracy: 0.
5860 - val_loss: 0.6611 - val_accuracy: 0.6128
Epoch 56/200
79/79 [==============================] - 1s 11ms/step - loss: 0.6522 - accuracy:
0.6100 - val_loss: 0.6906 - val_accuracy: 0.5632
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Epoch 57/200
79/79 [==============================] - 1s 11ms/step - loss: 0.6852 - accuracy:
0.5680 - val_loss: 0.6840 - val_accuracy: 0.5752
Epoch 58/200
79/79 [==============================] - 1s 11ms/step - loss: 0.6827 - accuracy:
0.5704 - val_loss: 0.6854 - val_accuracy: 0.5700
Epoch 59/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6810 - accuracy: 0.
5764 - val_loss: 0.6828 - val_accuracy: 0.5776
Epoch 60/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6783 - accuracy: 0.
5860 - val_loss: 0.6926 - val_accuracy: 0.5672
Epoch 61/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6904 - accuracy: 0.
5520 - val_loss: 0.6862 - val_accuracy: 0.5560
Epoch 62/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6876 - accuracy: 0.
5528 - val_loss: 0.6859 - val_accuracy: 0.5576
Epoch 63/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6825 - accuracy: 0.
5660 - val_loss: 0.6831 - val_accuracy: 0.5804
Epoch 64/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6773 - accuracy: 0.
5748 - val_loss: 0.6627 - val_accuracy: 0.6068
Epoch 65/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6539 - accuracy: 0.
6104 - val_loss: 0.6234 - val_accuracy: 0.6420
Epoch 66/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6399 - accuracy: 0.
6196 - val_loss: 0.6516 - val_accuracy: 0.6012
Epoch 67/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6334 - accuracy: 0.
6144 - val_loss: 0.6277 - val_accuracy: 0.6168
Epoch 68/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6232 - accuracy: 0.
6180 - val_loss: 0.6091 - val_accuracy: 0.6372
Epoch 69/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6128 - accuracy: 0.
6316 - val_loss: 0.6077 - val_accuracy: 0.6372
Epoch 70/200
79/79 [==============================] - 1s 10ms/step - loss: 0.6060 - accuracy:
0.6400 - val_loss: 0.5928 - val_accuracy: 0.6472
Epoch 71/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5940 - accuracy: 0.
6476 - val_loss: 0.5853 - val_accuracy: 0.6492
Epoch 72/200
79/79 [==============================] - 1s 10ms/step - loss: 0.5915 - accuracy:
0.6524 - val_loss: 0.5792 - val_accuracy: 0.6712
Epoch 73/200
79/79 [==============================] - 1s 12ms/step - loss: 0.5899 - accuracy:
0.6596 - val_loss: 0.5748 - val_accuracy: 0.6736
Epoch 74/200
79/79 [==============================] - 1s 11ms/step - loss: 0.5979 - accuracy:
0.6576 - val_loss: 0.6409 - val_accuracy: 0.6300
Epoch 75/200
79/79 [==============================] - 1s 12ms/step - loss: 0.6033 - accuracy:
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0.6536 - val_loss: 0.5773 - val_accuracy: 0.6660
Epoch 76/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5873 - accuracy: 0.
6600 - val_loss: 0.5735 - val_accuracy: 0.6784
Epoch 77/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5774 - accuracy: 0.
6700 - val_loss: 0.5628 - val_accuracy: 0.6776
Epoch 78/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5689 - accuracy: 0.
6768 - val_loss: 0.5669 - val_accuracy: 0.6824
Epoch 79/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5695 - accuracy: 0.
6788 - val_loss: 0.5582 - val_accuracy: 0.6940
Epoch 80/200
79/79 [==============================] - 1s 10ms/step - loss: 0.5607 - accuracy:
0.6884 - val_loss: 0.5587 - val_accuracy: 0.6944
Epoch 81/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5574 - accuracy: 0.
6908 - val_loss: 0.5509 - val_accuracy: 0.6932
Epoch 82/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5600 - accuracy: 0.
6872 - val_loss: 0.5491 - val_accuracy: 0.6920
Epoch 83/200
79/79 [==============================] - 1s 10ms/step - loss: 0.5781 - accuracy:
0.6800 - val_loss: 0.5612 - val_accuracy: 0.6960
Epoch 84/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5601 - accuracy: 0.
6912 - val_loss: 0.5514 - val_accuracy: 0.6916
Epoch 85/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5514 - accuracy: 0.
6996 - val_loss: 0.5473 - val_accuracy: 0.7040
Epoch 86/200
79/79 [==============================] - 1s 10ms/step - loss: 0.5593 - accuracy:
0.7048 - val_loss: 0.5669 - val_accuracy: 0.6992
Epoch 87/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5785 - accuracy: 0.
6900 - val_loss: 0.6222 - val_accuracy: 0.6520
Epoch 88/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6313 - accuracy: 0.
6436 - val_loss: 0.6240 - val_accuracy: 0.6468
Epoch 89/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6162 - accuracy: 0.
6608 - val_loss: 0.6156 - val_accuracy: 0.6560
Epoch 90/200
79/79 [==============================] - 1s 9ms/step - loss: 0.5974 - accuracy: 0.
6756 - val_loss: 0.5782 - val_accuracy: 0.6904
Epoch 91/200
79/79 [==============================] - 1s 11ms/step - loss: 0.5641 - accuracy:
0.6972 - val_loss: 0.5523 - val_accuracy: 0.7016
Epoch 92/200
79/79 [==============================] - 1s 11ms/step - loss: 0.5500 - accuracy:
0.7012 - val_loss: 0.5448 - val_accuracy: 0.7076
Epoch 93/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6278 - accuracy: 0.
6184 - val_loss: 0.6281 - val_accuracy: 0.6172
Epoch 94/200
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79/79 [==============================] - 1s 9ms/step - loss: 0.6314 - accuracy: 0.
6120 - val_loss: 0.6203 - val_accuracy: 0.6300
Epoch 95/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6280 - accuracy: 0.
6112 - val_loss: 0.6188 - val_accuracy: 0.6220
Epoch 96/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6250 - accuracy: 0.
6140 - val_loss: 0.6175 - val_accuracy: 0.6256
Epoch 97/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6228 - accuracy: 0.
6176 - val_loss: 0.6142 - val_accuracy: 0.6236
Epoch 98/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6207 - accuracy: 0.
6160 - val_loss: 0.6128 - val_accuracy: 0.6344
Epoch 99/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6196 - accuracy: 0.
6176 - val_loss: 0.6108 - val_accuracy: 0.6312
Epoch 100/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6212 - accuracy: 0.
6176 - val_loss: 0.6128 - val_accuracy: 0.6268
Epoch 101/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6411 - accuracy: 0.
5896 - val_loss: 0.6433 - val_accuracy: 0.5888
Epoch 102/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6295 - accuracy: 0.
5964 - val_loss: 0.6209 - val_accuracy: 0.6184
Epoch 103/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6177 - accuracy: 0.
6136 - val_loss: 0.6140 - val_accuracy: 0.6268
Epoch 104/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6120 - accuracy: 0.
6256 - val_loss: 0.6112 - val_accuracy: 0.6312
Epoch 105/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6101 - accuracy: 0.
6248 - val_loss: 0.6115 - val_accuracy: 0.6324
Epoch 106/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6098 - accuracy: 0.
6260 - val_loss: 0.6126 - val_accuracy: 0.6336
Epoch 107/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6082 - accuracy: 0.
6240 - val_loss: 0.6113 - val_accuracy: 0.6380
Epoch 108/200
79/79 [==============================] - 1s 10ms/step - loss: 0.6080 - accuracy:
0.6268 - val_loss: 0.6140 - val_accuracy: 0.6340
Epoch 109/200
79/79 [==============================] - 1s 11ms/step - loss: 0.6069 - accuracy:
0.6256 - val_loss: 0.6106 - val_accuracy: 0.6336
Epoch 110/200
79/79 [==============================] - 1s 11ms/step - loss: 0.6067 - accuracy:
0.6256 - val_loss: 0.6127 - val_accuracy: 0.6268
Epoch 111/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6079 - accuracy: 0.
6256 - val_loss: 0.6159 - val_accuracy: 0.6356
Epoch 112/200
79/79 [==============================] - 1s 7ms/step - loss: 0.6149 - accuracy: 0.
6204 - val_loss: 0.6159 - val_accuracy: 0.6356
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Epoch 113/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6101 - accuracy: 0.
6268 - val_loss: 0.6161 - val_accuracy: 0.6220
Epoch 114/200
79/79 [==============================] - 1s 8ms/step - loss: 0.6029 - accuracy: 0.
6340 - val_loss: 0.6064 - val_accuracy: 0.6504
Epoch 115/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5956 - accuracy: 0.
6520 - val_loss: 0.5968 - val_accuracy: 0.6648
Epoch 116/200
79/79 [==============================] - 1s 7ms/step - loss: 0.5838 - accuracy: 0.
6728 - val_loss: 0.5780 - val_accuracy: 0.6884
Epoch 117/200
79/79 [==============================] - 1s 9ms/step - loss: 0.5616 - accuracy: 0.
6948 - val_loss: 0.5562 - val_accuracy: 0.7028
Epoch 118/200
79/79 [==============================] - 1s 9ms/step - loss: 0.5514 - accuracy: 0.
7096 - val_loss: 0.5625 - val_accuracy: 0.7028
Epoch 119/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5525 - accuracy: 0.
7044 - val_loss: 0.5439 - val_accuracy: 0.6728
Epoch 120/200
79/79 [==============================] - 1s 9ms/step - loss: 0.5491 - accuracy: 0.
6792 - val_loss: 0.5457 - val_accuracy: 0.6884
Epoch 121/200
79/79 [==============================] - 1s 9ms/step - loss: 0.5449 - accuracy: 0.
7040 - val_loss: 0.5384 - val_accuracy: 0.7056
Epoch 122/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5500 - accuracy: 0.
6832 - val_loss: 0.5482 - val_accuracy: 0.6564
Epoch 123/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5439 - accuracy: 0.
6628 - val_loss: 0.5454 - val_accuracy: 0.6420
Epoch 124/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5446 - accuracy: 0.
6744 - val_loss: 0.5199 - val_accuracy: 0.7004
Epoch 125/200
79/79 [==============================] - 1s 9ms/step - loss: 0.5393 - accuracy: 0.
6700 - val_loss: 0.6455 - val_accuracy: 0.5436
Epoch 126/200
79/79 [==============================] - 1s 9ms/step - loss: 0.6140 - accuracy: 0.
5984 - val_loss: 0.5940 - val_accuracy: 0.6072
Epoch 127/200
79/79 [==============================] - 1s 11ms/step - loss: 0.5894 - accuracy:
0.6184 - val_loss: 0.5832 - val_accuracy: 0.6140
Epoch 128/200
79/79 [==============================] - 1s 11ms/step - loss: 0.5642 - accuracy:
0.6356 - val_loss: 0.5676 - val_accuracy: 0.6188
Epoch 129/200
79/79 [==============================] - 1s 10ms/step - loss: 0.5659 - accuracy:
0.6320 - val_loss: 0.6791 - val_accuracy: 0.5788
Epoch 130/200
79/79 [==============================] - 1s 9ms/step - loss: 0.5802 - accuracy: 0.
6296 - val_loss: 0.5805 - val_accuracy: 0.6300
Epoch 131/200
79/79 [==============================] - 1s 9ms/step - loss: 0.5661 - accuracy: 0.
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6324 - val_loss: 0.5702 - val_accuracy: 0.6356
Epoch 132/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5603 - accuracy: 0.
6428 - val_loss: 0.5614 - val_accuracy: 0.6364
Epoch 133/200
79/79 [==============================] - 1s 8ms/step - loss: 0.5427 - accuracy: 0.
6656 - val_loss: 0.5388 - val_accuracy: 0.6596
Epoch 134/200
79/79 [==============================] - 1s 9ms/step - loss: 0.5267 - accuracy: 0.
6588 - val_loss: 0.5234 - val_accuracy: 0.6904
Epoch 135/200
79/79 [==============================] - 1s 10ms/step - loss: 0.5139 - accuracy:
0.6948 - val_loss: 0.5049 - val_accuracy: 0.7032
Epoch 136/200
79/79 [==============================] - 1s 9ms/step - loss: 0.4979 - accuracy: 0.
7208 - val_loss: 0.4892 - val_accuracy: 0.7236
Epoch 137/200
79/79 [==============================] - 1s 9ms/step - loss: 0.4833 - accuracy: 0.
7388 - val_loss: 0.4790 - val_accuracy: 0.7324
Epoch 138/200
79/79 [==============================] - 1s 8ms/step - loss: 0.4915 - accuracy: 0.
7408 - val_loss: 0.4880 - val_accuracy: 0.7452
Epoch 139/200
79/79 [==============================] - 1s 9ms/step - loss: 0.4777 - accuracy: 0.
7448 - val_loss: 0.4809 - val_accuracy: 0.7488
Epoch 140/200
79/79 [==============================] - 1s 8ms/step - loss: 0.4690 - accuracy: 0.
7612 - val_loss: 0.4745 - val_accuracy: 0.7652
Epoch 141/200
79/79 [==============================] - 1s 8ms/step - loss: 0.4663 - accuracy: 0.
7600 - val_loss: 0.4627 - val_accuracy: 0.7772
Epoch 142/200
79/79 [==============================] - 1s 8ms/step - loss: 0.4608 - accuracy: 0.
7780 - val_loss: 0.4578 - val_accuracy: 0.7796
Epoch 143/200
79/79 [==============================] - 1s 9ms/step - loss: 0.4509 - accuracy: 0.
7772 - val_loss: 0.4590 - val_accuracy: 0.7888
Epoch 144/200
79/79 [==============================] - 1s 11ms/step - loss: 0.4452 - accuracy:
0.7908 - val_loss: 0.4559 - val_accuracy: 0.7872
Epoch 145/200
79/79 [==============================] - 1s 11ms/step - loss: 0.4466 - accuracy:
0.7908 - val_loss: 0.4471 - val_accuracy: 0.7956
Epoch 146/200
79/79 [==============================] - 1s 10ms/step - loss: 0.4294 - accuracy:
0.7984 - val_loss: 0.4299 - val_accuracy: 0.8028
Epoch 147/200
79/79 [==============================] - 1s 9ms/step - loss: 0.4218 - accuracy: 0.
8004 - val_loss: 0.4307 - val_accuracy: 0.8020
Epoch 148/200
79/79 [==============================] - 1s 9ms/step - loss: 0.4186 - accuracy: 0.
7980 - val_loss: 0.4165 - val_accuracy: 0.8036
Epoch 149/200
79/79 [==============================] - 1s 8ms/step - loss: 0.4136 - accuracy: 0.
8012 - val_loss: 0.4089 - val_accuracy: 0.8048
Epoch 150/200
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79/79 [==============================] - 1s 8ms/step - loss: 0.4349 - accuracy: 0.
7968 - val_loss: 0.4593 - val_accuracy: 0.7880
Epoch 151/200
79/79 [==============================] - 1s 8ms/step - loss: 0.4370 - accuracy: 0.
7928 - val_loss: 0.4342 - val_accuracy: 0.7960
Epoch 152/200
79/79 [==============================] - 1s 8ms/step - loss: 0.4205 - accuracy: 0.
7984 - val_loss: 0.4277 - val_accuracy: 0.7996
Epoch 153/200
79/79 [==============================] - 1s 8ms/step - loss: 0.4115 - accuracy: 0.
8012 - val_loss: 0.4119 - val_accuracy: 0.8048
Epoch 154/200
79/79 [==============================] - 1s 9ms/step - loss: 0.4058 - accuracy: 0.
8072 - val_loss: 0.4246 - val_accuracy: 0.7980
Epoch 155/200
79/79 [==============================] - 1s 8ms/step - loss: 0.3988 - accuracy: 0.
8128 - val_loss: 0.4131 - val_accuracy: 0.8092
Epoch 156/200
79/79 [==============================] - 1s 9ms/step - loss: 0.3990 - accuracy: 0.
8068 - val_loss: 0.3972 - val_accuracy: 0.8136
Epoch 157/200
79/79 [==============================] - 1s 8ms/step - loss: 0.3890 - accuracy: 0.
8136 - val_loss: 0.3916 - val_accuracy: 0.8160
Epoch 158/200
79/79 [==============================] - 1s 7ms/step - loss: 0.3898 - accuracy: 0.
8160 - val_loss: 0.3848 - val_accuracy: 0.8172
Epoch 159/200
79/79 [==============================] - 1s 9ms/step - loss: 0.3891 - accuracy: 0.
8140 - val_loss: 0.3790 - val_accuracy: 0.8204
Epoch 160/200
79/79 [==============================] - 1s 8ms/step - loss: 0.3745 - accuracy: 0.
8228 - val_loss: 0.3923 - val_accuracy: 0.8140
Epoch 161/200
79/79 [==============================] - 1s 10ms/step - loss: 0.3792 - accuracy:
0.8268 - val_loss: 0.3556 - val_accuracy: 0.8328
Epoch 162/200
79/79 [==============================] - 1s 11ms/step - loss: 0.3467 - accuracy:
0.8460 - val_loss: 0.3385 - val_accuracy: 0.8436
Epoch 163/200
79/79 [==============================] - 1s 11ms/step - loss: 0.2860 - accuracy:
0.8892 - val_loss: 0.2396 - val_accuracy: 0.9212
Epoch 164/200
79/79 [==============================] - 1s 9ms/step - loss: 0.2365 - accuracy: 0.
9236 - val_loss: 0.2528 - val_accuracy: 0.9124
Epoch 165/200
79/79 [==============================] - 1s 8ms/step - loss: 0.2415 - accuracy: 0.
9188 - val_loss: 0.3151 - val_accuracy: 0.8868
Epoch 166/200
79/79 [==============================] - 1s 10ms/step - loss: 0.2281 - accuracy:
0.9256 - val_loss: 0.2465 - val_accuracy: 0.9164
Epoch 167/200
79/79 [==============================] - 1s 9ms/step - loss: 0.2066 - accuracy: 0.
9364 - val_loss: 0.2002 - val_accuracy: 0.9476
Epoch 168/200
79/79 [==============================] - 1s 8ms/step - loss: 0.2005 - accuracy: 0.
9336 - val_loss: 0.2026 - val_accuracy: 0.9440
```

```
Epoch 169/200
79/79 [==============================] - 1s 8ms/step - loss: 0.1953 - accuracy: 0.
9408 - val_loss: 0.2052 - val_accuracy: 0.9468
Epoch 170/200
79/79 [==============================] - 1s 9ms/step - loss: 0.1983 - accuracy: 0.
9368 - val_loss: 0.1676 - val_accuracy: 0.9540
Epoch 171/200
79/79 [==============================] - 1s 8ms/step - loss: 0.1677 - accuracy: 0.
9500 - val_loss: 0.1740 - val_accuracy: 0.9456
Epoch 172/200
79/79 [==============================] - 1s 8ms/step - loss: 0.1573 - accuracy: 0.
9544 - val_loss: 0.1742 - val_accuracy: 0.9480
Epoch 173/200
79/79 [==============================] - 1s 9ms/step - loss: 0.1598 - accuracy: 0.
9520 - val_loss: 0.1608 - val_accuracy: 0.9532
Epoch 174/200
79/79 [==============================] - 1s 8ms/step - loss: 0.1434 - accuracy: 0.
9592 - val_loss: 0.1417 - val_accuracy: 0.9600
Epoch 175/200
79/79 [==============================] - 1s 8ms/step - loss: 0.2542 - accuracy: 0.
9264 - val_loss: 0.1661 - val_accuracy: 0.9444
Epoch 176/200
79/79 [==============================] - 1s 9ms/step - loss: 0.1517 - accuracy: 0.
9532 - val_loss: 0.1622 - val_accuracy: 0.9528
Epoch 177/200
79/79 [==============================] - 1s 9ms/step - loss: 0.1411 - accuracy: 0.
9608 - val_loss: 0.1385 - val_accuracy: 0.9632
Epoch 178/200
79/79 [==============================] - 1s 9ms/step - loss: 0.1307 - accuracy: 0.
9616 - val_loss: 0.1382 - val_accuracy: 0.9628
Epoch 179/200
79/79 [==============================] - 1s 10ms/step - loss: 0.1384 - accuracy:
0.9612 - val_loss: 0.1804 - val_accuracy: 0.9488
Epoch 180/200
79/79 [==============================] - 1s 11ms/step - loss: 0.1238 - accuracy:
0.9672 - val_loss: 0.1216 - val_accuracy: 0.9672
Epoch 181/200
79/79 [==============================] - 1s 11ms/step - loss: 0.1252 - accuracy:
0.9640 - val_loss: 0.1185 - val_accuracy: 0.9668
Epoch 182/200
79/79 [==============================] - 1s 9ms/step - loss: 0.1234 - accuracy: 0.
9640 - val_loss: 0.1426 - val_accuracy: 0.9612
Epoch 183/200
79/79 [==============================] - 1s 9ms/step - loss: 0.1209 - accuracy: 0.
9672 - val_loss: 0.1835 - val_accuracy: 0.9464
Epoch 184/200
79/79 [==============================] - 1s 9ms/step - loss: 0.1262 - accuracy: 0.
9644 - val_loss: 0.1252 - val_accuracy: 0.9616
Epoch 185/200
79/79 [==============================] - 1s 8ms/step - loss: 0.1198 - accuracy: 0.
9652 - val_loss: 0.1292 - val_accuracy: 0.9596
Epoch 186/200
79/79 [==============================] - 1s 8ms/step - loss: 0.1194 - accuracy: 0.
9656 - val_loss: 0.1145 - val_accuracy: 0.9708
Epoch 187/200
79/79 [==============================] - 1s 8ms/step - loss: 0.1037 - accuracy: 0.
```

