

autoencoder-Copy1

December 9, 2018

Video 13.1 <https://www.youtube.com/watch?v=kIGHE7Cfe1s>

Video 13.2 <https://www.youtube.com/watch?v=Rm9bJcDd1KU>

Video 13.3 <https://youtu.be/6HjZk-3LsjE>

0.0.1 Part 1

```
In [1]: from keras.callbacks import TensorBoard
        from keras.layers import Input, Dense
        from keras.models import Model
        from keras.datasets import mnist
        import numpy as np

        (xtrain, ytrain), (xtest, ytest) = mnist.load_data()

        xtrain = xtrain.astype('float32') / 255.
        xtest = xtest.astype('float32') / 255.
        xtrain = xtrain.reshape((len(xtrain), np.prod(xtrain.shape[1:])))
        xtest = xtest.reshape((len(xtest), np.prod(xtest.shape[1:])))
        xtrain.shape, xtest.shape
```

Using TensorFlow backend.

```
Out[1]: ((60000, 784), (10000, 784))
```

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In [2]: # this is the size of our encoded representations
        encoding_dim = 2 # 32 floats -> compression of factor 24.5, assuming the input is 784 f

        # this is our input placeholder
        x = input_img = Input(shape=(784,))
        # "encoded" is the encoded representation of the input
        x = Dense(256, activation='relu')(x)
        x = Dense(128, activation='relu')(x)
        encoded = Dense(encoding_dim, activation='relu')(x)

        # "decoded" is the lossy reconstruction of the input
        x = Dense(128, activation='relu')(encoded)
        x = Dense(256, activation='relu')(x)
```

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decoded = Dense(784, activation='sigmoid')(x)

# this model maps an input to its reconstruction
autoencoder = Model(input_img, decoded)

encoder = Model(input_img, encoded)

# create a placeholder for an encoded (32-dimensional) input
encoded_input = Input(shape=(encoding_dim,))
# retrieve the last layer of the autoencoder model
dcd1 = autoencoder.layers[-1]
dcd2 = autoencoder.layers[-2]
dcd3 = autoencoder.layers[-3]

# create the decoder model
decoder = Model(encoded_input, dcd1(dcd2(dcd3(encoded_input))))

autoencoder.compile(optimizer='adadelata',
                    loss='binary_crossentropy',
                    metrics=['accuracy'])
history2 = autoencoder.fit(xtrain, xtrain,
                          epochs=500,
                          batch_size=256,
                          shuffle=True,
                          validation_data=(xtest, xtest),
                          callbacks=[TensorBoard(log_dir='/tmp/autoencoder/encoding_dim_')])
acc2 = autoencoder.evaluate(xtest,
                           xtest,
                           verbose=0)

```

Train on 60000 samples, validate on 10000 samples

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Epoch 1/500
60000/60000 [=====] - 7s 112us/step - loss: 0.3464 - acc: 0.7525 - val_
Epoch 2/500
60000/60000 [=====] - 7s 120us/step - loss: 0.2548 - acc: 0.7943 - val_
Epoch 3/500
60000/60000 [=====] - 7s 120us/step - loss: 0.2414 - acc: 0.7923 - val_
Epoch 4/500
60000/60000 [=====] - 7s 118us/step - loss: 0.2371 - acc: 0.7935 - val_
Epoch 5/500
60000/60000 [=====] - 8s 126us/step - loss: 0.2344 - acc: 0.7940 - val_
Epoch 6/500
60000/60000 [=====] - 8s 134us/step - loss: 0.2322 - acc: 0.7940 - val_
Epoch 7/500
60000/60000 [=====] - 8s 130us/step - loss: 0.2306 - acc: 0.7939 - val_
Epoch 8/500
60000/60000 [=====] - 8s 129us/step - loss: 0.2293 - acc: 0.7941 - val_
Epoch 9/500

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60000/60000 [=====] - 8s 129us/step - loss: 0.2281 - acc: 0.7941 - val_
Epoch 10/500
60000/60000 [=====] - 8s 139us/step - loss: 0.2270 - acc: 0.7942 - val_
Epoch 11/500
60000/60000 [=====] - 7s 116us/step - loss: 0.2259 - acc: 0.7944 - val_
Epoch 12/500
60000/60000 [=====] - 7s 121us/step - loss: 0.2247 - acc: 0.7946 - val_
Epoch 13/500
60000/60000 [=====] - 7s 116us/step - loss: 0.2237 - acc: 0.7947 - val_
Epoch 14/500
60000/60000 [=====] - 6s 105us/step - loss: 0.2226 - acc: 0.7949 - val_
Epoch 15/500
60000/60000 [=====] - 6s 105us/step - loss: 0.2215 - acc: 0.7951 - val_
Epoch 16/500
60000/60000 [=====] - 6s 105us/step - loss: 0.2205 - acc: 0.7953 - val_
Epoch 17/500
60000/60000 [=====] - 7s 109us/step - loss: 0.2195 - acc: 0.7955 - val_
Epoch 18/500
60000/60000 [=====] - 6s 104us/step - loss: 0.2186 - acc: 0.7955 - val_
Epoch 19/500
60000/60000 [=====] - 7s 117us/step - loss: 0.2175 - acc: 0.7956 - val_
Epoch 20/500
60000/60000 [=====] - 7s 117us/step - loss: 0.2167 - acc: 0.7953 - val_
Epoch 21/500
60000/60000 [=====] - 7s 119us/step - loss: 0.2157 - acc: 0.7953 - val_
Epoch 22/500
60000/60000 [=====] - 7s 124us/step - loss: 0.2149 - acc: 0.7950 - val_
Epoch 23/500
60000/60000 [=====] - 8s 127us/step - loss: 0.2141 - acc: 0.7948 - val_
Epoch 24/500
60000/60000 [=====] - 7s 125us/step - loss: 0.2134 - acc: 0.7945 - val_
Epoch 25/500
60000/60000 [=====] - 8s 134us/step - loss: 0.2125 - acc: 0.7944 - val_
Epoch 26/500
60000/60000 [=====] - 8s 131us/step - loss: 0.2118 - acc: 0.7942 - val_
Epoch 27/500
60000/60000 [=====] - 8s 129us/step - loss: 0.2111 - acc: 0.7941 - val_
Epoch 28/500
60000/60000 [=====] - 8s 139us/step - loss: 0.2105 - acc: 0.7940 - val_
Epoch 29/500
60000/60000 [=====] - 7s 111us/step - loss: 0.2098 - acc: 0.7940 - val_
Epoch 30/500
60000/60000 [=====] - 7s 111us/step - loss: 0.2093 - acc: 0.7939 - val_
Epoch 31/500
60000/60000 [=====] - 7s 119us/step - loss: 0.2086 - acc: 0.7939 - val_
Epoch 32/500
60000/60000 [=====] - 7s 117us/step - loss: 0.2082 - acc: 0.7940 - val_
Epoch 33/500

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60000/60000 [=====] - 7s 117us/step - loss: 0.2075 - acc: 0.7941 - val_
 Epoch 34/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.2070 - acc: 0.7941 - val_
 Epoch 35/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.2065 - acc: 0.7941 - val_
 Epoch 36/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.2059 - acc: 0.7943 - val_
 Epoch 37/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.2055 - acc: 0.7943 - val_
 Epoch 38/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.2051 - acc: 0.7943 - val_
 Epoch 39/500
 60000/60000 [=====] - 7s 125us/step - loss: 0.2046 - acc: 0.7944 - val_
 Epoch 40/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.2042 - acc: 0.7944 - val_
 Epoch 41/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.2038 - acc: 0.7944 - val_
 Epoch 42/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.2033 - acc: 0.7946 - val_
 Epoch 43/500
 60000/60000 [=====] - 7s 123us/step - loss: 0.2030 - acc: 0.7946 - val_
 Epoch 44/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.2026 - acc: 0.7946 - val_
 Epoch 45/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.2022 - acc: 0.7946 - val_
 Epoch 46/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.2019 - acc: 0.7947 - val_
 Epoch 47/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.2015 - acc: 0.7947 - val_
 Epoch 48/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.2013 - acc: 0.7946 - val_
 Epoch 49/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.2008 - acc: 0.7948 - val_
 Epoch 50/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.2006 - acc: 0.7947 - val_
 Epoch 51/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.2003 - acc: 0.7947 - val_
 Epoch 52/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.2000 - acc: 0.7948 - val_
 Epoch 53/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1998 - acc: 0.7947 - val_
 Epoch 54/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.1993 - acc: 0.7948 - val_
 Epoch 55/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1990 - acc: 0.7949 - val_
 Epoch 56/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1989 - acc: 0.7948 - val_
 Epoch 57/500

60000/60000 [=====] - 7s 121us/step - loss: 0.1985 - acc: 0.7949 - val_
 Epoch 58/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1982 - acc: 0.7950 - val_
 Epoch 59/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1979 - acc: 0.7950 - val_
 Epoch 60/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1977 - acc: 0.7950 - val_
 Epoch 61/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1973 - acc: 0.7951 - val_
 Epoch 62/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1971 - acc: 0.7951 - val_l
 Epoch 63/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1969 - acc: 0.7951 - val_
 Epoch 64/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1966 - acc: 0.7951 - val_
 Epoch 65/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1963 - acc: 0.7952 - val_
 Epoch 66/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1960 - acc: 0.7953 - val_
 Epoch 67/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1956 - acc: 0.7953 - val_
 Epoch 68/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1954 - acc: 0.7954 - val_
 Epoch 69/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1950 - acc: 0.7954 - val_
 Epoch 70/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1948 - acc: 0.7954 - val_
 Epoch 71/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1946 - acc: 0.7955 - val_
 Epoch 72/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1942 - acc: 0.7955 - val_
 Epoch 73/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1940 - acc: 0.7956 - val_
 Epoch 74/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1937 - acc: 0.7956 - val_
 Epoch 75/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1934 - acc: 0.7957 - val_
 Epoch 76/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1932 - acc: 0.7956 - val_
 Epoch 77/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1930 - acc: 0.7957 - val_
 Epoch 78/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1927 - acc: 0.7957 - val_
 Epoch 79/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1924 - acc: 0.7958 - val_
 Epoch 80/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1922 - acc: 0.7958 - val_
 Epoch 81/500

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60000/60000 [=====] - 6s 101us/step - loss: 0.1920 - acc: 0.7958 - val_
Epoch 82/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1918 - acc: 0.7958 - val_
Epoch 83/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1916 - acc: 0.7959 - val_
Epoch 84/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1914 - acc: 0.7959 - val_
Epoch 85/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1911 - acc: 0.7959 - val_
Epoch 86/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1909 - acc: 0.7960 - val_
Epoch 87/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1908 - acc: 0.7960 - val_
Epoch 88/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1904 - acc: 0.7961 - val_
Epoch 89/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1902 - acc: 0.7961 - val_
Epoch 90/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1902 - acc: 0.7961 - val_
Epoch 91/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1899 - acc: 0.7961 - val_
Epoch 92/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1896 - acc: 0.7962 - val_
Epoch 93/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1896 - acc: 0.7962 - val_
Epoch 94/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1893 - acc: 0.7962 - val_
Epoch 95/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1891 - acc: 0.7963 - val_
Epoch 96/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1888 - acc: 0.7963 - val_
Epoch 97/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1888 - acc: 0.7963 - val_
Epoch 98/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1886 - acc: 0.7963 - val_
Epoch 99/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1883 - acc: 0.7964 - val_
Epoch 100/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1883 - acc: 0.7964 - val_
Epoch 101/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1881 - acc: 0.7965 - val_
Epoch 102/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1880 - acc: 0.7965 - val_
Epoch 103/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1877 - acc: 0.7965 - val_
Epoch 104/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1876 - acc: 0.7965 - val_
Epoch 105/500

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60000/60000 [=====] - 6s 101us/step - loss: 0.1874 - acc: 0.7966 - val_
 Epoch 106/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1873 - acc: 0.7966 - val_
 Epoch 107/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1869 - acc: 0.7966 - val_
 Epoch 108/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1870 - acc: 0.7966 - val_
 Epoch 109/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1867 - acc: 0.7967 - val_
 Epoch 110/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1865 - acc: 0.7967 - val_
 Epoch 111/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1864 - acc: 0.7967 - val_
 Epoch 112/500
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 Epoch 113/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1862 - acc: 0.7967 - val_
 Epoch 114/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1861 - acc: 0.7967 - val_
 Epoch 115/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1858 - acc: 0.7968 - val_
 Epoch 116/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1858 - acc: 0.7968 - val_
 Epoch 117/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1856 - acc: 0.7968 - val_
 Epoch 118/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1855 - acc: 0.7968 - val_
 Epoch 119/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1853 - acc: 0.7969 - val_
 Epoch 120/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1852 - acc: 0.7968 - val_
 Epoch 121/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1850 - acc: 0.7969 - val_
 Epoch 122/500
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 Epoch 123/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1851 - acc: 0.7969 - val_
 Epoch 124/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1848 - acc: 0.7969 - val_1
 Epoch 125/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1844 - acc: 0.7970 - val_
 Epoch 126/500
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 Epoch 127/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1843 - acc: 0.7970 - val_1
 Epoch 128/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1841 - acc: 0.7970 - val_
 Epoch 129/500

60000/60000 [=====] - 6s 100us/step - loss: 0.1841 - acc: 0.7970 - val_
 Epoch 130/500
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 Epoch 131/500
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 Epoch 132/500
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 Epoch 133/500
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 Epoch 134/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1834 - acc: 0.7972 - val_
 Epoch 135/500
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 Epoch 136/500
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 Epoch 137/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1833 - acc: 0.7972 - val_
 Epoch 138/500
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 Epoch 139/500
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 Epoch 140/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1828 - acc: 0.7973 - val_1
 Epoch 141/500
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 Epoch 142/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1827 - acc: 0.7973 - val_1
 Epoch 143/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1826 - acc: 0.7973 - val_
 Epoch 144/500
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 Epoch 145/500
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 Epoch 146/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1823 - acc: 0.7974 - val_
 Epoch 147/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1822 - acc: 0.7974 - val_
 Epoch 148/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1821 - acc: 0.7974 - val_
 Epoch 149/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1820 - acc: 0.7975 - val_
 Epoch 150/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1819 - acc: 0.7975 - val_
 Epoch 151/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1816 - acc: 0.7975 - val_
 Epoch 152/500
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 Epoch 153/500

