Code:

```
'''Trains a simple deep NN on the MNIST dataset.

Gets to 98.40% test accuracy after 20 epochs
(there is *a lot* of margin for parameter tuning).
2 seconds per epoch on a K520 GPU.
'''


from tensorflow import keras
from tensorflow.keras.datasets import mnist
from tensorflow.keras.layers import Dense, Dropout
from tensorflow.keras.models import Sequential
from tensorflow.keras.optimizers import RMSprop

batch_size = 128
num_classes = 10
epochs = 20

# the data, split between train and test sets
(x_train, y_train), (x_test, y_test) = mnist.load_data()

x_train = x_train.reshape(60000, 784)
x_test = x_test.reshape(10000, 784)
x_train = x_train.astype('float32')
x_test = x_test.astype('float32')
x_train /= 255
x_test /= 255
print(x_train.shape[0], 'train samples')
print(x_test.shape[0], 'test samples')

# convert class vectors to binary class matrices
y_train = keras.utils.to_categorical(y_train, num_classes)
y_test = keras.utils.to_categorical(y_test, num_classes)

model = Sequential()
model.add(Dense(512, activation='relu', input_shape=(784,)))
model.add(Dropout(0.2))
model.add(Dense(512, activation='relu'))
model.add(Dropout(0.2))
model.add(Dense(num_classes, activation='softmax'))

model.summary()

model.compile(loss='categorical_crossentropy',
              optimizer=RMSprop(),
              metrics=['accuracy'])

history = model.fit(x_train, y_train,
                    batch_size=batch_size,
                    epochs=epochs,
                    verbose=1,
                    validation_data=(x_test, y_test))
score = model.evaluate(x_test, y_test, verbose=0)
```

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print('Test loss:', score[0])
print('Test accuracy:', score[1])
```

Output:

C:\Users\vahin\anaconda3\python.exe
C:/Users/vahin/OneDrive/Documents/GitHub/dsc650/examples/mnist_mlp.py

2022-09-04 09:45:44.050794: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'cudart64_110.dll'; dlerror: cudart64_110.dll not found

2022-09-04 09:45:44.051393: I tensorflow/stream_executor/cuda/cudart_stub.cc:29] Ignore above cudart dlerror if you do not have a GPU set up on your machine.

60000 train samples

10000 test samples

2022-09-04 09:45:53.255332: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'nvcuda.dll'; dlerror: nvcuda.dll not found

2022-09-04 09:45:53.256422: W tensorflow/stream_executor/cuda/cuda_driver.cc:269] failed call to cuInit: UNKNOWN ERROR (303)

2022-09-04 09:45:53.270604: I tensorflow/stream_executor/cuda/cuda_diagnostics.cc:169] retrieving CUDA diagnostic information for host: DESKTOP-3040T48

2022-09-04 09:45:53.271355: I tensorflow/stream_executor/cuda/cuda_diagnostics.cc:176] hostname: DESKTOP-3040T48

2022-09-04 09:45:53.280752: I tensorflow/core/platform/cpu_feature_guard.cc:193] This TensorFlow binary is optimized with oneAPI Deep Neural Network Library (oneDNN) to use the following CPU instructions in performance-critical operations: AVX AVX2

To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.

Model: "sequential"

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Layer (type)	Output Shape	Param #
dense (Dense)	(None, 512)	401920
dropout (Dropout)	(None, 512)	0

dense_1 (Dense) (None, 512) 262656

dropout_1 (Dropout) (None, 512) 0

dense_2 (Dense) (None, 10) 5130

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Total params: 669,706

Trainable params: 669,706

Non-trainable params: 0

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Epoch 1/20

469/469 [==============================] - 11s 20ms/step - loss: 0.2500 - accuracy: 0.9235 - val_loss: 0.1037 - val_accuracy: 0.9674

Epoch 2/20

469/469 [==============================] - 9s 19ms/step - loss: 0.1034 - accuracy: 0.9690 - val_loss: 0.0796 - val_accuracy: 0.9761

Epoch 3/20

469/469 [==============================] - 9s 20ms/step - loss: 0.0752 - accuracy: 0.9775 - val_loss: 0.0752 - val_accuracy: 0.9788

Epoch 4/20

469/469 [==============================] - 10s 21ms/step - loss: 0.0613 - accuracy: 0.9814 - val_loss: 0.0815 - val_accuracy: 0.9771

Epoch 5/20

469/469 [==============================] - 9s 18ms/step - loss: 0.0516 - accuracy: 0.9844 - val_loss: 0.0710 - val_accuracy: 0.9812

Epoch 6/20

469/469 [==============================] - 9s 20ms/step - loss: 0.0430 - accuracy: 0.9873 - val_loss: 0.0773 - val_accuracy: 0.9813

Epoch 7/20

469/469 [==============================] - 9s 18ms/step - loss: 0.0385 - accuracy: 0.9884 - val_loss: 0.0770 - val_accuracy: 0.9806

Epoch 8/20

469/469 [==============================] - 10s 20ms/step - loss: 0.0334 - accuracy: 0.9905 - val_loss: 0.0799 - val_accuracy: 0.9828

Epoch 9/20

469/469 [==============================] - 8s 18ms/step - loss: 0.0331 - accuracy: 0.9906 - val_loss: 0.0888 - val_accuracy: 0.9806

Epoch 10/20

469/469 [==============================] - 8s 18ms/step - loss: 0.0290 - accuracy: 0.9915 - val_loss: 0.0851 - val_accuracy: 0.9839

Epoch 11/20

469/469 [==============================] - 8s 18ms/step - loss: 0.0272 - accuracy: 0.9922 - val_loss: 0.0943 - val_accuracy: 0.9824

Epoch 12/20

469/469 [==============================] - 9s 20ms/step - loss: 0.0244 - accuracy: 0.9928 - val_loss: 0.0916 - val_accuracy: 0.9823

Epoch 13/20

469/469 [==============================] - 9s 19ms/step - loss: 0.0234 - accuracy: 0.9934 - val_loss: 0.1014 - val_accuracy: 0.9844

Epoch 14/20

469/469 [==============================] - 9s 18ms/step - loss: 0.0221 - accuracy: 0.9934 - val_loss: 0.1016 - val_accuracy: 0.9830

Epoch 15/20

469/469 [==============================] - 9s 19ms/step - loss: 0.0199 - accuracy: 0.9945 - val_loss: 0.1256 - val_accuracy: 0.9815

Epoch 16/20

469/469 [==============================] - 9s 18ms/step - loss: 0.0207 - accuracy: 0.9941 - val_loss: 0.1002 - val_accuracy: 0.9841

Epoch 17/20

469/469 [==============================] - 9s 20ms/step - loss: 0.0195 - accuracy: 0.9945 - val_loss: 0.1042 - val_accuracy: 0.9839

Epoch 18/20

469/469 [==============================] - 10s 22ms/step - loss: 0.0184 - accuracy: 0.9951 - val_loss: 0.1090 - val_accuracy: 0.9842

Epoch 19/20

469/469 [==============================] - 10s 21ms/step - loss: 0.0167 - accuracy: 0.9953 - val_loss: 0.1014 - val_accuracy: 0.9857

Epoch 20/20

469/469 [==============================] - 9s 20ms/step - loss: 0.0168 - accuracy: 0.9958 - val_loss: 0.1371 - val_accuracy: 0.9845

Test loss: 0.13713757693767548

Test accuracy: 0.984499990940094