```
            9724 - val_loss: 0.0952 - val_accuracy: 0.9728
            Epoch 188/200
            79/79 [==============================] - 1s 8ms/step - loss: 0.1045 - accuracy: 0.
            9724 - val_loss: 0.1259 - val_accuracy: 0.9632
            Epoch 189/200
            79/79 [==============================] - 1s 9ms/step - loss: 0.0938 - accuracy: 0.
            9720 - val_loss: 0.1205 - val_accuracy: 0.9652
            Epoch 190/200
            79/79 [==============================] - 1s 8ms/step - loss: 0.0953 - accuracy: 0.
            9740 - val_loss: 0.2360 - val_accuracy: 0.9468
            Epoch 191/200
            79/79 [==============================] - 1s 9ms/step - loss: 0.0970 - accuracy: 0.
            9732 - val_loss: 0.1026 - val_accuracy: 0.9736
            Epoch 192/200
            79/79 [==============================] - 1s 8ms/step - loss: 0.0838 - accuracy: 0.
            9784 - val_loss: 0.0876 - val_accuracy: 0.9744
            Epoch 193/200
            79/79 [==============================] - 1s 8ms/step - loss: 0.0865 - accuracy: 0.
            9752 - val_loss: 0.0913 - val_accuracy: 0.9724
            Epoch 194/200
            79/79 [==============================] - 1s 10ms/step - loss: 0.0952 - accuracy:
            0.9740 - val_loss: 0.1381 - val_accuracy: 0.9604
            Epoch 195/200
            79/79 [==============================] - 1s 8ms/step - loss: 0.1432 - accuracy: 0.
            9616 - val_loss: 0.1557 - val_accuracy: 0.9584
            Epoch 196/200
            79/79 [==============================] - 1s 8ms/step - loss: 0.1515 - accuracy: 0.
            9560 - val_loss: 0.1339 - val_accuracy: 0.9648
            Epoch 197/200
            79/79 [==============================] - 1s 12ms/step - loss: 0.1205 - accuracy:
            0.9676 - val_loss: 0.1307 - val_accuracy: 0.9628
            Epoch 198/200
            79/79 [==============================] - 1s 11ms/step - loss: 0.1959 - accuracy:
            0.9452 - val_loss: 0.1671 - val_accuracy: 0.9536
            Epoch 199/200
            79/79 [==============================] - 1s 11ms/step - loss: 0.1790 - accuracy:
            0.9488 - val_loss: 0.2207 - val_accuracy: 0.9364
            Epoch 200/200
            79/79 [==============================] - 1s 9ms/step - loss: 0.1320 - accuracy: 0.
            9636 - val_loss: 0.1705 - val_accuracy: 0.9600
```

```python
In [23]:  # Plot the loss
          plt.plot(r.history['loss'], label='loss')
          plt.plot(r.history['val_loss'], label='val_loss')
          plt.legend()
```
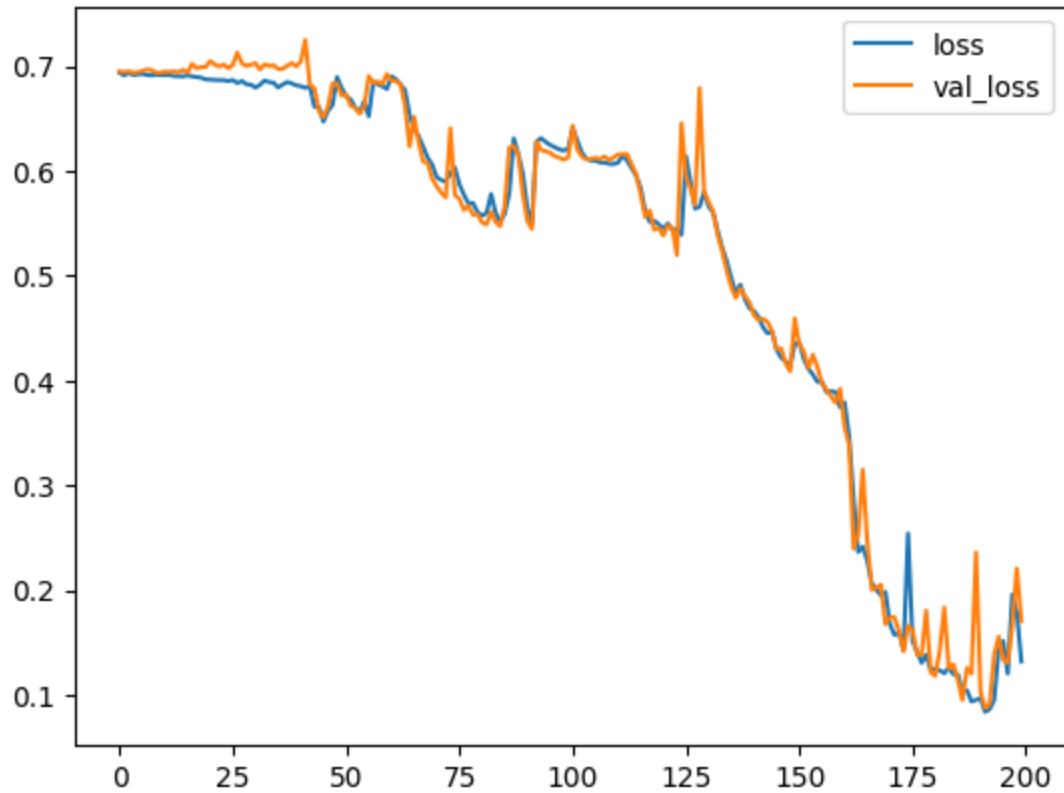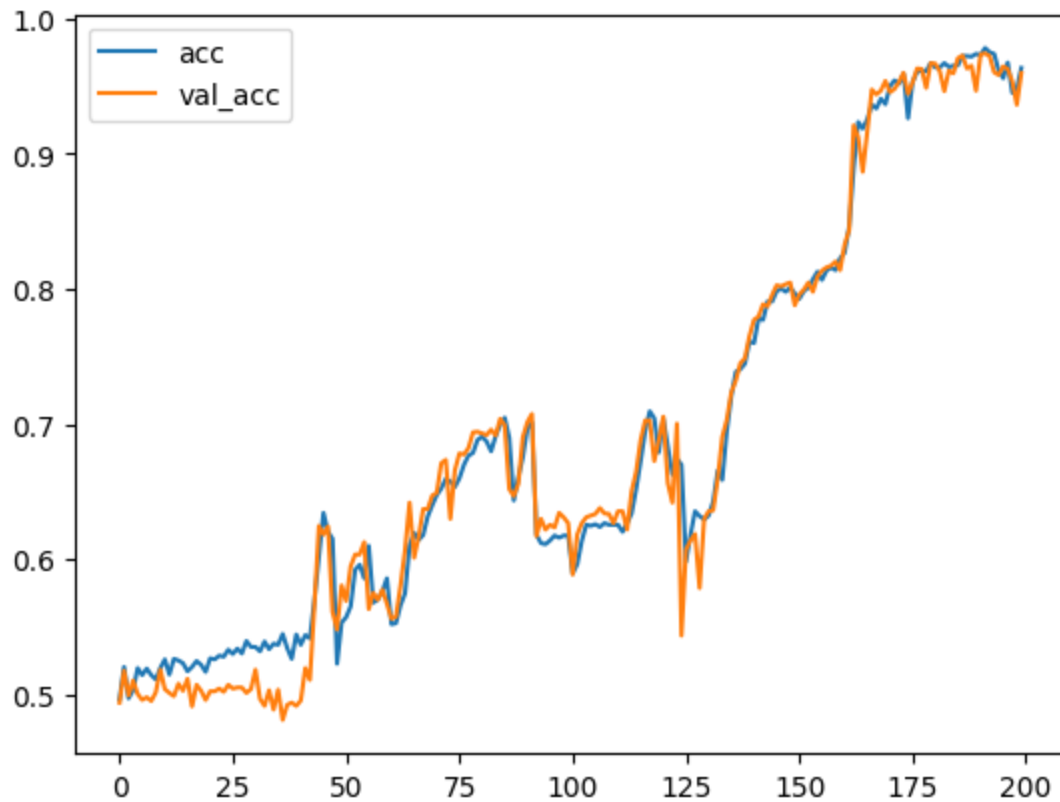
Out[23]: <matplotlib.legend.Legend at 0x7f8bd8b5d300>

In [24]:
```python
# Plot the accuracy too
plt.plot(r.history['accuracy'], label='acc')
plt.plot(r.history['val_accuracy'], label='val_acc')
plt.legend()
```

Out[24]: <matplotlib.legend.Legend at 0x7f8bd8aedcc0>

```
In [25]:   # Now test our GRU
           inputs = np.expand_dims(X, -1)

           # make the RNN
           i = Input(shape=(T, D))

           # method 1
           x = GRU(5)(i)

           x = Dense(1, activation='sigmoid')(x)
           model = Model(i, x)
           model.compile(
             loss='binary_crossentropy',
             optimizer=Adam(learning_rate=0.01),
             metrics=['accuracy'],
           )

           # train the RNN
           r = model.fit(
             inputs, Y,
             epochs=400,
             validation_split=0.5,
           )
```

```
Epoch 1/400
79/79 [==============================] - 4s 14ms/step - loss: 0.6938 - accuracy:
0.5004 - val_loss: 0.6942 - val_accuracy: 0.4852
Epoch 2/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6933 - accuracy: 0.
4992 - val_loss: 0.6947 - val_accuracy: 0.4876
Epoch 3/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6936 - accuracy: 0.
5048 - val_loss: 0.6962 - val_accuracy: 0.4856
Epoch 4/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6930 - accuracy: 0.
5080 - val_loss: 0.6944 - val_accuracy: 0.4860
Epoch 5/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6922 - accuracy: 0.
5228 - val_loss: 0.7002 - val_accuracy: 0.4824
Epoch 6/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6924 - accuracy: 0.
5172 - val_loss: 0.6940 - val_accuracy: 0.4944
Epoch 7/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6920 - accuracy: 0.
5160 - val_loss: 0.6958 - val_accuracy: 0.4936
Epoch 8/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6923 - accuracy: 0.
5220 - val_loss: 0.6981 - val_accuracy: 0.4820
Epoch 9/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6924 - accuracy:
0.5104 - val_loss: 0.6978 - val_accuracy: 0.4760
Epoch 10/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6917 - accuracy:
0.5220 - val_loss: 0.6953 - val_accuracy: 0.4924
Epoch 11/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6917 - accuracy:
0.5176 - val_loss: 0.6974 - val_accuracy: 0.4876
Epoch 12/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6923 - accuracy: 0.
5200 - val_loss: 0.7009 - val_accuracy: 0.4816
Epoch 13/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6922 - accuracy: 0.
5172 - val_loss: 0.7061 - val_accuracy: 0.4716
Epoch 14/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6926 - accuracy: 0.
5076 - val_loss: 0.6947 - val_accuracy: 0.5016
Epoch 15/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6917 - accuracy: 0.
5204 - val_loss: 0.6999 - val_accuracy: 0.4800
Epoch 16/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6918 - accuracy: 0.
5228 - val_loss: 0.6988 - val_accuracy: 0.4800
Epoch 17/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6921 - accuracy: 0.
5156 - val_loss: 0.6962 - val_accuracy: 0.5032
Epoch 18/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6914 - accuracy: 0.
5208 - val_loss: 0.6960 - val_accuracy: 0.4928
Epoch 19/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6919 - accuracy: 0.
```

```
5156 - val_loss: 0.6947 - val_accuracy: 0.5004
Epoch 20/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6919 - accuracy: 0.
5152 - val_loss: 0.6957 - val_accuracy: 0.4912
Epoch 21/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6912 - accuracy: 0.
5140 - val_loss: 0.6961 - val_accuracy: 0.5048
Epoch 22/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6910 - accuracy: 0.
5208 - val_loss: 0.6956 - val_accuracy: 0.4960
Epoch 23/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6904 - accuracy: 0.
5300 - val_loss: 0.6989 - val_accuracy: 0.4808
Epoch 24/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6907 - accuracy: 0.
5228 - val_loss: 0.6976 - val_accuracy: 0.4876
Epoch 25/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6903 - accuracy: 0.
5208 - val_loss: 0.6987 - val_accuracy: 0.4840
Epoch 26/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6900 - accuracy: 0.
5304 - val_loss: 0.6955 - val_accuracy: 0.5000
Epoch 27/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6900 - accuracy:
0.5200 - val_loss: 0.6970 - val_accuracy: 0.4900
Epoch 28/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6899 - accuracy:
0.5260 - val_loss: 0.6973 - val_accuracy: 0.4956
Epoch 29/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6893 - accuracy:
0.5320 - val_loss: 0.6979 - val_accuracy: 0.4980
Epoch 30/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6884 - accuracy: 0.
5372 - val_loss: 0.6971 - val_accuracy: 0.5016
Epoch 31/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6887 - accuracy: 0.
5364 - val_loss: 0.6981 - val_accuracy: 0.4960
Epoch 32/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6887 - accuracy: 0.
5272 - val_loss: 0.6974 - val_accuracy: 0.4968
Epoch 33/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6881 - accuracy: 0.
5440 - val_loss: 0.7016 - val_accuracy: 0.4788
Epoch 34/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6873 - accuracy: 0.
5376 - val_loss: 0.6949 - val_accuracy: 0.5124
Epoch 35/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6883 - accuracy: 0.
5268 - val_loss: 0.6987 - val_accuracy: 0.5020
Epoch 36/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6871 - accuracy: 0.
5456 - val_loss: 0.6983 - val_accuracy: 0.5020
Epoch 37/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6866 - accuracy: 0.
5420 - val_loss: 0.6979 - val_accuracy: 0.5048
Epoch 38/400
```

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79/79 [==============================] - 1s 8ms/step - loss: 0.6898 - accuracy: 0.
5344 - val_loss: 0.6995 - val_accuracy: 0.5024
Epoch 39/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6869 - accuracy: 0.
5492 - val_loss: 0.6996 - val_accuracy: 0.5120
Epoch 40/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6862 - accuracy: 0.
5460 - val_loss: 0.6964 - val_accuracy: 0.5188
Epoch 41/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6850 - accuracy: 0.
5460 - val_loss: 0.7009 - val_accuracy: 0.5060
Epoch 42/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6866 - accuracy: 0.
5428 - val_loss: 0.6968 - val_accuracy: 0.5028
Epoch 43/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6850 - accuracy: 0.
5524 - val_loss: 0.7048 - val_accuracy: 0.4952
Epoch 44/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6881 - accuracy: 0.
5380 - val_loss: 0.6990 - val_accuracy: 0.4968
Epoch 45/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6859 - accuracy: 0.
5608 - val_loss: 0.7018 - val_accuracy: 0.4932
Epoch 46/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6859 - accuracy:
0.5420 - val_loss: 0.7008 - val_accuracy: 0.4940
Epoch 47/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6839 - accuracy:
0.5520 - val_loss: 0.7047 - val_accuracy: 0.4944
Epoch 48/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6838 - accuracy:
0.5484 - val_loss: 0.7000 - val_accuracy: 0.5108
Epoch 49/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6844 - accuracy: 0.
5548 - val_loss: 0.7015 - val_accuracy: 0.4960
Epoch 50/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6837 - accuracy: 0.
5528 - val_loss: 0.7022 - val_accuracy: 0.5020
Epoch 51/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6817 - accuracy: 0.
5628 - val_loss: 0.7071 - val_accuracy: 0.4956
Epoch 52/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6830 - accuracy: 0.
5548 - val_loss: 0.7043 - val_accuracy: 0.4964
Epoch 53/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6820 - accuracy: 0.
5544 - val_loss: 0.7058 - val_accuracy: 0.4988
Epoch 54/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6862 - accuracy: 0.
5480 - val_loss: 0.7017 - val_accuracy: 0.4916
Epoch 55/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6831 - accuracy: 0.
5528 - val_loss: 0.7035 - val_accuracy: 0.5076
Epoch 56/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6823 - accuracy: 0.
5644 - val_loss: 0.7037 - val_accuracy: 0.4960
```

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Epoch 57/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6818 - accuracy: 0.
5540 - val_loss: 0.7006 - val_accuracy: 0.5012
Epoch 58/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6797 - accuracy: 0.
5588 - val_loss: 0.7012 - val_accuracy: 0.5132
Epoch 59/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6835 - accuracy: 0.
5500 - val_loss: 0.7067 - val_accuracy: 0.5040
Epoch 60/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6819 - accuracy: 0.
5588 - val_loss: 0.7046 - val_accuracy: 0.4904
Epoch 61/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6820 - accuracy: 0.
5500 - val_loss: 0.7045 - val_accuracy: 0.5092
Epoch 62/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6777 - accuracy: 0.
5620 - val_loss: 0.7066 - val_accuracy: 0.5076
Epoch 63/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6837 - accuracy: 0.
5528 - val_loss: 0.7050 - val_accuracy: 0.5048
Epoch 64/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6803 - accuracy:
0.5660 - val_loss: 0.7078 - val_accuracy: 0.5040
Epoch 65/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6784 - accuracy:
0.5668 - val_loss: 0.7105 - val_accuracy: 0.5008
Epoch 66/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6805 - accuracy:
0.5656 - val_loss: 0.7029 - val_accuracy: 0.4992
Epoch 67/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6807 - accuracy: 0.
5580 - val_loss: 0.7052 - val_accuracy: 0.4964
Epoch 68/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6845 - accuracy: 0.
5460 - val_loss: 0.7015 - val_accuracy: 0.5024
Epoch 69/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6819 - accuracy: 0.
5608 - val_loss: 0.7064 - val_accuracy: 0.4968
Epoch 70/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6805 - accuracy: 0.
5584 - val_loss: 0.7074 - val_accuracy: 0.4988
Epoch 71/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6815 - accuracy: 0.
5624 - val_loss: 0.7037 - val_accuracy: 0.5012
Epoch 72/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6792 - accuracy: 0.
5660 - val_loss: 0.7093 - val_accuracy: 0.4900
Epoch 73/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6832 - accuracy: 0.
5636 - val_loss: 0.7042 - val_accuracy: 0.4928
Epoch 74/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6800 - accuracy: 0.
5724 - val_loss: 0.7071 - val_accuracy: 0.4968
Epoch 75/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6778 - accuracy: 0.
```

```
5740 - val_loss: 0.7084 - val_accuracy: 0.4920
Epoch 76/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6777 - accuracy: 0.
5792 - val_loss: 0.7100 - val_accuracy: 0.4928
Epoch 77/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6783 - accuracy: 0.
5600 - val_loss: 0.7166 - val_accuracy: 0.5012
Epoch 78/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6831 - accuracy: 0.
5584 - val_loss: 0.7071 - val_accuracy: 0.4984
Epoch 79/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6797 - accuracy: 0.
5780 - val_loss: 0.7060 - val_accuracy: 0.5012
Epoch 80/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6786 - accuracy: 0.
5760 - val_loss: 0.7056 - val_accuracy: 0.5036
Epoch 81/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6789 - accuracy: 0.
5680 - val_loss: 0.7068 - val_accuracy: 0.4952
Epoch 82/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6755 - accuracy:
0.5852 - val_loss: 0.7081 - val_accuracy: 0.5004
Epoch 83/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6766 - accuracy:
0.5784 - val_loss: 0.7098 - val_accuracy: 0.5084
Epoch 84/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6757 - accuracy:
0.5756 - val_loss: 0.7133 - val_accuracy: 0.4868
Epoch 85/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6781 - accuracy: 0.
5736 - val_loss: 0.7143 - val_accuracy: 0.4952
Epoch 86/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6754 - accuracy: 0.
5836 - val_loss: 0.7137 - val_accuracy: 0.5000
Epoch 87/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6798 - accuracy: 0.
5628 - val_loss: 0.7074 - val_accuracy: 0.4972
Epoch 88/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6779 - accuracy: 0.
5624 - val_loss: 0.7070 - val_accuracy: 0.4932
Epoch 89/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6757 - accuracy: 0.
5728 - val_loss: 0.7104 - val_accuracy: 0.4976
Epoch 90/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6761 - accuracy: 0.
5828 - val_loss: 0.7122 - val_accuracy: 0.4972
Epoch 91/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6741 - accuracy: 0.
5852 - val_loss: 0.7154 - val_accuracy: 0.4924
Epoch 92/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6728 - accuracy: 0.
5872 - val_loss: 0.7156 - val_accuracy: 0.4932
Epoch 93/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6751 - accuracy: 0.
5884 - val_loss: 0.7144 - val_accuracy: 0.5088
Epoch 94/400
```