60000/60000 [=====] - 6s 100us/step - loss: 0.1818 - acc: 0.7975 - val_
 Epoch 154/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1816 - acc: 0.7975 - val_
 Epoch 155/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1814 - acc: 0.7976 - val_
 Epoch 156/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1814 - acc: 0.7976 - val_
 Epoch 157/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1814 - acc: 0.7976 - val_
 Epoch 158/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1813 - acc: 0.7976 - val_
 Epoch 159/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1811 - acc: 0.7976 - val_
 Epoch 160/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1810 - acc: 0.7977 - val_
 Epoch 161/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1808 - acc: 0.7977 - val_
 Epoch 162/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1809 - acc: 0.7976 - val_
 Epoch 163/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1808 - acc: 0.7977 - val_
 Epoch 164/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1808 - acc: 0.7977 - val_
 Epoch 165/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1808 - acc: 0.7977 - val_
 Epoch 166/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1807 - acc: 0.7977 - val_
 Epoch 167/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1804 - acc: 0.7978 - val_
 Epoch 168/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1805 - acc: 0.7978 - val_
 Epoch 169/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1805 - acc: 0.7977 - val_
 Epoch 170/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1802 - acc: 0.7978 - val_
 Epoch 171/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1802 - acc: 0.7978 - val_
 Epoch 172/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1800 - acc: 0.7978 - val_
 Epoch 173/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1800 - acc: 0.7979 - val_
 Epoch 174/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1801 - acc: 0.7978 - val_
 Epoch 175/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1800 - acc: 0.7979 - val_1
 Epoch 176/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1800 - acc: 0.7978 - val_
 Epoch 177/500

60000/60000 [=====] - 6s 99us/step - loss: 0.1797 - acc: 0.7979 - val_1
 Epoch 178/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1798 - acc: 0.7979 - val_1
 Epoch 179/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1797 - acc: 0.7979 - val_1
 Epoch 180/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1796 - acc: 0.7980 - val_1
 Epoch 181/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1794 - acc: 0.7980 - val_1
 Epoch 182/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1796 - acc: 0.7979 - val_1
 Epoch 183/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1794 - acc: 0.7980 - val_1
 Epoch 184/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1794 - acc: 0.7979 - val_1
 Epoch 185/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1792 - acc: 0.7980 - val_1
 Epoch 186/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1790 - acc: 0.7981 - val_1
 Epoch 187/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1792 - acc: 0.7980 - val_1
 Epoch 188/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1791 - acc: 0.7980 - val_1
 Epoch 189/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1790 - acc: 0.7981 - val_1
 Epoch 190/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1791 - acc: 0.7980 - val_1
 Epoch 191/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1789 - acc: 0.7981 - val_1
 Epoch 192/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1788 - acc: 0.7981 - val_1
 Epoch 193/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1788 - acc: 0.7981 - val_1
 Epoch 194/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1787 - acc: 0.7981 - val_1
 Epoch 195/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1786 - acc: 0.7981 - val_1
 Epoch 196/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1786 - acc: 0.7981 - val_1
 Epoch 197/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1784 - acc: 0.7981 - val_1
 Epoch 198/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1784 - acc: 0.7982 - val_1
 Epoch 199/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1786 - acc: 0.7981 - val_1
 Epoch 200/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1784 - acc: 0.7982 - val_1
 Epoch 201/500

```

60000/60000 [=====] - 6s 101us/step - loss: 0.1783 - acc: 0.7982 - val_
Epoch 202/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1783 - acc: 0.7982 - val_
Epoch 203/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1782 - acc: 0.7982 - val_
Epoch 204/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1783 - acc: 0.7982 - val_
Epoch 205/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1781 - acc: 0.7983 - val_
Epoch 206/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1782 - acc: 0.7982 - val_
Epoch 207/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1780 - acc: 0.7982 - val_
Epoch 208/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1780 - acc: 0.7983 - val_
Epoch 209/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1779 - acc: 0.7982 - val_
Epoch 210/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1778 - acc: 0.7983 - val_
Epoch 211/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1776 - acc: 0.7984 - val_
Epoch 212/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1778 - acc: 0.7983 - val_
Epoch 213/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1777 - acc: 0.7983 - val_
Epoch 214/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1776 - acc: 0.7984 - val_
Epoch 215/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1775 - acc: 0.7983 - val_
Epoch 216/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1777 - acc: 0.7983 - val_
Epoch 217/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1773 - acc: 0.7984 - val_1
Epoch 218/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1774 - acc: 0.7984 - val_
Epoch 219/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1773 - acc: 0.7984 - val_
Epoch 220/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1773 - acc: 0.7984 - val_
Epoch 221/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1773 - acc: 0.7984 - val_1
Epoch 222/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1774 - acc: 0.7984 - val_1
Epoch 223/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1772 - acc: 0.7984 - val_1
Epoch 224/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1772 - acc: 0.7984 - val_1
Epoch 225/500

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60000/60000 [=====] - 6s 102us/step - loss: 0.1773 - acc: 0.7984 - val_
 Epoch 226/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1772 - acc: 0.7984 - val_
 Epoch 227/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1771 - acc: 0.7984 - val_1
 Epoch 228/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1769 - acc: 0.7985 - val_
 Epoch 229/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1769 - acc: 0.7985 - val_1
 Epoch 230/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1769 - acc: 0.7985 - val_
 Epoch 231/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1769 - acc: 0.7985 - val_
 Epoch 232/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1767 - acc: 0.7985 - val_
 Epoch 233/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1767 - acc: 0.7985 - val_1
 Epoch 234/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1767 - acc: 0.7985 - val_1
 Epoch 235/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1767 - acc: 0.7986 - val_1
 Epoch 236/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1765 - acc: 0.7986 - val_1
 Epoch 237/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1766 - acc: 0.7986 - val_1
 Epoch 238/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1764 - acc: 0.7986 - val_
 Epoch 239/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1766 - acc: 0.7985 - val_1
 Epoch 240/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1764 - acc: 0.7986 - val_
 Epoch 241/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1763 - acc: 0.7986 - val_1
 Epoch 242/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1763 - acc: 0.7986 - val_1
 Epoch 243/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1763 - acc: 0.7986 - val_1
 Epoch 244/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1763 - acc: 0.7986 - val_1
 Epoch 245/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1762 - acc: 0.7986 - val_
 Epoch 246/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1761 - acc: 0.7986 - val_1
 Epoch 247/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1761 - acc: 0.7986 - val_1
 Epoch 248/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1761 - acc: 0.7987 - val_1
 Epoch 249/500

60000/60000 [=====] - 6s 98us/step - loss: 0.1760 - acc: 0.7987 - val_1
 Epoch 250/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1761 - acc: 0.7986 - val_1
 Epoch 251/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1759 - acc: 0.7987 - val_1
 Epoch 252/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1759 - acc: 0.7987 - val_1
 Epoch 253/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1758 - acc: 0.7987 - val_1
 Epoch 254/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1758 - acc: 0.7987 - val_1
 Epoch 255/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1758 - acc: 0.7987 - val_1
 Epoch 256/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1758 - acc: 0.7987 - val_1
 Epoch 257/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1758 - acc: 0.7987 - val_1
 Epoch 258/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1757 - acc: 0.7988 - val_1
 Epoch 259/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1757 - acc: 0.7987 - val_1
 Epoch 260/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1757 - acc: 0.7987 - val_1
 Epoch 261/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1756 - acc: 0.7987 - val_1
 Epoch 262/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1755 - acc: 0.7988 - val_1
 Epoch 263/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1755 - acc: 0.7988 - val_1
 Epoch 264/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1755 - acc: 0.7988 - val_1
 Epoch 265/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1755 - acc: 0.7988 - val_1
 Epoch 266/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1753 - acc: 0.7989 - val_1
 Epoch 267/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1753 - acc: 0.7988 - val_1
 Epoch 268/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1755 - acc: 0.7988 - val_1
 Epoch 269/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1753 - acc: 0.7988 - val_1
 Epoch 270/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1753 - acc: 0.7988 - val_1
 Epoch 271/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1753 - acc: 0.7988 - val_1
 Epoch 272/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1751 - acc: 0.7989 - val_1
 Epoch 273/500

60000/60000 [=====] - 6s 102us/step - loss: 0.1752 - acc: 0.7988 - val_
 Epoch 274/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1752 - acc: 0.7989 - val_
 Epoch 275/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1752 - acc: 0.7989 - val_
 Epoch 276/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1751 - acc: 0.7989 - val_1
 Epoch 277/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1751 - acc: 0.7989 - val_1
 Epoch 278/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1751 - acc: 0.7989 - val_1
 Epoch 279/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1751 - acc: 0.7989 - val_1
 Epoch 280/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1748 - acc: 0.7990 - val_
 Epoch 281/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1749 - acc: 0.7989 - val_1
 Epoch 282/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1748 - acc: 0.7990 - val_1
 Epoch 283/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1749 - acc: 0.7989 - val_1
 Epoch 284/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1747 - acc: 0.7989 - val_1
 Epoch 285/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1746 - acc: 0.7990 - val_
 Epoch 286/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1747 - acc: 0.7990 - val_
 Epoch 287/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1749 - acc: 0.7989 - val_
 Epoch 288/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1747 - acc: 0.7990 - val_
 Epoch 289/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1747 - acc: 0.7990 - val_
 Epoch 290/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1745 - acc: 0.7990 - val_
 Epoch 291/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1747 - acc: 0.7990 - val_1
 Epoch 292/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1744 - acc: 0.7990 - val_1
 Epoch 293/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1745 - acc: 0.7990 - val_
 Epoch 294/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1745 - acc: 0.7990 - val_1
 Epoch 295/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1743 - acc: 0.7991 - val_
 Epoch 296/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1745 - acc: 0.7990 - val_1
 Epoch 297/500

60000/60000 [=====] - 6s 97us/step - loss: 0.1744 - acc: 0.7990 - val_1
 Epoch 298/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1744 - acc: 0.7990 - val_1
 Epoch 299/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1743 - acc: 0.7990 - val_1
 Epoch 300/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1743 - acc: 0.7991 - val_1
 Epoch 301/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1743 - acc: 0.7990 - val_1
 Epoch 302/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1741 - acc: 0.7991 - val_1
 Epoch 303/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1742 - acc: 0.7991 - val_1
 Epoch 304/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1743 - acc: 0.7990 - val_1
 Epoch 305/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1741 - acc: 0.7991 - val_1
 Epoch 306/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1741 - acc: 0.7991 - val_1
 Epoch 307/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1740 - acc: 0.7991 - val_1
 Epoch 308/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1740 - acc: 0.7991 - val_1
 Epoch 309/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1741 - acc: 0.7991 - val_1
 Epoch 310/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1740 - acc: 0.7991 - val_1
 Epoch 311/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1740 - acc: 0.7991 - val_1
 Epoch 312/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1739 - acc: 0.7992 - val_1
 Epoch 313/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1740 - acc: 0.7991 - val_1
 Epoch 314/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1739 - acc: 0.7991 - val_1
 Epoch 315/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1738 - acc: 0.7992 - val_1
 Epoch 316/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1737 - acc: 0.7992 - val_1
 Epoch 317/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1740 - acc: 0.7991 - val_1
 Epoch 318/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1738 - acc: 0.7991 - val_1
 Epoch 319/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1738 - acc: 0.7992 - val_1
 Epoch 320/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1737 - acc: 0.7992 - val_1
 Epoch 321/500

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60000/60000 [=====] - 6s 98us/step - loss: 0.1738 - acc: 0.7992 - val_1
Epoch 322/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1736 - acc: 0.7992 - val_1
Epoch 323/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1734 - acc: 0.7992 - val_1
Epoch 324/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1737 - acc: 0.7992 - val_1
Epoch 325/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1735 - acc: 0.7992 - val_1
Epoch 326/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1736 - acc: 0.7992 - val_1
Epoch 327/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1735 - acc: 0.7992 - val_1
Epoch 328/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1736 - acc: 0.7992 - val_1
Epoch 329/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1735 - acc: 0.7992 - val_1
Epoch 330/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1734 - acc: 0.7993 - val_1
Epoch 331/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1736 - acc: 0.7992 - val_1
Epoch 332/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1734 - acc: 0.7993 - val_1
Epoch 333/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1733 - acc: 0.7993 - val_1
Epoch 334/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1733 - acc: 0.7993 - val_1
Epoch 335/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1732 - acc: 0.7993 - val_1
Epoch 336/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1733 - acc: 0.7993 - val_1
Epoch 337/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1732 - acc: 0.7993 - val_1
Epoch 338/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1732 - acc: 0.7993 - val_1
Epoch 339/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1731 - acc: 0.7993 - val_1
Epoch 340/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1731 - acc: 0.7993 - val_1
Epoch 341/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1732 - acc: 0.7993 - val_1
Epoch 342/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1731 - acc: 0.7993 - val_1
Epoch 343/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1731 - acc: 0.7993 - val_1
Epoch 344/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1732 - acc: 0.7993 - val_1
Epoch 345/500

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60000/60000 [=====] - 6s 100us/step - loss: 0.1731 - acc: 0.7993 - val_
Epoch 346/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1731 - acc: 0.7993 - val_
Epoch 347/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1731 - acc: 0.7993 - val_1
Epoch 348/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1729 - acc: 0.7994 - val_
Epoch 349/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1729 - acc: 0.7994 - val_1
Epoch 350/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1729 - acc: 0.7994 - val_
Epoch 351/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1730 - acc: 0.7993 - val_1
Epoch 352/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1727 - acc: 0.7994 - val_1
Epoch 353/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1727 - acc: 0.7994 - val_1
Epoch 354/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1728 - acc: 0.7994 - val_1
Epoch 355/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1728 - acc: 0.7994 - val_1
Epoch 356/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1727 - acc: 0.7994 - val_
Epoch 357/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1728 - acc: 0.7994 - val_1
Epoch 358/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1727 - acc: 0.7994 - val_1
Epoch 359/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1728 - acc: 0.7994 - val_
Epoch 360/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1726 - acc: 0.7994 - val_1
Epoch 361/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1725 - acc: 0.7994 - val_
Epoch 362/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1724 - acc: 0.7995 - val_1
Epoch 363/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1726 - acc: 0.7994 - val_1
Epoch 364/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1725 - acc: 0.7994 - val_1
Epoch 365/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1725 - acc: 0.7994 - val_1
Epoch 366/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1725 - acc: 0.7994 - val_
Epoch 367/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1726 - acc: 0.7994 - val_1
Epoch 368/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1724 - acc: 0.7995 - val_1
Epoch 369/500

60000/60000 [=====] - 6s 98us/step - loss: 0.1725 - acc: 0.7994 - val_1
 Epoch 370/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1723 - acc: 0.7995 - val_1
 Epoch 371/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1724 - acc: 0.7995 - val_1
 Epoch 372/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1723 - acc: 0.7995 - val_1
 Epoch 373/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1723 - acc: 0.7995 - val_1
 Epoch 374/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1724 - acc: 0.7995 - val_1
 Epoch 375/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1722 - acc: 0.7995 - val_1
 Epoch 376/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1722 - acc: 0.7995 - val_1
 Epoch 377/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1723 - acc: 0.7995 - val_1
 Epoch 378/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1722 - acc: 0.7995 - val_1
 Epoch 379/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1720 - acc: 0.7996 - val_1
 Epoch 380/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1721 - acc: 0.7995 - val_1
 Epoch 381/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1720 - acc: 0.7995 - val_1
 Epoch 382/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1723 - acc: 0.7994 - val_1
 Epoch 383/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1721 - acc: 0.7995 - val_1
 Epoch 384/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1720 - acc: 0.7996 - val_1
 Epoch 385/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1720 - acc: 0.7995 - val_1
 Epoch 386/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1721 - acc: 0.7995 - val_1
 Epoch 387/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1720 - acc: 0.7995 - val_1
 Epoch 388/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1719 - acc: 0.7995 - val_1
 Epoch 389/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1722 - acc: 0.7995 - val_1
 Epoch 390/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1719 - acc: 0.7996 - val_1
 Epoch 391/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1718 - acc: 0.7996 - val_1
 Epoch 392/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1721 - acc: 0.7995 - val_1
 Epoch 393/500

60000/60000 [=====] - 6s 99us/step - loss: 0.1717 - acc: 0.7996 - val_1
 Epoch 394/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1720 - acc: 0.7995 - val_1
 Epoch 395/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1718 - acc: 0.7996 - val_1
 Epoch 396/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1718 - acc: 0.7996 - val_1
 Epoch 397/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1718 - acc: 0.7996 - val_1
 Epoch 398/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1719 - acc: 0.7996 - val_1
 Epoch 399/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1717 - acc: 0.7996 - val_1
 Epoch 400/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1717 - acc: 0.7996 - val_1
 Epoch 401/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1716 - acc: 0.7996 - val_1
 Epoch 402/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1716 - acc: 0.7996 - val_1
 Epoch 403/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1718 - acc: 0.7996 - val_1
 Epoch 404/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1716 - acc: 0.7996 - val_1
 Epoch 405/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1716 - acc: 0.7996 - val_1
 Epoch 406/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1716 - acc: 0.7996 - val_1
 Epoch 407/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1714 - acc: 0.7997 - val_1
 Epoch 408/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1715 - acc: 0.7996 - val_1
 Epoch 409/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1714 - acc: 0.7997 - val_1
 Epoch 410/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1714 - acc: 0.7997 - val_1
 Epoch 411/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1714 - acc: 0.7996 - val_1
 Epoch 412/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1715 - acc: 0.7996 - val_1
 Epoch 413/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1714 - acc: 0.7997 - val_1
 Epoch 414/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1714 - acc: 0.7997 - val_1
 Epoch 415/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1714 - acc: 0.7997 - val_1
 Epoch 416/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1714 - acc: 0.7997 - val_1
 Epoch 417/500

60000/60000 [=====] - 6s 98us/step - loss: 0.1714 - acc: 0.7996 - val_1
 Epoch 418/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1714 - acc: 0.7997 - val_1
 Epoch 419/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1712 - acc: 0.7997 - val_1
 Epoch 420/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1712 - acc: 0.7997 - val_1
 Epoch 421/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.1712 - acc: 0.7997 - val_1
 Epoch 422/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1711 - acc: 0.7997 - val_1
 Epoch 423/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1712 - acc: 0.7997 - val_1
 Epoch 424/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.1713 - acc: 0.7997 - val_1
 Epoch 425/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1711 - acc: 0.7997 - val_1
 Epoch 426/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1712 - acc: 0.7997 - val_1
 Epoch 427/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1711 - acc: 0.7997 - val_1
 Epoch 428/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1711 - acc: 0.7997 - val_1
 Epoch 429/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1712 - acc: 0.7997 - val_1
 Epoch 430/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1711 - acc: 0.7997 - val_1
 Epoch 431/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1709 - acc: 0.7998 - val_1
 Epoch 432/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1710 - acc: 0.7998 - val_1
 Epoch 433/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1708 - acc: 0.7998 - val_1
 Epoch 434/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1709 - acc: 0.7998 - val_1
 Epoch 435/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1709 - acc: 0.7998 - val_1
 Epoch 436/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1710 - acc: 0.7997 - val_1
 Epoch 437/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1709 - acc: 0.7998 - val_1
 Epoch 438/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1709 - acc: 0.7998 - val_1
 Epoch 439/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1709 - acc: 0.7998 - val_1
 Epoch 440/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1708 - acc: 0.7998 - val_1
 Epoch 441/500

60000/60000 [=====] - 6s 101us/step - loss: 0.1706 - acc: 0.7998 - val_
 Epoch 442/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1711 - acc: 0.7997 - val_
 Epoch 443/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1709 - acc: 0.7998 - val_
 Epoch 444/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1707 - acc: 0.7998 - val_
 Epoch 445/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1708 - acc: 0.7998 - val_
 Epoch 446/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1709 - acc: 0.7998 - val_
 Epoch 447/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1708 - acc: 0.7998 - val_
 Epoch 448/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1706 - acc: 0.7998 - val_l
 Epoch 449/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1707 - acc: 0.7998 - val_
 Epoch 450/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1707 - acc: 0.7998 - val_
 Epoch 451/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1707 - acc: 0.7998 - val_l
 Epoch 452/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1708 - acc: 0.7998 - val_
 Epoch 453/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1705 - acc: 0.7999 - val_
 Epoch 454/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1707 - acc: 0.7998 - val_l
 Epoch 455/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1706 - acc: 0.7998 - val_
 Epoch 456/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1705 - acc: 0.7998 - val_
 Epoch 457/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1704 - acc: 0.7998 - val_
 Epoch 458/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1708 - acc: 0.7998 - val_
 Epoch 459/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1705 - acc: 0.7998 - val_
 Epoch 460/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1704 - acc: 0.7999 - val_
 Epoch 461/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1704 - acc: 0.7999 - val_
 Epoch 462/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1704 - acc: 0.7999 - val_
 Epoch 463/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1704 - acc: 0.7999 - val_
 Epoch 464/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1705 - acc: 0.7998 - val_
 Epoch 465/500

