sgd-cnn-notes

February 25, 2024

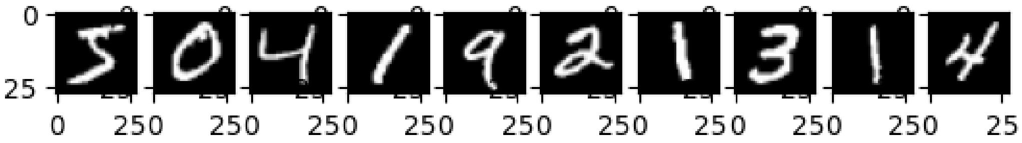
[ ]:

```
from tensorflow import keras
from keras.datasets import mnist

(x_train, y_train), (x_test, y_test) = mnist.load_data()

# print out first 10 images in our training data
imgplot = show_images(x_train[0:10])

# check the size of our dataset
print("number of training images:",x_train.shape[0])
print("number of test images:",y_test.shape[0])
```



```
number of training images: 60000
number of test images: 10000
```

[ ]:

```
import numpy as np
# Scale images to the [0, 1] range
x_train = x_train.astype("float32") / 255
x_test = x_test.astype("float32") / 255
# Make sure images have shape (28, 28, 1)
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")
```

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

[ ]:

```
from tensorflow.keras import layers

num_classes = 10
hidden_dim = 32
# create a Sequential model
model = keras.Sequential(
    [
        keras.Input(shape=(28,28,1)),
        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"),
    ]
)

# print out model structure
model.summary()
```

```
Model: "sequential_1"

_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_2 (Conv2D)           (None, 26, 26, 32)        320

 max_pooling2d_2 (MaxPoolin  (None, 13, 13, 32)        0
 g2D)

 conv2d_3 (Conv2D)           (None, 11, 11, 64)        18496

 max_pooling2d_3 (MaxPoolin  (None, 5, 5, 64)          0
 g2D)

 flatten_1 (Flatten)         (None, 1600)              0

 dense_1 (Dense)             (None, 10)                16010

=================================================================
Total params: 34826 (136.04 KB)
Trainable params: 34826 (136.04 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

[ ]:

```
optimizer = 'adam' # default adam hparams
optimizer = keras.optimizers.Adam(learning_rate=0.001)
```

```python
model.compile(optimizer=optimizer,
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])

batch_size = 32
epochs = 10
import tensorflow as tf
# from tensorflow import Session
config = tf.compat.v1.ConfigProto()
config.gpu_options.allow_growth = True
sess = tf.compat.v1.Session(config=config)

history = model.fit(x_train, y_train,
                    epochs=epochs,
                    validation_split=0.2)
```

```
Epoch 1/10
```

```
2024-02-05 12:48:59.929425: I
external/local_xla/xla/stream_executor/cuda/cuda_executor.cc:901] successful
NUMA node read from SysFS had negative value (-1), but there must be at least
one NUMA node, so returning NUMA node zero. See more at
https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus-
pci#L344-L355
2024-02-05 12:48:59.929523: I
external/local_xla/xla/stream_executor/cuda/cuda_executor.cc:901] successful
NUMA node read from SysFS had negative value (-1), but there must be at least
one NUMA node, so returning NUMA node zero. See more at
https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus-
pci#L344-L355
2024-02-05 12:48:59.929562: I
external/local_xla/xla/stream_executor/cuda/cuda_executor.cc:901] successful
NUMA node read from SysFS had negative value (-1), but there must be at least
one NUMA node, so returning NUMA node zero. See more at
https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus-
pci#L344-L355
2024-02-05 12:48:59.929620: I
external/local_xla/xla/stream_executor/cuda/cuda_executor.cc:901] successful
NUMA node read from SysFS had negative value (-1), but there must be at least
one NUMA node, so returning NUMA node zero. See more at
https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus-
pci#L344-L355
2024-02-05 12:48:59.929658: I
external/local_xla/xla/stream_executor/cuda/cuda_executor.cc:901] successful
NUMA node read from SysFS had negative value (-1), but there must be at least
one NUMA node, so returning NUMA node zero. See more at
https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus-
pci#L344-L355
```