```
79/79 [==============================] - 1s 9ms/step - loss: 0.6810 - accuracy: 0.
5684 - val_loss: 0.7161 - val_accuracy: 0.4916
Epoch 95/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6864 - accuracy: 0.
5548 - val_loss: 0.7033 - val_accuracy: 0.5088
Epoch 96/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6783 - accuracy: 0.
5672 - val_loss: 0.7084 - val_accuracy: 0.4968
Epoch 97/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6795 - accuracy: 0.
5644 - val_loss: 0.7099 - val_accuracy: 0.4932
Epoch 98/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6788 - accuracy: 0.
5776 - val_loss: 0.7030 - val_accuracy: 0.5096
Epoch 99/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6758 - accuracy: 0.
5824 - val_loss: 0.7104 - val_accuracy: 0.4936
Epoch 100/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6769 - accuracy: 0.
5724 - val_loss: 0.7055 - val_accuracy: 0.5092
Epoch 101/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6752 - accuracy:
0.5768 - val_loss: 0.7106 - val_accuracy: 0.5016
Epoch 102/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6738 - accuracy:
0.5832 - val_loss: 0.7062 - val_accuracy: 0.5116
Epoch 103/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6714 - accuracy:
0.5932 - val_loss: 0.7136 - val_accuracy: 0.5060
Epoch 104/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6737 - accuracy: 0.
5772 - val_loss: 0.7105 - val_accuracy: 0.4980
Epoch 105/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6764 - accuracy: 0.
5716 - val_loss: 0.7139 - val_accuracy: 0.5020
Epoch 106/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6942 - accuracy: 0.
5316 - val_loss: 0.6996 - val_accuracy: 0.5208
Epoch 107/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6850 - accuracy: 0.
5488 - val_loss: 0.7000 - val_accuracy: 0.5016
Epoch 108/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6798 - accuracy: 0.
5616 - val_loss: 0.7043 - val_accuracy: 0.4992
Epoch 109/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6762 - accuracy: 0.
5748 - val_loss: 0.7048 - val_accuracy: 0.5016
Epoch 110/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6752 - accuracy: 0.
5800 - val_loss: 0.7073 - val_accuracy: 0.5056
Epoch 111/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6743 - accuracy: 0.
5748 - val_loss: 0.7063 - val_accuracy: 0.5068
Epoch 112/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6724 - accuracy: 0.
5876 - val_loss: 0.7091 - val_accuracy: 0.5132
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Epoch 113/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6849 - accuracy: 0.
5576 - val_loss: 0.7037 - val_accuracy: 0.5104
Epoch 114/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6811 - accuracy: 0.
5680 - val_loss: 0.7015 - val_accuracy: 0.5148
Epoch 115/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6737 - accuracy: 0.
5884 - val_loss: 0.7042 - val_accuracy: 0.5172
Epoch 116/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6719 - accuracy: 0.
5868 - val_loss: 0.7072 - val_accuracy: 0.5180
Epoch 117/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6711 - accuracy: 0.
5836 - val_loss: 0.7064 - val_accuracy: 0.5148
Epoch 118/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6727 - accuracy:
0.5880 - val_loss: 0.7091 - val_accuracy: 0.5008
Epoch 119/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6715 - accuracy:
0.5896 - val_loss: 0.7112 - val_accuracy: 0.5072
Epoch 120/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6720 - accuracy:
0.5904 - val_loss: 0.7079 - val_accuracy: 0.5148
Epoch 121/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6686 - accuracy: 0.
5876 - val_loss: 0.7085 - val_accuracy: 0.5188
Epoch 122/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6748 - accuracy: 0.
5812 - val_loss: 0.7073 - val_accuracy: 0.5140
Epoch 123/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6735 - accuracy: 0.
5944 - val_loss: 0.7042 - val_accuracy: 0.5228
Epoch 124/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6684 - accuracy: 0.
6032 - val_loss: 0.7046 - val_accuracy: 0.5244
Epoch 125/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6681 - accuracy: 0.
5956 - val_loss: 0.7020 - val_accuracy: 0.5264
Epoch 126/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6687 - accuracy: 0.
5900 - val_loss: 0.7041 - val_accuracy: 0.5348
Epoch 127/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6684 - accuracy: 0.
5876 - val_loss: 0.7061 - val_accuracy: 0.5248
Epoch 128/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6641 - accuracy: 0.
5984 - val_loss: 0.7037 - val_accuracy: 0.5348
Epoch 129/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6635 - accuracy: 0.
6072 - val_loss: 0.7058 - val_accuracy: 0.5232
Epoch 130/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6633 - accuracy: 0.
6036 - val_loss: 0.7061 - val_accuracy: 0.5348
Epoch 131/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6674 - accuracy: 0.
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5928 - val_loss: 0.6999 - val_accuracy: 0.5336
Epoch 132/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6666 - accuracy: 0.
5992 - val_loss: 0.7002 - val_accuracy: 0.5352
Epoch 133/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6614 - accuracy: 0.
6076 - val_loss: 0.7037 - val_accuracy: 0.5328
Epoch 134/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6645 - accuracy: 0.
6032 - val_loss: 0.6957 - val_accuracy: 0.5412
Epoch 135/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6599 - accuracy: 0.
6048 - val_loss: 0.6992 - val_accuracy: 0.5424
Epoch 136/400
79/79 [==============================] - 1s 12ms/step - loss: 0.6601 - accuracy:
0.6036 - val_loss: 0.6930 - val_accuracy: 0.5452
Epoch 137/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6605 - accuracy:
0.6088 - val_loss: 0.6922 - val_accuracy: 0.5444
Epoch 138/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6633 - accuracy:
0.5964 - val_loss: 0.6865 - val_accuracy: 0.5536
Epoch 139/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6541 - accuracy: 0.
6156 - val_loss: 0.6956 - val_accuracy: 0.5544
Epoch 140/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6612 - accuracy: 0.
6008 - val_loss: 0.6940 - val_accuracy: 0.5564
Epoch 141/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6555 - accuracy: 0.
6112 - val_loss: 0.6841 - val_accuracy: 0.5680
Epoch 142/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6483 - accuracy: 0.
6192 - val_loss: 0.6820 - val_accuracy: 0.5728
Epoch 143/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6429 - accuracy: 0.
6264 - val_loss: 0.6699 - val_accuracy: 0.5816
Epoch 144/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6384 - accuracy: 0.
6344 - val_loss: 0.6714 - val_accuracy: 0.5620
Epoch 145/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6349 - accuracy: 0.
6404 - val_loss: 0.6785 - val_accuracy: 0.5720
Epoch 146/400
79/79 [==============================] - 1s 7ms/step - loss: 0.6289 - accuracy: 0.
6388 - val_loss: 0.6545 - val_accuracy: 0.5888
Epoch 147/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6285 - accuracy: 0.
6500 - val_loss: 0.6494 - val_accuracy: 0.6056
Epoch 148/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6161 - accuracy: 0.
6600 - val_loss: 0.6435 - val_accuracy: 0.6132
Epoch 149/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6190 - accuracy: 0.
6444 - val_loss: 0.6409 - val_accuracy: 0.6088
Epoch 150/400
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79/79 [==============================] - 1s 9ms/step - loss: 0.6122 - accuracy: 0.
6496 - val_loss: 0.6291 - val_accuracy: 0.6232
Epoch 151/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6056 - accuracy: 0.
6644 - val_loss: 0.6416 - val_accuracy: 0.5992
Epoch 152/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6018 - accuracy: 0.
6636 - val_loss: 0.6193 - val_accuracy: 0.6332
Epoch 153/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6064 - accuracy: 0.
6648 - val_loss: 0.6404 - val_accuracy: 0.6172
Epoch 154/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5918 - accuracy:
0.6716 - val_loss: 0.6240 - val_accuracy: 0.6272
Epoch 155/400
79/79 [==============================] - 1s 11ms/step - loss: 0.5878 - accuracy:
0.6820 - val_loss: 0.6075 - val_accuracy: 0.6464
Epoch 156/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6071 - accuracy:
0.6564 - val_loss: 0.6253 - val_accuracy: 0.6288
Epoch 157/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5921 - accuracy: 0.
6748 - val_loss: 0.6182 - val_accuracy: 0.6424
Epoch 158/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5789 - accuracy: 0.
6812 - val_loss: 0.6155 - val_accuracy: 0.6320
Epoch 159/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5792 - accuracy: 0.
6816 - val_loss: 0.5973 - val_accuracy: 0.6536
Epoch 160/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5710 - accuracy: 0.
6908 - val_loss: 0.5871 - val_accuracy: 0.6848
Epoch 161/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5621 - accuracy: 0.
7092 - val_loss: 0.5880 - val_accuracy: 0.6912
Epoch 162/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5651 - accuracy: 0.
7040 - val_loss: 0.6155 - val_accuracy: 0.6480
Epoch 163/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5495 - accuracy: 0.
7192 - val_loss: 0.5717 - val_accuracy: 0.7000
Epoch 164/400
79/79 [==============================] - 1s 7ms/step - loss: 0.5480 - accuracy: 0.
7252 - val_loss: 0.5663 - val_accuracy: 0.6972
Epoch 165/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5438 - accuracy: 0.
7296 - val_loss: 0.5710 - val_accuracy: 0.6812
Epoch 166/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5567 - accuracy: 0.
7068 - val_loss: 0.5828 - val_accuracy: 0.6780
Epoch 167/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5312 - accuracy: 0.
7276 - val_loss: 0.5648 - val_accuracy: 0.7032
Epoch 168/400
79/79 [==============================] - 1s 7ms/step - loss: 0.5177 - accuracy: 0.
7400 - val_loss: 0.5403 - val_accuracy: 0.7180
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Epoch 169/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5015 - accuracy: 0.
7500 - val_loss: 0.5319 - val_accuracy: 0.7320
Epoch 170/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5098 - accuracy: 0.
7484 - val_loss: 0.5251 - val_accuracy: 0.7320
Epoch 171/400
79/79 [==============================] - 1s 9ms/step - loss: 0.4878 - accuracy: 0.
7580 - val_loss: 0.5162 - val_accuracy: 0.7400
Epoch 172/400
79/79 [==============================] - 1s 11ms/step - loss: 0.4814 - accuracy:
0.7616 - val_loss: 0.5300 - val_accuracy: 0.7332
Epoch 173/400
79/79 [==============================] - 1s 11ms/step - loss: 0.4649 - accuracy:
0.7792 - val_loss: 0.4971 - val_accuracy: 0.7416
Epoch 174/400
79/79 [==============================] - 1s 11ms/step - loss: 0.4572 - accuracy:
0.7756 - val_loss: 0.4762 - val_accuracy: 0.7644
Epoch 175/400
79/79 [==============================] - 1s 8ms/step - loss: 0.4452 - accuracy: 0.
7864 - val_loss: 0.4753 - val_accuracy: 0.7620
Epoch 176/400
79/79 [==============================] - 1s 10ms/step - loss: 0.4465 - accuracy:
0.7888 - val_loss: 0.4718 - val_accuracy: 0.7676
Epoch 177/400
79/79 [==============================] - 1s 9ms/step - loss: 0.4434 - accuracy: 0.
7912 - val_loss: 0.4810 - val_accuracy: 0.7636
Epoch 178/400
79/79 [==============================] - 1s 9ms/step - loss: 0.4259 - accuracy: 0.
8028 - val_loss: 0.4717 - val_accuracy: 0.7580
Epoch 179/400
79/79 [==============================] - 1s 9ms/step - loss: 0.4177 - accuracy: 0.
8024 - val_loss: 0.4713 - val_accuracy: 0.7636
Epoch 180/400
79/79 [==============================] - 1s 8ms/step - loss: 0.4230 - accuracy: 0.
7948 - val_loss: 0.4454 - val_accuracy: 0.7760
Epoch 181/400
79/79 [==============================] - 1s 8ms/step - loss: 0.4121 - accuracy: 0.
8108 - val_loss: 0.4469 - val_accuracy: 0.7864
Epoch 182/400
79/79 [==============================] - 1s 8ms/step - loss: 0.3993 - accuracy: 0.
8180 - val_loss: 0.4749 - val_accuracy: 0.7676
Epoch 183/400
79/79 [==============================] - 1s 9ms/step - loss: 0.4151 - accuracy: 0.
8096 - val_loss: 0.4424 - val_accuracy: 0.7928
Epoch 184/400
79/79 [==============================] - 1s 7ms/step - loss: 0.3954 - accuracy: 0.
8196 - val_loss: 0.4355 - val_accuracy: 0.7916
Epoch 185/400
79/79 [==============================] - 1s 8ms/step - loss: 0.4009 - accuracy: 0.
8160 - val_loss: 0.4308 - val_accuracy: 0.7992
Epoch 186/400
79/79 [==============================] - 1s 9ms/step - loss: 0.3860 - accuracy: 0.
8304 - val_loss: 0.4251 - val_accuracy: 0.8060
Epoch 187/400
79/79 [==============================] - 1s 9ms/step - loss: 0.3852 - accuracy: 0.
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8204 - val_loss: 0.4302 - val_accuracy: 0.7956
Epoch 188/400
79/79 [==============================] - 1s 7ms/step - loss: 0.3957 - accuracy: 0.
8216 - val_loss: 0.4421 - val_accuracy: 0.8032
Epoch 189/400
79/79 [==============================] - 1s 9ms/step - loss: 0.4023 - accuracy: 0.
8184 - val_loss: 0.4200 - val_accuracy: 0.8016
Epoch 190/400
79/79 [==============================] - 1s 11ms/step - loss: 0.3753 - accuracy:
0.8292 - val_loss: 0.4290 - val_accuracy: 0.7980
Epoch 191/400
79/79 [==============================] - 1s 11ms/step - loss: 0.3768 - accuracy:
0.8312 - val_loss: 0.4108 - val_accuracy: 0.8036
Epoch 192/400
79/79 [==============================] - 1s 9ms/step - loss: 0.3708 - accuracy: 0.
8356 - val_loss: 0.4123 - val_accuracy: 0.8064
Epoch 193/400
79/79 [==============================] - 1s 8ms/step - loss: 0.3654 - accuracy: 0.
8344 - val_loss: 0.4262 - val_accuracy: 0.8012
Epoch 194/400
79/79 [==============================] - 1s 8ms/step - loss: 0.3716 - accuracy: 0.
8332 - val_loss: 0.3950 - val_accuracy: 0.8216
Epoch 195/400
79/79 [==============================] - 1s 7ms/step - loss: 0.3716 - accuracy: 0.
8380 - val_loss: 0.3817 - val_accuracy: 0.8212
Epoch 196/400
79/79 [==============================] - 1s 10ms/step - loss: 0.3623 - accuracy:
0.8432 - val_loss: 0.3728 - val_accuracy: 0.8348
Epoch 197/400
79/79 [==============================] - 1s 9ms/step - loss: 0.3661 - accuracy: 0.
8328 - val_loss: 0.3658 - val_accuracy: 0.8304
Epoch 198/400
79/79 [==============================] - 1s 7ms/step - loss: 0.5548 - accuracy: 0.
7224 - val_loss: 0.5964 - val_accuracy: 0.6664
Epoch 199/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5516 - accuracy: 0.
7136 - val_loss: 0.5336 - val_accuracy: 0.7184
Epoch 200/400
79/79 [==============================] - 1s 8ms/step - loss: 0.4781 - accuracy: 0.
7744 - val_loss: 0.4528 - val_accuracy: 0.7884
Epoch 201/400
79/79 [==============================] - 1s 9ms/step - loss: 0.4130 - accuracy: 0.
8120 - val_loss: 0.4093 - val_accuracy: 0.8220
Epoch 202/400
79/79 [==============================] - 1s 9ms/step - loss: 0.3781 - accuracy: 0.
8288 - val_loss: 0.3818 - val_accuracy: 0.8300
Epoch 203/400
79/79 [==============================] - 1s 8ms/step - loss: 0.3546 - accuracy: 0.
8420 - val_loss: 0.3568 - val_accuracy: 0.8488
Epoch 204/400
79/79 [==============================] - 1s 8ms/step - loss: 0.3321 - accuracy: 0.
8548 - val_loss: 0.3380 - val_accuracy: 0.8544
Epoch 205/400
79/79 [==============================] - 1s 7ms/step - loss: 0.3152 - accuracy: 0.
8620 - val_loss: 0.3256 - val_accuracy: 0.8616
Epoch 206/400
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79/79 [==============================] - 1s 8ms/step - loss: 0.2997 - accuracy: 0.
8776 - val_loss: 0.3145 - val_accuracy: 0.8624
Epoch 207/400
79/79 [==============================] - 1s 8ms/step - loss: 0.2894 - accuracy: 0.
8776 - val_loss: 0.3015 - val_accuracy: 0.8664
Epoch 208/400
79/79 [==============================] - 1s 10ms/step - loss: 0.2828 - accuracy:
0.8756 - val_loss: 0.2893 - val_accuracy: 0.8816
Epoch 209/400
79/79 [==============================] - 1s 11ms/step - loss: 0.2648 - accuracy:
0.8908 - val_loss: 0.2923 - val_accuracy: 0.8808
Epoch 210/400
79/79 [==============================] - 1s 11ms/step - loss: 0.2623 - accuracy:
0.8896 - val_loss: 0.2647 - val_accuracy: 0.8900
Epoch 211/400
79/79 [==============================] - 1s 9ms/step - loss: 0.2491 - accuracy: 0.
8984 - val_loss: 0.2584 - val_accuracy: 0.8904
Epoch 212/400
79/79 [==============================] - 1s 8ms/step - loss: 0.2485 - accuracy: 0.
9024 - val_loss: 0.2503 - val_accuracy: 0.8980
Epoch 213/400
79/79 [==============================] - 1s 9ms/step - loss: 0.2290 - accuracy: 0.
9052 - val_loss: 0.2539 - val_accuracy: 0.8976
Epoch 214/400
79/79 [==============================] - 1s 9ms/step - loss: 0.2262 - accuracy: 0.
9112 - val_loss: 0.2421 - val_accuracy: 0.9036
Epoch 215/400
79/79 [==============================] - 1s 9ms/step - loss: 0.2183 - accuracy: 0.
9104 - val_loss: 0.2393 - val_accuracy: 0.9136
Epoch 216/400
79/79 [==============================] - 1s 8ms/step - loss: 0.2162 - accuracy: 0.
9120 - val_loss: 0.2269 - val_accuracy: 0.9116
Epoch 217/400
79/79 [==============================] - 1s 8ms/step - loss: 0.2110 - accuracy: 0.
9160 - val_loss: 0.2231 - val_accuracy: 0.9144
Epoch 218/400
79/79 [==============================] - 1s 7ms/step - loss: 0.1846 - accuracy: 0.
9264 - val_loss: 0.2163 - val_accuracy: 0.9148
Epoch 219/400
79/79 [==============================] - 1s 8ms/step - loss: 0.1793 - accuracy: 0.
9288 - val_loss: 0.2000 - val_accuracy: 0.9288
Epoch 220/400
79/79 [==============================] - 1s 8ms/step - loss: 0.1609 - accuracy: 0.
9324 - val_loss: 0.1878 - val_accuracy: 0.9252
Epoch 221/400
79/79 [==============================] - 1s 10ms/step - loss: 0.1481 - accuracy:
0.9424 - val_loss: 0.1761 - val_accuracy: 0.9320
Epoch 222/400
79/79 [==============================] - 1s 9ms/step - loss: 0.1605 - accuracy: 0.
9392 - val_loss: 0.1804 - val_accuracy: 0.9304
Epoch 223/400
79/79 [==============================] - 1s 8ms/step - loss: 0.1381 - accuracy: 0.
9524 - val_loss: 0.1610 - val_accuracy: 0.9396
Epoch 224/400
79/79 [==============================] - 1s 8ms/step - loss: 0.1467 - accuracy: 0.
9460 - val_loss: 0.1421 - val_accuracy: 0.9496
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Epoch 225/400
79/79 [==============================] - 1s 10ms/step - loss: 0.1356 - accuracy:
0.9512 - val_loss: 0.1746 - val_accuracy: 0.9364
Epoch 226/400
79/79 [==============================] - 1s 11ms/step - loss: 0.1865 - accuracy:
0.9272 - val_loss: 0.1797 - val_accuracy: 0.9316
Epoch 227/400
79/79 [==============================] - 1s 11ms/step - loss: 0.1345 - accuracy:
0.9460 - val_loss: 0.1482 - val_accuracy: 0.9408
Epoch 228/400
79/79 [==============================] - 1s 11ms/step - loss: 0.1218 - accuracy:
0.9544 - val_loss: 0.1265 - val_accuracy: 0.9512
Epoch 229/400
79/79 [==============================] - 1s 8ms/step - loss: 0.1109 - accuracy: 0.
9616 - val_loss: 0.1266 - val_accuracy: 0.9512
Epoch 230/400
79/79 [==============================] - 1s 9ms/step - loss: 0.1153 - accuracy: 0.
9624 - val_loss: 0.1521 - val_accuracy: 0.9420
Epoch 231/400
79/79 [==============================] - 1s 8ms/step - loss: 0.2007 - accuracy: 0.
9320 - val_loss: 0.2130 - val_accuracy: 0.9236
Epoch 232/400
79/79 [==============================] - 1s 8ms/step - loss: 0.1437 - accuracy: 0.
9504 - val_loss: 0.1563 - val_accuracy: 0.9388
Epoch 233/400
79/79 [==============================] - 1s 9ms/step - loss: 0.1218 - accuracy: 0.
9504 - val_loss: 0.1550 - val_accuracy: 0.9416
Epoch 234/400
79/79 [==============================] - 1s 8ms/step - loss: 0.1226 - accuracy: 0.
9556 - val_loss: 0.1324 - val_accuracy: 0.9484
Epoch 235/400
79/79 [==============================] - 1s 9ms/step - loss: 0.1149 - accuracy: 0.
9576 - val_loss: 0.1797 - val_accuracy: 0.9372
Epoch 236/400
79/79 [==============================] - 1s 9ms/step - loss: 0.1121 - accuracy: 0.
9644 - val_loss: 0.1095 - val_accuracy: 0.9588
Epoch 237/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0924 - accuracy: 0.
9656 - val_loss: 0.1319 - val_accuracy: 0.9560
Epoch 238/400
79/79 [==============================] - 1s 9ms/step - loss: 0.2391 - accuracy: 0.
9264 - val_loss: 0.2167 - val_accuracy: 0.9272
Epoch 239/400
79/79 [==============================] - 1s 9ms/step - loss: 0.1750 - accuracy: 0.
9428 - val_loss: 0.1655 - val_accuracy: 0.9456
Epoch 240/400
79/79 [==============================] - 1s 9ms/step - loss: 0.1499 - accuracy: 0.
9524 - val_loss: 0.1448 - val_accuracy: 0.9520
Epoch 241/400
79/79 [==============================] - 1s 8ms/step - loss: 0.1313 - accuracy: 0.
9588 - val_loss: 0.1352 - val_accuracy: 0.9560
Epoch 242/400
79/79 [==============================] - 1s 8ms/step - loss: 0.1145 - accuracy: 0.
9640 - val_loss: 0.1112 - val_accuracy: 0.9632
Epoch 243/400
79/79 [==============================] - 1s 12ms/step - loss: 0.1026 - accuracy:
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0.9644 - val_loss: 0.1025 - val_accuracy: 0.9660
Epoch 244/400
79/79 [==============================] - 1s 11ms/step - loss: 0.0940 - accuracy:
0.9692 - val_loss: 0.1026 - val_accuracy: 0.9616
Epoch 245/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0901 - accuracy:
0.9708 - val_loss: 0.0985 - val_accuracy: 0.9684
Epoch 246/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0994 - accuracy: 0.
9664 - val_loss: 0.1522 - val_accuracy: 0.9504
Epoch 247/400
79/79 [==============================] - 1s 9ms/step - loss: 0.1042 - accuracy: 0.
9648 - val_loss: 0.0921 - val_accuracy: 0.9720
Epoch 248/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0840 - accuracy: 0.
9720 - val_loss: 0.0977 - val_accuracy: 0.9692
Epoch 249/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0913 - accuracy: 0.
9684 - val_loss: 0.0994 - val_accuracy: 0.9660
Epoch 250/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0830 - accuracy: 0.
9748 - val_loss: 0.0803 - val_accuracy: 0.9756
Epoch 251/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0958 - accuracy: 0.
9680 - val_loss: 0.0980 - val_accuracy: 0.9684
Epoch 252/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0917 - accuracy: 0.
9696 - val_loss: 0.2914 - val_accuracy: 0.8968
Epoch 253/400
79/79 [==============================] - 1s 8ms/step - loss: 0.1444 - accuracy: 0.
9488 - val_loss: 0.1044 - val_accuracy: 0.9632
Epoch 254/400
79/79 [==============================] - 1s 8ms/step - loss: 0.1010 - accuracy: 0.
9696 - val_loss: 0.0820 - val_accuracy: 0.9708
Epoch 255/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0872 - accuracy: 0.
9720 - val_loss: 0.0911 - val_accuracy: 0.9656
Epoch 256/400
79/79 [==============================] - 1s 9ms/step - loss: 0.1035 - accuracy: 0.
9660 - val_loss: 0.1111 - val_accuracy: 0.9604
Epoch 257/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0931 - accuracy:
0.9684 - val_loss: 0.1093 - val_accuracy: 0.9596
Epoch 258/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0906 - accuracy: 0.
9692 - val_loss: 0.0890 - val_accuracy: 0.9684
Epoch 259/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0733 - accuracy: 0.
9784 - val_loss: 0.0843 - val_accuracy: 0.9688
Epoch 260/400
79/79 [==============================] - 1s 10ms/step - loss: 0.1019 - accuracy:
0.9636 - val_loss: 0.1601 - val_accuracy: 0.9428
Epoch 261/400
79/79 [==============================] - 1s 11ms/step - loss: 0.0979 - accuracy:
0.9664 - val_loss: 0.0888 - val_accuracy: 0.9664
Epoch 262/400
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79/79 [==============================] - 1s 11ms/step - loss: 0.0760 - accuracy:
0.9740 - val_loss: 0.0894 - val_accuracy: 0.9696
Epoch 263/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0694 - accuracy:
0.9764 - val_loss: 0.0788 - val_accuracy: 0.9736
Epoch 264/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0756 - accuracy:
0.9736 - val_loss: 0.0783 - val_accuracy: 0.9700
Epoch 265/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0685 - accuracy: 0.
9772 - val_loss: 0.0868 - val_accuracy: 0.9668
Epoch 266/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0721 - accuracy:
0.9756 - val_loss: 0.0831 - val_accuracy: 0.9696
Epoch 267/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0621 - accuracy: 0.
9780 - val_loss: 0.0738 - val_accuracy: 0.9740
Epoch 268/400
79/79 [==============================] - 1s 7ms/step - loss: 0.0626 - accuracy: 0.
9820 - val_loss: 0.0822 - val_accuracy: 0.9712
Epoch 269/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0727 - accuracy: 0.
9760 - val_loss: 0.0788 - val_accuracy: 0.9728
Epoch 270/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0654 - accuracy: 0.
9760 - val_loss: 0.0733 - val_accuracy: 0.9760
Epoch 271/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0586 - accuracy: 0.
9804 - val_loss: 0.0711 - val_accuracy: 0.9720
Epoch 272/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0654 - accuracy: 0.
9792 - val_loss: 0.0710 - val_accuracy: 0.9752
Epoch 273/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0777 - accuracy: 0.
9776 - val_loss: 0.0707 - val_accuracy: 0.9740
Epoch 274/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0648 - accuracy: 0.
9788 - val_loss: 0.0604 - val_accuracy: 0.9808
Epoch 275/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0642 - accuracy: 0.
9780 - val_loss: 0.0787 - val_accuracy: 0.9700
Epoch 276/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0610 - accuracy: 0.
9788 - val_loss: 0.0754 - val_accuracy: 0.9744
Epoch 277/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0704 - accuracy: 0.
9776 - val_loss: 0.0873 - val_accuracy: 0.9700
Epoch 278/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0594 - accuracy:
0.9780 - val_loss: 0.0678 - val_accuracy: 0.9768
Epoch 279/400
79/79 [==============================] - 1s 11ms/step - loss: 0.0538 - accuracy:
0.9804 - val_loss: 0.0717 - val_accuracy: 0.9748
Epoch 280/400
79/79 [==============================] - 1s 11ms/step - loss: 0.0549 - accuracy:
0.9828 - val_loss: 0.0724 - val_accuracy: 0.9752
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Epoch 281/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0542 - accuracy:
0.9824 - val_loss: 0.0776 - val_accuracy: 0.9732
Epoch 282/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0614 - accuracy: 0.
9808 - val_loss: 0.0693 - val_accuracy: 0.9792
Epoch 283/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0518 - accuracy: 0.
9812 - val_loss: 0.0692 - val_accuracy: 0.9724
Epoch 284/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0503 - accuracy: 0.
9820 - val_loss: 0.0759 - val_accuracy: 0.9716
Epoch 285/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0544 - accuracy: 0.
9804 - val_loss: 0.0634 - val_accuracy: 0.9780
Epoch 286/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0552 - accuracy: 0.
9836 - val_loss: 0.0721 - val_accuracy: 0.9752
Epoch 287/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0531 - accuracy: 0.
9848 - val_loss: 0.0720 - val_accuracy: 0.9728
Epoch 288/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0592 - accuracy: 0.
9796 - val_loss: 0.0747 - val_accuracy: 0.9724
Epoch 289/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0521 - accuracy: 0.
9792 - val_loss: 0.0596 - val_accuracy: 0.9764
Epoch 290/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0499 - accuracy: 0.
9844 - val_loss: 0.0790 - val_accuracy: 0.9692
Epoch 291/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0539 - accuracy: 0.
9820 - val_loss: 0.0562 - val_accuracy: 0.9784
Epoch 292/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0548 - accuracy: 0.
9828 - val_loss: 0.0540 - val_accuracy: 0.9796
Epoch 293/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0587 - accuracy: 0.
9800 - val_loss: 0.0620 - val_accuracy: 0.9788
Epoch 294/400
79/79 [==============================] - 1s 9ms/step - loss: 0.1370 - accuracy: 0.
9560 - val_loss: 0.0902 - val_accuracy: 0.9684
Epoch 295/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0639 - accuracy:
0.9796 - val_loss: 0.0536 - val_accuracy: 0.9800
Epoch 296/400
79/79 [==============================] - 1s 11ms/step - loss: 0.2431 - accuracy:
0.9260 - val_loss: 0.2570 - val_accuracy: 0.9128
Epoch 297/400
79/79 [==============================] - 1s 11ms/step - loss: 0.1617 - accuracy:
0.9436 - val_loss: 0.1373 - val_accuracy: 0.9468
Epoch 298/400
79/79 [==============================] - 1s 10ms/step - loss: 0.1447 - accuracy:
0.9436 - val_loss: 0.1433 - val_accuracy: 0.9464
Epoch 299/400
79/79 [==============================] - 1s 7ms/step - loss: 0.1193 - accuracy: 0.
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9560 - val_loss: 0.1153 - val_accuracy: 0.9572
Epoch 300/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0975 - accuracy: 0.
9656 - val_loss: 0.0967 - val_accuracy: 0.9632
Epoch 301/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0805 - accuracy: 0.
9728 - val_loss: 0.0804 - val_accuracy: 0.9684
Epoch 302/400
79/79 [==============================] - 1s 7ms/step - loss: 0.0675 - accuracy: 0.
9744 - val_loss: 0.0693 - val_accuracy: 0.9748
Epoch 303/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0603 - accuracy: 0.
9792 - val_loss: 0.0764 - val_accuracy: 0.9732
Epoch 304/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0583 - accuracy:
0.9792 - val_loss: 0.0554 - val_accuracy: 0.9780
Epoch 305/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0532 - accuracy:
0.9812 - val_loss: 0.0738 - val_accuracy: 0.9752
Epoch 306/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0537 - accuracy: 0.
9860 - val_loss: 0.0623 - val_accuracy: 0.9776
Epoch 307/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0426 - accuracy: 0.
9872 - val_loss: 0.0684 - val_accuracy: 0.9788
Epoch 308/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0381 - accuracy: 0.
9880 - val_loss: 0.0987 - val_accuracy: 0.9708
Epoch 309/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0656 - accuracy: 0.
9800 - val_loss: 0.0764 - val_accuracy: 0.9752
Epoch 310/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0461 - accuracy: 0.
9836 - val_loss: 0.0616 - val_accuracy: 0.9788
Epoch 311/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0386 - accuracy: 0.
9868 - val_loss: 0.0547 - val_accuracy: 0.9820
Epoch 312/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0360 - accuracy: 0.
9872 - val_loss: 0.0590 - val_accuracy: 0.9804
Epoch 313/400
79/79 [==============================] - 1s 9ms/step - loss: 0.3477 - accuracy: 0.
9092 - val_loss: 0.3650 - val_accuracy: 0.8936
Epoch 314/400
79/79 [==============================] - 1s 11ms/step - loss: 0.2001 - accuracy:
0.9404 - val_loss: 0.0955 - val_accuracy: 0.9732
Epoch 315/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0953 - accuracy:
0.9700 - val_loss: 0.0846 - val_accuracy: 0.9748
Epoch 316/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0898 - accuracy: 0.
9760 - val_loss: 0.0779 - val_accuracy: 0.9768
Epoch 317/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0727 - accuracy:
0.9792 - val_loss: 0.0723 - val_accuracy: 0.9768
Epoch 318/400
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79/79 [==============================] - 1s 8ms/step - loss: 0.0708 - accuracy: 0.
9800 - val_loss: 0.0693 - val_accuracy: 0.9792
Epoch 319/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0661 - accuracy: 0.
9804 - val_loss: 0.0672 - val_accuracy: 0.9784
Epoch 320/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0577 - accuracy: 0.
9832 - val_loss: 0.0633 - val_accuracy: 0.9792
Epoch 321/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0559 - accuracy: 0.
9824 - val_loss: 0.0685 - val_accuracy: 0.9764
Epoch 322/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0530 - accuracy: 0.
9828 - val_loss: 0.0621 - val_accuracy: 0.9800
Epoch 323/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0499 - accuracy: 0.
9840 - val_loss: 0.0637 - val_accuracy: 0.9800
Epoch 324/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0489 - accuracy: 0.
9848 - val_loss: 0.0611 - val_accuracy: 0.9820
Epoch 325/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0481 - accuracy: 0.
9868 - val_loss: 0.0628 - val_accuracy: 0.9808
Epoch 326/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0459 - accuracy: 0.
9840 - val_loss: 0.0682 - val_accuracy: 0.9792
Epoch 327/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0460 - accuracy: 0.
9860 - val_loss: 0.0729 - val_accuracy: 0.9764
Epoch 328/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0418 - accuracy: 0.
9864 - val_loss: 0.0539 - val_accuracy: 0.9816
Epoch 329/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0462 - accuracy: 0.
9872 - val_loss: 0.0584 - val_accuracy: 0.9824
Epoch 330/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0400 - accuracy: 0.
9868 - val_loss: 0.0613 - val_accuracy: 0.9824
Epoch 331/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0455 - accuracy:
0.9864 - val_loss: 0.0607 - val_accuracy: 0.9816
Epoch 332/400
79/79 [==============================] - 1s 11ms/step - loss: 0.0433 - accuracy:
0.9860 - val_loss: 0.0680 - val_accuracy: 0.9780
Epoch 333/400
79/79 [==============================] - 1s 11ms/step - loss: 0.0427 - accuracy:
0.9864 - val_loss: 0.0615 - val_accuracy: 0.9816
Epoch 334/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0424 - accuracy: 0.
9876 - val_loss: 0.0574 - val_accuracy: 0.9836
Epoch 335/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0389 - accuracy: 0.
9884 - val_loss: 0.0587 - val_accuracy: 0.9840
Epoch 336/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0409 - accuracy: 0.
9872 - val_loss: 0.0643 - val_accuracy: 0.9828
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Epoch 337/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0421 - accuracy: 0.
9876 - val_loss: 0.0586 - val_accuracy: 0.9820
Epoch 338/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0386 - accuracy: 0.
9888 - val_loss: 0.0629 - val_accuracy: 0.9816
Epoch 339/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0499 - accuracy: 0.
9868 - val_loss: 0.0690 - val_accuracy: 0.9800
Epoch 340/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0441 - accuracy: 0.
9856 - val_loss: 0.0515 - val_accuracy: 0.9856
Epoch 341/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0410 - accuracy: 0.
9856 - val_loss: 0.0591 - val_accuracy: 0.9816
Epoch 342/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0437 - accuracy: 0.
9872 - val_loss: 0.0637 - val_accuracy: 0.9780
Epoch 343/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0382 - accuracy: 0.
9900 - val_loss: 0.0645 - val_accuracy: 0.9804
Epoch 344/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0410 - accuracy: 0.
9892 - val_loss: 0.0626 - val_accuracy: 0.9812
Epoch 345/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0509 - accuracy: 0.
9876 - val_loss: 0.0391 - val_accuracy: 0.9864
Epoch 346/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0453 - accuracy: 0.
9848 - val_loss: 0.0431 - val_accuracy: 0.9852
Epoch 347/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0452 - accuracy: 0.
9844 - val_loss: 0.0740 - val_accuracy: 0.9736
Epoch 348/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0440 - accuracy:
0.9848 - val_loss: 0.0450 - val_accuracy: 0.9852
Epoch 349/400
79/79 [==============================] - 1s 11ms/step - loss: 0.0421 - accuracy:
0.9872 - val_loss: 0.0512 - val_accuracy: 0.9832
Epoch 350/400
79/79 [==============================] - 1s 11ms/step - loss: 0.0383 - accuracy:
0.9872 - val_loss: 0.0444 - val_accuracy: 0.9860
Epoch 351/400
79/79 [==============================] - 1s 11ms/step - loss: 0.0384 - accuracy:
0.9892 - val_loss: 0.0476 - val_accuracy: 0.9828
Epoch 352/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0445 - accuracy: 0.
9860 - val_loss: 0.0527 - val_accuracy: 0.9832
Epoch 353/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0405 - accuracy: 0.
9860 - val_loss: 0.0438 - val_accuracy: 0.9860
Epoch 354/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0356 - accuracy: 0.
9880 - val_loss: 0.0400 - val_accuracy: 0.9872
Epoch 355/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0419 - accuracy:
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0.9876 - val_loss: 0.0504 - val_accuracy: 0.9848
Epoch 356/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0404 - accuracy: 0.
9884 - val_loss: 0.0526 - val_accuracy: 0.9828
Epoch 357/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0366 - accuracy: 0.
9880 - val_loss: 0.0454 - val_accuracy: 0.9844
Epoch 358/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0410 - accuracy: 0.
9860 - val_loss: 0.0392 - val_accuracy: 0.9864
Epoch 359/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0307 - accuracy: 0.
9912 - val_loss: 0.0352 - val_accuracy: 0.9884
Epoch 360/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0328 - accuracy: 0.
9912 - val_loss: 0.0360 - val_accuracy: 0.9896
Epoch 361/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0303 - accuracy: 0.
9900 - val_loss: 0.0403 - val_accuracy: 0.9880
Epoch 362/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0339 - accuracy: 0.
9892 - val_loss: 0.0444 - val_accuracy: 0.9880
Epoch 363/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0337 - accuracy: 0.
9888 - val_loss: 0.0395 - val_accuracy: 0.9856
Epoch 364/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0289 - accuracy: 0.
9912 - val_loss: 0.0377 - val_accuracy: 0.9876
Epoch 365/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0336 - accuracy: 0.
9888 - val_loss: 0.0399 - val_accuracy: 0.9868
Epoch 366/400
79/79 [==============================] - 1s 11ms/step - loss: 0.0384 - accuracy:
0.9848 - val_loss: 0.0365 - val_accuracy: 0.9884
Epoch 367/400
79/79 [==============================] - 1s 11ms/step - loss: 0.0337 - accuracy:
0.9892 - val_loss: 0.0414 - val_accuracy: 0.9860
Epoch 368/400
79/79 [==============================] - 1s 11ms/step - loss: 0.0410 - accuracy:
0.9852 - val_loss: 0.0400 - val_accuracy: 0.9848
Epoch 369/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0294 - accuracy: 0.
9900 - val_loss: 0.0365 - val_accuracy: 0.9896
Epoch 370/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0361 - accuracy:
0.9892 - val_loss: 0.0476 - val_accuracy: 0.9856
Epoch 371/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0279 - accuracy: 0.
9916 - val_loss: 0.0382 - val_accuracy: 0.9868
Epoch 372/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0303 - accuracy: 0.
9908 - val_loss: 0.0387 - val_accuracy: 0.9852
Epoch 373/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0244 - accuracy: 0.
9920 - val_loss: 0.0333 - val_accuracy: 0.9884
Epoch 374/400
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79/79 [==============================] - 1s 8ms/step - loss: 0.0285 - accuracy: 0.
9928 - val_loss: 0.0448 - val_accuracy: 0.9832
Epoch 375/400
79/79 [==============================] - 1s 7ms/step - loss: 0.0296 - accuracy: 0.
9896 - val_loss: 0.0449 - val_accuracy: 0.9868
Epoch 376/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0268 - accuracy: 0.
9900 - val_loss: 0.0421 - val_accuracy: 0.9880
Epoch 377/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0821 - accuracy: 0.
9768 - val_loss: 0.0878 - val_accuracy: 0.9764
Epoch 378/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0834 - accuracy: 0.
9756 - val_loss: 0.0684 - val_accuracy: 0.9840
Epoch 379/400
79/79 [==============================] - 1s 10ms/step - loss: 0.3007 - accuracy:
0.9416 - val_loss: 0.1587 - val_accuracy: 0.9668
Epoch 380/400
79/79 [==============================] - 1s 8ms/step - loss: 0.1517 - accuracy: 0.
9620 - val_loss: 0.0505 - val_accuracy: 0.9828
Epoch 381/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0700 - accuracy: 0.
9776 - val_loss: 0.0510 - val_accuracy: 0.9824
Epoch 382/400
79/79 [==============================] - 1s 10ms/step - loss: 0.0544 - accuracy:
0.9812 - val_loss: 0.0470 - val_accuracy: 0.9808
Epoch 383/400
79/79 [==============================] - 1s 8ms/step - loss: 0.0410 - accuracy: 0.
9848 - val_loss: 0.0461 - val_accuracy: 0.9824
Epoch 384/400
79/79 [==============================] - 1s 9ms/step - loss: 0.0699 - accuracy: 0.
9744 - val_loss: 0.0729 - val_accuracy: 0.9688
Epoch 385/400
79/79 [==============================] - 1s 11ms/step - loss: 0.0442 - accuracy:
0.9824 - val_loss: 0.0502 - val_accuracy: 0.9820
Epoch 386/400
79/79 [==============================] - 1s 11ms/step - loss: 0.2134 - accuracy:
0.9368 - val_loss: 0.2993 - val_accuracy: 0.9156
Epoch 387/400
79/79 [==============================] - 1s 9ms/step - loss: 0.2960 - accuracy: 0.
9160 - val_loss: 0.2941 - val_accuracy: 0.9096
Epoch 388/400
79/79 [==============================] - 1s 8ms/step - loss: 0.3183 - accuracy: 0.
9072 - val_loss: 0.2944 - val_accuracy: 0.9124
Epoch 389/400
79/79 [==============================] - 1s 8ms/step - loss: 0.2917 - accuracy: 0.
9088 - val_loss: 0.3411 - val_accuracy: 0.8932
Epoch 390/400
79/79 [==============================] - 1s 7ms/step - loss: 0.4316 - accuracy: 0.
8716 - val_loss: 0.3722 - val_accuracy: 0.8868
Epoch 391/400
79/79 [==============================] - 1s 8ms/step - loss: 0.3726 - accuracy: 0.
8748 - val_loss: 0.3600 - val_accuracy: 0.8788
Epoch 392/400
79/79 [==============================] - 1s 8ms/step - loss: 0.3526 - accuracy: 0.
8800 - val_loss: 0.3242 - val_accuracy: 0.8852
```

