CNN ORG Mode

Jesus Sierralaya

April 11, 2024

Contents

1 Load libraries

```python
import os; os.environ['TF_CPP_MIN_LOG_LEVEL'] = '2'
import matplotlib.pyplot as plt
import numpy as np
import keras
from keras import layers
import tensorflow as tf
import argparse
from sklearn.preprocessing import LabelBinarizer
from keras.datasets import mnist
```

2 Set parameters

```python
num_classes = 10
input_shape = (28, 28, 1)
```

3 Pre-process

```python
(x_train, y_train), (x_test, y_test) = keras.datasets.mnist.load_data()

x_train = x_train.astype("float32") / 255
x_test = x_test.astype("float32") / 255

x_train = np.expand_dims(x_train, -1)
x_test = np.expand_dims(x_test, -1)
print("x_train shape:", x_train.shape)
print(x_train.shape[0], "train samples")
print(x_test.shape[0], "test samples")

label_binarizer = LabelBinarizer()
y_train = label_binarizer.fit_transform(y_train)
y_test = label_binarizer.fit_transform(y_test)
```

```
x_train shape: (60000, 28, 28, 1)
60000 train samples
10000 test samples
```

4 Create the model

```python
model = keras.Sequential(
    [
        keras.Input(shape=input_shape),
        layers.Conv2D(32, kernel_size=(3, 3), activation="relu"),
        layers.MaxPooling2D(pool_size=(2, 2)),
        layers.Conv2D(64, kernel_size=(3, 3), activation="relu"),
        layers.MaxPooling2D(pool_size=(2, 2)),
        layers.Flatten(),
        layers.Dropout(0.5),
        layers.Dense(num_classes, activation="softmax"),
    ]
)

model.summary()
```

```
Model: "sequential_3"
_________________________________________________________________
 Layer (type)                Output Shape              Param #   
=================================================================
 conv2d_6 (Conv2D)           (None, 26, 26, 32)        320       
                                                                 
 max_pooling2d_6 (MaxPoolin  (None, 13, 13, 32)        0         
 g2D)                                                            
                                                                 
 conv2d_7 (Conv2D)           (None, 11, 11, 64)        18496     
                                                                 
 max_pooling2d_7 (MaxPoolin  (None, 5, 5, 64)          0         
 g2D)                                                            
                                                                 
 flatten_3 (Flatten)         (None, 1600)              0         
                                                                 
 dropout_3 (Dropout)         (None, 1600)              0         
                                                                 
 dense_3 (Dense)             (None, 10)                16010     
                                                                 
=================================================================
Total params: 34826 (136.04 KB)
Trainable params: 34826 (136.04 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

5 Set the parameters, compile and train the model

```
batch_size = 128
epochs = 10

model.compile(loss="categorical_crossentropy", optimizer="adam", metrics=["accuracy"])

history = model.fit(x_train, y_train, batch_size=batch_size, epochs=epochs, validation_split=0.1, verbose = False)
```

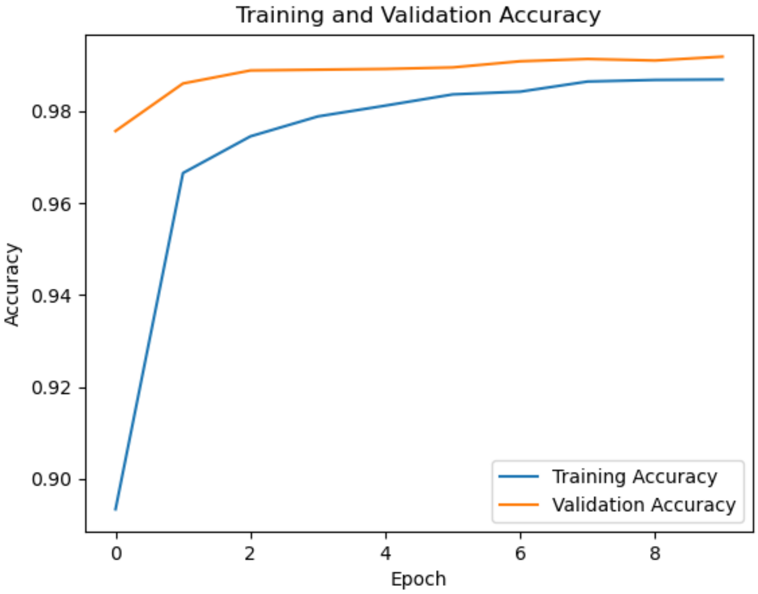
6 Evaluate the performance of the trained model

```
test_loss, test_accuracy = model.evaluate(x_test, y_test, verbose=2)
print(f"Test accuracy: {test_accuracy * 100:.2f}%")
f"{test_accuracy * 100:.2f}%"
```

The test accuracy is 98.97%.

7 Learning graph

```
plt.figure()
plt.plot(history.history['accuracy'], label='Training Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.title('Training and Validation Accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()
```


Training and Validation Accuracy
Accuracy
0.90
0.92
0.94
0.96
0.98
Epoch
0
2
4
6
8
Training Accuracy
Validation Accuracy