Untitled

April 26, 2023

[1]:
```
from keras.datasets import mnist
(train_images, train_labels), (test_images, test_labels) = mnist.load_data()
```

```
2023-04-26 10:14:15.612913: I tensorflow/tsl/cuda/cudart_stub.cc:28] Could not
find cuda drivers on your machine, GPU will not be used.
2023-04-26 10:14:15.973897: I tensorflow/tsl/cuda/cudart_stub.cc:28] Could not
find cuda drivers on your machine, GPU will not be used.
2023-04-26 10:14:15.978258: I tensorflow/core/platform/cpu_feature_guard.cc:182]
This TensorFlow binary is optimized to use available CPU instructions in
performance-critical operations.
To enable the following instructions: AVX2 FMA, in other operations, rebuild
TensorFlow with the appropriate compiler flags.
2023-04-26 10:14:17.187704: W
tensorflow/compiler/tf2tensorrt/utils/py_utils.cc:38] TF-TRT Warning: Could not
find TensorRT
```

[2]:
```
train_images.shape
```

[2]:
```
(60000, 28, 28)
```

[3]:
```
len(train_labels)
```

[3]:
```
60000
```

[7]:
```
train_images[0]
```

[7]:
```
array([[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
```

```
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   3,
  18,  18,  18, 126, 136, 175,  26, 166, 255, 247, 127,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,  30,  36,  94, 154, 170,
 253, 253, 253, 253, 253, 225, 172, 253, 242, 195,  64,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,  49, 238, 253, 253, 253, 253,
 253, 253, 253, 253, 251,  93,  82,  82,  56,  39,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,  18, 219, 253, 253, 253, 253,
 253, 198, 182, 247, 241,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,  80, 156, 107, 253, 253,
 205,  11,   0,  43, 154,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,  14,   1, 154, 253,
  90,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0, 139, 253,
 190,   2,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  11, 190,
 253,  70,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  35,
 241, 225, 160, 108,   1,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
  81, 240, 253, 253, 119,  25,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,  45, 186, 253, 253, 150,  27,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0,  16,  93, 252, 253, 187,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0,   0,   0, 249, 253, 249,  64,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,  46, 130, 183, 253, 253, 207,   2,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  39,
 148, 229, 253, 253, 253, 250, 182,   0,   0,   0,   0,   0,   0,
```

```
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  24, 114, 221,
 253, 253, 253, 253, 201,  78,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,  23,  66, 213, 253, 253,
 253, 253, 198,  81,   2,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,  18, 171, 219, 253, 253, 253, 253,
 195,  80,   9,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,  55, 172, 226, 253, 253, 253, 253, 244, 133,
  11,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0, 136, 253, 253, 253, 212, 135, 132,  16,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0]], dtype=uint8)
```

[9]:
```
train_images[0][0]
```

[9]:
```
array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0], dtype=uint8)
```

[10]:
```
len(train_images[0][0])
```

[10]:
```
28
```

[6]:
```
train_labels
```

[6]:
```
array([5, 0, 4, …, 5, 6, 8], dtype=uint8)
```

[11]:
```
test_images.shape
```

[11]:
```
(10000, 28, 28)
```

[12]:
```
from keras import models
from keras import layers
network = models.Sequential()
network.add(layers.Dense(512, activation='relu', input_shape=(28 * 28,)))
```

```
network.add(layers.Dense(10, activation='softmax'))
```

[13]:
```
network.compile(optimizer='rmsprop',
loss='categorical_crossentropy',
metrics=['accuracy'])
```

[14]:
```
train_images = train_images.reshape((60000, 28 * 28))
train_images = train_images.astype('float32') / 255
test_images = test_images.reshape((10000, 28 * 28))
test_images = test_images.astype('float32') / 255
```

[15]:
```
from keras.utils import to_categorical
train_labels = to_categorical(train_labels)
test_labels = to_categorical(test_labels)
```

[16]:
```
network.fit(train_images, train_labels, epochs=5, batch_size=128)
```

```
Epoch 1/5
469/469 [==============================] - 4s 7ms/step - loss: 0.2622 -
accuracy: 0.9247
Epoch 2/5
469/469 [==============================] - 3s 7ms/step - loss: 0.1056 -
accuracy: 0.9690
Epoch 3/5
469/469 [==============================] - 3s 7ms/step - loss: 0.0713 -
accuracy: 0.9785
Epoch 4/5
469/469 [==============================] - 3s 7ms/step - loss: 0.0515 -
accuracy: 0.9847
Epoch 5/5
469/469 [==============================] - 3s 7ms/step - loss: 0.0391 -
accuracy: 0.9887
```