```
2024-02-05 12:48:59.929689: I
tensorflow/core/common_runtime/gpu/gpu_device.cc:1929] Created device
/job:localhost/replica:0/task:0/device:GPU:0 with 1009 MB memory:  -> device: 0,
name: NVIDIA GeForce RTX 3080, pci bus id: 0000:01:00.0, compute capability: 8.6
```

```
1500/1500 [==============================] - 7s 4ms/step - loss: 0.1747 -
accuracy: 0.9458 - val_loss: 0.0780 - val_accuracy: 0.9758
Epoch 2/10
1500/1500 [==============================] - 7s 5ms/step - loss: 0.0586 -
accuracy: 0.9821 - val_loss: 0.0488 - val_accuracy: 0.9858
Epoch 3/10
1500/1500 [==============================] - 6s 4ms/step - loss: 0.0417 -
accuracy: 0.9865 - val_loss: 0.0431 - val_accuracy: 0.9875
Epoch 4/10
1500/1500 [==============================] - 6s 4ms/step - loss: 0.0321 -
accuracy: 0.9898 - val_loss: 0.0440 - val_accuracy: 0.9880
Epoch 5/10
1500/1500 [==============================] - 7s 5ms/step - loss: 0.0258 -
accuracy: 0.9915 - val_loss: 0.0425 - val_accuracy: 0.9880
Epoch 6/10
1500/1500 [==============================] - 6s 4ms/step - loss: 0.0205 -
accuracy: 0.9934 - val_loss: 0.0452 - val_accuracy: 0.9881
Epoch 7/10
1500/1500 [==============================] - 6s 4ms/step - loss: 0.0166 -
accuracy: 0.9946 - val_loss: 0.0487 - val_accuracy: 0.9874
Epoch 8/10
1500/1500 [==============================] - 6s 4ms/step - loss: 0.0131 -
accuracy: 0.9959 - val_loss: 0.0523 - val_accuracy: 0.9864
Epoch 9/10
1500/1500 [==============================] - 6s 4ms/step - loss: 0.0100 -
accuracy: 0.9966 - val_loss: 0.0453 - val_accuracy: 0.9887
Epoch 10/10
1500/1500 [==============================] - 6s 4ms/step - loss: 0.0089 -
accuracy: 0.9971 - val_loss: 0.0510 - val_accuracy: 0.9883
```

[ ]:

```
scores, acc = model.evaluate(x_test, y_test, verbose=0)
print('Test loss:', scores)
print('Test accuracy:', acc)
```

