

手写体识别实验报告

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首先，加载 MNIST 数据集，并归一化，将像素值缩放到 0 到 1 之间，

```
# 加载MNIST数据集
(x_train, y_train), (x_test, y_test) = mnist.load_data()

# 将像素值缩放到0到1之间
x_train, x_test = x_train / 255.0, x_test / 255.0
```

然后增加了一维以适应 CNN 的输入要求。

接着，创建了一个包含三个卷积层、两个池化层和两个全连接层的 CNN 模型。

模型的第一层是一个 32 个过滤器（filters）大小为 3x3 的卷积层，激活函数使用 ReLU。接下来的池化层将图像的大小减半。然后再加上一个 64 个过滤器大小为 3x3 的卷积层，接着还有一个池化层。最后是一个 64 个过滤器大小为 3x3 的卷积层，然后通过 Flatten()函数将二维特征图变为一维向量，接着连接两个全连接层。

```
# 创建CNN模型
model = tf.keras.Sequential([
    layers.Conv2D(32, (3, 3), activation='relu', input_shape=(28, 28, 1)),
    layers.MaxPooling2D((2, 2)),
    layers.Conv2D(64, (3, 3), activation='relu'),
    layers.MaxPooling2D((2, 2)),
    layers.Conv2D(64, (3, 3), activation='relu'),
    layers.Flatten(),
    layers.Dense(64, activation='relu'),
    layers.Dense(10)
])
```

最后，编译模型，使用 adam 优化器和稀疏分类交叉熵损失函数，同时设定评价指标为准确率。对训练数据进行了 5 个 epoch 的训练，使用测试数据评估了模型的性能，输出了测试集的准确率。

```
# 编译模型
model.compile(optimizer='adam',
              loss=tf.keras.losses.SparseCategoricalCrossentropy(from_logits=True),
              metrics=['accuracy'])

# 训练模型
model.fit(x_train, y_train, epochs=5, validation_data=(x_test, y_test))

# 评估模型
test_loss, test_acc = model.evaluate(x_test, y_test, verbose=2)
print('\nTest accuracy:', test_acc)
```

最终结果如下，accuracy 为 99.22%，可能是因为过拟合了。

```
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags:
2023-03-20 20:48:15.695414: I tensorflow/core/util/port.cc:104] oneDNN custom operations are on. You may see slightly different numerical results due to floating-point round-off errors from different computation orders. To turn them off, set the environment variable 'TF_ENABLE_ONEDNN_OPTS=0'.
2023-03-20 20:48:15.699223: W tensorflow/compiler/xla/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libcuda.so.11.0'; dlerror: libcuda.so.11.0: cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /root/.miniconda3/pkgs/cudatoolkit-11.0-0
2023-03-20 20:48:15.699558: I tensorflow/compiler/xla/stream_executor/cuda/cudart_stub.cc:29] Ignore above cudart dlerror if you do not have a GPU set up on your machine.
2023-03-20 20:48:16.188451: W tensorflow/compiler/xla/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libnvinfer.so.7'; dlerror: libnvinfer.so.7: cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /root/.miniconda3/pkgs/cudatoolkit-11.0-0
2023-03-20 20:48:16.189049: W tensorflow/compiler/xla/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libnvinfer_plugin.so.7'; dlerror: libnvinfer_plugin.so.7: cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /root/.miniconda3/pkgs/cudatoolkit-11.0-0
2023-03-20 20:48:16.200050: W tensorflow/compiler/xla/stream_executor/cuda/cuda_apis.cc:58] [TF-WARNING] Cannot dlopen some TensorFlow libraries. If you would like to use Windows GPU with TensorFlow, please make sure the missing libraries mentioned above are installed properly.
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/mnist.zip:
11808034/11808034 [=====] - 16.0us/step
2023-03-20 20:48:16.714529: I tensorflow/compiler/xla/stream_executor/cuda/cuda_gpu_executor.cc:811] successful NvML node read from SysFS had negative value (-1), but there must be at least one NvML node, so returning NvML node zero
2023-03-20 20:48:16.715013: I tensorflow/compiler/xla/stream_executor/cuda/cuda_gpu_executor.cc:811] successful NvML node read from SysFS had negative value (-1), but there must be at least one NvML node, so returning NvML node zero
2023-03-20 20:48:16.715527: W tensorflow/compiler/xla/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libcuda.so.11.0'; dlerror: libcuda.so.11.0: cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /root/.miniconda3/pkgs/cudatoolkit-11.0-0
2023-03-20 20:48:16.715644: W tensorflow/compiler/xla/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libcuda.so.11'; dlerror: libcuda.so.11: cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /root/.miniconda3/pkgs/cudatoolkit-11.0-0
2023-03-20 20:48:16.715715: W tensorflow/compiler/xla/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libcuda.so.11'; dlerror: libcuda.so.11: cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /root/.miniconda3/pkgs/cudatoolkit-11.0-0
2023-03-20 20:48:16.717095: W tensorflow/compiler/xla/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libnvrtc.so.11'; dlerror: libnvrtc.so.11: cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /root/.miniconda3/pkgs/cudatoolkit-11.0-0
2023-03-20 20:48:16.717691: W tensorflow/compiler/xla/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libnvidia-ml.so.11'; dlerror: libnvidia-ml.so.11: cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /root/.miniconda3/pkgs/cudatoolkit-11.0-0
2023-03-20 20:48:16.717789: W tensorflow/compiler/xla/stream_executor/cuda/cuda_apis.cc:58] [TF-WARNING] Cannot dlopen some TensorFlow libraries. Please make sure the missing libraries mentioned above are installed properly if you would like to use GPU. Follow the guide at https://www.tensorflow.org/install/gpu for how the required libraries for your platform.
Adapting configuration for your platform.
2023-03-20 20:48:16.718079: I tensorflow/compiler/xla/feature_guard.cc:153] This TensorFlow binary is optimized with oneAPI Deep Neural Network Library (oneDNN) to use the following CPU instructions in performance-critical operations: AVX2 AVX512F AVX512_VNNI FMA
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.
Epoch 1/5
1675/1875 [=====] - 13s 6ms/step - loss: 0.1462 - accuracy: 0.8548 - val_loss: 0.8457 - val_accuracy: 0.8846
Epoch 2/5
1675/1875 [=====] - 11s 6ms/step - loss: 0.8472 - accuracy: 0.2851 - val_loss: 0.8309 - val_accuracy: 0.8686
Epoch 3/5
1675/1875 [=====] - 13s 7ms/step - loss: 0.8504 - accuracy: 0.8895 - val_loss: 0.8304 - val_accuracy: 0.9089
Epoch 4/5
1675/1875 [=====] - 11s 6ms/step - loss: 0.8246 - accuracy: 0.9922 - val_loss: 0.8357 - val_accuracy: 0.8691
Epoch 5/5
1675/1875 [=====] - 12s 7ms/step - loss: 0.8204 - accuracy: 0.9916 - val_loss: 0.8246 - val_accuracy: 0.9922
317/317 - 1s - loss: 0.8246 - accuracy: 0.9922 - 1s/epoch - 4ms/step
Test accuracy: 0.9922000169754028
```