[16]:
```
<keras.callbacks.History at 0x7f6fc6fecfd0>
```

[17]:
```
test_loss, test_acc = network.evaluate(test_images, test_labels)
```

```
313/313 [==============================] - 1s 2ms/step - loss: 0.0665 -
accuracy: 0.9788
```

[2]:
```
pip install keras
```

```
Requirement already satisfied: keras in /home/h/anaconda3/lib/python3.9/site-
packages (2.12.0)
Note: you may need to restart the kernel to use updated packages.
```

[5]:
```
!pip install tensorflow
```

```
Collecting tensorflow
  Downloading
tensorflow-2.12.0-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl
(585.9 MB)

585.9/585.9 MB 689.5 kB/s eta 0:00:00m eta
0:00:01[36m0:00:19
Collecting grpcio<2.0,>=1.24.3
  Downloading
grpcio-1.54.0-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (5.1 MB)

5.1/5.1 MB 463.4 kB/s eta 0:00:00m eta
0:00:01[36m0:00:01
Requirement already satisfied: setuptools in
/home/h/anaconda3/lib/python3.9/site-packages (from tensorflow) (63.4.1)
Collecting absl-py>=1.0.0
  Downloading absl_py-1.4.0-py3-none-any.whl (126 kB)

126.5/126.5 kB 536.7 kB/s eta 0:00:001m532.0 kB/s
eta 0:00:01
Requirement already satisfied: wrapt<1.15,>=1.11.0 in
/home/h/anaconda3/lib/python3.9/site-packages (from tensorflow) (1.14.1)
Requirement already satisfied: typing-extensions>=3.6.6 in
/home/h/anaconda3/lib/python3.9/site-packages (from tensorflow) (4.3.0)
Collecting gast<=0.4.0,>=0.2.1
  Downloading gast-0.4.0-py3-none-any.whl (9.8 kB)
Collecting termcolor>=1.1.0
  Downloading termcolor-2.2.0-py3-none-any.whl (6.6 kB)
Collecting tensorboard<2.13,>=2.12
  Downloading tensorboard-2.12.2-py3-none-any.whl (5.6 MB)

5.6/5.6 MB 862.5 kB/s eta 0:00:00m eta
0:00:01[36m0:00:01
Collecting
protobuf!=4.21.0,!=4.21.1,!=4.21.2,!=4.21.3,!=4.21.4,!=4.21.5,<5.0.0dev,>=3.20.3
  Downloading protobuf-4.22.3-cp37-abi3-manylinux2014_x86_64.whl (302 kB)

302.4/302.4 kB 962.6 kB/s eta 0:00:00 kB/s eta
0:00:01:01
Collecting flatbuffers>=2.0
  Downloading flatbuffers-23.3.3-py2.py3-none-any.whl (26 kB)
Collecting tensorflow-io-gcs-filesystem>=0.23.1
  Downloading tensorflow_io_gcs_filesystem-0.32.0-cp39-cp39-manylinux_2_12_x86_6
4.manylinux2010_x86_64.whl (2.4 MB)

2.4/2.4 MB 722.7 kB/s eta 0:00:00m eta
0:00:01[36m0:00:01
Collecting opt-einsum>=2.3.2
```

```
  Downloading opt_einsum-3.3.0-py3-none-any.whl (65 kB)

65.5/65.5 kB 639.8 kB/s eta 0:00:00 kB/s eta
0:00:0101
Requirement already satisfied: keras<2.13,>=2.12.0 in
/home/h/anaconda3/lib/python3.9/site-packages (from tensorflow) (2.12.0)
Collecting tensorflow-estimator<2.13,>=2.12.0
  Downloading tensorflow_estimator-2.12.0-py2.py3-none-any.whl (440 kB)

440.7/440.7 kB 721.2 kB/s eta 0:00:00[36m0:00:01m
eta 0:00:01
Collecting libclang>=13.0.0
  Downloading libclang-16.0.0-py2.py3-none-manylinux2010_x86_64.whl (22.9 MB)

22.9/22.9 MB 744.6 kB/s eta 0:00:00m eta
0:00:01[36m0:00:01
Collecting astunparse>=1.6.0
  Downloading astunparse-1.6.3-py2.py3-none-any.whl (12 kB)