```
Test loss: 0.04213538020849228
Test accuracy: 0.9898999929428101
```

[ ]:

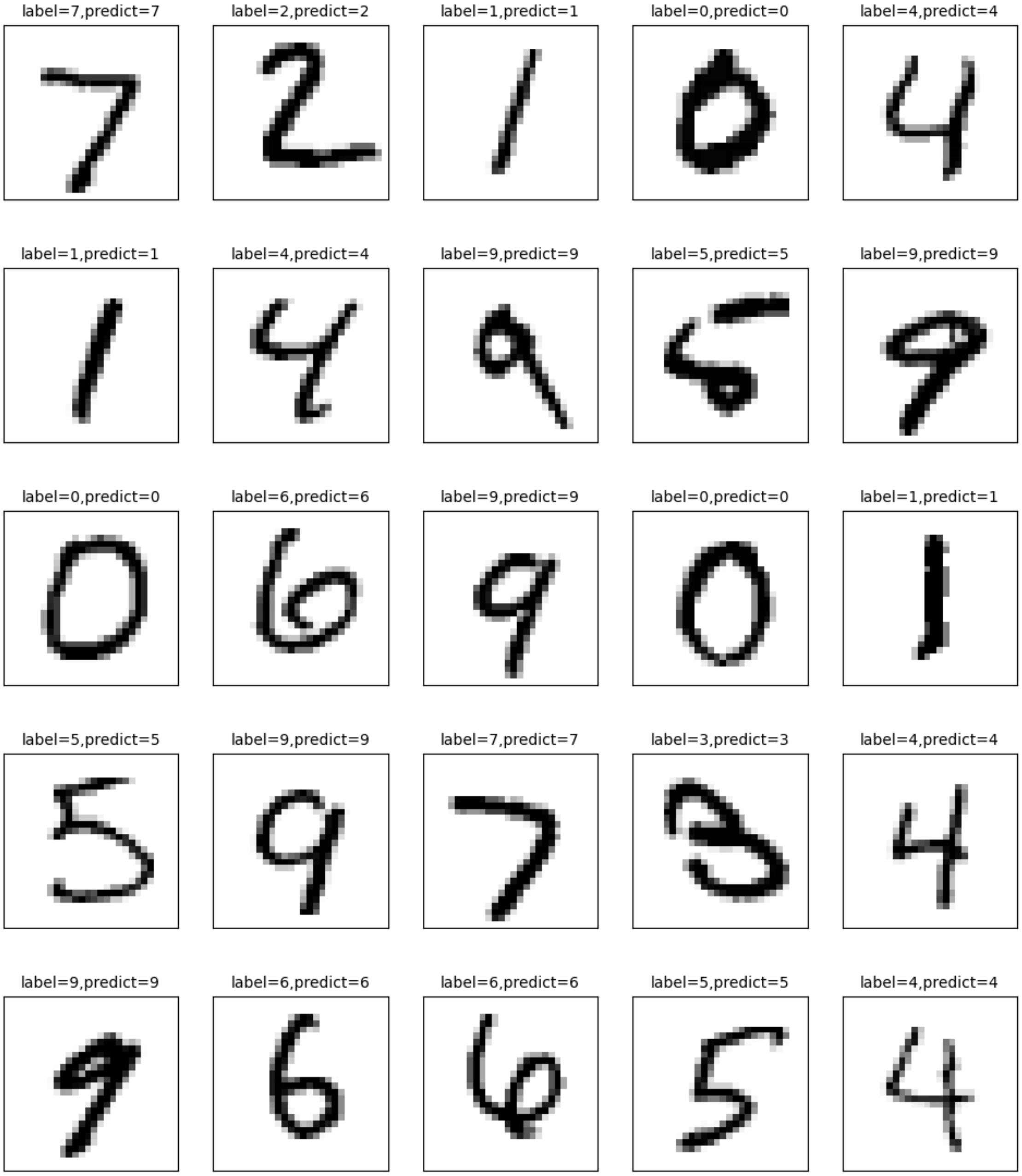
```
import numpy as np


predict_x=model.predict(x_test)
classes_x=np.argmax(predict_x,axis=1)
```

```
i = 0  # start from 0
j = 25 # end at 25

(_, _), (x_test_image, y_test_label) = mnist.load_data()
plot_images_labels_prediction(x_test_image,y_test_label,classes_x,i,j)
```

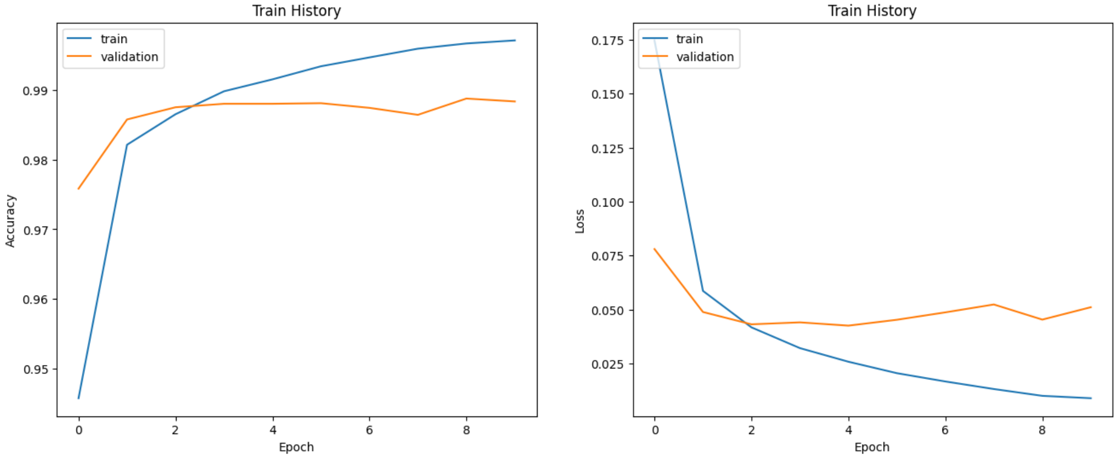
```
313/313 [==============================] - 0s 424us/step
```



[ ]:

```
#show train history
show_train_history(history)
```

```
dict_keys(['loss', 'accuracy', 'val_loss', 'val_accuracy'])
```



[ ]:

```

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