```

60000/60000 [=====] - 6s 101us/step - loss: 0.1705 - acc: 0.7999 - val_
Epoch 466/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1706 - acc: 0.7998 - val_1
Epoch 467/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1704 - acc: 0.7999 - val_1
Epoch 468/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1705 - acc: 0.7998 - val_1
Epoch 469/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1703 - acc: 0.7999 - val_1
Epoch 470/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1702 - acc: 0.7999 - val_
Epoch 471/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1702 - acc: 0.7999 - val_1
Epoch 472/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1703 - acc: 0.7999 - val_1
Epoch 473/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1702 - acc: 0.7999 - val_1
Epoch 474/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1704 - acc: 0.7998 - val_
Epoch 475/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1701 - acc: 0.7999 - val_
Epoch 476/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1701 - acc: 0.7999 - val_
Epoch 477/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1702 - acc: 0.7999 - val_
Epoch 478/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1702 - acc: 0.7999 - val_
Epoch 479/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1701 - acc: 0.7999 - val_1
Epoch 480/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1700 - acc: 0.8000 - val_
Epoch 481/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1699 - acc: 0.8000 - val_
Epoch 482/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1702 - acc: 0.7999 - val_
Epoch 483/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1702 - acc: 0.7999 - val_
Epoch 484/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1700 - acc: 0.8000 - val_1
Epoch 485/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1701 - acc: 0.7999 - val_
Epoch 486/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1701 - acc: 0.7999 - val_
Epoch 487/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1699 - acc: 0.8000 - val_
Epoch 488/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1700 - acc: 0.8000 - val_
Epoch 489/500

```

```

60000/60000 [=====] - 6s 100us/step - loss: 0.1701 - acc: 0.7999 - val_
Epoch 490/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1699 - acc: 0.8000 - val_
Epoch 491/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1700 - acc: 0.7999 - val_
Epoch 492/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1699 - acc: 0.8000 - val_
Epoch 493/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1699 - acc: 0.7999 - val_
Epoch 494/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1698 - acc: 0.8000 - val_
Epoch 495/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1700 - acc: 0.7999 - val_
Epoch 496/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1698 - acc: 0.8000 - val_
Epoch 497/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1699 - acc: 0.8000 - val_
Epoch 498/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1697 - acc: 0.8000 - val_
Epoch 499/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1699 - acc: 0.8000 - val_
Epoch 500/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1697 - acc: 0.8000 - val_

```

```

In [3]: # this is the size of our encoded representations
        encoding_dim = 4 # 32 floats -> compression of factor 24.5, assuming the input is 784 f

        # this is our input placeholder
        x = input_img = Input(shape=(784,))
        # "encoded" is the encoded representation of the input
        x = Dense(256, activation='relu')(x)
        x = Dense(128, activation='relu')(x)
        encoded = Dense(encoding_dim, activation='relu')(x)

        # "decoded" is the lossy reconstruction of the input
        x = Dense(128, activation='relu')(encoded)
        x = Dense(256, activation='relu')(x)
        decoded = Dense(784, activation='sigmoid')(x)

        # this model maps an input to its reconstruction
        autoencoder = Model(input_img, decoded)

        encoder = Model(input_img, encoded)

        # create a placeholder for an encoded (32-dimensional) input
        encoded_input = Input(shape=(encoding_dim,))

```

```

# retrieve the last layer of the autoencoder model
dcd1 = autoencoder.layers[-1]
dcd2 = autoencoder.layers[-2]
dcd3 = autoencoder.layers[-3]

# create the decoder model
decoder = Model(encoded_input, dcd1(dcd2(dcd3(encoded_input))))

autoencoder.compile(optimizer='adadelta',
                    loss='binary_crossentropy',
                    metrics=['accuracy'])
history4 = autoencoder.fit(xtrain, xtrain,
                          epochs=500,
                          batch_size=256,
                          shuffle=True,
                          validation_data=(xtest, xtest),
                          callbacks=[TensorBoard(log_dir='/tmp/autoencoder/encoding_dim_')])
acc4 = autoencoder.evaluate(xtest,
                           xtest,
                           verbose=0)

```

Train on 60000 samples, validate on 10000 samples

```

Epoch 1/500
60000/60000 [=====] - 8s 127us/step - loss: 0.3380 - acc: 0.7546 - val_
Epoch 2/500
60000/60000 [=====] - 6s 106us/step - loss: 0.2591 - acc: 0.7947 - val_
Epoch 3/500
60000/60000 [=====] - 6s 100us/step - loss: 0.2535 - acc: 0.7977 - val_
Epoch 4/500
60000/60000 [=====] - 6s 104us/step - loss: 0.2516 - acc: 0.7990 - val_
Epoch 5/500
60000/60000 [=====] - 6s 100us/step - loss: 0.2507 - acc: 0.7998 - val_
Epoch 6/500
60000/60000 [=====] - 6s 99us/step - loss: 0.2502 - acc: 0.8002 - val_
Epoch 7/500
60000/60000 [=====] - 6s 106us/step - loss: 0.2497 - acc: 0.8005 - val_
Epoch 8/500
60000/60000 [=====] - 7s 118us/step - loss: 0.2491 - acc: 0.8010 - val_
Epoch 9/500
60000/60000 [=====] - 7s 122us/step - loss: 0.2486 - acc: 0.8013 - val_
Epoch 10/500
60000/60000 [=====] - 8s 135us/step - loss: 0.2478 - acc: 0.8014 - val_
Epoch 11/500
60000/60000 [=====] - 6s 104us/step - loss: 0.2469 - acc: 0.8010 - val_
Epoch 12/500
60000/60000 [=====] - 6s 102us/step - loss: 0.2457 - acc: 0.8001 - val_
Epoch 13/500
60000/60000 [=====] - 6s 106us/step - loss: 0.2447 - acc: 0.7988 - val_

```



```

Epoch 14/500
60000/60000 [=====] - 6s 104us/step - loss: 0.2439 - acc: 0.7978 - val_
Epoch 15/500
60000/60000 [=====] - 6s 103us/step - loss: 0.2432 - acc: 0.7971 - val_
Epoch 16/500
60000/60000 [=====] - 6s 105us/step - loss: 0.2426 - acc: 0.7964 - val_
Epoch 17/500
60000/60000 [=====] - 6s 108us/step - loss: 0.2421 - acc: 0.7962 - val_
Epoch 18/500
60000/60000 [=====] - 6s 108us/step - loss: 0.2417 - acc: 0.7960 - val_
Epoch 19/500
60000/60000 [=====] - 6s 104us/step - loss: 0.2409 - acc: 0.7960 - val_
Epoch 20/500
60000/60000 [=====] - 6s 103us/step - loss: 0.2382 - acc: 0.7968 - val_
Epoch 21/500
60000/60000 [=====] - 6s 104us/step - loss: 0.2349 - acc: 0.7960 - val_
Epoch 22/500
60000/60000 [=====] - 6s 106us/step - loss: 0.2309 - acc: 0.7939 - val_
Epoch 23/500
60000/60000 [=====] - 6s 103us/step - loss: 0.2276 - acc: 0.7934 - val_
Epoch 24/500
60000/60000 [=====] - 6s 104us/step - loss: 0.2256 - acc: 0.7938 - val_
Epoch 25/500
60000/60000 [=====] - 6s 103us/step - loss: 0.2240 - acc: 0.7941 - val_
Epoch 26/500
60000/60000 [=====] - 7s 112us/step - loss: 0.2222 - acc: 0.7948 - val_
Epoch 27/500
60000/60000 [=====] - 7s 121us/step - loss: 0.2210 - acc: 0.7951 - val_
Epoch 28/500
60000/60000 [=====] - 6s 102us/step - loss: 0.2197 - acc: 0.7956 - val_
Epoch 29/500
60000/60000 [=====] - 6s 101us/step - loss: 0.2184 - acc: 0.7960 - val_
Epoch 30/500
60000/60000 [=====] - 6s 101us/step - loss: 0.2173 - acc: 0.7963 - val_
Epoch 31/500
60000/60000 [=====] - 6s 102us/step - loss: 0.2163 - acc: 0.7965 - val_
Epoch 32/500
60000/60000 [=====] - 6s 104us/step - loss: 0.2152 - acc: 0.7966 - val_
Epoch 33/500
60000/60000 [=====] - 6s 101us/step - loss: 0.2141 - acc: 0.7966 - val_
Epoch 34/500
60000/60000 [=====] - 6s 101us/step - loss: 0.2130 - acc: 0.7964 - val_
Epoch 35/500
60000/60000 [=====] - 6s 100us/step - loss: 0.2122 - acc: 0.7962 - val_
Epoch 36/500
60000/60000 [=====] - 6s 100us/step - loss: 0.2113 - acc: 0.7962 - val_
Epoch 37/500
60000/60000 [=====] - 6s 104us/step - loss: 0.2107 - acc: 0.7960 - val_

```