Requirement already satisfied: six>=1.12.0 in
/home/h/anaconda3/lib/python3.9/site-packages (from tensorflow) (1.16.0)
Collecting numpy<1.24,>=1.22
  Downloading
numpy-1.23.5-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (17.1 MB)

17.1/17.1 MB 957.0 kB/s eta 0:00:00m eta
0:00:01[36m0:00:01
Requirement already satisfied: packaging in
/home/h/anaconda3/lib/python3.9/site-packages (from tensorflow) (21.3)
Requirement already satisfied: h5py>=2.9.0 in
/home/h/anaconda3/lib/python3.9/site-packages (from tensorflow) (3.7.0)
Collecting google-pasta>=0.1.1
  Downloading google_pasta-0.2.0-py3-none-any.whl (57 kB)

57.5/57.5 kB 883.2 kB/s eta 0:00:00MB/s eta
0:00:01
Collecting jax>=0.3.15
  Downloading jax-0.4.8.tar.gz (1.2 MB)

1.2/1.2 MB 969.0 kB/s eta 0:00:00m eta
0:00:01[36m0:00:01
  Installing build dependencies … done
  Getting requirements to build wheel … done
  Preparing metadata (pyproject.toml) … done
Requirement already satisfied: wheel<1.0,>=0.23.0 in
/home/h/anaconda3/lib/python3.9/site-packages (from
astunparse>=1.6.0->tensorflow) (0.37.1)
Requirement already satisfied: scipy>=1.7 in
/home/h/anaconda3/lib/python3.9/site-packages (from jax>=0.3.15->tensorflow)
```

```
(1.9.1)
Collecting ml-dtypes>=0.0.3
  Downloading
ml_dtypes-0.1.0-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (191
kB)

191.1/191.1 kB 937.3 kB/s eta 0:00:001m974.0 kB/s
eta 0:00:01
Collecting google-auth<3,>=1.6.3
  Downloading google_auth-2.17.3-py2.py3-none-any.whl (178 kB)

178.2/178.2 kB 956.8 kB/s eta 0:00:001m949.3 kB/s
eta 0:00:01
Requirement already satisfied: werkzeug>=1.0.1 in
/home/h/anaconda3/lib/python3.9/site-packages (from
tensorboard<2.13,>=2.12->tensorflow) (2.0.3)
Collecting google-auth-oauthlib<1.1,>=0.5
  Downloading google_auth_oauthlib-1.0.0-py2.py3-none-any.whl (18 kB)
Collecting tensorboard-data-server<0.8.0,>=0.7.0
  Downloading tensorboard_data_server-0.7.0-py3-none-manylinux2014_x86_64.whl
(6.6 MB)

6.6/6.6 MB 967.4 kB/s eta 0:00:00m eta
0:00:01[36m0:00:01
Collecting tensorboard-plugin-wit>=1.6.0
  Downloading tensorboard_plugin_wit-1.8.1-py3-none-any.whl (781 kB)

781.3/781.3 kB 964.5 kB/s eta 0:00:00[36m0:00:01m
eta 0:00:01
Requirement already satisfied: requests<3,>=2.21.0 in
/home/h/anaconda3/lib/python3.9/site-packages (from
tensorboard<2.13,>=2.12->tensorflow) (2.28.1)
Requirement already satisfied: markdown>=2.6.8 in
/home/h/anaconda3/lib/python3.9/site-packages (from
tensorboard<2.13,>=2.12->tensorflow) (3.3.4)
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in
/home/h/anaconda3/lib/python3.9/site-packages (from packaging->tensorflow)
(3.0.9)
Collecting cachetools<6.0,>=2.0.0
  Downloading cachetools-5.3.0-py3-none-any.whl (9.3 kB)
Collecting rsa<5,>=3.1.4
  Downloading rsa-4.9-py3-none-any.whl (34 kB)
Requirement already satisfied: pyasn1-modules>=0.2.1 in
/home/h/anaconda3/lib/python3.9/site-packages (from google-
auth<3,>=1.6.3->tensorboard<2.13,>=2.12->tensorflow) (0.2.8)