```
Epoch 393/400
79/79 [==============================] - 1s 9ms/step - loss: 0.3356 - accuracy: 0.
8736 - val_loss: 0.4000 - val_accuracy: 0.8396
Epoch 394/400
79/79 [==============================] - 1s 7ms/step - loss: 0.3927 - accuracy: 0.
8408 - val_loss: 0.3980 - val_accuracy: 0.8484
Epoch 395/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5236 - accuracy: 0.
7788 - val_loss: 0.5561 - val_accuracy: 0.7856
Epoch 396/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5931 - accuracy: 0.
7380 - val_loss: 0.5489 - val_accuracy: 0.7856
Epoch 397/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5347 - accuracy: 0.
7760 - val_loss: 0.5270 - val_accuracy: 0.7924
Epoch 398/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5295 - accuracy: 0.
7820 - val_loss: 0.5430 - val_accuracy: 0.7904
Epoch 399/400
79/79 [==============================] - 1s 9ms/step - loss: 0.4795 - accuracy: 0.
8116 - val_loss: 0.4559 - val_accuracy: 0.8300
Epoch 400/400
79/79 [==============================] - 1s 8ms/step - loss: 0.3774 - accuracy: 0.
8572 - val_loss: 0.3578 - val_accuracy: 0.8724
```
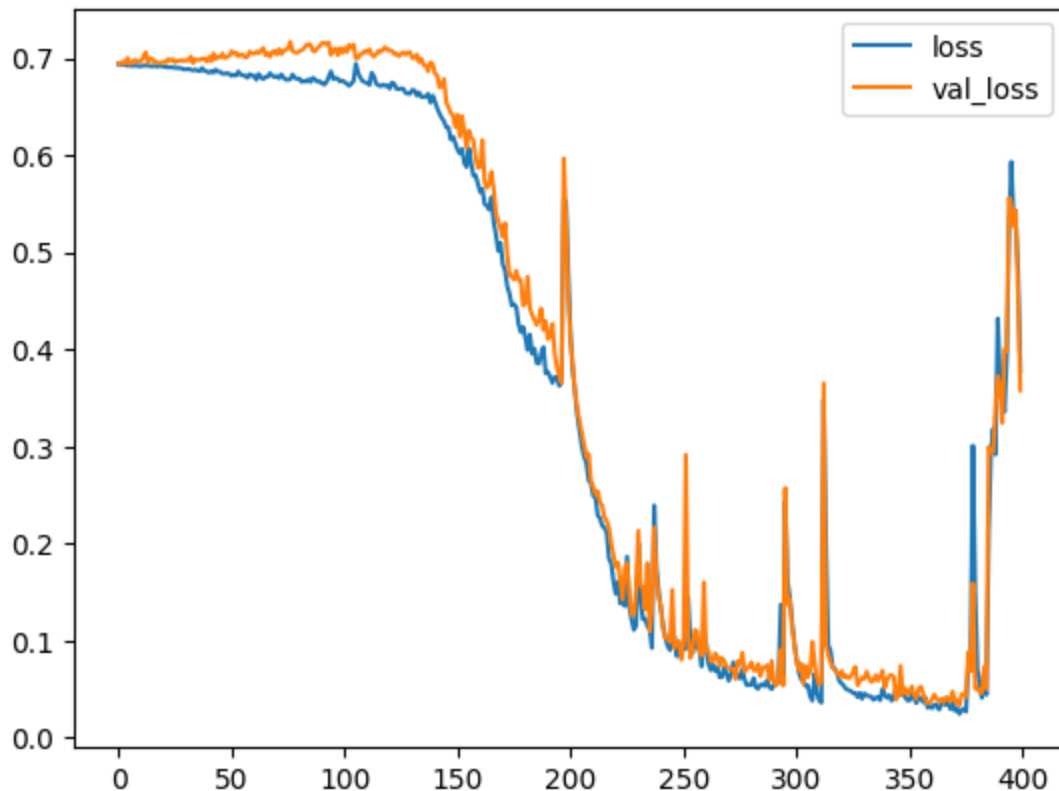
In [26]:
```python
# Plot the loss
plt.plot(r.history['loss'], label='loss')
plt.plot(r.history['val_loss'], label='val_loss')
plt.legend()
```
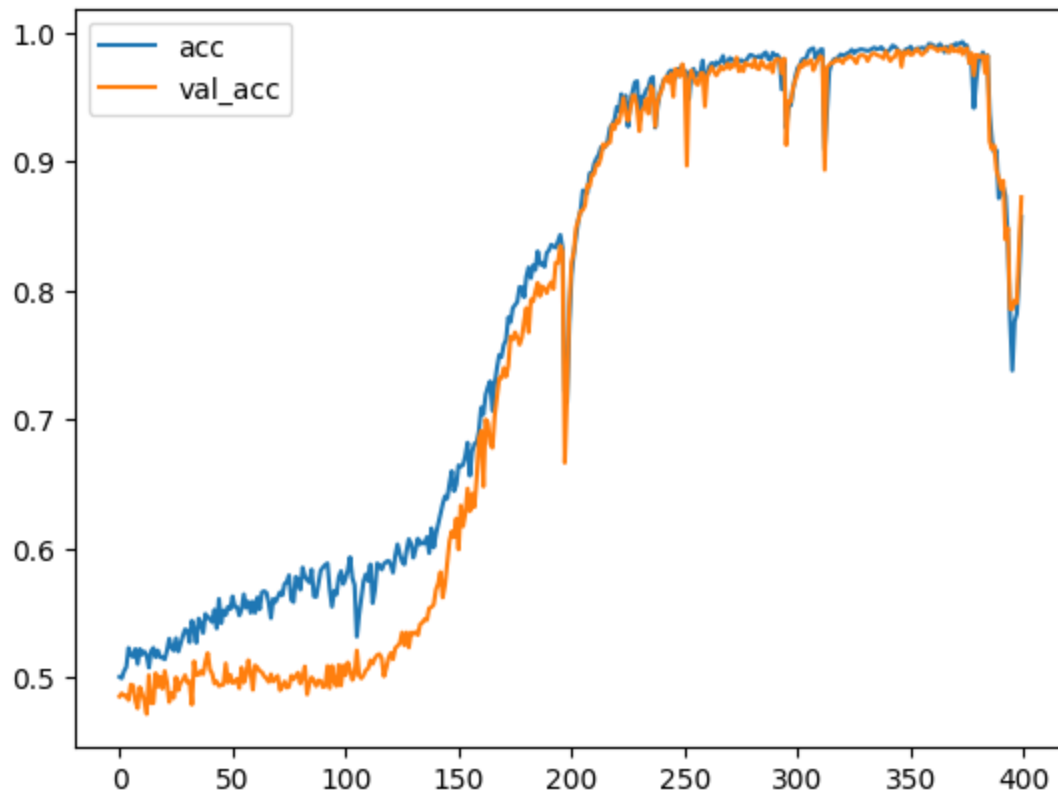
Out[26]:   <matplotlib.legend.Legend at 0x7f8c5206ba90>

In [27]:
```python
# Plot the accuracy too
plt.plot(r.history['accuracy'], label='acc')
plt.plot(r.history['val_accuracy'], label='val_acc')
plt.legend()
```

Out[27]: <matplotlib.legend.Legend at 0x7f8c500e1ff0>

In [28]:
```python
# Make the problem harder by making T larger
T = 30
D = 1
X = []
Y = []