```

Epoch 38/500
60000/60000 [=====] - 6s 103us/step - loss: 0.2099 - acc: 0.7959 - val_
Epoch 39/500
60000/60000 [=====] - 6s 100us/step - loss: 0.2093 - acc: 0.7958 - val_
Epoch 40/500
60000/60000 [=====] - 6s 101us/step - loss: 0.2087 - acc: 0.7958 - val_
Epoch 41/500
60000/60000 [=====] - 6s 101us/step - loss: 0.2081 - acc: 0.7957 - val_
Epoch 42/500
60000/60000 [=====] - 6s 103us/step - loss: 0.2076 - acc: 0.7956 - val_
Epoch 43/500
60000/60000 [=====] - 6s 101us/step - loss: 0.2070 - acc: 0.7955 - val_
Epoch 44/500
60000/60000 [=====] - 6s 100us/step - loss: 0.2065 - acc: 0.7954 - val_
Epoch 45/500
60000/60000 [=====] - 6s 100us/step - loss: 0.2060 - acc: 0.7954 - val_
Epoch 46/500
60000/60000 [=====] - 6s 101us/step - loss: 0.2055 - acc: 0.7953 - val_
Epoch 47/500
60000/60000 [=====] - 6s 104us/step - loss: 0.2050 - acc: 0.7951 - val_
Epoch 48/500
60000/60000 [=====] - 6s 102us/step - loss: 0.2046 - acc: 0.7951 - val_
Epoch 49/500
60000/60000 [=====] - 6s 101us/step - loss: 0.2040 - acc: 0.7950 - val_
Epoch 50/500
60000/60000 [=====] - 6s 101us/step - loss: 0.2036 - acc: 0.7949 - val_
Epoch 51/500
60000/60000 [=====] - 6s 101us/step - loss: 0.2032 - acc: 0.7949 - val_
Epoch 52/500
60000/60000 [=====] - 6s 103us/step - loss: 0.2028 - acc: 0.7948 - val_
Epoch 53/500
60000/60000 [=====] - 6s 102us/step - loss: 0.2023 - acc: 0.7949 - val_
Epoch 54/500
60000/60000 [=====] - 6s 102us/step - loss: 0.2019 - acc: 0.7948 - val_
Epoch 55/500
60000/60000 [=====] - 6s 100us/step - loss: 0.2015 - acc: 0.7948 - val_
Epoch 56/500
60000/60000 [=====] - 6s 100us/step - loss: 0.2011 - acc: 0.7948 - val_
Epoch 57/500
60000/60000 [=====] - 6s 105us/step - loss: 0.2007 - acc: 0.7949 - val_
Epoch 58/500
60000/60000 [=====] - 6s 102us/step - loss: 0.2003 - acc: 0.7949 - val_
Epoch 59/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1999 - acc: 0.7949 - val_1
Epoch 60/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1994 - acc: 0.7950 - val_1
Epoch 61/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1988 - acc: 0.7950 - val_1

```

Epoch 62/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1975 - acc: 0.7953 - val_1
Epoch 63/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1952 - acc: 0.7959 - val_1
Epoch 64/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1929 - acc: 0.7966 - val_1
Epoch 65/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1913 - acc: 0.7969 - val_1
Epoch 66/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1898 - acc: 0.7972 - val_1
Epoch 67/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1887 - acc: 0.7973 - val_1
Epoch 68/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1874 - acc: 0.7974 - val_1
Epoch 69/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1865 - acc: 0.7974 - val_1
Epoch 70/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1855 - acc: 0.7974 - val_1
Epoch 71/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1847 - acc: 0.7975 - val_1
Epoch 72/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1838 - acc: 0.7976 - val_1
Epoch 73/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1830 - acc: 0.7977 - val_1
Epoch 74/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1823 - acc: 0.7978 - val_1
Epoch 75/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1816 - acc: 0.7979 - val_1
Epoch 76/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1811 - acc: 0.7979 - val_1
Epoch 77/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1803 - acc: 0.7980 - val_1
Epoch 78/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1799 - acc: 0.7981 - val_1
Epoch 79/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1793 - acc: 0.7982 - val_1
Epoch 80/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1787 - acc: 0.7983 - val_1
Epoch 81/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1782 - acc: 0.7983 - val_1
Epoch 82/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1777 - acc: 0.7984 - val_1
Epoch 83/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1773 - acc: 0.7985 - val_1
Epoch 84/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1769 - acc: 0.7985 - val_1
Epoch 85/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1765 - acc: 0.7986 - val_1

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Epoch 86/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1762 - acc: 0.7986 - val_1
Epoch 87/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1757 - acc: 0.7987 - val_1
Epoch 88/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1753 - acc: 0.7987 - val_1
Epoch 89/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1752 - acc: 0.7987 - val_1
Epoch 90/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1748 - acc: 0.7988 - val_1
Epoch 91/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1746 - acc: 0.7988 - val_1
Epoch 92/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1742 - acc: 0.7989 - val_1
Epoch 93/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1739 - acc: 0.7990 - val_1
Epoch 94/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1738 - acc: 0.7989 - val_1
Epoch 95/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1734 - acc: 0.7990 - val_1
Epoch 96/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1733 - acc: 0.7991 - val_1
Epoch 97/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1729 - acc: 0.7991 - val_1
Epoch 98/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1727 - acc: 0.7991 - val_1
Epoch 99/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1725 - acc: 0.7992 - val_1
Epoch 100/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1722 - acc: 0.7992 - val_1
Epoch 101/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1720 - acc: 0.7992 - val_1
Epoch 102/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1718 - acc: 0.7993 - val_1
Epoch 103/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1717 - acc: 0.7993 - val_1
Epoch 104/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1714 - acc: 0.7994 - val_1
Epoch 105/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1712 - acc: 0.7994 - val_1
Epoch 106/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1711 - acc: 0.7994 - val_1
Epoch 107/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1708 - acc: 0.7995 - val_1
Epoch 108/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1707 - acc: 0.7995 - val_1
Epoch 109/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1704 - acc: 0.7995 - val_1

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Epoch 110/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1704 - acc: 0.7995 - val_1
Epoch 111/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1702 - acc: 0.7995 - val_1
Epoch 112/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1700 - acc: 0.7996 - val_1
Epoch 113/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1698 - acc: 0.7996 - val_1
Epoch 114/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1697 - acc: 0.7996 - val_1
Epoch 115/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1695 - acc: 0.7997 - val_1
Epoch 116/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1694 - acc: 0.7997 - val_1
Epoch 117/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1693 - acc: 0.7997 - val_1
Epoch 118/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1690 - acc: 0.7998 - val_1
Epoch 119/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1690 - acc: 0.7998 - val_1
Epoch 120/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1688 - acc: 0.7998 - val_1
Epoch 121/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1686 - acc: 0.7998 - val_1
Epoch 122/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1685 - acc: 0.7999 - val_1
Epoch 123/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1683 - acc: 0.7999 - val_1
Epoch 124/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1683 - acc: 0.7999 - val_1
Epoch 125/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1680 - acc: 0.7999 - val_1
Epoch 126/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1679 - acc: 0.8000 - val_1
Epoch 127/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1679 - acc: 0.7999 - val_1
Epoch 128/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1677 - acc: 0.8000 - val_1
Epoch 129/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1676 - acc: 0.8000 - val_1
Epoch 130/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1676 - acc: 0.8000 - val_1
Epoch 131/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1673 - acc: 0.8001 - val_1
Epoch 132/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1672 - acc: 0.8001 - val_1
Epoch 133/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1671 - acc: 0.8001 - val_1

Epoch 134/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1669 - acc: 0.8002 - val_1

Epoch 135/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1668 - acc: 0.8002 - val_1

Epoch 136/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1669 - acc: 0.8002 - val_1

Epoch 137/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1666 - acc: 0.8002 - val_1

Epoch 138/500
60000/60000 [=====] - 8s 126us/step - loss: 0.1666 - acc: 0.8002 - val_1

Epoch 139/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1664 - acc: 0.8003 - val_1

Epoch 140/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1662 - acc: 0.8003 - val_1

Epoch 141/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1661 - acc: 0.8003 - val_1

Epoch 142/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1660 - acc: 0.8003 - val_1

Epoch 143/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1660 - acc: 0.8003 - val_1

Epoch 144/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1658 - acc: 0.8004 - val_1

Epoch 145/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1657 - acc: 0.8004 - val_1

Epoch 146/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1656 - acc: 0.8004 - val_1

Epoch 147/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1655 - acc: 0.8004 - val_1

Epoch 148/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1654 - acc: 0.8005 - val_1

Epoch 149/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1654 - acc: 0.8005 - val_1

Epoch 150/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1652 - acc: 0.8005 - val_1

Epoch 151/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1651 - acc: 0.8006 - val_1

Epoch 152/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1651 - acc: 0.8005 - val_1

Epoch 153/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1650 - acc: 0.8006 - val_1

Epoch 154/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1648 - acc: 0.8006 - val_1

Epoch 155/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1648 - acc: 0.8006 - val_1

Epoch 156/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1646 - acc: 0.8006 - val_1

Epoch 157/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1646 - acc: 0.8006 - val_1

Epoch 158/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1645 - acc: 0.8007 - val_
 Epoch 159/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1644 - acc: 0.8007 - val_
 Epoch 160/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1643 - acc: 0.8007 - val_
 Epoch 161/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1641 - acc: 0.8007 - val_
 Epoch 162/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1641 - acc: 0.8008 - val_1
 Epoch 163/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1639 - acc: 0.8008 - val_1
 Epoch 164/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1639 - acc: 0.8008 - val_1
 Epoch 165/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1638 - acc: 0.8008 - val_1
 Epoch 166/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1637 - acc: 0.8008 - val_
 Epoch 167/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1636 - acc: 0.8009 - val_
 Epoch 168/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1635 - acc: 0.8009 - val_
 Epoch 169/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1635 - acc: 0.8009 - val_
 Epoch 170/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1634 - acc: 0.8009 - val_
 Epoch 171/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1632 - acc: 0.8009 - val_
 Epoch 172/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1633 - acc: 0.8009 - val_
 Epoch 173/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1631 - acc: 0.8010 - val_
 Epoch 174/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1631 - acc: 0.8009 - val_
 Epoch 175/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1630 - acc: 0.8010 - val_1
 Epoch 176/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1629 - acc: 0.8010 - val_
 Epoch 177/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1628 - acc: 0.8010 - val_1
 Epoch 178/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1627 - acc: 0.8010 - val_1
 Epoch 179/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1626 - acc: 0.8010 - val_1
 Epoch 180/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1626 - acc: 0.8011 - val_1
 Epoch 181/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1625 - acc: 0.8011 - val_

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Epoch 182/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1624 - acc: 0.8011 - val_1
Epoch 183/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1623 - acc: 0.8011 - val_1
Epoch 184/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1623 - acc: 0.8011 - val_1
Epoch 185/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1622 - acc: 0.8011 - val_1
Epoch 186/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1622 - acc: 0.8011 - val_1
Epoch 187/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1622 - acc: 0.8011 - val_1
Epoch 188/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1620 - acc: 0.8012 - val_1
Epoch 189/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1619 - acc: 0.8012 - val_1
Epoch 190/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1619 - acc: 0.8012 - val_1
Epoch 191/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1617 - acc: 0.8012 - val_1
Epoch 192/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1617 - acc: 0.8012 - val_1
Epoch 193/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1617 - acc: 0.8012 - val_1
Epoch 194/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1616 - acc: 0.8013 - val_1
Epoch 195/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1615 - acc: 0.8013 - val_1
Epoch 196/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1614 - acc: 0.8013 - val_1
Epoch 197/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1615 - acc: 0.8013 - val_1
Epoch 198/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1611 - acc: 0.8013 - val_1
Epoch 199/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1613 - acc: 0.8013 - val_1
Epoch 200/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1611 - acc: 0.8013 - val_1
Epoch 201/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1611 - acc: 0.8013 - val_1
Epoch 202/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1610 - acc: 0.8013 - val_1
Epoch 203/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1609 - acc: 0.8014 - val_1
Epoch 204/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1608 - acc: 0.8014 - val_1
Epoch 205/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1609 - acc: 0.8014 - val_1

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Epoch 206/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1609 - acc: 0.8014 - val_1
Epoch 207/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1607 - acc: 0.8014 - val_1
Epoch 208/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1606 - acc: 0.8014 - val_1
Epoch 209/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1606 - acc: 0.8014 - val_1
Epoch 210/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1607 - acc: 0.8014 - val_1
Epoch 211/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1604 - acc: 0.8015 - val_1
Epoch 212/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1605 - acc: 0.8015 - val_1
Epoch 213/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1603 - acc: 0.8015 - val_1
Epoch 214/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1603 - acc: 0.8015 - val_1
Epoch 215/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1603 - acc: 0.8015 - val_1
Epoch 216/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1601 - acc: 0.8015 - val_1
Epoch 217/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1602 - acc: 0.8015 - val_1
Epoch 218/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1600 - acc: 0.8016 - val_1
Epoch 219/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1599 - acc: 0.8016 - val_1
Epoch 220/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1599 - acc: 0.8016 - val_1
Epoch 221/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1600 - acc: 0.8016 - val_1
Epoch 222/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1598 - acc: 0.8016 - val_1
Epoch 223/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1599 - acc: 0.8016 - val_1
Epoch 224/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1597 - acc: 0.8016 - val_1
Epoch 225/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1596 - acc: 0.8016 - val_1
Epoch 226/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1596 - acc: 0.8016 - val_1
Epoch 227/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1595 - acc: 0.8017 - val_1
Epoch 228/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1596 - acc: 0.8016 - val_1
Epoch 229/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1596 - acc: 0.8016 - val_1

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Epoch 230/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1594 - acc: 0.8017 - val_1
Epoch 231/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1593 - acc: 0.8017 - val_1
Epoch 232/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1595 - acc: 0.8017 - val_1
Epoch 233/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1593 - acc: 0.8017 - val_1
Epoch 234/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1593 - acc: 0.8017 - val_1
Epoch 235/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1592 - acc: 0.8017 - val_1
Epoch 236/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1591 - acc: 0.8017 - val_1
Epoch 237/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1590 - acc: 0.8017 - val_1
Epoch 238/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1591 - acc: 0.8017 - val_1
Epoch 239/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1590 - acc: 0.8017 - val_1
Epoch 240/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1589 - acc: 0.8018 - val_1
Epoch 241/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1588 - acc: 0.8018 - val_1
Epoch 242/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1589 - acc: 0.8018 - val_1
Epoch 243/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1588 - acc: 0.8018 - val_1
Epoch 244/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1588 - acc: 0.8018 - val_1
Epoch 245/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1586 - acc: 0.8018 - val_1
Epoch 246/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1587 - acc: 0.8018 - val_1
Epoch 247/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1586 - acc: 0.8018 - val_1
Epoch 248/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1585 - acc: 0.8018 - val_1
Epoch 249/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1585 - acc: 0.8018 - val_1
Epoch 250/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1584 - acc: 0.8018 - val_1
Epoch 251/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1584 - acc: 0.8019 - val_1
Epoch 252/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1582 - acc: 0.8019 - val_1
Epoch 253/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1582 - acc: 0.8019 - val_1

Epoch 254/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1583 - acc: 0.8019 - val_1
 Epoch 255/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1581 - acc: 0.8019 - val_1
 Epoch 256/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1581 - acc: 0.8019 - val_1
 Epoch 257/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1581 - acc: 0.8019 - val_1
 Epoch 258/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1582 - acc: 0.8019 - val_1
 Epoch 259/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1581 - acc: 0.8019 - val_1
 Epoch 260/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1579 - acc: 0.8019 - val_1
 Epoch 261/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1579 - acc: 0.8020 - val_1
 Epoch 262/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1578 - acc: 0.8020 - val_1
 Epoch 263/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1578 - acc: 0.8020 - val_1
 Epoch 264/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1578 - acc: 0.8020 - val_1
 Epoch 265/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1578 - acc: 0.8020 - val_1
 Epoch 266/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1577 - acc: 0.8020 - val_1
 Epoch 267/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1577 - acc: 0.8020 - val_1
 Epoch 268/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1576 - acc: 0.8020 - val_1
 Epoch 269/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1576 - acc: 0.8020 - val_1
 Epoch 270/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1575 - acc: 0.8020 - val_1
 Epoch 271/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1576 - acc: 0.8020 - val_1
 Epoch 272/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1573 - acc: 0.8020 - val_1
 Epoch 273/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1573 - acc: 0.8021 - val_1
 Epoch 274/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1574 - acc: 0.8021 - val_1
 Epoch 275/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1572 - acc: 0.8021 - val_1
 Epoch 276/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1572 - acc: 0.8021 - val_1
 Epoch 277/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1570 - acc: 0.8021 - val_1

Epoch 278/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1567 - acc: 0.8022 - val_1
 Epoch 279/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1565 - acc: 0.8023 - val_1
 Epoch 280/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.1563 - acc: 0.8023 - val_1
 Epoch 281/500
 60000/60000 [=====] - 7s 125us/step - loss: 0.1560 - acc: 0.8024 - val_1
 Epoch 282/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.1556 - acc: 0.8025 - val_1
 Epoch 283/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1554 - acc: 0.8025 - val_1
 Epoch 284/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1551 - acc: 0.8026 - val_1
 Epoch 285/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1549 - acc: 0.8027 - val_1
 Epoch 286/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1546 - acc: 0.8028 - val_1
 Epoch 287/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1542 - acc: 0.8029 - val_1
 Epoch 288/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1540 - acc: 0.8030 - val_1
 Epoch 289/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1537 - acc: 0.8031 - val_1
 Epoch 290/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1534 - acc: 0.8032 - val_1
 Epoch 291/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1531 - acc: 0.8033 - val_1
 Epoch 292/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1531 - acc: 0.8033 - val_1
 Epoch 293/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1528 - acc: 0.8034 - val_1
 Epoch 294/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1526 - acc: 0.8034 - val_1
 Epoch 295/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1525 - acc: 0.8034 - val_1
 Epoch 296/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1522 - acc: 0.8035 - val_1
 Epoch 297/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1521 - acc: 0.8035 - val_1
 Epoch 298/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1520 - acc: 0.8036 - val_1
 Epoch 299/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1516 - acc: 0.8036 - val_1
 Epoch 300/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1516 - acc: 0.8037 - val_1
 Epoch 301/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1515 - acc: 0.8037 - val_1

Epoch 302/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1514 - acc: 0.8037 - val_1
Epoch 303/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1510 - acc: 0.8038 - val_1
Epoch 304/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1510 - acc: 0.8038 - val_1
Epoch 305/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1508 - acc: 0.8038 - val_1
Epoch 306/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1506 - acc: 0.8038 - val_1
Epoch 307/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1506 - acc: 0.8038 - val_1
Epoch 308/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1506 - acc: 0.8038 - val_1
Epoch 309/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1504 - acc: 0.8038 - val_1
Epoch 310/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1502 - acc: 0.8039 - val_1
Epoch 311/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1500 - acc: 0.8039 - val_1
Epoch 312/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1500 - acc: 0.8039 - val_1
Epoch 313/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1497 - acc: 0.8040 - val_1
Epoch 314/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1498 - acc: 0.8040 - val_1
Epoch 315/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1497 - acc: 0.8040 - val_1
Epoch 316/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1495 - acc: 0.8040 - val_1
Epoch 317/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1495 - acc: 0.8040 - val_1
Epoch 318/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1496 - acc: 0.8040 - val_1
Epoch 319/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1492 - acc: 0.8041 - val_1
Epoch 320/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1492 - acc: 0.8041 - val_1
Epoch 321/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1491 - acc: 0.8041 - val_1
Epoch 322/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1491 - acc: 0.8041 - val_1
Epoch 323/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1490 - acc: 0.8041 - val_1
Epoch 324/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1488 - acc: 0.8042 - val_1
Epoch 325/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1489 - acc: 0.8041 - val_1