Collecting requests-oauthlib>=0.7.0
  Downloading requests_oauthlib-1.3.1-py2.py3-none-any.whl (23 kB)
Requirement already satisfied: charset-normalizer<3,>=2 in
```

```
/home/h/anaconda3/lib/python3.9/site-packages (from
requests<3,>=2.21.0->tensorboard<2.13,>=2.12->tensorflow) (2.0.4)
Requirement already satisfied: certifi>=2017.4.17 in
/home/h/anaconda3/lib/python3.9/site-packages (from
requests<3,>=2.21.0->tensorboard<2.13,>=2.12->tensorflow) (2022.9.14)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in
/home/h/anaconda3/lib/python3.9/site-packages (from
requests<3,>=2.21.0->tensorboard<2.13,>=2.12->tensorflow) (1.26.11)
Requirement already satisfied: idna<4,>=2.5 in
/home/h/anaconda3/lib/python3.9/site-packages (from
requests<3,>=2.21.0->tensorboard<2.13,>=2.12->tensorflow) (3.3)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in
/home/h/anaconda3/lib/python3.9/site-packages (from
pyasn1-modules>=0.2.1->google-
auth<3,>=1.6.3->tensorboard<2.13,>=2.12->tensorflow) (0.4.8)
Requirement already satisfied: oauthlib>=3.0.0 in
/home/h/anaconda3/lib/python3.9/site-packages (from requests-
oauthlib>=0.7.0->google-auth-
oauthlib<1.1,>=0.5->tensorboard<2.13,>=2.12->tensorflow) (3.2.2)
Building wheels for collected packages: jax
  Building wheel for jax (pyproject.toml) … done
  Created wheel for jax: filename=jax-0.4.8-py3-none-any.whl size=1439678
sha256=b5da90f7f1e5e11477d6cf18fa00554f411a3f2f95fcaeeb81fc28d08b911f11
  Stored in directory: /home/h/.cache/pip/wheels/05/94/dc/81042da9bced43ff430bc0
2043d213d9e4b210b584c39e31c1
Successfully built jax
Installing collected packages: tensorboard-plugin-wit, libclang, flatbuffers,
termcolor, tensorflow-io-gcs-filesystem, tensorflow-estimator, tensorboard-data-
server, rsa, protobuf, numpy, grpcio, google-pasta, gast, cachetools,
astunparse, absl-py, requests-oauthlib, opt-einsum, ml-dtypes, google-auth, jax,
google-auth-oauthlib, tensorboard, tensorflow
  Attempting uninstall: numpy
    Found existing installation: numpy 1.21.5
    Uninstalling numpy-1.21.5:
      Successfully uninstalled numpy-1.21.5
ERROR: pip's dependency resolver does not currently take into account all
the packages that are installed. This behaviour is the source of the following
dependency conflicts.
daal4py 2021.6.0 requires daal==2021.4.0, which is not installed.
numba 0.55.1 requires numpy<1.22,>=1.18, but you have numpy 1.23.5 which is
incompatible.
Successfully installed absl-py-1.4.0 astunparse-1.6.3 cachetools-5.3.0
flatbuffers-23.3.3 gast-0.4.0 google-auth-2.17.3 google-auth-oauthlib-1.0.0
google-pasta-0.2.0 grpcio-1.54.0 jax-0.4.8 libclang-16.0.0 ml-dtypes-0.1.0
```

```
numpy-1.23.5 opt-einsum-3.3.0 protobuf-4.22.3 requests-oauthlib-1.3.1 rsa-4.9
tensorboard-2.12.2 tensorboard-data-server-0.7.0 tensorboard-plugin-wit-1.8.1
tensorflow-2.12.0 tensorflow-estimator-2.12.0 tensorflow-io-gcs-
filesystem-0.32.0 termcolor-2.2.0
```