for t in range(5000):
  x = np.random.randn(T)
  X.append(x)
  y = get_label(x, 0, 1, 2) # long distance
  Y.append(y)

X = np.array(X)
Y = np.array(Y)
N = len(X)
```

In [29]:
```python
# Now test our LSTM
inputs = np.expand_dims(X, -1)

# make the RNN
i = Input(shape=(T, D))

# method 1
```

```python
x = LSTM(15)(i)

x = Dense(1, activation='sigmoid')(x)
model = Model(i, x)
model.compile(
  loss='binary_crossentropy',
  optimizer=Adam(learning_rate=0.01),
  metrics=['accuracy'],
)

# train the RNN
r = model.fit(
  inputs, Y,
  epochs=400,
  validation_split=0.5,
)
```

```
Epoch 1/400
79/79 [==============================] - 4s 14ms/step - loss: 0.6952 - accuracy:
0.4956 - val_loss: 0.6929 - val_accuracy: 0.4984
Epoch 2/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6941 - accuracy: 0.
5060 - val_loss: 0.6947 - val_accuracy: 0.4940
Epoch 3/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6931 - accuracy: 0.
5112 - val_loss: 0.6938 - val_accuracy: 0.5004
Epoch 4/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6942 - accuracy: 0.
4844 - val_loss: 0.6932 - val_accuracy: 0.5000
Epoch 5/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6934 - accuracy: 0.
5068 - val_loss: 0.6933 - val_accuracy: 0.4880
Epoch 6/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6934 - accuracy: 0.
5084 - val_loss: 0.6936 - val_accuracy: 0.4856
Epoch 7/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6941 - accuracy:
0.4944 - val_loss: 0.6940 - val_accuracy: 0.5012
Epoch 8/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6935 - accuracy:
0.5020 - val_loss: 0.6933 - val_accuracy: 0.4956
Epoch 9/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6933 - accuracy: 0.
5052 - val_loss: 0.6936 - val_accuracy: 0.4908
Epoch 10/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6931 - accuracy: 0.
4980 - val_loss: 0.6942 - val_accuracy: 0.4924
Epoch 11/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6930 - accuracy: 0.
5088 - val_loss: 0.6948 - val_accuracy: 0.4972
Epoch 12/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6937 - accuracy: 0.
4968 - val_loss: 0.6948 - val_accuracy: 0.4960
Epoch 13/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6935 - accuracy: 0.
5148 - val_loss: 0.6939 - val_accuracy: 0.5008
Epoch 14/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6927 - accuracy:
0.5216 - val_loss: 0.6946 - val_accuracy: 0.4880
Epoch 15/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6924 - accuracy:
0.5068 - val_loss: 0.6961 - val_accuracy: 0.4816
Epoch 16/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6925 - accuracy:
0.5168 - val_loss: 0.6955 - val_accuracy: 0.4844
Epoch 17/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6920 - accuracy: 0.
5264 - val_loss: 0.6959 - val_accuracy: 0.5008
Epoch 18/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6925 - accuracy: 0.
5304 - val_loss: 0.6953 - val_accuracy: 0.4744
Epoch 19/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6912 - accuracy: 0.
```

```
5216 - val_loss: 0.6960 - val_accuracy: 0.4860
Epoch 20/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6901 - accuracy: 0.
5172 - val_loss: 0.6978 - val_accuracy: 0.4976
Epoch 21/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6973 - accuracy: 0.
5184 - val_loss: 0.6963 - val_accuracy: 0.4984
Epoch 22/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6960 - accuracy: 0.
4964 - val_loss: 0.6963 - val_accuracy: 0.4988
Epoch 23/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6946 - accuracy: 0.
5024 - val_loss: 0.6946 - val_accuracy: 0.4972
Epoch 24/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6929 - accuracy: 0.
5140 - val_loss: 0.7001 - val_accuracy: 0.4988
Epoch 25/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6947 - accuracy:
0.4896 - val_loss: 0.6943 - val_accuracy: 0.4984
Epoch 26/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6939 - accuracy: 0.
4960 - val_loss: 0.6956 - val_accuracy: 0.4980
Epoch 27/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6929 - accuracy: 0.
5128 - val_loss: 0.6955 - val_accuracy: 0.4988
Epoch 28/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6951 - accuracy:
0.4924 - val_loss: 0.6946 - val_accuracy: 0.4992
Epoch 29/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6927 - accuracy: 0.
5108 - val_loss: 0.6939 - val_accuracy: 0.4916
Epoch 30/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6931 - accuracy: 0.
5216 - val_loss: 0.6946 - val_accuracy: 0.4892
Epoch 31/400
79/79 [==============================] - 1s 12ms/step - loss: 0.6928 - accuracy:
0.5128 - val_loss: 0.6956 - val_accuracy: 0.5064
Epoch 32/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6923 - accuracy:
0.5000 - val_loss: 0.6948 - val_accuracy: 0.4868
Epoch 33/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6901 - accuracy:
0.5288 - val_loss: 0.6980 - val_accuracy: 0.4940
Epoch 34/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6879 - accuracy: 0.
5408 - val_loss: 0.6982 - val_accuracy: 0.4920
Epoch 35/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6872 - accuracy: 0.
5488 - val_loss: 0.7016 - val_accuracy: 0.4904
Epoch 36/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6846 - accuracy: 0.
5504 - val_loss: 0.7043 - val_accuracy: 0.4860
Epoch 37/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6854 - accuracy: 0.
5576 - val_loss: 0.7013 - val_accuracy: 0.5032
Epoch 38/400
```

```
79/79 [==============================] - 1s 9ms/step - loss: 0.6943 - accuracy: 0.
5148 - val_loss: 0.6994 - val_accuracy: 0.4892
Epoch 39/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6865 - accuracy: 0.
5368 - val_loss: 0.6994 - val_accuracy: 0.4988
Epoch 40/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6853 - accuracy: 0.
5304 - val_loss: 0.6997 - val_accuracy: 0.5004
Epoch 41/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6839 - accuracy: 0.
5520 - val_loss: 0.7015 - val_accuracy: 0.5132
Epoch 42/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6917 - accuracy: 0.
5264 - val_loss: 0.6988 - val_accuracy: 0.4868
Epoch 43/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6901 - accuracy: 0.
5300 - val_loss: 0.6982 - val_accuracy: 0.5052
Epoch 44/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6890 - accuracy: 0.
5256 - val_loss: 0.6997 - val_accuracy: 0.4992
Epoch 45/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6871 - accuracy: 0.
5464 - val_loss: 0.7036 - val_accuracy: 0.4792
Epoch 46/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6864 - accuracy: 0.
5452 - val_loss: 0.7024 - val_accuracy: 0.4856
Epoch 47/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6835 - accuracy: 0.
5500 - val_loss: 0.7083 - val_accuracy: 0.4788
Epoch 48/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6839 - accuracy:
0.5448 - val_loss: 0.7096 - val_accuracy: 0.4752
Epoch 49/400
79/79 [==============================] - 1s 12ms/step - loss: 0.6888 - accuracy:
0.5328 - val_loss: 0.7048 - val_accuracy: 0.5004
Epoch 50/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6902 - accuracy:
0.5272 - val_loss: 0.6989 - val_accuracy: 0.4864
Epoch 51/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6868 - accuracy: 0.
5252 - val_loss: 0.7028 - val_accuracy: 0.4768
Epoch 52/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6839 - accuracy: 0.
5432 - val_loss: 0.7033 - val_accuracy: 0.4960
Epoch 53/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6863 - accuracy: 0.
5368 - val_loss: 0.7046 - val_accuracy: 0.4924
Epoch 54/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6851 - accuracy:
0.5392 - val_loss: 0.7066 - val_accuracy: 0.4992
Epoch 55/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6891 - accuracy: 0.
5412 - val_loss: 0.6995 - val_accuracy: 0.5084
Epoch 56/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6900 - accuracy: 0.
5360 - val_loss: 0.6981 - val_accuracy: 0.5088
```

```
Epoch 57/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6886 - accuracy: 0.
5348 - val_loss: 0.6988 - val_accuracy: 0.5228
Epoch 58/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6894 - accuracy: 0.
5324 - val_loss: 0.6987 - val_accuracy: 0.5040
Epoch 59/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6895 - accuracy:
0.5348 - val_loss: 0.6993 - val_accuracy: 0.4872
Epoch 60/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6854 - accuracy:
0.5492 - val_loss: 0.6998 - val_accuracy: 0.5004
Epoch 61/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6863 - accuracy: 0.
5476 - val_loss: 0.6992 - val_accuracy: 0.4932
Epoch 62/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6848 - accuracy: 0.
5472 - val_loss: 0.7014 - val_accuracy: 0.4940
Epoch 63/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6827 - accuracy: 0.
5532 - val_loss: 0.7004 - val_accuracy: 0.5016
Epoch 64/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6813 - accuracy: 0.
5544 - val_loss: 0.7054 - val_accuracy: 0.4984
Epoch 65/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6883 - accuracy:
0.5424 - val_loss: 0.7029 - val_accuracy: 0.4840
Epoch 66/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6859 - accuracy:
0.5544 - val_loss: 0.7003 - val_accuracy: 0.4936
Epoch 67/400
79/79 [==============================] - 1s 12ms/step - loss: 0.6839 - accuracy:
0.5492 - val_loss: 0.7054 - val_accuracy: 0.4900
Epoch 68/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6809 - accuracy: 0.
5516 - val_loss: 0.7058 - val_accuracy: 0.4836
Epoch 69/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6802 - accuracy: 0.
5468 - val_loss: 0.7082 - val_accuracy: 0.4896
Epoch 70/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6821 - accuracy: 0.
5468 - val_loss: 0.7061 - val_accuracy: 0.4908
Epoch 71/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6882 - accuracy:
0.5368 - val_loss: 0.7027 - val_accuracy: 0.4848
Epoch 72/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6863 - accuracy: 0.
5492 - val_loss: 0.7002 - val_accuracy: 0.4904
Epoch 73/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6822 - accuracy: 0.
5584 - val_loss: 0.7004 - val_accuracy: 0.4912
Epoch 74/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6822 - accuracy: 0.
5440 - val_loss: 0.7056 - val_accuracy: 0.4872
Epoch 75/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6801 - accuracy: 0.
```

```
5636 - val_loss: 0.7055 - val_accuracy: 0.4912
Epoch 76/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6759 - accuracy: 0.
5704 - val_loss: 0.7141 - val_accuracy: 0.4832
Epoch 77/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6747 - accuracy: 0.
5728 - val_loss: 0.7137 - val_accuracy: 0.4816
Epoch 78/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6839 - accuracy: 0.
5584 - val_loss: 0.7079 - val_accuracy: 0.4872
Epoch 79/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6816 - accuracy: 0.
5600 - val_loss: 0.7029 - val_accuracy: 0.5032
Epoch 80/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6785 - accuracy: 0.
5616 - val_loss: 0.7100 - val_accuracy: 0.4876
Epoch 81/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6763 - accuracy: 0.
5680 - val_loss: 0.7086 - val_accuracy: 0.4868
Epoch 82/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6732 - accuracy:
0.5748 - val_loss: 0.7090 - val_accuracy: 0.4888
Epoch 83/400
79/79 [==============================] - 1s 12ms/step - loss: 0.6710 - accuracy:
0.5872 - val_loss: 0.7141 - val_accuracy: 0.4868
Epoch 84/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6723 - accuracy:
0.5820 - val_loss: 0.7164 - val_accuracy: 0.4944
Epoch 85/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6919 - accuracy: 0.
5468 - val_loss: 0.7062 - val_accuracy: 0.5080
Epoch 86/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6963 - accuracy:
0.5184 - val_loss: 0.7012 - val_accuracy: 0.5056
Epoch 87/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6928 - accuracy: 0.
5124 - val_loss: 0.7000 - val_accuracy: 0.4988
Epoch 88/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6912 - accuracy: 0.
5276 - val_loss: 0.7005 - val_accuracy: 0.4980
Epoch 89/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6953 - accuracy: 0.
5024 - val_loss: 0.6999 - val_accuracy: 0.4772
Epoch 90/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6943 - accuracy: 0.
5108 - val_loss: 0.6981 - val_accuracy: 0.4928
Epoch 91/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6940 - accuracy: 0.
5112 - val_loss: 0.6972 - val_accuracy: 0.4844
Epoch 92/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6930 - accuracy: 0.
5120 - val_loss: 0.6972 - val_accuracy: 0.4704
Epoch 93/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6930 - accuracy: 0.
5152 - val_loss: 0.6973 - val_accuracy: 0.4816
Epoch 94/400
```