```

Epoch 326/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1487 - acc: 0.8042 - val_
Epoch 327/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1485 - acc: 0.8042 - val_
Epoch 328/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1485 - acc: 0.8042 - val_
Epoch 329/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1485 - acc: 0.8042 - val_
Epoch 330/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1484 - acc: 0.8042 - val_
Epoch 331/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1482 - acc: 0.8043 - val_
Epoch 332/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1482 - acc: 0.8043 - val_
Epoch 333/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1482 - acc: 0.8043 - val_
Epoch 334/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1482 - acc: 0.8043 - val_
Epoch 335/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1481 - acc: 0.8043 - val_
Epoch 336/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1480 - acc: 0.8043 - val_
Epoch 337/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1479 - acc: 0.8043 - val_
Epoch 338/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1478 - acc: 0.8044 - val_
Epoch 339/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1481 - acc: 0.8043 - val_
Epoch 340/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1479 - acc: 0.8043 - val_
Epoch 341/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1477 - acc: 0.8044 - val_
Epoch 342/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1477 - acc: 0.8043 - val_
Epoch 343/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1476 - acc: 0.8044 - val_
Epoch 344/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1477 - acc: 0.8044 - val_
Epoch 345/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1475 - acc: 0.8044 - val_
Epoch 346/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1474 - acc: 0.8044 - val_
Epoch 347/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1473 - acc: 0.8044 - val_
Epoch 348/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1474 - acc: 0.8044 - val_
Epoch 349/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1473 - acc: 0.8044 - val_

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Epoch 350/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1473 - acc: 0.8044 - val_1
Epoch 351/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1473 - acc: 0.8044 - val_1
Epoch 352/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1471 - acc: 0.8045 - val_1
Epoch 353/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1471 - acc: 0.8045 - val_1
Epoch 354/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1471 - acc: 0.8045 - val_1
Epoch 355/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1471 - acc: 0.8045 - val_1
Epoch 356/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1470 - acc: 0.8045 - val_1
Epoch 357/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1470 - acc: 0.8045 - val_1
Epoch 358/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1469 - acc: 0.8045 - val_1
Epoch 359/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1469 - acc: 0.8045 - val_1
Epoch 360/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1469 - acc: 0.8045 - val_1
Epoch 361/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1469 - acc: 0.8045 - val_1
Epoch 362/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1468 - acc: 0.8045 - val_1
Epoch 363/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1467 - acc: 0.8045 - val_1
Epoch 364/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1466 - acc: 0.8046 - val_1
Epoch 365/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1467 - acc: 0.8045 - val_1
Epoch 366/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1465 - acc: 0.8046 - val_1
Epoch 367/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1467 - acc: 0.8045 - val_1
Epoch 368/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1464 - acc: 0.8046 - val_1
Epoch 369/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1464 - acc: 0.8046 - val_1
Epoch 370/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1463 - acc: 0.8046 - val_1
Epoch 371/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1464 - acc: 0.8046 - val_1
Epoch 372/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1463 - acc: 0.8046 - val_1
Epoch 373/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1463 - acc: 0.8046 - val_1

Epoch 374/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1462 - acc: 0.8046 - val_
 Epoch 375/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1463 - acc: 0.8046 - val_
 Epoch 376/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1461 - acc: 0.8047 - val_
 Epoch 377/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1462 - acc: 0.8046 - val_l
 Epoch 378/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1460 - acc: 0.8046 - val_
 Epoch 379/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1461 - acc: 0.8046 - val_
 Epoch 380/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1460 - acc: 0.8047 - val_
 Epoch 381/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1460 - acc: 0.8047 - val_
 Epoch 382/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1459 - acc: 0.8047 - val_
 Epoch 383/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1459 - acc: 0.8047 - val_l
 Epoch 384/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1460 - acc: 0.8046 - val_
 Epoch 385/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1458 - acc: 0.8047 - val_
 Epoch 386/500
 60000/60000 [=====] - 8s 130us/step - loss: 0.1457 - acc: 0.8047 - val_
 Epoch 387/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1459 - acc: 0.8047 - val_
 Epoch 388/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1459 - acc: 0.8047 - val_
 Epoch 389/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1457 - acc: 0.8047 - val_
 Epoch 390/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1459 - acc: 0.8047 - val_
 Epoch 391/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1455 - acc: 0.8047 - val_
 Epoch 392/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1456 - acc: 0.8047 - val_
 Epoch 393/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1457 - acc: 0.8047 - val_
 Epoch 394/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1455 - acc: 0.8048 - val_
 Epoch 395/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1455 - acc: 0.8047 - val_
 Epoch 396/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1455 - acc: 0.8047 - val_
 Epoch 397/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1454 - acc: 0.8047 - val_


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Epoch 398/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1456 - acc: 0.8047 - val_
Epoch 399/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1454 - acc: 0.8048 - val_
Epoch 400/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1454 - acc: 0.8048 - val_
Epoch 401/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1453 - acc: 0.8048 - val_
Epoch 402/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1454 - acc: 0.8048 - val_
Epoch 403/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1453 - acc: 0.8048 - val_
Epoch 404/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1452 - acc: 0.8048 - val_
Epoch 405/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1451 - acc: 0.8048 - val_
Epoch 406/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1452 - acc: 0.8048 - val_
Epoch 407/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1452 - acc: 0.8048 - val_
Epoch 408/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1450 - acc: 0.8048 - val_
Epoch 409/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1449 - acc: 0.8048 - val_
Epoch 410/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1450 - acc: 0.8048 - val_
Epoch 411/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1449 - acc: 0.8048 - val_
Epoch 412/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1450 - acc: 0.8048 - val_
Epoch 413/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1448 - acc: 0.8048 - val_
Epoch 414/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1450 - acc: 0.8048 - val_
Epoch 415/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1449 - acc: 0.8048 - val_
Epoch 416/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1449 - acc: 0.8048 - val_
Epoch 417/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1448 - acc: 0.8049 - val_
Epoch 418/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1449 - acc: 0.8048 - val_
Epoch 419/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1447 - acc: 0.8048 - val_
Epoch 420/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1448 - acc: 0.8049 - val_
Epoch 421/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1446 - acc: 0.8049 - val_

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Epoch 422/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1447 - acc: 0.8049 - val_
Epoch 423/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1447 - acc: 0.8049 - val_
Epoch 424/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1446 - acc: 0.8049 - val_
Epoch 425/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1446 - acc: 0.8049 - val_
Epoch 426/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1446 - acc: 0.8049 - val_
Epoch 427/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1444 - acc: 0.8049 - val_
Epoch 428/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1445 - acc: 0.8049 - val_
Epoch 429/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1444 - acc: 0.8049 - val_
Epoch 430/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1445 - acc: 0.8049 - val_
Epoch 431/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1445 - acc: 0.8049 - val_
Epoch 432/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1444 - acc: 0.8049 - val_
Epoch 433/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1444 - acc: 0.8049 - val_
Epoch 434/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1443 - acc: 0.8049 - val_
Epoch 435/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1444 - acc: 0.8049 - val_
Epoch 436/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1443 - acc: 0.8049 - val_
Epoch 437/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1442 - acc: 0.8050 - val_
Epoch 438/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1443 - acc: 0.8049 - val_
Epoch 439/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1442 - acc: 0.8050 - val_
Epoch 440/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1442 - acc: 0.8050 - val_
Epoch 441/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1443 - acc: 0.8049 - val_
Epoch 442/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1441 - acc: 0.8050 - val_
Epoch 443/500
60000/60000 [=====] - 8s 131us/step - loss: 0.1443 - acc: 0.8049 - val_
Epoch 444/500
60000/60000 [=====] - 8s 126us/step - loss: 0.1441 - acc: 0.8050 - val_
Epoch 445/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1441 - acc: 0.8050 - val_

```

Epoch 446/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1441 - acc: 0.8050 - val_1
Epoch 447/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1441 - acc: 0.8050 - val_1
Epoch 448/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1440 - acc: 0.8050 - val_1
Epoch 449/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1440 - acc: 0.8050 - val_1
Epoch 450/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1440 - acc: 0.8050 - val_1
Epoch 451/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1440 - acc: 0.8050 - val_1
Epoch 452/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1439 - acc: 0.8050 - val_1
Epoch 453/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1439 - acc: 0.8050 - val_1
Epoch 454/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1439 - acc: 0.8050 - val_1
Epoch 455/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1438 - acc: 0.8050 - val_1
Epoch 456/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1437 - acc: 0.8050 - val_1
Epoch 457/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1438 - acc: 0.8050 - val_1
Epoch 458/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1438 - acc: 0.8050 - val_1
Epoch 459/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1437 - acc: 0.8050 - val_1
Epoch 460/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1436 - acc: 0.8050 - val_1
Epoch 461/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1438 - acc: 0.8050 - val_1
Epoch 462/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1436 - acc: 0.8050 - val_1
Epoch 463/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1437 - acc: 0.8050 - val_1
Epoch 464/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1437 - acc: 0.8050 - val_1
Epoch 465/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1436 - acc: 0.8051 - val_1
Epoch 466/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1435 - acc: 0.8051 - val_1
Epoch 467/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1435 - acc: 0.8051 - val_1
Epoch 468/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1434 - acc: 0.8051 - val_1
Epoch 469/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1434 - acc: 0.8051 - val_1

Epoch 470/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1436 - acc: 0.8050 - val_1
Epoch 471/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1435 - acc: 0.8051 - val_1
Epoch 472/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1435 - acc: 0.8051 - val_1
Epoch 473/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1434 - acc: 0.8051 - val_1
Epoch 474/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1435 - acc: 0.8050 - val_1
Epoch 475/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1434 - acc: 0.8051 - val_1
Epoch 476/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1433 - acc: 0.8051 - val_1
Epoch 477/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1434 - acc: 0.8051 - val_1
Epoch 478/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1434 - acc: 0.8051 - val_1
Epoch 479/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1433 - acc: 0.8051 - val_1
Epoch 480/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1433 - acc: 0.8051 - val_1
Epoch 481/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1432 - acc: 0.8051 - val_1
Epoch 482/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1432 - acc: 0.8051 - val_1
Epoch 483/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1432 - acc: 0.8051 - val_1
Epoch 484/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1431 - acc: 0.8051 - val_1
Epoch 485/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1431 - acc: 0.8051 - val_1
Epoch 486/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1432 - acc: 0.8051 - val_1
Epoch 487/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1431 - acc: 0.8051 - val_1
Epoch 488/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1430 - acc: 0.8051 - val_1
Epoch 489/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1430 - acc: 0.8051 - val_1
Epoch 490/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1430 - acc: 0.8051 - val_1
Epoch 491/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1431 - acc: 0.8051 - val_1
Epoch 492/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1430 - acc: 0.8051 - val_1
Epoch 493/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1430 - acc: 0.8052 - val_1