[19]:
```
import numpy as np
```

[27]:
```
x = np.array(12)
x
```

[27]:
```
array(12)
```

[28]:
```
x.ndim
```

[28]:
```
0
```

[29]:
```
x.shape
```

[29]:
```
()
```

[30]:
```
x = np.array([12, 3, 6, 14])
x
```

[30]:
```
array([12,  3,  6, 14])
```

[31]:
```
x.ndim
```

[31]:
```
1
```

[32]:
```
x.shape
```

[32]:
```
(4,)
```

[34]:
```
train_labels.ndim
```

[34]:
```
2
```

[35]:
```
train_images.ndim
```

[35]:
```
2
```

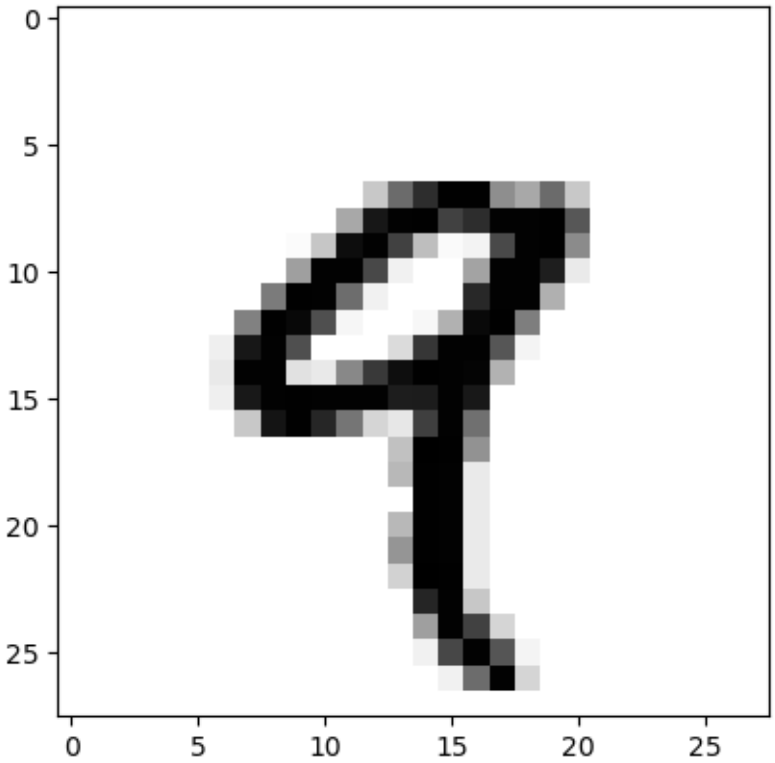
[36]:
```
(train_images, train_labels), (test_images, test_labels) = mnist.load_data()
```

[37]:
```
train_images.ndim
```

[37]:
```
3
```

[38]:
```
digit = train_images[4]
```

[39]:
```
import matplotlib.pyplot as plt
plt.imshow(digit, cmap=plt.cm.binary)
plt.show()
```



[1]:
```
from keras import layers
layer = layers.Dense(32, input_shape=(784,))
```

```
2023-04-26 19:52:57.891623: I tensorflow/tsl/cuda/cudart_stub.cc:28] Could not
find cuda drivers on your machine, GPU will not be used.
2023-04-26 19:52:58.313652: I tensorflow/tsl/cuda/cudart_stub.cc:28] Could not
find cuda drivers on your machine, GPU will not be used.
2023-04-26 19:52:58.315793: I tensorflow/core/platform/cpu_feature_guard.cc:182]
This TensorFlow binary is optimized to use available CPU instructions in
performance-critical operations.
To enable the following instructions: AVX2 FMA, in other operations, rebuild
TensorFlow with the appropriate compiler flags.
2023-04-26 19:52:59.554334: W
tensorflow/compiler/tf2tensorrt/utils/py_utils.cc:38] TF-TRT Warning: Could not
find TensorRT
```

[2]:
```
from keras import models
model = models.Sequential()
```

```
model.add(layers.Dense(32, input_shape=(784,)))
model.add(layers.Dense(32))
```

[3]:
```
type(model)
```

[3]:
```
keras.engine.sequential.Sequential
```

[4]:
```
type(layers)
```

[4]:
```
module
```

[5]:
```
layers
```

[5]:
```
<module 'keras.layers' from '/home/h/anaconda3/lib/python3.9/site-
packages/keras/layers/__init__.py'>
```

[6]:
```
model
```

[6]:
```
<keras.engine.sequential.Sequential at 0x7fc120ee5be0>
```

[7]:
```
# model and layers are a neural network
```

[ ]:
```

```