```
79/79 [==============================] - 1s 10ms/step - loss: 0.6944 - accuracy:
0.5052 - val_loss: 0.6985 - val_accuracy: 0.4756
Epoch 95/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6927 - accuracy: 0.
5244 - val_loss: 0.6979 - val_accuracy: 0.4800
Epoch 96/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6925 - accuracy: 0.
5088 - val_loss: 0.6991 - val_accuracy: 0.4872
Epoch 97/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6927 - accuracy: 0.
5112 - val_loss: 0.6977 - val_accuracy: 0.4840
Epoch 98/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6899 - accuracy:
0.5288 - val_loss: 0.6987 - val_accuracy: 0.4876
Epoch 99/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6914 - accuracy:
0.5108 - val_loss: 0.6999 - val_accuracy: 0.4988
Epoch 100/400
79/79 [==============================] - 1s 12ms/step - loss: 0.6915 - accuracy:
0.5296 - val_loss: 0.6971 - val_accuracy: 0.4876
Epoch 101/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6899 - accuracy:
0.5272 - val_loss: 0.6997 - val_accuracy: 0.4832
Epoch 102/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6906 - accuracy: 0.
5384 - val_loss: 0.6960 - val_accuracy: 0.5008
Epoch 103/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6912 - accuracy:
0.5232 - val_loss: 0.6989 - val_accuracy: 0.4812
Epoch 104/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6965 - accuracy: 0.
5044 - val_loss: 0.6976 - val_accuracy: 0.4884
Epoch 105/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6940 - accuracy:
0.5012 - val_loss: 0.6979 - val_accuracy: 0.4936
Epoch 106/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6934 - accuracy: 0.
5132 - val_loss: 0.6962 - val_accuracy: 0.4804
Epoch 107/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6928 - accuracy: 0.
5100 - val_loss: 0.6952 - val_accuracy: 0.4976
Epoch 108/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6916 - accuracy: 0.
5112 - val_loss: 0.6949 - val_accuracy: 0.4920
Epoch 109/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6913 - accuracy:
0.5224 - val_loss: 0.6957 - val_accuracy: 0.5024
Epoch 110/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6914 - accuracy: 0.
5188 - val_loss: 0.6987 - val_accuracy: 0.5064
Epoch 111/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6940 - accuracy: 0.
5284 - val_loss: 0.6943 - val_accuracy: 0.4932
Epoch 112/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6920 - accuracy: 0.
5176 - val_loss: 0.6949 - val_accuracy: 0.5024
```

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Epoch 113/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6908 - accuracy:
0.5244 - val_loss: 0.6950 - val_accuracy: 0.4952
Epoch 114/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6914 - accuracy: 0.
5216 - val_loss: 0.6960 - val_accuracy: 0.5044
Epoch 115/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6899 - accuracy:
0.5344 - val_loss: 0.6954 - val_accuracy: 0.4924
Epoch 116/400
79/79 [==============================] - 1s 16ms/step - loss: 0.6902 - accuracy:
0.5264 - val_loss: 0.6990 - val_accuracy: 0.5028
Epoch 117/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6892 - accuracy:
0.5332 - val_loss: 0.6959 - val_accuracy: 0.5032
Epoch 118/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6883 - accuracy:
0.5344 - val_loss: 0.6950 - val_accuracy: 0.5144
Epoch 119/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6875 - accuracy: 0.
5380 - val_loss: 0.6949 - val_accuracy: 0.5104
Epoch 120/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6863 - accuracy: 0.
5508 - val_loss: 0.6988 - val_accuracy: 0.5112
Epoch 121/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6857 - accuracy: 0.
5464 - val_loss: 0.6974 - val_accuracy: 0.4960
Epoch 122/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6853 - accuracy: 0.
5452 - val_loss: 0.6964 - val_accuracy: 0.5128
Epoch 123/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6847 - accuracy: 0.
5468 - val_loss: 0.6953 - val_accuracy: 0.5176
Epoch 124/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6821 - accuracy: 0.
5532 - val_loss: 0.6950 - val_accuracy: 0.5044
Epoch 125/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6800 - accuracy: 0.
5564 - val_loss: 0.6914 - val_accuracy: 0.5336
Epoch 126/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6760 - accuracy: 0.
5632 - val_loss: 0.6935 - val_accuracy: 0.5288
Epoch 127/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6748 - accuracy: 0.
5676 - val_loss: 0.6894 - val_accuracy: 0.5252
Epoch 128/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6692 - accuracy: 0.
5708 - val_loss: 0.6884 - val_accuracy: 0.5564
Epoch 129/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6667 - accuracy:
0.5712 - val_loss: 0.6757 - val_accuracy: 0.5544
Epoch 130/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6583 - accuracy: 0.
5844 - val_loss: 0.6759 - val_accuracy: 0.5568
Epoch 131/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6568 - accuracy: 0.
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5772 - val_loss: 0.6766 - val_accuracy: 0.5448
Epoch 132/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6507 - accuracy:
0.5796 - val_loss: 0.6685 - val_accuracy: 0.5312
Epoch 133/400
79/79 [==============================] - 1s 16ms/step - loss: 0.6489 - accuracy:
0.5976 - val_loss: 0.6721 - val_accuracy: 0.5628
Epoch 134/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6570 - accuracy:
0.5808 - val_loss: 0.6787 - val_accuracy: 0.5336
Epoch 135/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6938 - accuracy: 0.
5092 - val_loss: 0.6990 - val_accuracy: 0.4972
Epoch 136/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6711 - accuracy: 0.
5572 - val_loss: 0.6783 - val_accuracy: 0.5128
Epoch 137/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6612 - accuracy: 0.
5776 - val_loss: 0.6630 - val_accuracy: 0.5612
Epoch 138/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6516 - accuracy:
0.5844 - val_loss: 0.6719 - val_accuracy: 0.5472
Epoch 139/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6552 - accuracy:
0.5836 - val_loss: 0.6820 - val_accuracy: 0.5248
Epoch 140/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6916 - accuracy: 0.
5148 - val_loss: 0.6973 - val_accuracy: 0.5096
Epoch 141/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6927 - accuracy: 0.
5192 - val_loss: 0.6975 - val_accuracy: 0.5020
Epoch 142/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6928 - accuracy: 0.
5092 - val_loss: 0.6976 - val_accuracy: 0.4916
Epoch 143/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6917 - accuracy: 0.
5224 - val_loss: 0.6969 - val_accuracy: 0.4924
Epoch 144/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6918 - accuracy: 0.
5188 - val_loss: 0.6975 - val_accuracy: 0.4988
Epoch 145/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6925 - accuracy:
0.5192 - val_loss: 0.6961 - val_accuracy: 0.5084
Epoch 146/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6902 - accuracy: 0.
5380 - val_loss: 0.7004 - val_accuracy: 0.5024
Epoch 147/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6916 - accuracy: 0.
5212 - val_loss: 0.6965 - val_accuracy: 0.4940
Epoch 148/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6919 - accuracy: 0.
5156 - val_loss: 0.6969 - val_accuracy: 0.4952
Epoch 149/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6905 - accuracy:
0.5268 - val_loss: 0.6967 - val_accuracy: 0.5012
Epoch 150/400
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79/79 [==============================] - 1s 11ms/step - loss: 0.6902 - accuracy:
0.5300 - val_loss: 0.6970 - val_accuracy: 0.5084
Epoch 151/400
79/79 [==============================] - 1s 12ms/step - loss: 0.6903 - accuracy:
0.5232 - val_loss: 0.6962 - val_accuracy: 0.4988
Epoch 152/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6909 - accuracy: 0.
5220 - val_loss: 0.6969 - val_accuracy: 0.4904
Epoch 153/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6901 - accuracy: 0.
5256 - val_loss: 0.6975 - val_accuracy: 0.5032
Epoch 154/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6891 - accuracy: 0.
5248 - val_loss: 0.6976 - val_accuracy: 0.4912
Epoch 155/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6893 - accuracy: 0.
5264 - val_loss: 0.6976 - val_accuracy: 0.4904
Epoch 156/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6888 - accuracy:
0.5400 - val_loss: 0.6982 - val_accuracy: 0.5036
Epoch 157/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6885 - accuracy:
0.5316 - val_loss: 0.6977 - val_accuracy: 0.4984
Epoch 158/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6894 - accuracy: 0.
5304 - val_loss: 0.6989 - val_accuracy: 0.4980
Epoch 159/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6876 - accuracy: 0.
5348 - val_loss: 0.6991 - val_accuracy: 0.4972
Epoch 160/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6879 - accuracy:
0.5348 - val_loss: 0.7002 - val_accuracy: 0.4880
Epoch 161/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6883 - accuracy: 0.
5288 - val_loss: 0.6968 - val_accuracy: 0.5028
Epoch 162/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6868 - accuracy: 0.
5444 - val_loss: 0.7011 - val_accuracy: 0.4936
Epoch 163/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6865 - accuracy: 0.
5436 - val_loss: 0.6996 - val_accuracy: 0.4956
Epoch 164/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6889 - accuracy: 0.
5364 - val_loss: 0.6984 - val_accuracy: 0.5020
Epoch 165/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6853 - accuracy: 0.
5468 - val_loss: 0.7030 - val_accuracy: 0.4936
Epoch 166/400
79/79 [==============================] - 1s 12ms/step - loss: 0.6866 - accuracy:
0.5392 - val_loss: 0.7024 - val_accuracy: 0.4916
Epoch 167/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6859 - accuracy:
0.5420 - val_loss: 0.6999 - val_accuracy: 0.4996
Epoch 168/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6857 - accuracy:
0.5496 - val_loss: 0.6989 - val_accuracy: 0.5032
```

