ex13

September 17, 2024

[16]:
```
import tensorflow as tf
from tensorflow.keras import layers, models
from tensorflow.keras.datasets import mnist
from tensorflow.keras.utils import to_categorical
```

[17]:
```
(train_images, train_labels), (test_images, test_labels) = mnist.load_data()

train_images = train_images.reshape((60000, 28 * 28)).astype('float32') / 255
test_images = test_images.reshape((10000, 28 * 28)).astype('float32') / 255

train_labels = to_categorical(train_labels)
test_labels = to_categorical(test_labels)
```

[18]:
```
model = models.Sequential()
model.add(layers.Dense(512, activation='relu', input_shape=(28 * 28,)))
model.add(layers.Dense(10, activation='softmax'))

model.compile(optimizer='rmsprop', loss='categorical_crossentropy',␣
 ↪metrics=['accuracy'])

model.fit(train_images, train_labels, epochs=20, batch_size=500)
```

```
Epoch 1/20
120/120 [==============================] - 1s 5ms/step - loss: 0.4185 -
accuracy: 0.8821
Epoch 2/20
120/120 [==============================] - 1s 5ms/step - loss: 0.1874 -
accuracy: 0.9462
Epoch 3/20
120/120 [==============================] - 1s 5ms/step - loss: 0.1297 -
accuracy: 0.9632
Epoch 4/20
120/120 [==============================] - 1s 5ms/step - loss: 0.0989 -
accuracy: 0.9721
Epoch 5/20
120/120 [==============================] - 1s 5ms/step - loss: 0.0786 -
accuracy: 0.9781
Epoch 6/20
```

```
120/120 [==============================] - 1s 5ms/step - loss: 0.0652 -
accuracy: 0.9815
Epoch 7/20
120/120 [==============================] - 1s 5ms/step - loss: 0.0543 -
accuracy: 0.9849
Epoch 8/20
120/120 [==============================] - 1s 5ms/step - loss: 0.0454 -
accuracy: 0.9877
Epoch 9/20
120/120 [==============================] - 1s 5ms/step - loss: 0.0390 -
accuracy: 0.9894
Epoch 10/20
120/120 [==============================] - 1s 5ms/step - loss: 0.0327 -
accuracy: 0.9915
Epoch 11/20
120/120 [==============================] - 1s 5ms/step - loss: 0.0283 -
accuracy: 0.9924
Epoch 12/20
120/120 [==============================] - 1s 5ms/step - loss: 0.0241 -
accuracy: 0.9944
Epoch 13/20
120/120 [==============================] - 1s 5ms/step - loss: 0.0202 -
accuracy: 0.9954
Epoch 14/20
120/120 [==============================] - 1s 5ms/step - loss: 0.0178 -
accuracy: 0.9961
Epoch 15/20
120/120 [==============================] - 1s 6ms/step - loss: 0.0147 -
accuracy: 0.9971
Epoch 16/20
120/120 [==============================] - 1s 6ms/step - loss: 0.0124 -
accuracy: 0.9980
Epoch 17/20
120/120 [==============================] - 1s 6ms/step - loss: 0.0107 -
accuracy: 0.9983
Epoch 18/20
120/120 [==============================] - 1s 6ms/step - loss: 0.0092 -
accuracy: 0.9987
Epoch 19/20
120/120 [==============================] - 1s 6ms/step - loss: 0.0076 -
accuracy: 0.9991
Epoch 20/20
120/120 [==============================] - 1s 6ms/step - loss: 0.0065 -
accuracy: 0.9992
```

[18]: <keras.src.callbacks.History at 0x14e83d68150>

[19]:
```
test_loss, test_acc = model.evaluate(test_images, test_labels)
print("Test accuracy:", test_acc)

train_loss, train_acc = model.evaluate(train_images, train_labels)
print("Train accuracy:", train_acc)
```

```
313/313 [==============================] - 1s 2ms/step - loss: 0.0554 -
accuracy: 0.9828
Test accuracy: 0.9828000068664551
1875/1875 [==============================] - 3s 2ms/step - loss: 0.0049 -
accuracy: 0.9998
Train accuracy: 0.999750018119812
```