PradipKumarDas /
Teaching

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PradipKumarDas Notebooks for subject Deep Learning [21AML171] were renamed according...

e55b76b · 3 months ago

381 lines (381 loc) · 11.7 KB

Preview Code Blame Raw

Convolutional Neural Networks

Practical 1

Building a Convolutional Neural Network (CNN) from Scratch on MNIST dataset.

NOTE: This notebook is recommended to run on GPU to save time during model training.

In [22]:

```
# Imports required packages

import numpy as np
import tensorflow as tf
from tensorflow.keras.datasets import mnist
```

In [8]:

```
# Loads MNIST dataset
# NOTE: Downloading for the first time may take few minutes to complete

mnist = tf.keras.datasets.mnist.load_data()
```

```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-data
sets/mnist.npz
11490434/11490434 [==============================] - 3s 0us/step
```

In [10]:

```
# Considering dataset is organized in tuple, items are referenced as follow
(X_train_full, y_train_full), (X_test, y_test) = mnist
```

In [12]:

```
# Checks the shape of the datasets

print("Full training set shape:", X_train_full.shape)
print("Test set shape:", X_test.shape)
```

```
Full training set shape: (60000, 28, 28)
Test set shape: (10000, 28, 28)
```

In [14]:

```
# Normalizes the data between 0 and 1 for effective neural network model tr
X_train_full = X_train_full / 255.
X_test = X_test / 255.
```

In [16]:

```
# Splits train dataset further to seperate 5000 instances to be used as val

X_train, X_val = X_train_full[:-5000], X_train_full[-5000:]
y_train, y_val = y_train_full[:-5000], y_train_full[-5000:]
```

In [24]:

```
# To match the input shape of the CNN model, a channel dimention gets added
```

```
X_train = X_train[..., np.newaxis]
X_val = X_val[..., np.newaxis]
X_test = X_test[..., np.newaxis]
```

In [26]:

```
# Checks for the updated shape
X_train.shape
```

Out[26]:

```
(55000, 28, 28, 1)
```

In [28]:

```
# Creates CNN model by having convoluted, pooling, dropout and dense layer
# Each convoluted layer is further initialized with specific kernel size, p

tf.random.set_seed(42)

model = tf.keras.Sequential([
    tf.keras.layers.Conv2D(32, kernel_size=3, padding="same", activation="r
    tf.keras.layers.Conv2D(64, kernel_size=3, padding="same", activation="r
    tf.keras.layers.MaxPool2D(),
    tf.keras.layers.Flatten(),
    tf.keras.layers.Dropout(0.25),
    tf.keras.layers.Dense(128, activation="relu", kernel_initializer="he_nc
    tf.keras.layers.Dropout(0.5),
    tf.keras.layers.Dense(10, activation="softmax")
])

model.compile(loss="sparse_categorical_crossentropy", optimizer="nadam", me
```

```
2024-08-28 10:29:00.610493: I tensorflow/core/common_runtime/process_util.cc:
146] Creating new thread pool with default inter op setting: 2. Tune using in
ter_op_parallelism_threads for best performance.
```

In [30]:

```
# Fits the model.
model.fit(X_train, y_train, epochs=10, validation_data=(X_val, y_val))
```

```
Epoch 1/10
1719/1719 [==============================] - 516s 300ms/step - loss: 0.1911 -
accuracy: 0.9420 - val_loss: 0.0433 - val_accuracy: 0.9878
Epoch 2/10
1719/1719 [==============================] - 514s 299ms/step - loss: 0.0795 -
accuracy: 0.9751 - val_loss: 0.0449 - val_accuracy: 0.9868
Epoch 3/10
1719/1719 [==============================] - 512s 298ms/step - loss: 0.0601 -
accuracy: 0.9819 - val_loss: 0.0329 - val_accuracy: 0.9922
Epoch 4/10
1719/1719 [==============================] - 493s 287ms/step - loss: 0.0477 -
accuracy: 0.9851 - val_loss: 0.0364 - val_accuracy: 0.9902
Epoch 5/10
1719/1719 [==============================] - 487s 283ms/step - loss: 0.0408 -
accuracy: 0.9871 - val_loss: 0.0325 - val_accuracy: 0.9916
Epoch 6/10
1719/1719 [==============================] - 478s 278ms/step - loss: 0.0344 -
accuracy: 0.9892 - val_loss: 0.0450 - val_accuracy: 0.9906
Epoch 7/10
1719/1719 [==============================] - 511s 297ms/step - loss: 0.0297 -
accuracy: 0.9907 - val_loss: 0.0370 - val_accuracy: 0.9920
Epoch 8/10
1719/1719 [==============================] - 494s 287ms/step - loss: 0.0282 -
accuracy: 0.9910 - val_loss: 0.0361 - val_accuracy: 0.9914
Epoch 9/10
Epoch 9/10
1719/1719 [==============================] - 518s 302ms/step - loss: 0.0249 -
accuracy: 0.9922 - val_loss: 0.0403 - val_accuracy: 0.9932
Epoch 10/10
1719/1719 [==============================] - 533s 310ms/step - loss: 0.0235 -
accuracy: 0.9925 - val_loss: 0.0370 - val_accuracy: 0.9920
```

Out[30]: `<keras.callbacks.History at 0x7a43d43eacd0>`

In [49]:

```
# Saves the trained model for later reference
# NOTE: Make sure the folder "models" exists under the current working dire

model.save("./models/my_mnist_cnn_model.keras")
```

```
2024-08-28 11:53:42.973180: I tensorflow/core/common_runtime/executor.cc:119
7] [/device:CPU:0] (DEBUG INFO) Executor start aborting (this does not indica
te an error and you can ignore this message): INVALID_ARGUMENT: You must feed
a value for placeholder tensor 'inputs' with dtype float and shape [?,12544]
         [[{{node inputs}}]]
2024-08-28 11:53:42.980319: I tensorflow/core/common_runtime/executor.cc:119
7] [/device:CPU:0] (DEBUG INFO) Executor start aborting (this does not indica
te an error and you can ignore this message): INVALID_ARGUMENT: You must feed
a value for placeholder tensor 'inputs' with dtype float and shape [?,128]
         [[{{node inputs}}]]
2024-08-28 11:53:43.100294: I tensorflow/core/common_runtime/executor.cc:119
7] [/device:CPU:0] (DEBUG INFO) Executor start aborting (this does not indica
te an error and you can ignore this message): INVALID_ARGUMENT: You must feed
a value for placeholder tensor 'inputs' with dtype float and shape [?,12544]
         [[{{node inputs}}]]
2024-08-28 11:53:43.117217: I tensorflow/core/common_runtime/executor.cc:119
7] [/device:CPU:0] (DEBUG INFO) Executor start aborting (this does not indica
te an error and you can ignore this message): INVALID_ARGUMENT: You must feed
a value for placeholder tensor 'inputs' with dtype float and shape [?,128]
         [[{{node inputs}}]]
WARNING:absl:Found untraced functions such as _jit_compiled_convolution_op, _
jit_compiled_convolution_op, _update_step_xla while saving (showing 3 of 3).
These functions will not be directly callable after loading.
INFO:tensorflow:Assets written to: ./models/my_mnist_cnn_model/assets
```