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Epoch 169/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6851 - accuracy: 0.
5472 - val_loss: 0.6995 - val_accuracy: 0.4956
Epoch 170/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6850 - accuracy:
0.5492 - val_loss: 0.7008 - val_accuracy: 0.5000
Epoch 171/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6831 - accuracy:
0.5460 - val_loss: 0.7016 - val_accuracy: 0.5036
Epoch 172/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6848 - accuracy: 0.
5568 - val_loss: 0.7012 - val_accuracy: 0.5052
Epoch 173/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6840 - accuracy: 0.
5552 - val_loss: 0.7017 - val_accuracy: 0.5096
Epoch 174/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6827 - accuracy: 0.
5532 - val_loss: 0.7037 - val_accuracy: 0.4904
Epoch 175/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6808 - accuracy: 0.
5600 - val_loss: 0.7093 - val_accuracy: 0.4960
Epoch 176/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6804 - accuracy: 0.
5564 - val_loss: 0.7031 - val_accuracy: 0.5044
Epoch 177/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6790 - accuracy:
0.5692 - val_loss: 0.7071 - val_accuracy: 0.5004
Epoch 178/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6783 - accuracy: 0.
5680 - val_loss: 0.7034 - val_accuracy: 0.4976
Epoch 179/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6792 - accuracy: 0.
5624 - val_loss: 0.7033 - val_accuracy: 0.5080
Epoch 180/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6770 - accuracy: 0.
5724 - val_loss: 0.7055 - val_accuracy: 0.5036
Epoch 181/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6760 - accuracy:
0.5776 - val_loss: 0.7062 - val_accuracy: 0.5020
Epoch 182/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6751 - accuracy: 0.
5708 - val_loss: 0.7083 - val_accuracy: 0.5000
Epoch 183/400
79/79 [==============================] - 1s 12ms/step - loss: 0.6753 - accuracy:
0.5688 - val_loss: 0.7120 - val_accuracy: 0.4932
Epoch 184/400
79/79 [==============================] - 1s 12ms/step - loss: 0.6719 - accuracy:
0.5824 - val_loss: 0.7122 - val_accuracy: 0.4932
Epoch 185/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6731 - accuracy: 0.
5768 - val_loss: 0.7120 - val_accuracy: 0.4980
Epoch 186/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6722 - accuracy: 0.
5796 - val_loss: 0.7138 - val_accuracy: 0.4928
Epoch 187/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6706 - accuracy: 0.
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5868 - val_loss: 0.7157 - val_accuracy: 0.4944
Epoch 188/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6727 - accuracy:
0.5764 - val_loss: 0.7153 - val_accuracy: 0.5024
Epoch 189/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6682 - accuracy: 0.
5884 - val_loss: 0.7214 - val_accuracy: 0.4864
Epoch 190/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6654 - accuracy:
0.5900 - val_loss: 0.7140 - val_accuracy: 0.5056
Epoch 191/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6638 - accuracy: 0.
6028 - val_loss: 0.7235 - val_accuracy: 0.4936
Epoch 192/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6619 - accuracy:
0.6000 - val_loss: 0.7258 - val_accuracy: 0.4900
Epoch 193/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6629 - accuracy:
0.5956 - val_loss: 0.7251 - val_accuracy: 0.4924
Epoch 194/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6577 - accuracy:
0.6120 - val_loss: 0.7232 - val_accuracy: 0.5064
Epoch 195/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6613 - accuracy: 0.
5952 - val_loss: 0.7203 - val_accuracy: 0.5072
Epoch 196/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6568 - accuracy: 0.
6048 - val_loss: 0.7236 - val_accuracy: 0.5012
Epoch 197/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6549 - accuracy: 0.
6088 - val_loss: 0.7322 - val_accuracy: 0.4976
Epoch 198/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6522 - accuracy:
0.6148 - val_loss: 0.7264 - val_accuracy: 0.5052
Epoch 199/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6503 - accuracy:
0.6080 - val_loss: 0.7336 - val_accuracy: 0.5072
Epoch 200/400
79/79 [==============================] - 1s 12ms/step - loss: 0.6481 - accuracy:
0.6076 - val_loss: 0.7334 - val_accuracy: 0.5036
Epoch 201/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6460 - accuracy:
0.6052 - val_loss: 0.7288 - val_accuracy: 0.5116
Epoch 202/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6459 - accuracy: 0.
6144 - val_loss: 0.7409 - val_accuracy: 0.4940
Epoch 203/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6410 - accuracy: 0.
6204 - val_loss: 0.7390 - val_accuracy: 0.5052
Epoch 204/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6462 - accuracy: 0.
6196 - val_loss: 0.7442 - val_accuracy: 0.5064
Epoch 205/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6407 - accuracy: 0.
6208 - val_loss: 0.7443 - val_accuracy: 0.5000
Epoch 206/400
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79/79 [==============================] - 1s 8ms/step - loss: 0.6377 - accuracy: 0.
6232 - val_loss: 0.7537 - val_accuracy: 0.4904
Epoch 207/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6416 - accuracy: 0.
6160 - val_loss: 0.7438 - val_accuracy: 0.4944
Epoch 208/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6338 - accuracy:
0.6268 - val_loss: 0.7454 - val_accuracy: 0.4980
Epoch 209/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6287 - accuracy:
0.6380 - val_loss: 0.7438 - val_accuracy: 0.5008
Epoch 210/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6287 - accuracy: 0.
6340 - val_loss: 0.7569 - val_accuracy: 0.4940
Epoch 211/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6255 - accuracy: 0.
6416 - val_loss: 0.7603 - val_accuracy: 0.5072
Epoch 212/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6282 - accuracy: 0.
6400 - val_loss: 0.7635 - val_accuracy: 0.4960
Epoch 213/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6308 - accuracy: 0.
6372 - val_loss: 0.7605 - val_accuracy: 0.4924
Epoch 214/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6190 - accuracy:
0.6544 - val_loss: 0.7721 - val_accuracy: 0.4848
Epoch 215/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6249 - accuracy: 0.
6432 - val_loss: 0.7701 - val_accuracy: 0.5008
Epoch 216/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6132 - accuracy:
0.6580 - val_loss: 0.7654 - val_accuracy: 0.5032
Epoch 217/400
79/79 [==============================] - 1s 12ms/step - loss: 0.6176 - accuracy:
0.6448 - val_loss: 0.7754 - val_accuracy: 0.4940
Epoch 218/400
79/79 [==============================] - 1s 16ms/step - loss: 0.6295 - accuracy:
0.6308 - val_loss: 0.7752 - val_accuracy: 0.4900
Epoch 219/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6141 - accuracy: 0.
6584 - val_loss: 0.7845 - val_accuracy: 0.4836
Epoch 220/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6269 - accuracy: 0.
6328 - val_loss: 0.7684 - val_accuracy: 0.4896
Epoch 221/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6290 - accuracy:
0.6444 - val_loss: 0.7724 - val_accuracy: 0.5036
Epoch 222/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6350 - accuracy: 0.
6420 - val_loss: 0.7730 - val_accuracy: 0.5036
Epoch 223/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6141 - accuracy: 0.
6596 - val_loss: 0.7758 - val_accuracy: 0.4860
Epoch 224/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6226 - accuracy:
0.6472 - val_loss: 0.7791 - val_accuracy: 0.4948
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Epoch 225/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6137 - accuracy:
0.6572 - val_loss: 0.7791 - val_accuracy: 0.4904
Epoch 226/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6119 - accuracy: 0.
6628 - val_loss: 0.7806 - val_accuracy: 0.4992
Epoch 227/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6157 - accuracy: 0.
6500 - val_loss: 0.7989 - val_accuracy: 0.4852
Epoch 228/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6099 - accuracy:
0.6624 - val_loss: 0.7956 - val_accuracy: 0.4920
Epoch 229/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6002 - accuracy: 0.
6760 - val_loss: 0.7937 - val_accuracy: 0.4924
Epoch 230/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6102 - accuracy: 0.
6516 - val_loss: 0.7789 - val_accuracy: 0.4920
Epoch 231/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6138 - accuracy: 0.
6504 - val_loss: 0.7903 - val_accuracy: 0.4972
Epoch 232/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6125 - accuracy:
0.6552 - val_loss: 0.7881 - val_accuracy: 0.5016
Epoch 233/400
79/79 [==============================] - 1s 11ms/step - loss: 0.5932 - accuracy:
0.6792 - val_loss: 0.7929 - val_accuracy: 0.4876
Epoch 234/400
79/79 [==============================] - 1s 11ms/step - loss: 0.5918 - accuracy:
0.6772 - val_loss: 0.7892 - val_accuracy: 0.4924
Epoch 235/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6028 - accuracy:
0.6720 - val_loss: 0.8032 - val_accuracy: 0.5000
Epoch 236/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6155 - accuracy:
0.6532 - val_loss: 0.7995 - val_accuracy: 0.4960
Epoch 237/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6081 - accuracy:
0.6656 - val_loss: 0.7889 - val_accuracy: 0.5004
Epoch 238/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5879 - accuracy: 0.
6728 - val_loss: 0.8017 - val_accuracy: 0.4900
Epoch 239/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5970 - accuracy: 0.
6752 - val_loss: 0.8049 - val_accuracy: 0.4916
Epoch 240/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5996 - accuracy: 0.
6736 - val_loss: 0.7961 - val_accuracy: 0.4952
Epoch 241/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5978 - accuracy:
0.6672 - val_loss: 0.8151 - val_accuracy: 0.4996
Epoch 242/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6591 - accuracy: 0.
6060 - val_loss: 0.7903 - val_accuracy: 0.5040
Epoch 243/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6576 - accuracy:
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                  0.6060 - val_loss: 0.7734 - val_accuracy: 0.5044
                  Epoch 244/400
                  79/79 [==============================] - 1s 8ms/step - loss: 0.6173 - accuracy: 0.
                  6512 - val_loss: 0.7846 - val_accuracy: 0.4912
                  Epoch 245/400
                  79/79 [==============================] - 1s 8ms/step - loss: 0.5983 - accuracy: 0.
                  6708 - val_loss: 0.7839 - val_accuracy: 0.4952
                  Epoch 246/400
                  79/79 [==============================] - 1s 8ms/step - loss: 0.5999 - accuracy: 0.
                  6796 - val_loss: 0.7929 - val_accuracy: 0.4984
                  Epoch 247/400
                  79/79 [==============================] - 1s 8ms/step - loss: 0.5942 - accuracy: 0.
                  6768 - val_loss: 0.8055 - val_accuracy: 0.4936
                  Epoch 248/400
                  79/79 [==============================] - 1s 8ms/step - loss: 0.5930 - accuracy: 0.
                  6680 - val_loss: 0.7974 - val_accuracy: 0.4928
                  Epoch 249/400
                  79/79 [==============================] - 1s 10ms/step - loss: 0.5851 - accuracy:
                  0.6844 - val_loss: 0.7998 - val_accuracy: 0.4972
                  Epoch 250/400
                  79/79 [==============================] - 1s 12ms/step - loss: 0.5755 - accuracy:
                  0.6996 - val_loss: 0.8073 - val_accuracy: 0.5016
                  Epoch 251/400
                  79/79 [==============================] - 1s 11ms/step - loss: 0.5873 - accuracy:
                  0.6788 - val_loss: 0.8073 - val_accuracy: 0.4936
                  Epoch 252/400
                  79/79 [==============================] - 1s 11ms/step - loss: 0.5781 - accuracy:
                  0.6916 - val_loss: 0.8212 - val_accuracy: 0.4968
                  Epoch 253/400
                  79/79 [==============================] - 1s 10ms/step - loss: 0.5912 - accuracy:
                  0.6768 - val_loss: 0.8278 - val_accuracy: 0.4936
                  Epoch 254/400
                  79/79 [==============================] - 1s 9ms/step - loss: 0.5921 - accuracy: 0.
                  6800 - val_loss: 0.8137 - val_accuracy: 0.4844
                  Epoch 255/400
                  79/79 [==============================] - 1s 8ms/step - loss: 0.5834 - accuracy: 0.
                  6968 - val_loss: 0.8113 - val_accuracy: 0.5044
                  Epoch 256/400
                  79/79 [==============================] - 1s 8ms/step - loss: 0.5778 - accuracy: 0.
                  6924 - val_loss: 0.8061 - val_accuracy: 0.5024
                  Epoch 257/400
                  79/79 [==============================] - 1s 8ms/step - loss: 0.5973 - accuracy: 0.
                  6708 - val_loss: 0.7949 - val_accuracy: 0.5132
                  Epoch 258/400
                  79/79 [==============================] - 1s 10ms/step - loss: 0.5743 - accuracy:
                  0.6932 - val_loss: 0.8124 - val_accuracy: 0.5040
                  Epoch 259/400
                  79/79 [==============================] - 1s 9ms/step - loss: 0.5844 - accuracy: 0.
                  6896 - val_loss: 0.8119 - val_accuracy: 0.5020
                  Epoch 260/400
                  79/79 [==============================] - 1s 10ms/step - loss: 0.5761 - accuracy:
                  0.6904 - val_loss: 0.8256 - val_accuracy: 0.4928
                  Epoch 261/400
                  79/79 [==============================] - 1s 9ms/step - loss: 0.5848 - accuracy: 0.
                  6812 - val_loss: 0.8262 - val_accuracy: 0.5064
                  Epoch 262/400
```

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79/79 [==============================] - 1s 10ms/step - loss: 0.5666 - accuracy:
0.6940 - val_loss: 0.8340 - val_accuracy: 0.4984
Epoch 263/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5653 - accuracy: 0.
6992 - val_loss: 0.8372 - val_accuracy: 0.5020
Epoch 264/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5874 - accuracy: 0.
6756 - val_loss: 0.8199 - val_accuracy: 0.4904
Epoch 265/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5703 - accuracy: 0.
6932 - val_loss: 0.8486 - val_accuracy: 0.4988
Epoch 266/400
79/79 [==============================] - 1s 11ms/step - loss: 0.5658 - accuracy:
0.7056 - val_loss: 0.8417 - val_accuracy: 0.4980
Epoch 267/400
79/79 [==============================] - 1s 12ms/step - loss: 0.5705 - accuracy:
0.6936 - val_loss: 0.8314 - val_accuracy: 0.5172
Epoch 268/400
79/79 [==============================] - 1s 12ms/step - loss: 0.5583 - accuracy:
0.7084 - val_loss: 0.8463 - val_accuracy: 0.5120
Epoch 269/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5589 - accuracy: 0.
7088 - val_loss: 0.8513 - val_accuracy: 0.5072
Epoch 270/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5833 - accuracy:
0.6820 - val_loss: 0.8601 - val_accuracy: 0.4900
Epoch 271/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5817 - accuracy:
0.6868 - val_loss: 0.8209 - val_accuracy: 0.5020
Epoch 272/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5693 - accuracy: 0.
6904 - val_loss: 0.8467 - val_accuracy: 0.4968
Epoch 273/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5843 - accuracy: 0.
6840 - val_loss: 0.8303 - val_accuracy: 0.5092
Epoch 274/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5879 - accuracy: 0.
6924 - val_loss: 0.8325 - val_accuracy: 0.5004
Epoch 275/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5818 - accuracy:
0.6844 - val_loss: 0.8636 - val_accuracy: 0.4904
Epoch 276/400
79/79 [==============================] - 1s 8ms/step - loss: 0.6028 - accuracy: 0.
6616 - val_loss: 0.8362 - val_accuracy: 0.4916
Epoch 277/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5771 - accuracy: 0.
6872 - val_loss: 0.8303 - val_accuracy: 0.4976
Epoch 278/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5629 - accuracy:
0.7072 - val_loss: 0.8581 - val_accuracy: 0.4912
Epoch 279/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5599 - accuracy: 0.
7064 - val_loss: 0.8403 - val_accuracy: 0.4960
Epoch 280/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5746 - accuracy: 0.
6860 - val_loss: 0.8584 - val_accuracy: 0.4932
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Epoch 281/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5657 - accuracy: 0.
7044 - val_loss: 0.8332 - val_accuracy: 0.5012
Epoch 282/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5967 - accuracy: 0.
6664 - val_loss: 0.8455 - val_accuracy: 0.5004
Epoch 283/400
79/79 [==============================] - 1s 11ms/step - loss: 0.5726 - accuracy:
0.6800 - val_loss: 0.8432 - val_accuracy: 0.4828
Epoch 284/400
79/79 [==============================] - 1s 12ms/step - loss: 0.5817 - accuracy:
0.6836 - val_loss: 0.8467 - val_accuracy: 0.4960
Epoch 285/400
79/79 [==============================] - 1s 12ms/step - loss: 0.5672 - accuracy:
0.7024 - val_loss: 0.8623 - val_accuracy: 0.4824
Epoch 286/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5809 - accuracy: 0.
6840 - val_loss: 0.8408 - val_accuracy: 0.4860
Epoch 287/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5723 - accuracy: 0.
6956 - val_loss: 0.8749 - val_accuracy: 0.5024
Epoch 288/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5679 - accuracy: 0.
6912 - val_loss: 0.8484 - val_accuracy: 0.4988
Epoch 289/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5820 - accuracy:
0.6824 - val_loss: 0.8519 - val_accuracy: 0.5032
Epoch 290/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5722 - accuracy: 0.
6904 - val_loss: 0.8475 - val_accuracy: 0.4908
Epoch 291/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5673 - accuracy:
0.6964 - val_loss: 0.8497 - val_accuracy: 0.5008
Epoch 292/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5827 - accuracy:
0.6824 - val_loss: 0.8528 - val_accuracy: 0.5040
Epoch 293/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5768 - accuracy: 0.
6820 - val_loss: 0.8296 - val_accuracy: 0.4960
Epoch 294/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5471 - accuracy:
0.7136 - val_loss: 0.8397 - val_accuracy: 0.4900
Epoch 295/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5566 - accuracy: 0.
7024 - val_loss: 0.8656 - val_accuracy: 0.4876
Epoch 296/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5606 - accuracy: 0.
7000 - val_loss: 0.8535 - val_accuracy: 0.4944
Epoch 297/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5542 - accuracy:
0.7168 - val_loss: 0.8640 - val_accuracy: 0.5040
Epoch 298/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5723 - accuracy:
0.6876 - val_loss: 0.8944 - val_accuracy: 0.4996
Epoch 299/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5956 - accuracy:
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0.6716 - val_loss: 0.8504 - val_accuracy: 0.4944
Epoch 300/400
79/79 [==============================] - 1s 11ms/step - loss: 0.5757 - accuracy:
0.6876 - val_loss: 0.8389 - val_accuracy: 0.4984
Epoch 301/400
79/79 [==============================] - 1s 12ms/step - loss: 0.5484 - accuracy:
0.7116 - val_loss: 0.8643 - val_accuracy: 0.4956
Epoch 302/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5435 - accuracy: 0.
7224 - val_loss: 0.8549 - val_accuracy: 0.5068
Epoch 303/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5338 - accuracy: 0.
7216 - val_loss: 0.8657 - val_accuracy: 0.4904
Epoch 304/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5334 - accuracy:
0.7208 - val_loss: 0.8892 - val_accuracy: 0.4836
Epoch 305/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5426 - accuracy:
0.7096 - val_loss: 0.8895 - val_accuracy: 0.5076
Epoch 306/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5683 - accuracy:
0.6920 - val_loss: 0.8697 - val_accuracy: 0.4944
Epoch 307/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5384 - accuracy:
0.7208 - val_loss: 0.8882 - val_accuracy: 0.4892
Epoch 308/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5509 - accuracy:
0.7120 - val_loss: 0.8862 - val_accuracy: 0.5052
Epoch 309/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5656 - accuracy: 0.
7072 - val_loss: 0.8875 - val_accuracy: 0.4800
Epoch 310/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5370 - accuracy: 0.
7224 - val_loss: 0.9103 - val_accuracy: 0.4844
Epoch 311/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5671 - accuracy:
0.6980 - val_loss: 0.8701 - val_accuracy: 0.4984
Epoch 312/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5451 - accuracy: 0.
7104 - val_loss: 0.8882 - val_accuracy: 0.4936
Epoch 313/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5460 - accuracy:
0.7116 - val_loss: 0.8795 - val_accuracy: 0.4960
Epoch 314/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5647 - accuracy:
0.7020 - val_loss: 0.8976 - val_accuracy: 0.5112
Epoch 315/400
79/79 [==============================] - 1s 9ms/step - loss: 0.6686 - accuracy: 0.
6244 - val_loss: 0.8443 - val_accuracy: 0.5008
Epoch 316/400
79/79 [==============================] - 1s 11ms/step - loss: 0.6401 - accuracy:
0.6380 - val_loss: 0.8398 - val_accuracy: 0.4964
Epoch 317/400
79/79 [==============================] - 1s 12ms/step - loss: 0.6021 - accuracy:
0.6624 - val_loss: 0.8330 - val_accuracy: 0.4836
Epoch 318/400
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79/79 [==============================] - 1s 11ms/step - loss: 0.5945 - accuracy:
0.6720 - val_loss: 0.8261 - val_accuracy: 0.4940
Epoch 319/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5801 - accuracy: 0.
6876 - val_loss: 0.8336 - val_accuracy: 0.4904
Epoch 320/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5629 - accuracy:
0.7028 - val_loss: 0.8541 - val_accuracy: 0.4900
Epoch 321/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5702 - accuracy:
0.6984 - val_loss: 0.8474 - val_accuracy: 0.4860
Epoch 322/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5565 - accuracy: 0.
7004 - val_loss: 0.8513 - val_accuracy: 0.4988
Epoch 323/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5395 - accuracy: 0.
7164 - val_loss: 0.8756 - val_accuracy: 0.4868
Epoch 324/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6226 - accuracy:
0.6536 - val_loss: 0.8322 - val_accuracy: 0.5096
Epoch 325/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5999 - accuracy:
0.6640 - val_loss: 0.8267 - val_accuracy: 0.5048
Epoch 326/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5626 - accuracy: 0.
6944 - val_loss: 0.8498 - val_accuracy: 0.4928
Epoch 327/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5413 - accuracy:
0.7168 - val_loss: 0.8583 - val_accuracy: 0.4924
Epoch 328/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5451 - accuracy:
0.7116 - val_loss: 0.8586 - val_accuracy: 0.4856
Epoch 329/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5303 - accuracy: 0.
7244 - val_loss: 0.8567 - val_accuracy: 0.4980
Epoch 330/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5432 - accuracy: 0.
7184 - val_loss: 0.8660 - val_accuracy: 0.5012
Epoch 331/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5223 - accuracy:
0.7316 - val_loss: 0.8705 - val_accuracy: 0.4904
Epoch 332/400
79/79 [==============================] - 1s 11ms/step - loss: 0.5167 - accuracy:
0.7344 - val_loss: 0.8869 - val_accuracy: 0.4984
Epoch 333/400
79/79 [==============================] - 1s 11ms/step - loss: 0.5412 - accuracy:
0.7180 - val_loss: 0.8672 - val_accuracy: 0.4952
Epoch 334/400
79/79 [==============================] - 1s 12ms/step - loss: 0.5331 - accuracy:
0.7192 - val_loss: 0.8841 - val_accuracy: 0.5024
Epoch 335/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5220 - accuracy: 0.
7316 - val_loss: 0.9045 - val_accuracy: 0.4980
Epoch 336/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5222 - accuracy: 0.
7260 - val_loss: 0.9088 - val_accuracy: 0.4916
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Epoch 337/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5251 - accuracy:
0.7308 - val_loss: 0.8923 - val_accuracy: 0.4888
Epoch 338/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5302 - accuracy: 0.
7320 - val_loss: 0.8726 - val_accuracy: 0.4868
Epoch 339/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5227 - accuracy: 0.
7252 - val_loss: 0.9085 - val_accuracy: 0.4848
Epoch 340/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5192 - accuracy: 0.
7340 - val_loss: 0.9031 - val_accuracy: 0.4968
Epoch 341/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5348 - accuracy: 0.
7224 - val_loss: 0.9150 - val_accuracy: 0.4876
Epoch 342/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5167 - accuracy:
0.7340 - val_loss: 0.9156 - val_accuracy: 0.4868
Epoch 343/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5123 - accuracy: 0.
7428 - val_loss: 0.8998 - val_accuracy: 0.5060
Epoch 344/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5326 - accuracy:
0.7200 - val_loss: 0.9088 - val_accuracy: 0.4960
Epoch 345/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5103 - accuracy:
0.7364 - val_loss: 0.9195 - val_accuracy: 0.5040
Epoch 346/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5148 - accuracy: 0.
7344 - val_loss: 0.9224 - val_accuracy: 0.5044
Epoch 347/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5326 - accuracy: 0.
7248 - val_loss: 0.9183 - val_accuracy: 0.5008
Epoch 348/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5192 - accuracy:
0.7376 - val_loss: 0.9190 - val_accuracy: 0.4944
Epoch 349/400
79/79 [==============================] - 1s 12ms/step - loss: 0.5288 - accuracy:
0.7280 - val_loss: 0.9298 - val_accuracy: 0.4924
Epoch 350/400
79/79 [==============================] - 1s 11ms/step - loss: 0.5046 - accuracy:
0.7388 - val_loss: 0.9491 - val_accuracy: 0.4992
Epoch 351/400
79/79 [==============================] - 1s 11ms/step - loss: 0.5114 - accuracy:
0.7440 - val_loss: 0.9271 - val_accuracy: 0.4912
Epoch 352/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5041 - accuracy: 0.
7396 - val_loss: 0.9372 - val_accuracy: 0.4984
Epoch 353/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5789 - accuracy:
0.6984 - val_loss: 0.9868 - val_accuracy: 0.4888
Epoch 354/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6600 - accuracy:
0.6372 - val_loss: 0.9044 - val_accuracy: 0.4952
Epoch 355/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6094 - accuracy:
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0.6620 - val_loss: 0.8859 - val_accuracy: 0.4988
Epoch 356/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5486 - accuracy: 0.
7144 - val_loss: 0.8952 - val_accuracy: 0.5028
Epoch 357/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5270 - accuracy: 0.
7264 - val_loss: 0.9238 - val_accuracy: 0.4932
Epoch 358/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5128 - accuracy: 0.
7312 - val_loss: 0.9127 - val_accuracy: 0.4896
Epoch 359/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5048 - accuracy: 0.
7448 - val_loss: 0.9139 - val_accuracy: 0.4864
Epoch 360/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5242 - accuracy:
0.7332 - val_loss: 0.9105 - val_accuracy: 0.4884
Epoch 361/400
79/79 [==============================] - 1s 8ms/step - loss: 0.4971 - accuracy: 0.
7476 - val_loss: 0.9360 - val_accuracy: 0.4892
Epoch 362/400
79/79 [==============================] - 1s 8ms/step - loss: 0.4902 - accuracy: 0.
7584 - val_loss: 0.9389 - val_accuracy: 0.4904
Epoch 363/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5313 - accuracy:
0.7304 - val_loss: 0.9763 - val_accuracy: 0.4932
Epoch 364/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5827 - accuracy: 0.
6848 - val_loss: 0.9183 - val_accuracy: 0.5040
Epoch 365/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5582 - accuracy:
0.6972 - val_loss: 0.9114 - val_accuracy: 0.4836
Epoch 366/400
79/79 [==============================] - 1s 11ms/step - loss: 0.5071 - accuracy:
0.7488 - val_loss: 0.9449 - val_accuracy: 0.4852
Epoch 367/400
79/79 [==============================] - 1s 11ms/step - loss: 0.5640 - accuracy:
0.7004 - val_loss: 0.9244 - val_accuracy: 0.4876
Epoch 368/400
79/79 [==============================] - 1s 11ms/step - loss: 0.5456 - accuracy:
0.7132 - val_loss: 0.9113 - val_accuracy: 0.4944
Epoch 369/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5187 - accuracy: 0.
7376 - val_loss: 0.8999 - val_accuracy: 0.4888
Epoch 370/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5222 - accuracy: 0.
7332 - val_loss: 0.9249 - val_accuracy: 0.4940
Epoch 371/400
79/79 [==============================] - 1s 8ms/step - loss: 0.4975 - accuracy: 0.
7496 - val_loss: 0.9077 - val_accuracy: 0.4924
Epoch 372/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5006 - accuracy: 0.
7376 - val_loss: 0.9215 - val_accuracy: 0.4940
Epoch 373/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5257 - accuracy: 0.
7336 - val_loss: 0.9237 - val_accuracy: 0.4988
Epoch 374/400
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79/79 [==============================] - 1s 9ms/step - loss: 0.5189 - accuracy: 0.
7252 - val_loss: 0.9430 - val_accuracy: 0.4812
Epoch 375/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5336 - accuracy: 0.
7212 - val_loss: 0.9308 - val_accuracy: 0.4836
Epoch 376/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5243 - accuracy: 0.
7308 - val_loss: 0.9297 - val_accuracy: 0.4956
Epoch 377/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5498 - accuracy:
0.7060 - val_loss: 0.9420 - val_accuracy: 0.4808
Epoch 378/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5234 - accuracy:
0.7336 - val_loss: 0.9281 - val_accuracy: 0.4920
Epoch 379/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5150 - accuracy:
0.7356 - val_loss: 0.9154 - val_accuracy: 0.4948
Epoch 380/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5259 - accuracy: 0.
7324 - val_loss: 0.9319 - val_accuracy: 0.4900
Epoch 381/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5298 - accuracy:
0.7288 - val_loss: 0.9312 - val_accuracy: 0.4964
Epoch 382/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5344 - accuracy: 0.
7260 - val_loss: 0.9345 - val_accuracy: 0.4880
Epoch 383/400
79/79 [==============================] - 1s 11ms/step - loss: 0.5443 - accuracy:
0.7084 - val_loss: 0.9346 - val_accuracy: 0.4972
Epoch 384/400
79/79 [==============================] - 1s 11ms/step - loss: 0.5112 - accuracy:
0.7400 - val_loss: 0.9551 - val_accuracy: 0.5032
Epoch 385/400
79/79 [==============================] - 1s 12ms/step - loss: 0.5153 - accuracy:
0.7316 - val_loss: 0.9556 - val_accuracy: 0.4948
Epoch 386/400
79/79 [==============================] - 1s 8ms/step - loss: 0.4926 - accuracy: 0.
7568 - val_loss: 0.9446 - val_accuracy: 0.4936
Epoch 387/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5064 - accuracy: 0.
7424 - val_loss: 0.9641 - val_accuracy: 0.5016
Epoch 388/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5096 - accuracy:
0.7368 - val_loss: 0.9702 - val_accuracy: 0.4992
Epoch 389/400
79/79 [==============================] - 1s 10ms/step - loss: 0.6058 - accuracy:
0.6752 - val_loss: 0.9240 - val_accuracy: 0.4992
Epoch 390/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5850 - accuracy: 0.
6864 - val_loss: 0.9380 - val_accuracy: 0.4948
Epoch 391/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5589 - accuracy: 0.
7000 - val_loss: 0.9207 - val_accuracy: 0.4948
Epoch 392/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5089 - accuracy: 0.
7432 - val_loss: 0.9351 - val_accuracy: 0.4892
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```
Epoch 393/400
79/79 [==============================] - 1s 8ms/step - loss: 0.4979 - accuracy: 0.
7548 - val_loss: 0.9373 - val_accuracy: 0.4848
Epoch 394/400
79/79 [==============================] - 1s 10ms/step - loss: 0.4982 - accuracy:
0.7512 - val_loss: 0.9418 - val_accuracy: 0.4904
Epoch 395/400
79/79 [==============================] - 1s 10ms/step - loss: 0.4847 - accuracy:
0.7568 - val_loss: 0.9742 - val_accuracy: 0.4880
Epoch 396/400
79/79 [==============================] - 1s 9ms/step - loss: 0.5257 - accuracy: 0.
7324 - val_loss: 0.9417 - val_accuracy: 0.5024
Epoch 397/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5353 - accuracy:
0.7216 - val_loss: 0.9607 - val_accuracy: 0.5036
Epoch 398/400
79/79 [==============================] - 1s 8ms/step - loss: 0.5190 - accuracy: 0.
7316 - val_loss: 0.9569 - val_accuracy: 0.4948
Epoch 399/400
79/79 [==============================] - 1s 10ms/step - loss: 0.5101 - accuracy:
0.7448 - val_loss: 0.9697 - val_accuracy: 0.4880
Epoch 400/400
79/79 [==============================] - 1s 12ms/step - loss: 0.5114 - accuracy:
0.7408 - val_loss: 0.9539 - val_accuracy: 0.4908
```
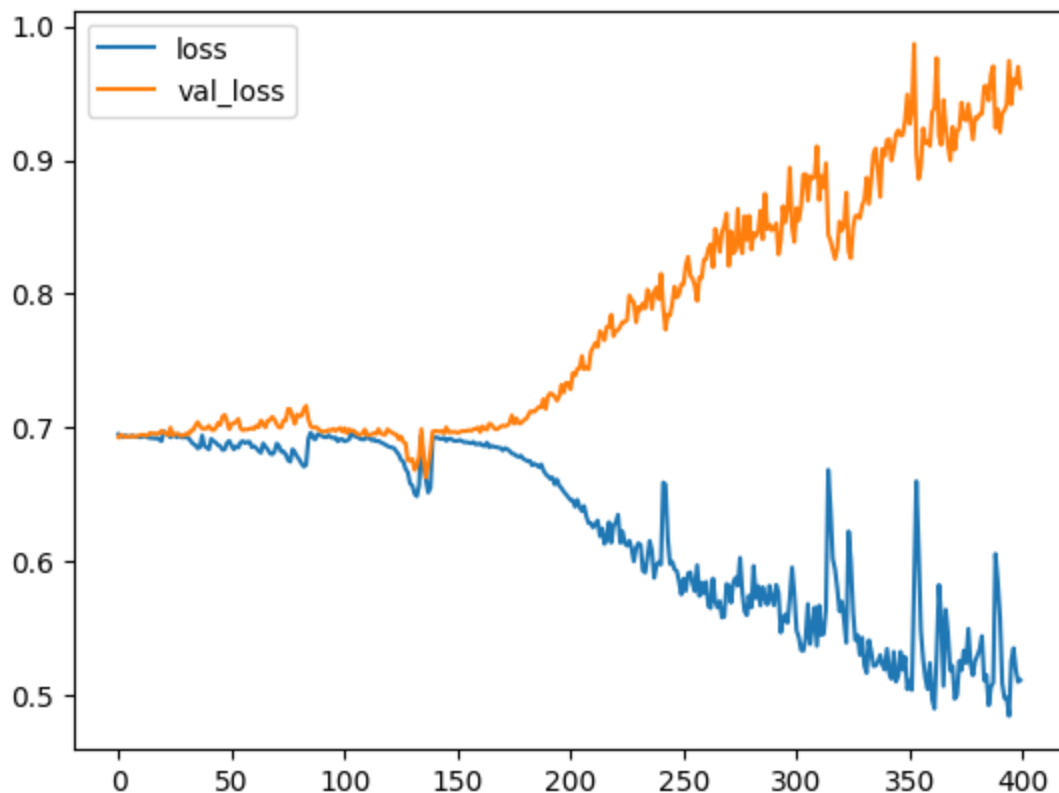
In [30]:
```python
# Plot the loss
plt.plot(r.history['loss'], label='loss')
plt.plot(r.history['val_loss'], label='val_loss')
plt.legend()
```
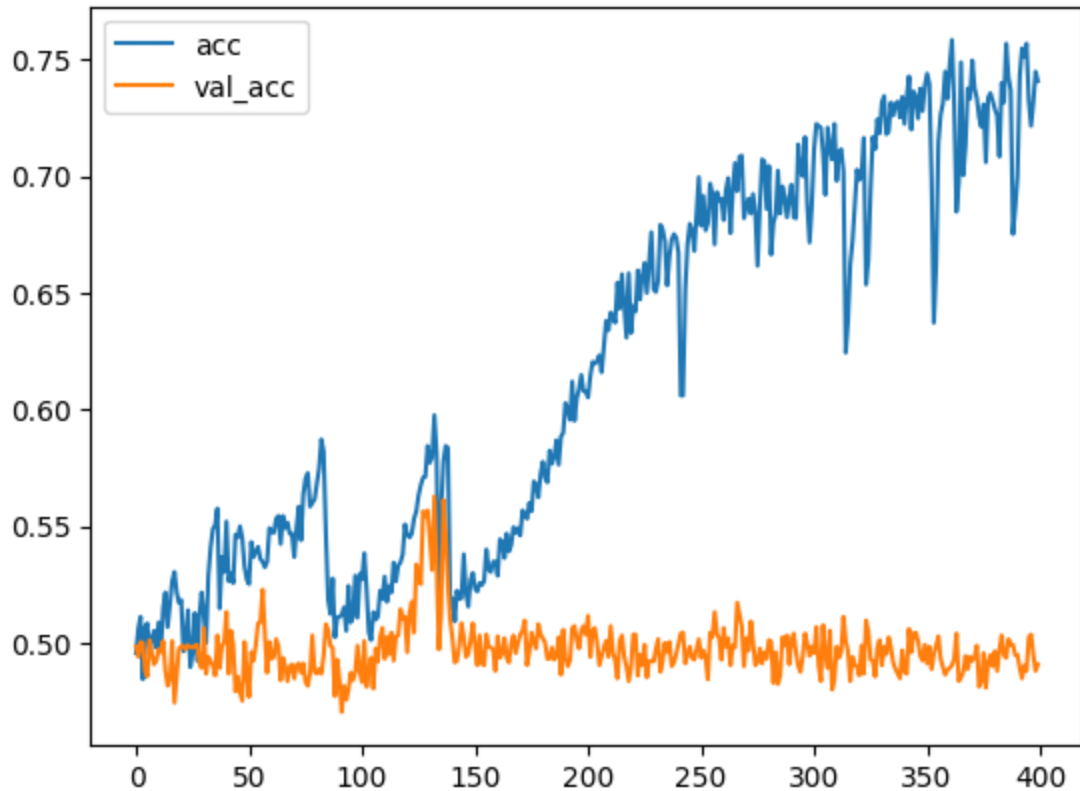
Out[30]: <matplotlib.legend.Legend at 0x7f8c5051a2f0>