```

Epoch 494/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1429 - acc: 0.8052 - val_
Epoch 495/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1430 - acc: 0.8051 - val_
Epoch 496/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1429 - acc: 0.8051 - val_
Epoch 497/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1429 - acc: 0.8052 - val_
Epoch 498/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1430 - acc: 0.8051 - val_
Epoch 499/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1430 - acc: 0.8051 - val_
Epoch 500/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1428 - acc: 0.8052 - val_

```

```

In [5]: # this is the size of our encoded representations
        encoding_dim = 6 # 32 floats -> compression of factor 24.5, assuming the input is 784 f

        # this is our input placeholder
        x = input_img = Input(shape=(784,))
        # "encoded" is the encoded representation of the input
        x = Dense(256, activation='relu')(x)
        x = Dense(128, activation='relu')(x)
        encoded = Dense(encoding_dim, activation='relu')(x)

        # "decoded" is the lossy reconstruction of the input
        x = Dense(128, activation='relu')(encoded)
        x = Dense(256, activation='relu')(x)
        decoded = Dense(784, activation='sigmoid')(x)

        # this model maps an input to its reconstruction
        autoencoder = Model(input_img, decoded)

        encoder = Model(input_img, encoded)

        # create a placeholder for an encoded (32-dimensional) input
        encoded_input = Input(shape=(encoding_dim,))
        # retrieve the last layer of the autoencoder model
        dcd1 = autoencoder.layers[-1]
        dcd2 = autoencoder.layers[-2]
        dcd3 = autoencoder.layers[-3]

        # create the decoder model
        decoder = Model(encoded_input, dcd1(dcd2(dcd3(encoded_input))))

        autoencoder.compile(optimizer='adadelta',

```

```

        loss='binary_crossentropy',
        metrics=['accuracy'])
history6 = autoencoder.fit(xtrain, xtrain,
                           epochs=500,
                           batch_size=256,
                           shuffle=True,
                           validation_data=(xtest, xtest),
                           callbacks=[TensorBoard(log_dir='/tmp/autoencoder/encoding_dim_')])
acc6 = autoencoder.evaluate(xtest,
                           xtest,
                           verbose=0)

```

Train on 60000 samples, validate on 10000 samples

```

Epoch 1/500
60000/60000 [=====] - 6s 104us/step - loss: 0.3582 - acc: 0.7464 - val_
Epoch 2/500
60000/60000 [=====] - 6s 98us/step - loss: 0.2583 - acc: 0.7947 - val_
Epoch 3/500
60000/60000 [=====] - 6s 100us/step - loss: 0.2452 - acc: 0.7946 - val_
Epoch 4/500
60000/60000 [=====] - 6s 103us/step - loss: 0.2344 - acc: 0.7950 - val_
Epoch 5/500
60000/60000 [=====] - 6s 108us/step - loss: 0.2152 - acc: 0.7950 - val_
Epoch 6/500
60000/60000 [=====] - 6s 102us/step - loss: 0.2008 - acc: 0.7962 - val_
Epoch 7/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1948 - acc: 0.7965 - val_
Epoch 8/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1904 - acc: 0.7967 - val_
Epoch 9/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1863 - acc: 0.7971 - val_
Epoch 10/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1825 - acc: 0.7977 - val_
Epoch 11/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1796 - acc: 0.7982 - val_
Epoch 12/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1769 - acc: 0.7987 - val_
Epoch 13/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1747 - acc: 0.7991 - val_
Epoch 14/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1728 - acc: 0.7994 - val_
Epoch 15/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1709 - acc: 0.7997 - val_
Epoch 16/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1695 - acc: 0.8000 - val_
Epoch 17/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1682 - acc: 0.8003 - val_
Epoch 18/500

```

60000/60000 [=====] - 6s 101us/step - loss: 0.1669 - acc: 0.8005 - val_
Epoch 19/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1658 - acc: 0.8007 - val_
Epoch 20/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1649 - acc: 0.8009 - val_
Epoch 21/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1639 - acc: 0.8011 - val_
Epoch 22/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1631 - acc: 0.8012 - val_
Epoch 23/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1622 - acc: 0.8014 - val_
Epoch 24/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1614 - acc: 0.8016 - val_
Epoch 25/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1603 - acc: 0.8017 - val_
Epoch 26/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1588 - acc: 0.8019 - val_
Epoch 27/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1574 - acc: 0.8021 - val_
Epoch 28/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1561 - acc: 0.8023 - val_
Epoch 29/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1549 - acc: 0.8025 - val_
Epoch 30/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1540 - acc: 0.8027 - val_
Epoch 31/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1533 - acc: 0.8028 - val_
Epoch 32/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1525 - acc: 0.8029 - val_
Epoch 33/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1519 - acc: 0.8030 - val_
Epoch 34/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1512 - acc: 0.8032 - val_
Epoch 35/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1506 - acc: 0.8033 - val_
Epoch 36/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1499 - acc: 0.8034 - val_
Epoch 37/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1495 - acc: 0.8035 - val_
Epoch 38/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1489 - acc: 0.8036 - val_
Epoch 39/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1484 - acc: 0.8037 - val_1
Epoch 40/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1480 - acc: 0.8038 - val_1
Epoch 41/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1475 - acc: 0.8038 - val_1
Epoch 42/500

60000/60000 [=====] - 6s 100us/step - loss: 0.1471 - acc: 0.8039 - val_1
Epoch 43/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1468 - acc: 0.8040 - val_1
Epoch 44/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1464 - acc: 0.8040 - val_1
Epoch 45/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1459 - acc: 0.8042 - val_1
Epoch 46/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1457 - acc: 0.8042 - val_1
Epoch 47/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1453 - acc: 0.8043 - val_1
Epoch 48/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1449 - acc: 0.8043 - val_1
Epoch 49/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1447 - acc: 0.8044 - val_1
Epoch 50/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1443 - acc: 0.8045 - val_1
Epoch 51/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1439 - acc: 0.8045 - val_1
Epoch 52/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1437 - acc: 0.8046 - val_1
Epoch 53/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1436 - acc: 0.8046 - val_1
Epoch 54/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1431 - acc: 0.8047 - val_1
Epoch 55/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1429 - acc: 0.8047 - val_1
Epoch 56/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1427 - acc: 0.8048 - val_1
Epoch 57/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1425 - acc: 0.8048 - val_1
Epoch 58/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1422 - acc: 0.8049 - val_1
Epoch 59/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1420 - acc: 0.8049 - val_1
Epoch 60/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1416 - acc: 0.8050 - val_1
Epoch 61/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1415 - acc: 0.8050 - val_1
Epoch 62/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1413 - acc: 0.8050 - val_1
Epoch 63/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1410 - acc: 0.8051 - val_1
Epoch 64/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1408 - acc: 0.8051 - val_1
Epoch 65/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1407 - acc: 0.8051 - val_1
Epoch 66/500


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60000/60000 [=====] - 6s 100us/step - loss: 0.1404 - acc: 0.8052 - val_
Epoch 67/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1402 - acc: 0.8052 - val_1
Epoch 68/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1402 - acc: 0.8052 - val_1
Epoch 69/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1398 - acc: 0.8053 - val_1
Epoch 70/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1398 - acc: 0.8054 - val_
Epoch 71/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1394 - acc: 0.8054 - val_1
Epoch 72/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1392 - acc: 0.8055 - val_1
Epoch 73/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1392 - acc: 0.8055 - val_1
Epoch 74/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1390 - acc: 0.8055 - val_1
Epoch 75/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1388 - acc: 0.8055 - val_1
Epoch 76/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1386 - acc: 0.8056 - val_1
Epoch 77/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1385 - acc: 0.8056 - val_1
Epoch 78/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1383 - acc: 0.8057 - val_1
Epoch 79/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1381 - acc: 0.8057 - val_
Epoch 80/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1380 - acc: 0.8057 - val_
Epoch 81/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1379 - acc: 0.8057 - val_1
Epoch 82/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1377 - acc: 0.8058 - val_1
Epoch 83/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1375 - acc: 0.8058 - val_1
Epoch 84/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1374 - acc: 0.8059 - val_1
Epoch 85/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1373 - acc: 0.8059 - val_1
Epoch 86/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1371 - acc: 0.8059 - val_1
Epoch 87/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1370 - acc: 0.8059 - val_1
Epoch 88/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1369 - acc: 0.8060 - val_1
Epoch 89/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1367 - acc: 0.8060 - val_
Epoch 90/500

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60000/60000 [=====] - 6s 99us/step - loss: 0.1366 - acc: 0.8060 - val_l
Epoch 91/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1364 - acc: 0.8061 - val_l
Epoch 92/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1364 - acc: 0.8061 - val_l
Epoch 93/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1361 - acc: 0.8061 - val_l
Epoch 94/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1360 - acc: 0.8062 - val_l
Epoch 95/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1360 - acc: 0.8062 - val_l
Epoch 96/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1358 - acc: 0.8062 - val_l
Epoch 97/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1357 - acc: 0.8062 - val_l
Epoch 98/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1355 - acc: 0.8063 - val_l
Epoch 99/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1356 - acc: 0.8063 - val_l
Epoch 100/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1353 - acc: 0.8063 - val_l
Epoch 101/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1351 - acc: 0.8064 - val_l
Epoch 102/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1351 - acc: 0.8064 - val_l
Epoch 103/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1350 - acc: 0.8064 - val_l
Epoch 104/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1349 - acc: 0.8064 - val_l
Epoch 105/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1347 - acc: 0.8065 - val_l
Epoch 106/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1347 - acc: 0.8065 - val_l
Epoch 107/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1345 - acc: 0.8065 - val_l
Epoch 108/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1345 - acc: 0.8065 - val_l
Epoch 109/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1344 - acc: 0.8065 - val_l
Epoch 110/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1341 - acc: 0.8066 - val_l
Epoch 111/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1342 - acc: 0.8066 - val_l
Epoch 112/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1338 - acc: 0.8067 - val_l
Epoch 113/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1339 - acc: 0.8067 - val_l
Epoch 114/500