In [31]:
```python
# Plot the accuracy too
plt.plot(r.history['accuracy'], label='acc')
plt.plot(r.history['val_accuracy'], label='val_acc')
plt.legend()
```

Out[31]: <matplotlib.legend.Legend at 0x7f8bd83eb250>

In [32]:
```python
# Now try a LSTM with Global Max Pooling
inputs = np.expand_dims(X, -1)

# make the RNN
i = Input(shape=(T, D))

# method 2
x = LSTM(5, return_sequences=True)(i)
x = GlobalMaxPool1D()(x)

x = Dense(1, activation='sigmoid')(x)
model = Model(i, x)
model.compile(
  loss='binary_crossentropy',
  optimizer=Adam(learning_rate=0.01),
  metrics=['accuracy'],
)

# train the RNN
r = model.fit(
  inputs, Y,
  epochs=100,
```

```
    validation_split=0.5,
)
```

```
Epoch 1/100
79/79 [==============================] - 3s 14ms/step - loss: 0.6959 - accuracy:
0.4952 - val_loss: 0.6927 - val_accuracy: 0.5104
Epoch 2/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6939 - accuracy: 0.
4840 - val_loss: 0.6928 - val_accuracy: 0.5040
Epoch 3/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6934 - accuracy: 0.
5024 - val_loss: 0.6930 - val_accuracy: 0.5044
Epoch 4/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6936 - accuracy: 0.
5088 - val_loss: 0.6928 - val_accuracy: 0.5316
Epoch 5/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6932 - accuracy: 0.
5108 - val_loss: 0.6929 - val_accuracy: 0.5036
Epoch 6/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6934 - accuracy: 0.
4900 - val_loss: 0.6928 - val_accuracy: 0.5100
Epoch 7/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6930 - accuracy: 0.
4968 - val_loss: 0.6927 - val_accuracy: 0.5028
Epoch 8/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6928 - accuracy: 0.
4964 - val_loss: 0.6926 - val_accuracy: 0.5292
Epoch 9/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6914 - accuracy: 0.
5120 - val_loss: 0.6913 - val_accuracy: 0.5356
Epoch 10/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6929 - accuracy: 0.
5132 - val_loss: 0.6911 - val_accuracy: 0.5268
Epoch 11/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6903 - accuracy: 0.
5056 - val_loss: 0.6876 - val_accuracy: 0.5064
Epoch 12/100
79/79 [==============================] - 1s 12ms/step - loss: 0.6838 - accuracy:
0.5136 - val_loss: 0.6865 - val_accuracy: 0.5432
Epoch 13/100
79/79 [==============================] - 1s 12ms/step - loss: 0.6949 - accuracy:
0.5152 - val_loss: 0.7018 - val_accuracy: 0.4896
Epoch 14/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6962 - accuracy: 0.
5020 - val_loss: 0.6959 - val_accuracy: 0.5008
Epoch 15/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6947 - accuracy: 0.
5052 - val_loss: 0.6924 - val_accuracy: 0.5132
Epoch 16/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6933 - accuracy: 0.
5156 - val_loss: 0.6935 - val_accuracy: 0.5008
Epoch 17/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6937 - accuracy: 0.
5056 - val_loss: 0.6918 - val_accuracy: 0.5340
Epoch 18/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6930 - accuracy: 0.
5248 - val_loss: 0.6921 - val_accuracy: 0.5240
Epoch 19/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6934 - accuracy: 0.
```

```
5040 - val_loss: 0.6917 - val_accuracy: 0.5396
Epoch 20/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6929 - accuracy: 0.
5200 - val_loss: 0.6913 - val_accuracy: 0.5384
Epoch 21/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6922 - accuracy: 0.
5288 - val_loss: 0.6907 - val_accuracy: 0.5416
Epoch 22/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6923 - accuracy: 0.
5316 - val_loss: 0.6909 - val_accuracy: 0.5400
Epoch 23/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6917 - accuracy: 0.
5308 - val_loss: 0.6900 - val_accuracy: 0.5476
Epoch 24/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6912 - accuracy: 0.
5288 - val_loss: 0.6894 - val_accuracy: 0.5476
Epoch 25/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6908 - accuracy: 0.
5288 - val_loss: 0.6891 - val_accuracy: 0.5448
Epoch 26/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6900 - accuracy: 0.
5296 - val_loss: 0.6885 - val_accuracy: 0.5452
Epoch 27/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6891 - accuracy: 0.
5400 - val_loss: 0.6867 - val_accuracy: 0.5636
Epoch 28/100
79/79 [==============================] - 1s 10ms/step - loss: 0.6889 - accuracy:
0.5356 - val_loss: 0.6917 - val_accuracy: 0.5256
Epoch 29/100
79/79 [==============================] - 1s 12ms/step - loss: 0.6880 - accuracy:
0.5376 - val_loss: 0.6807 - val_accuracy: 0.5800
Epoch 30/100
79/79 [==============================] - 1s 12ms/step - loss: 0.6825 - accuracy:
0.5532 - val_loss: 0.6733 - val_accuracy: 0.5936
Epoch 31/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6685 - accuracy: 0.
5844 - val_loss: 0.6629 - val_accuracy: 0.6288
Epoch 32/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6652 - accuracy: 0.
5980 - val_loss: 0.6835 - val_accuracy: 0.5364
Epoch 33/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6583 - accuracy: 0.
6180 - val_loss: 0.6550 - val_accuracy: 0.6488
Epoch 34/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6368 - accuracy: 0.
6596 - val_loss: 0.6182 - val_accuracy: 0.6828
Epoch 35/100
79/79 [==============================] - 1s 9ms/step - loss: 0.6917 - accuracy: 0.
6076 - val_loss: 0.6722 - val_accuracy: 0.5720
Epoch 36/100
79/79 [==============================] - 1s 8ms/step - loss: 0.6299 - accuracy: 0.
6656 - val_loss: 0.5912 - val_accuracy: 0.7240
Epoch 37/100
79/79 [==============================] - 1s 10ms/step - loss: 0.5824 - accuracy:
0.7332 - val_loss: 0.5506 - val_accuracy: 0.7536
Epoch 38/100
```

```
79/79 [==============================] - 1s 9ms/step - loss: 0.5418 - accuracy: 0.
7624 - val_loss: 0.5251 - val_accuracy: 0.7672
Epoch 39/100
79/79 [==============================] - 1s 10ms/step - loss: 0.5239 - accuracy:
0.7632 - val_loss: 0.4996 - val_accuracy: 0.7816
Epoch 40/100
79/79 [==============================] - 1s 8ms/step - loss: 0.4919 - accuracy: 0.
7820 - val_loss: 0.4843 - val_accuracy: 0.7832
Epoch 41/100
79/79 [==============================] - 1s 8ms/step - loss: 0.4675 - accuracy: 0.
7948 - val_loss: 0.4546 - val_accuracy: 0.8044
Epoch 42/100
79/79 [==============================] - 1s 9ms/step - loss: 0.4526 - accuracy: 0.
8060 - val_loss: 0.4382 - val_accuracy: 0.8172
Epoch 43/100
79/79 [==============================] - 1s 8ms/step - loss: 0.4239 - accuracy: 0.
8316 - val_loss: 0.4094 - val_accuracy: 0.8288
Epoch 44/100
79/79 [==============================] - 1s 8ms/step - loss: 0.4081 - accuracy: 0.
8280 - val_loss: 0.3887 - val_accuracy: 0.8436
Epoch 45/100
79/79 [==============================] - 1s 9ms/step - loss: 0.3929 - accuracy: 0.
8468 - val_loss: 0.3681 - val_accuracy: 0.8504
Epoch 46/100
79/79 [==============================] - 1s 12ms/step - loss: 0.4122 - accuracy:
0.8300 - val_loss: 0.4088 - val_accuracy: 0.8268
Epoch 47/100
79/79 [==============================] - 1s 12ms/step - loss: 0.3879 - accuracy:
0.8452 - val_loss: 0.3700 - val_accuracy: 0.8508
Epoch 48/100
79/79 [==============================] - 1s 10ms/step - loss: 0.3586 - accuracy:
0.8640 - val_loss: 0.3327 - val_accuracy: 0.8608
Epoch 49/100
79/79 [==============================] - 1s 9ms/step - loss: 0.3327 - accuracy: 0.
8764 - val_loss: 0.3169 - val_accuracy: 0.8824
Epoch 50/100
79/79 [==============================] - 1s 10ms/step - loss: 0.4150 - accuracy:
0.8220 - val_loss: 0.3685 - val_accuracy: 0.8460
Epoch 51/100
79/79 [==============================] - 1s 8ms/step - loss: 0.3754 - accuracy: 0.
8464 - val_loss: 0.3675 - val_accuracy: 0.8492
Epoch 52/100
79/79 [==============================] - 1s 8ms/step - loss: 0.3778 - accuracy: 0.
8488 - val_loss: 0.3513 - val_accuracy: 0.8612
Epoch 53/100
79/79 [==============================] - 1s 10ms/step - loss: 0.4153 - accuracy:
0.8244 - val_loss: 0.3784 - val_accuracy: 0.8504
Epoch 54/100
79/79 [==============================] - 1s 8ms/step - loss: 0.3872 - accuracy: 0.
8516 - val_loss: 0.4993 - val_accuracy: 0.7888
Epoch 55/100
79/79 [==============================] - 1s 8ms/step - loss: 0.4560 - accuracy: 0.
7968 - val_loss: 0.4393 - val_accuracy: 0.8088
Epoch 56/100
79/79 [==============================] - 1s 9ms/step - loss: 0.4219 - accuracy: 0.
8176 - val_loss: 0.4092 - val_accuracy: 0.8328
```

```
Epoch 57/100
79/79 [==============================] - 1s 8ms/step - loss: 0.3894 - accuracy: 0.
8420 - val_loss: 0.3728 - val_accuracy: 0.8492
Epoch 58/100
79/79 [==============================] - 1s 10ms/step - loss: 0.3614 - accuracy:
0.8572 - val_loss: 0.3511 - val_accuracy: 0.8636
Epoch 59/100
79/79 [==============================] - 1s 8ms/step - loss: 0.3450 - accuracy: 0.
8668 - val_loss: 0.3238 - val_accuracy: 0.8720
Epoch 60/100
79/79 [==============================] - 1s 10ms/step - loss: 0.3256 - accuracy:
0.8752 - val_loss: 0.3114 - val_accuracy: 0.8796
Epoch 61/100
79/79 [==============================] - 1s 8ms/step - loss: 0.3625 - accuracy: 0.
8600 - val_loss: 0.3585 - val_accuracy: 0.8540
Epoch 62/100
79/79 [==============================] - 1s 9ms/step - loss: 0.3353 - accuracy: 0.
8664 - val_loss: 0.3037 - val_accuracy: 0.8876
Epoch 63/100
79/79 [==============================] - 1s 12ms/step - loss: 0.3180 - accuracy:
0.8788 - val_loss: 0.3326 - val_accuracy: 0.8696
Epoch 64/100
79/79 [==============================] - 1s 12ms/step - loss: 0.3620 - accuracy:
0.8456 - val_loss: 0.3443 - val_accuracy: 0.8468
Epoch 65/100
79/79 [==============================] - 1s 10ms/step - loss: 0.3529 - accuracy:
0.8416 - val_loss: 0.3269 - val_accuracy: 0.8628
Epoch 66/100
79/79 [==============================] - 1s 9ms/step - loss: 0.3207 - accuracy: 0.
8664 - val_loss: 0.3011 - val_accuracy: 0.8848
Epoch 67/100
79/79 [==============================] - 1s 9ms/step - loss: 0.3009 - accuracy: 0.
8840 - val_loss: 0.2961 - val_accuracy: 0.8896
Epoch 68/100
79/79 [==============================] - 1s 9ms/step - loss: 0.3022 - accuracy: 0.
8836 - val_loss: 0.2858 - val_accuracy: 0.8904
Epoch 69/100
79/79 [==============================] - 1s 8ms/step - loss: 0.3002 - accuracy: 0.
8844 - val_loss: 0.2792 - val_accuracy: 0.8956
Epoch 70/100
79/79 [==============================] - 1s 9ms/step - loss: 0.2778 - accuracy: 0.
8936 - val_loss: 0.2796 - val_accuracy: 0.8952
Epoch 71/100
79/79 [==============================] - 1s 8ms/step - loss: 0.2884 - accuracy: 0.
8920 - val_loss: 0.2773 - val_accuracy: 0.8884
Epoch 72/100
79/79 [==============================] - 1s 8ms/step - loss: 0.2731 - accuracy: 0.
8960 - val_loss: 0.2701 - val_accuracy: 0.8980
Epoch 73/100
79/79 [==============================] - 1s 8ms/step - loss: 0.2765 - accuracy: 0.
8944 - val_loss: 0.2576 - val_accuracy: 0.9000
Epoch 74/100
79/79 [==============================] - 1s 8ms/step - loss: 0.2543 - accuracy: 0.
9032 - val_loss: 0.2524 - val_accuracy: 0.9052
Epoch 75/100
79/79 [==============================] - 1s 10ms/step - loss: 0.2465 - accuracy:
```

```
0.9056 - val_loss: 0.2437 - val_accuracy: 0.9028
Epoch 76/100
79/79 [==============================] - 1s 8ms/step - loss: 0.2378 - accuracy: 0.
9052 - val_loss: 0.2365 - val_accuracy: 0.9068
Epoch 77/100
79/79 [==============================] - 1s 8ms/step - loss: 0.2639 - accuracy: 0.
8980 - val_loss: 0.2492 - val_accuracy: 0.9072
Epoch 78/100
79/79 [==============================] - 1s 8ms/step - loss: 0.2476 - accuracy: 0.
9028 - val_loss: 0.2353 - val_accuracy: 0.9044
Epoch 79/100
79/79 [==============================] - 1s 8ms/step - loss: 0.2394 - accuracy: 0.
9060 - val_loss: 0.2259 - val_accuracy: 0.9108
Epoch 80/100
79/79 [==============================] - 1s 11ms/step - loss: 0.2490 - accuracy:
0.8940 - val_loss: 0.2454 - val_accuracy: 0.8964
Epoch 81/100
79/79 [==============================] - 1s 12ms/step - loss: 0.2343 - accuracy:
0.9060 - val_loss: 0.2302 - val_accuracy: 0.9068
Epoch 82/100
79/79 [==============================] - 1s 11ms/step - loss: 0.2301 - accuracy:
0.9144 - val_loss: 0.2357 - val_accuracy: 0.9060
Epoch 83/100
79/79 [==============================] - 1s 10ms/step - loss: 0.2310 - accuracy:
0.9088 - val_loss: 0.3819 - val_accuracy: 0.8564
Epoch 84/100
79/79 [==============================] - 1s 8ms/step - loss: 0.4538 - accuracy: 0.
8012 - val_loss: 0.3723 - val_accuracy: 0.8364
Epoch 85/100
79/79 [==============================] - 1s 10ms/step - loss: 0.3234 - accuracy:
0.8568 - val_loss: 0.3054 - val_accuracy: 0.8692
Epoch 86/100
79/79 [==============================] - 1s 10ms/step - loss: 0.2792 - accuracy:
0.8900 - val_loss: 0.2792 - val_accuracy: 0.8832
Epoch 87/100
79/79 [==============================] - 1s 8ms/step - loss: 0.2586 - accuracy: 0.
9016 - val_loss: 0.2652 - val_accuracy: 0.8924
Epoch 88/100
79/79 [==============================] - 1s 8ms/step - loss: 0.2492 - accuracy: 0.
9024 - val_loss: 0.2596 - val_accuracy: 0.9020
Epoch 89/100
79/79 [==============================] - 1s 8ms/step - loss: 0.2358 - accuracy: 0.
9084 - val_loss: 0.2387 - val_accuracy: 0.9084
Epoch 90/100
79/79 [==============================] - 1s 8ms/step - loss: 0.2286 - accuracy: 0.
9104 - val_loss: 0.2350 - val_accuracy: 0.9084
Epoch 91/100
79/79 [==============================] - 1s 10ms/step - loss: 0.2241 - accuracy:
0.9148 - val_loss: 0.2306 - val_accuracy: 0.9116
Epoch 92/100
79/79 [==============================] - 1s 10ms/step - loss: 0.2232 - accuracy:
0.9124 - val_loss: 0.2281 - val_accuracy: 0.9100
Epoch 93/100
79/79 [==============================] - 1s 10ms/step - loss: 0.2210 - accuracy:
0.9128 - val_loss: 0.2258 - val_accuracy: 0.9116
Epoch 94/100
```

```
79/79 [==============================] - 1s 10ms/step - loss: 0.2169 - accuracy:
0.9164 - val_loss: 0.2235 - val_accuracy: 0.9156
Epoch 95/100
79/79 [==============================] - 1s 8ms/step - loss: 0.2132 - accuracy: 0.
9156 - val_loss: 0.2226 - val_accuracy: 0.9124
Epoch 96/100
79/79 [==============================] - 1s 9ms/step - loss: 0.2106 - accuracy: 0.
9176 - val_loss: 0.2184 - val_accuracy: 0.9176
Epoch 97/100
79/79 [==============================] - 1s 12ms/step - loss: 0.2088 - accuracy:
0.9212 - val_loss: 0.2174 - val_accuracy: 0.9184
Epoch 98/100
79/79 [==============================] - 1s 11ms/step - loss: 0.2113 - accuracy:
0.9188 - val_loss: 0.2141 - val_accuracy: 0.9192
Epoch 99/100
79/79 [==============================] - 1s 11ms/step - loss: 0.2050 - accuracy:
0.9192 - val_loss: 0.2112 - val_accuracy: 0.9192
Epoch 100/100
79/79 [==============================] - 1s 8ms/step - loss: 0.2063 - accuracy: 0.
9212 - val_loss: 0.2133 - val_accuracy: 0.9204
```
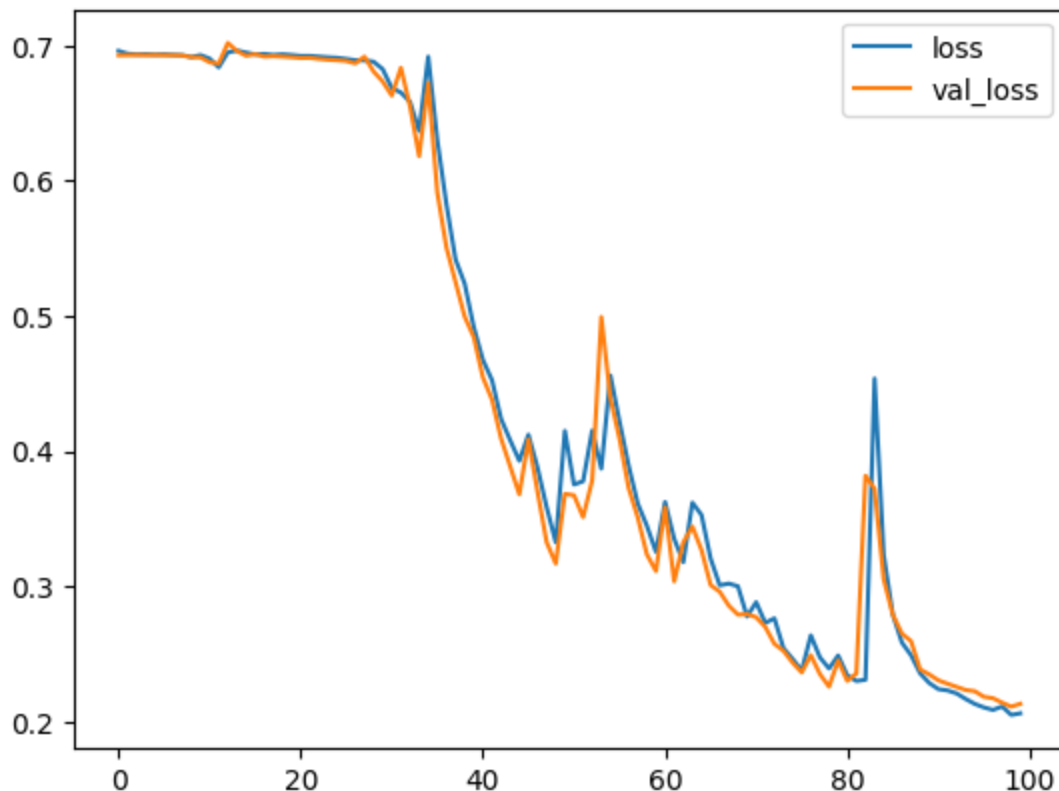
In [33]:
```python
# Plot the loss
plt.plot(r.history['loss'], label='loss')
plt.plot(r.history['val_loss'], label='val_loss')
plt.legend()
```

Out[33]: <matplotlib.legend.Legend at 0x7f8bce312a10>

In [34]:
```python
# Plot the accuracy too
plt.plot(r.history['accuracy'], label='acc')
```

```
plt.plot(r.history['val_accuracy'], label='val_acc')
plt.legend()
```

Out[34]: <matplotlib.legend.Legend at 0x7f8bce3a3100>