```

```

60000/60000 [=====] - 6s 100us/step - loss: 0.1339 - acc: 0.8067 - val_
Epoch 115/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1337 - acc: 0.8067 - val_
Epoch 116/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1336 - acc: 0.8067 - val_
Epoch 117/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1335 - acc: 0.8067 - val_1
Epoch 118/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1334 - acc: 0.8068 - val_1
Epoch 119/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1333 - acc: 0.8068 - val_1
Epoch 120/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1332 - acc: 0.8068 - val_1
Epoch 121/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1330 - acc: 0.8069 - val_1
Epoch 122/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1332 - acc: 0.8068 - val_1
Epoch 123/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1330 - acc: 0.8069 - val_1
Epoch 124/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1328 - acc: 0.8069 - val_1
Epoch 125/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1328 - acc: 0.8069 - val_
Epoch 126/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1327 - acc: 0.8069 - val_1
Epoch 127/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1325 - acc: 0.8070 - val_
Epoch 128/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1325 - acc: 0.8070 - val_1
Epoch 129/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1325 - acc: 0.8070 - val_1
Epoch 130/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1323 - acc: 0.8070 - val_1
Epoch 131/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1324 - acc: 0.8070 - val_
Epoch 132/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1322 - acc: 0.8071 - val_1
Epoch 133/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1319 - acc: 0.8071 - val_
Epoch 134/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1320 - acc: 0.8071 - val_
Epoch 135/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1318 - acc: 0.8071 - val_1
Epoch 136/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1320 - acc: 0.8071 - val_1
Epoch 137/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1318 - acc: 0.8072 - val_
Epoch 138/500

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60000/60000 [=====] - 6s 99us/step - loss: 0.1317 - acc: 0.8072 - val_1
 Epoch 139/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1317 - acc: 0.8072 - val_1
 Epoch 140/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1316 - acc: 0.8072 - val_1
 Epoch 141/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1314 - acc: 0.8072 - val_1
 Epoch 142/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1314 - acc: 0.8073 - val_1
 Epoch 143/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1311 - acc: 0.8073 - val_1
 Epoch 144/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1311 - acc: 0.8073 - val_1
 Epoch 145/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1312 - acc: 0.8073 - val_1
 Epoch 146/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1311 - acc: 0.8073 - val_1
 Epoch 147/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1310 - acc: 0.8073 - val_1
 Epoch 148/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1310 - acc: 0.8073 - val_1
 Epoch 149/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1308 - acc: 0.8074 - val_1
 Epoch 150/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1308 - acc: 0.8074 - val_1
 Epoch 151/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1308 - acc: 0.8074 - val_1
 Epoch 152/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1306 - acc: 0.8074 - val_1
 Epoch 153/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1305 - acc: 0.8075 - val_1
 Epoch 154/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1307 - acc: 0.8074 - val_1
 Epoch 155/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1303 - acc: 0.8075 - val_1
 Epoch 156/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.1304 - acc: 0.8075 - val_1
 Epoch 157/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.1302 - acc: 0.8075 - val_1
 Epoch 158/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.1301 - acc: 0.8076 - val_1
 Epoch 159/500
 60000/60000 [=====] - 8s 141us/step - loss: 0.1300 - acc: 0.8076 - val_1
 Epoch 160/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1301 - acc: 0.8076 - val_1
 Epoch 161/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.1300 - acc: 0.8076 - val_1
 Epoch 162/500

60000/60000 [=====] - 7s 122us/step - loss: 0.1299 - acc: 0.8076 - val_
 Epoch 163/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.1298 - acc: 0.8076 - val_
 Epoch 164/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.1298 - acc: 0.8076 - val_
 Epoch 165/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.1297 - acc: 0.8076 - val_
 Epoch 166/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1297 - acc: 0.8076 - val_
 Epoch 167/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1296 - acc: 0.8077 - val_
 Epoch 168/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1295 - acc: 0.8077 - val_
 Epoch 169/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1295 - acc: 0.8077 - val_
 Epoch 170/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1295 - acc: 0.8077 - val_
 Epoch 171/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1293 - acc: 0.8077 - val_
 Epoch 172/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1293 - acc: 0.8077 - val_
 Epoch 173/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1292 - acc: 0.8078 - val_
 Epoch 174/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1292 - acc: 0.8078 - val_
 Epoch 175/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1292 - acc: 0.8078 - val_
 Epoch 176/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1291 - acc: 0.8078 - val_
 Epoch 177/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1290 - acc: 0.8078 - val_
 Epoch 178/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1291 - acc: 0.8078 - val_
 Epoch 179/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1289 - acc: 0.8078 - val_
 Epoch 180/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1287 - acc: 0.8079 - val_
 Epoch 181/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1287 - acc: 0.8079 - val_
 Epoch 182/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1288 - acc: 0.8079 - val_
 Epoch 183/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1286 - acc: 0.8079 - val_
 Epoch 184/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1286 - acc: 0.8079 - val_
 Epoch 185/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1286 - acc: 0.8079 - val_
 Epoch 186/500

60000/60000 [=====] - 6s 104us/step - loss: 0.1284 - acc: 0.8079 - val_
 Epoch 187/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1284 - acc: 0.8079 - val_
 Epoch 188/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1283 - acc: 0.8079 - val_
 Epoch 189/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1284 - acc: 0.8079 - val_
 Epoch 190/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1283 - acc: 0.8080 - val_
 Epoch 191/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1281 - acc: 0.8080 - val_
 Epoch 192/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1283 - acc: 0.8080 - val_
 Epoch 193/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1280 - acc: 0.8080 - val_
 Epoch 194/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1282 - acc: 0.8080 - val_
 Epoch 195/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1280 - acc: 0.8080 - val_
 Epoch 196/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1279 - acc: 0.8080 - val_
 Epoch 197/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1280 - acc: 0.8080 - val_
 Epoch 198/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1279 - acc: 0.8080 - val_
 Epoch 199/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1278 - acc: 0.8081 - val_
 Epoch 200/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1279 - acc: 0.8080 - val_
 Epoch 201/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1278 - acc: 0.8081 - val_
 Epoch 202/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1276 - acc: 0.8081 - val_
 Epoch 203/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1277 - acc: 0.8081 - val_
 Epoch 204/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1276 - acc: 0.8081 - val_
 Epoch 205/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1276 - acc: 0.8081 - val_
 Epoch 206/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1275 - acc: 0.8081 - val_
 Epoch 207/500
 60000/60000 [=====] - 8s 125us/step - loss: 0.1274 - acc: 0.8081 - val_
 Epoch 208/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.1274 - acc: 0.8081 - val_
 Epoch 209/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1273 - acc: 0.8082 - val_
 Epoch 210/500

60000/60000 [=====] - 8s 138us/step - loss: 0.1273 - acc: 0.8082 - val_
 Epoch 211/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.1272 - acc: 0.8082 - val_
 Epoch 212/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.1272 - acc: 0.8082 - val_
 Epoch 213/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1271 - acc: 0.8082 - val_
 Epoch 214/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1271 - acc: 0.8082 - val_1
 Epoch 215/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1271 - acc: 0.8082 - val_
 Epoch 216/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1268 - acc: 0.8083 - val_
 Epoch 217/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1269 - acc: 0.8082 - val_
 Epoch 218/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1270 - acc: 0.8082 - val_
 Epoch 219/500
 60000/60000 [=====] - 7s 125us/step - loss: 0.1268 - acc: 0.8083 - val_
 Epoch 220/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.1269 - acc: 0.8082 - val_
 Epoch 221/500
 60000/60000 [=====] - 9s 151us/step - loss: 0.1267 - acc: 0.8083 - val_
 Epoch 222/500
 60000/60000 [=====] - 9s 154us/step - loss: 0.1267 - acc: 0.8083 - val_
 Epoch 223/500
 60000/60000 [=====] - 8s 136us/step - loss: 0.1266 - acc: 0.8083 - val_
 Epoch 224/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.1267 - acc: 0.8083 - val_
 Epoch 225/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.1265 - acc: 0.8083 - val_
 Epoch 226/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1266 - acc: 0.8083 - val_
 Epoch 227/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1265 - acc: 0.8083 - val_1
 Epoch 228/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1265 - acc: 0.8083 - val_
 Epoch 229/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1265 - acc: 0.8083 - val_1
 Epoch 230/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1263 - acc: 0.8084 - val_
 Epoch 231/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1264 - acc: 0.8083 - val_1
 Epoch 232/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1263 - acc: 0.8084 - val_
 Epoch 233/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1263 - acc: 0.8084 - val_
 Epoch 234/500

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60000/60000 [=====] - 6s 97us/step - loss: 0.1263 - acc: 0.8083 - val_1
Epoch 235/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1261 - acc: 0.8084 - val_1
Epoch 236/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1262 - acc: 0.8084 - val_1
Epoch 237/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1262 - acc: 0.8084 - val_1
Epoch 238/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1259 - acc: 0.8084 - val_1
Epoch 239/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1261 - acc: 0.8084 - val_1
Epoch 240/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1260 - acc: 0.8084 - val_1
Epoch 241/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1259 - acc: 0.8084 - val_1
Epoch 242/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1259 - acc: 0.8084 - val_1
Epoch 243/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1259 - acc: 0.8084 - val_1
Epoch 244/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1258 - acc: 0.8084 - val_1
Epoch 245/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1258 - acc: 0.8085 - val_1
Epoch 246/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1256 - acc: 0.8085 - val_1
Epoch 247/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1258 - acc: 0.8084 - val_1
Epoch 248/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1258 - acc: 0.8084 - val_1
Epoch 249/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1255 - acc: 0.8085 - val_1
Epoch 250/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1257 - acc: 0.8085 - val_1
Epoch 251/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1256 - acc: 0.8085 - val_1
Epoch 252/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1256 - acc: 0.8085 - val_1
Epoch 253/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1255 - acc: 0.8085 - val_1
Epoch 254/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1255 - acc: 0.8085 - val_1
Epoch 255/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1254 - acc: 0.8085 - val_1
Epoch 256/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1254 - acc: 0.8085 - val_1
Epoch 257/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1254 - acc: 0.8085 - val_1
Epoch 258/500

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60000/60000 [=====] - 6s 97us/step - loss: 0.1254 - acc: 0.8085 - val_1
 Epoch 259/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1253 - acc: 0.8085 - val_1
 Epoch 260/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1253 - acc: 0.8085 - val_1
 Epoch 261/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1252 - acc: 0.8086 - val_1
 Epoch 262/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1252 - acc: 0.8086 - val_1
 Epoch 263/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1251 - acc: 0.8086 - val_1
 Epoch 264/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1251 - acc: 0.8086 - val_1
 Epoch 265/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1252 - acc: 0.8086 - val_1
 Epoch 266/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1251 - acc: 0.8086 - val_1
 Epoch 267/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1250 - acc: 0.8086 - val_1
 Epoch 268/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1250 - acc: 0.8086 - val_1
 Epoch 269/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1250 - acc: 0.8086 - val_1
 Epoch 270/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1250 - acc: 0.8086 - val_1
 Epoch 271/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1249 - acc: 0.8086 - val_1
 Epoch 272/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1249 - acc: 0.8086 - val_1
 Epoch 273/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1247 - acc: 0.8086 - val_1
 Epoch 274/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1249 - acc: 0.8086 - val_1
 Epoch 275/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1246 - acc: 0.8087 - val_1
 Epoch 276/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1247 - acc: 0.8086 - val_1
 Epoch 277/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1248 - acc: 0.8086 - val_1
 Epoch 278/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1245 - acc: 0.8087 - val_1
 Epoch 279/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1246 - acc: 0.8087 - val_1
 Epoch 280/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1246 - acc: 0.8087 - val_1
 Epoch 281/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1246 - acc: 0.8087 - val_1
 Epoch 282/500

60000/60000 [=====] - 6s 98us/step - loss: 0.1245 - acc: 0.8087 - val_1
 Epoch 283/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1245 - acc: 0.8087 - val_1
 Epoch 284/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1244 - acc: 0.8087 - val_1
 Epoch 285/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1246 - acc: 0.8087 - val_1
 Epoch 286/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1243 - acc: 0.8087 - val_1
 Epoch 287/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1244 - acc: 0.8087 - val_1
 Epoch 288/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1244 - acc: 0.8087 - val_1
 Epoch 289/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1243 - acc: 0.8087 - val_1
 Epoch 290/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1243 - acc: 0.8087 - val_1
 Epoch 291/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1243 - acc: 0.8087 - val_1
 Epoch 292/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1243 - acc: 0.8087 - val_1
 Epoch 293/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1242 - acc: 0.8087 - val_1
 Epoch 294/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1242 - acc: 0.8087 - val_1
 Epoch 295/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1242 - acc: 0.8087 - val_1
 Epoch 296/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1240 - acc: 0.8088 - val_1
 Epoch 297/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1241 - acc: 0.8088 - val_1
 Epoch 298/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1240 - acc: 0.8088 - val_1
 Epoch 299/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1240 - acc: 0.8088 - val_1
 Epoch 300/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1240 - acc: 0.8088 - val_1
 Epoch 301/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1240 - acc: 0.8088 - val_1
 Epoch 302/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1240 - acc: 0.8088 - val_1
 Epoch 303/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1239 - acc: 0.8088 - val_1
 Epoch 304/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1239 - acc: 0.8088 - val_1
 Epoch 305/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1238 - acc: 0.8088 - val_1
 Epoch 306/500

60000/60000 [=====] - 6s 99us/step - loss: 0.1238 - acc: 0.8088 - val_1
 Epoch 307/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1237 - acc: 0.8088 - val_1
 Epoch 308/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1238 - acc: 0.8088 - val_1
 Epoch 309/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1237 - acc: 0.8088 - val_1
 Epoch 310/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1238 - acc: 0.8088 - val_1
 Epoch 311/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1236 - acc: 0.8088 - val_1
 Epoch 312/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1237 - acc: 0.8088 - val_1
 Epoch 313/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1236 - acc: 0.8088 - val_1
 Epoch 314/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1236 - acc: 0.8088 - val_1
 Epoch 315/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1234 - acc: 0.8089 - val_1
 Epoch 316/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1235 - acc: 0.8089 - val_1
 Epoch 317/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1235 - acc: 0.8088 - val_1
 Epoch 318/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1234 - acc: 0.8089 - val_1
 Epoch 319/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1235 - acc: 0.8089 - val_1
 Epoch 320/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1234 - acc: 0.8089 - val_1
 Epoch 321/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1235 - acc: 0.8089 - val_1
 Epoch 322/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1234 - acc: 0.8089 - val_1
 Epoch 323/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1233 - acc: 0.8089 - val_1
 Epoch 324/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1234 - acc: 0.8089 - val_1
 Epoch 325/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1233 - acc: 0.8089 - val_1
 Epoch 326/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1233 - acc: 0.8089 - val_1
 Epoch 327/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1232 - acc: 0.8089 - val_1
 Epoch 328/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1232 - acc: 0.8089 - val_1
 Epoch 329/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1231 - acc: 0.8089 - val_1
 Epoch 330/500

60000/60000 [=====] - 6s 98us/step - loss: 0.1232 - acc: 0.8089 - val_1
 Epoch 331/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1232 - acc: 0.8089 - val_1
 Epoch 332/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1231 - acc: 0.8089 - val_1
 Epoch 333/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1231 - acc: 0.8089 - val_1
 Epoch 334/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1230 - acc: 0.8089 - val_1
 Epoch 335/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1231 - acc: 0.8089 - val_1
 Epoch 336/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1230 - acc: 0.8089 - val_1
 Epoch 337/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1231 - acc: 0.8089 - val_1
 Epoch 338/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1229 - acc: 0.8089 - val_1
 Epoch 339/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1230 - acc: 0.8089 - val_1
 Epoch 340/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1229 - acc: 0.8090 - val_1
 Epoch 341/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1229 - acc: 0.8090 - val_1
 Epoch 342/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1230 - acc: 0.8090 - val_1
 Epoch 343/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1229 - acc: 0.8090 - val_1
 Epoch 344/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1228 - acc: 0.8090 - val_1
 Epoch 345/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1229 - acc: 0.8090 - val_1
 Epoch 346/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1228 - acc: 0.8090 - val_1
 Epoch 347/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1228 - acc: 0.8090 - val_1
 Epoch 348/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1228 - acc: 0.8090 - val_1
 Epoch 349/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1226 - acc: 0.8090 - val_1
 Epoch 350/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1227 - acc: 0.8090 - val_1
 Epoch 351/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1227 - acc: 0.8090 - val_1
 Epoch 352/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1227 - acc: 0.8090 - val_1
 Epoch 353/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1226 - acc: 0.8090 - val_1
 Epoch 354/500

60000/60000 [=====] - 6s 97us/step - loss: 0.1226 - acc: 0.8090 - val_1
 Epoch 355/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1226 - acc: 0.8090 - val_1
 Epoch 356/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1225 - acc: 0.8090 - val_1
 Epoch 357/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1225 - acc: 0.8090 - val_1
 Epoch 358/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1226 - acc: 0.8090 - val_1
 Epoch 359/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1225 - acc: 0.8090 - val_1
 Epoch 360/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1225 - acc: 0.8090 - val_1
 Epoch 361/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1225 - acc: 0.8090 - val_1
 Epoch 362/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1225 - acc: 0.8090 - val_1
 Epoch 363/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1223 - acc: 0.8090 - val_1
 Epoch 364/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1224 - acc: 0.8090 - val_1
 Epoch 365/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1223 - acc: 0.8091 - val_1
 Epoch 366/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1222 - acc: 0.8091 - val_1
 Epoch 367/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1223 - acc: 0.8091 - val_1
 Epoch 368/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1223 - acc: 0.8091 - val_1
 Epoch 369/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1222 - acc: 0.8091 - val_1
 Epoch 370/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1222 - acc: 0.8091 - val_1
 Epoch 371/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1221 - acc: 0.8091 - val_1
 Epoch 372/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1222 - acc: 0.8091 - val_1
 Epoch 373/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1221 - acc: 0.8091 - val_1
 Epoch 374/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1222 - acc: 0.8091 - val_1
 Epoch 375/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1220 - acc: 0.8091 - val_1
 Epoch 376/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1222 - acc: 0.8091 - val_1
 Epoch 377/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1221 - acc: 0.8091 - val_1
 Epoch 378/500

60000/60000 [=====] - 6s 100us/step - loss: 0.1220 - acc: 0.8091 - val_
 Epoch 379/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1220 - acc: 0.8091 - val_l
 Epoch 380/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1220 - acc: 0.8091 - val_l
 Epoch 381/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1220 - acc: 0.8091 - val_
 Epoch 382/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1220 - acc: 0.8091 - val_l
 Epoch 383/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1220 - acc: 0.8091 - val_l
 Epoch 384/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1219 - acc: 0.8091 - val_l
 Epoch 385/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1219 - acc: 0.8091 - val_l
 Epoch 386/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1219 - acc: 0.8091 - val_
 Epoch 387/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1219 - acc: 0.8091 - val_l
 Epoch 388/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1219 - acc: 0.8091 - val_l
 Epoch 389/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1219 - acc: 0.8091 - val_l
 Epoch 390/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1218 - acc: 0.8092 - val_l
 Epoch 391/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1219 - acc: 0.8091 - val_
 Epoch 392/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1216 - acc: 0.8092 - val_
 Epoch 393/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1219 - acc: 0.8091 - val_
 Epoch 394/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1217 - acc: 0.8092 - val_l
 Epoch 395/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1218 - acc: 0.8092 - val_l
 Epoch 396/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1217 - acc: 0.8092 - val_
 Epoch 397/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1217 - acc: 0.8092 - val_
 Epoch 398/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1217 - acc: 0.8092 - val_l
 Epoch 399/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1217 - acc: 0.8092 - val_l
 Epoch 400/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1217 - acc: 0.8092 - val_
 Epoch 401/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1215 - acc: 0.8092 - val_
 Epoch 402/500

```

60000/60000 [=====] - 6s 99us/step - loss: 0.1216 - acc: 0.8092 - val_1
Epoch 403/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1215 - acc: 0.8092 - val_1
Epoch 404/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1215 - acc: 0.8092 - val_1
Epoch 405/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1215 - acc: 0.8092 - val_1
Epoch 406/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1215 - acc: 0.8092 - val_1
Epoch 407/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1214 - acc: 0.8092 - val_1
Epoch 408/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1215 - acc: 0.8092 - val_1
Epoch 409/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1214 - acc: 0.8092 - val_1
Epoch 410/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1214 - acc: 0.8092 - val_1
Epoch 411/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1214 - acc: 0.8092 - val_1
Epoch 412/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1213 - acc: 0.8092 - val_1
Epoch 413/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1213 - acc: 0.8092 - val_1
Epoch 414/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1213 - acc: 0.8092 - val_1
Epoch 415/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1213 - acc: 0.8092 - val_1
Epoch 416/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1213 - acc: 0.8092 - val_1
Epoch 417/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1214 - acc: 0.8092 - val_1
Epoch 418/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1213 - acc: 0.8092 - val_1
Epoch 419/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1213 - acc: 0.8092 - val_1
Epoch 420/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1213 - acc: 0.8092 - val_1
Epoch 421/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1212 - acc: 0.8092 - val_1
Epoch 422/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1212 - acc: 0.8092 - val_1
Epoch 423/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1211 - acc: 0.8093 - val_1
Epoch 424/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1213 - acc: 0.8093 - val_1
Epoch 425/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1212 - acc: 0.8093 - val_1
Epoch 426/500

```

60000/60000 [=====] - 6s 98us/step - loss: 0.1212 - acc: 0.8093 - val_1
Epoch 427/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1211 - acc: 0.8093 - val_1
Epoch 428/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1212 - acc: 0.8093 - val_1
Epoch 429/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1211 - acc: 0.8093 - val_1
Epoch 430/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1210 - acc: 0.8093 - val_1
Epoch 431/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1210 - acc: 0.8093 - val_1
Epoch 432/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1211 - acc: 0.8093 - val_1
Epoch 433/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1210 - acc: 0.8093 - val_1
Epoch 434/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1210 - acc: 0.8093 - val_1
Epoch 435/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1209 - acc: 0.8093 - val_1
Epoch 436/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1209 - acc: 0.8093 - val_1
Epoch 437/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1210 - acc: 0.8093 - val_1
Epoch 438/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1209 - acc: 0.8093 - val_1
Epoch 439/500
60000/60000 [=====] - 6s 95us/step - loss: 0.1208 - acc: 0.8093 - val_1
Epoch 440/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1209 - acc: 0.8093 - val_1
Epoch 441/500
60000/60000 [=====] - 6s 94us/step - loss: 0.1208 - acc: 0.8093 - val_1
Epoch 442/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1208 - acc: 0.8093 - val_1
Epoch 443/500
60000/60000 [=====] - 6s 95us/step - loss: 0.1208 - acc: 0.8093 - val_1
Epoch 444/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1208 - acc: 0.8093 - val_1
Epoch 445/500
60000/60000 [=====] - 6s 95us/step - loss: 0.1207 - acc: 0.8093 - val_1
Epoch 446/500
60000/60000 [=====] - 6s 95us/step - loss: 0.1208 - acc: 0.8093 - val_1
Epoch 447/500
60000/60000 [=====] - 6s 95us/step - loss: 0.1207 - acc: 0.8093 - val_1
Epoch 448/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1207 - acc: 0.8093 - val_1
Epoch 449/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1207 - acc: 0.8093 - val_1
Epoch 450/500

60000/60000 [=====] - 6s 96us/step - loss: 0.1207 - acc: 0.8093 - val_1
 Epoch 451/500
 60000/60000 [=====] - 6s 95us/step - loss: 0.1207 - acc: 0.8093 - val_1
 Epoch 452/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1207 - acc: 0.8093 - val_1
 Epoch 453/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1207 - acc: 0.8093 - val_1
 Epoch 454/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1206 - acc: 0.8093 - val_1
 Epoch 455/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1207 - acc: 0.8093 - val_1
 Epoch 456/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1206 - acc: 0.8093 - val_1
 Epoch 457/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1206 - acc: 0.8093 - val_1
 Epoch 458/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1206 - acc: 0.8094 - val_1
 Epoch 459/500
 60000/60000 [=====] - 6s 95us/step - loss: 0.1205 - acc: 0.8094 - val_1
 Epoch 460/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1205 - acc: 0.8094 - val_1
 Epoch 461/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1205 - acc: 0.8094 - val_1
 Epoch 462/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1206 - acc: 0.8094 - val_1
 Epoch 463/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1205 - acc: 0.8094 - val_1
 Epoch 464/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1204 - acc: 0.8094 - val_1
 Epoch 465/500
 60000/60000 [=====] - 6s 95us/step - loss: 0.1204 - acc: 0.8094 - val_1
 Epoch 466/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1205 - acc: 0.8094 - val_1
 Epoch 467/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1205 - acc: 0.8094 - val_1
 Epoch 468/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1204 - acc: 0.8094 - val_1
 Epoch 469/500
 60000/60000 [=====] - 6s 95us/step - loss: 0.1204 - acc: 0.8094 - val_1
 Epoch 470/500
 60000/60000 [=====] - 6s 95us/step - loss: 0.1204 - acc: 0.8094 - val_1
 Epoch 471/500
 60000/60000 [=====] - 6s 95us/step - loss: 0.1204 - acc: 0.8094 - val_1
 Epoch 472/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1204 - acc: 0.8094 - val_1
 Epoch 473/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1203 - acc: 0.8094 - val_1
 Epoch 474/500

60000/60000 [=====] - 6s 99us/step - loss: 0.1203 - acc: 0.8094 - val_1
 Epoch 475/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1203 - acc: 0.8094 - val_1
 Epoch 476/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1203 - acc: 0.8094 - val_1
 Epoch 477/500
 60000/60000 [=====] - 6s 95us/step - loss: 0.1203 - acc: 0.8094 - val_1
 Epoch 478/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1203 - acc: 0.8094 - val_1
 Epoch 479/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1202 - acc: 0.8094 - val_1
 Epoch 480/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1203 - acc: 0.8094 - val_1
 Epoch 481/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1202 - acc: 0.8094 - val_1
 Epoch 482/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1202 - acc: 0.8094 - val_1
 Epoch 483/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1203 - acc: 0.8094 - val_1
 Epoch 484/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1202 - acc: 0.8094 - val_1
 Epoch 485/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1202 - acc: 0.8094 - val_1
 Epoch 486/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1201 - acc: 0.8094 - val_1
 Epoch 487/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1201 - acc: 0.8094 - val_1
 Epoch 488/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1200 - acc: 0.8094 - val_1
 Epoch 489/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1202 - acc: 0.8094 - val_1
 Epoch 490/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1201 - acc: 0.8094 - val_1
 Epoch 491/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1200 - acc: 0.8094 - val_1
 Epoch 492/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1202 - acc: 0.8094 - val_1
 Epoch 493/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1200 - acc: 0.8094 - val_1
 Epoch 494/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1201 - acc: 0.8094 - val_1
 Epoch 495/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1200 - acc: 0.8094 - val_1
 Epoch 496/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1201 - acc: 0.8094 - val_1
 Epoch 497/500
 60000/60000 [=====] - 6s 95us/step - loss: 0.1199 - acc: 0.8094 - val_1
 Epoch 498/500

```

60000/60000 [=====] - 6s 95us/step - loss: 0.1200 - acc: 0.8094 - val_1
Epoch 499/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1199 - acc: 0.8095 - val_1
Epoch 500/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1199 - acc: 0.8095 - val_1

```

```

In [4]: # this is the size of our encoded representations
        encoding_dim = 8 # 32 floats -> compression of factor 24.5, assuming the input is 784 f

        # this is our input placeholder
        x = input_img = Input(shape=(784,))
        # "encoded" is the encoded representation of the input
        x = Dense(256, activation='relu')(x)
        x = Dense(128, activation='relu')(x)
        encoded = Dense(encoding_dim, activation='relu')(x)

        # "decoded" is the lossy reconstruction of the input
        x = Dense(128, activation='relu')(encoded)
        x = Dense(256, activation='relu')(x)
        decoded = Dense(784, activation='sigmoid')(x)

        # this model maps an input to its reconstruction
        autoencoder = Model(input_img, decoded)

        encoder = Model(input_img, encoded)

        # create a placeholder for an encoded (32-dimensional) input
        encoded_input = Input(shape=(encoding_dim,))
        # retrieve the last layer of the autoencoder model
        dcd1 = autoencoder.layers[-1]
        dcd2 = autoencoder.layers[-2]
        dcd3 = autoencoder.layers[-3]

        # create the decoder model
        decoder = Model(encoded_input, dcd1(dcd2(dcd3(encoded_input))))

        autoencoder.compile(optimizer='adadelta',
                            loss='binary_crossentropy',
                            metrics=['accuracy'])
        history8 = autoencoder.fit(xtrain, xtrain,
                                    epochs=500,
                                    batch_size=256,
                                    shuffle=True,
                                    validation_data=(xtest, xtest),
                                    callbacks=[TensorBoard(log_dir='/tmp/autoencoder/encoding_dim_
acc8 = autoencoder.evaluate(xtest,

```

```
xtest,  
verbose=0)
```

Train on 60000 samples, validate on 10000 samples

```
Epoch 1/500  
60000/60000 [=====] - 6s 104us/step - loss: 0.3561 - acc: 0.7551 - val_  
Epoch 2/500  
60000/60000 [=====] - 6s 99us/step - loss: 0.2586 - acc: 0.7955 - val_1  
Epoch 3/500  
60000/60000 [=====] - 6s 99us/step - loss: 0.2450 - acc: 0.7964 - val_1  
Epoch 4/500  
60000/60000 [=====] - 6s 106us/step - loss: 0.2260 - acc: 0.7942 - val_  
Epoch 5/500  
60000/60000 [=====] - 6s 99us/step - loss: 0.2120 - acc: 0.7954 - val_1  
Epoch 6/500  
60000/60000 [=====] - 6s 99us/step - loss: 0.1984 - acc: 0.7960 - val_1  
Epoch 7/500  
60000/60000 [=====] - 6s 100us/step - loss: 0.1907 - acc: 0.7966 - val_  
Epoch 8/500  
60000/60000 [=====] - 6s 100us/step - loss: 0.1836 - acc: 0.7975 - val_  
Epoch 9/500  
60000/60000 [=====] - 6s 103us/step - loss: 0.1780 - acc: 0.7986 - val_  
Epoch 10/500  
60000/60000 [=====] - 6s 99us/step - loss: 0.1729 - acc: 0.7998 - val_1  
Epoch 11/500  
60000/60000 [=====] - 6s 99us/step - loss: 0.1681 - acc: 0.8008 - val_1  
Epoch 12/500  
60000/60000 [=====] - 6s 99us/step - loss: 0.1642 - acc: 0.8016 - val_1  
Epoch 13/500  
60000/60000 [=====] - 6s 101us/step - loss: 0.1606 - acc: 0.8023 - val_  
Epoch 14/500  
60000/60000 [=====] - 6s 103us/step - loss: 0.1576 - acc: 0.8029 - val_  
Epoch 15/500  
60000/60000 [=====] - 6s 101us/step - loss: 0.1550 - acc: 0.8034 - val_  
Epoch 16/500  
60000/60000 [=====] - 6s 100us/step - loss: 0.1531 - acc: 0.8038 - val_  
Epoch 17/500  
60000/60000 [=====] - 6s 101us/step - loss: 0.1512 - acc: 0.8042 - val_  
Epoch 18/500  
60000/60000 [=====] - 6s 104us/step - loss: 0.1498 - acc: 0.8044 - val_  
Epoch 19/500  
60000/60000 [=====] - 6s 100us/step - loss: 0.1482 - acc: 0.8047 - val_  
Epoch 20/500  
60000/60000 [=====] - 6s 99us/step - loss: 0.1471 - acc: 0.8049 - val_1  
Epoch 21/500  
60000/60000 [=====] - 6s 99us/step - loss: 0.1461 - acc: 0.8051 - val_1  
Epoch 22/500  
60000/60000 [=====] - 6s 99us/step - loss: 0.1449 - acc: 0.8053 - val_1
```

Epoch 23/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1440 - acc: 0.8054 - val_
Epoch 24/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1432 - acc: 0.8056 - val_1
Epoch 25/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1423 - acc: 0.8057 - val_
Epoch 26/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1416 - acc: 0.8058 - val_
Epoch 27/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1408 - acc: 0.8060 - val_
Epoch 28/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1401 - acc: 0.8060 - val_
Epoch 29/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1393 - acc: 0.8062 - val_
Epoch 30/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1387 - acc: 0.8063 - val_
Epoch 31/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1381 - acc: 0.8064 - val_
Epoch 32/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1375 - acc: 0.8065 - val_
Epoch 33/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1369 - acc: 0.8065 - val_
Epoch 34/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1364 - acc: 0.8066 - val_
Epoch 35/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1358 - acc: 0.8067 - val_
Epoch 36/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1354 - acc: 0.8068 - val_
Epoch 37/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1347 - acc: 0.8069 - val_
Epoch 38/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1344 - acc: 0.8070 - val_
Epoch 39/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1338 - acc: 0.8071 - val_
Epoch 40/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1334 - acc: 0.8071 - val_
Epoch 41/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1329 - acc: 0.8072 - val_
Epoch 42/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1326 - acc: 0.8072 - val_
Epoch 43/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1323 - acc: 0.8073 - val_
Epoch 44/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1319 - acc: 0.8074 - val_
Epoch 45/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1315 - acc: 0.8074 - val_
Epoch 46/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1311 - acc: 0.8075 - val_

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Epoch 47/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1308 - acc: 0.8075 - val_
Epoch 48/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1304 - acc: 0.8076 - val_
Epoch 49/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1302 - acc: 0.8076 - val_
Epoch 50/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1298 - acc: 0.8077 - val_
Epoch 51/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1294 - acc: 0.8078 - val_
Epoch 52/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1292 - acc: 0.8078 - val_
Epoch 53/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1290 - acc: 0.8078 - val_
Epoch 54/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1286 - acc: 0.8079 - val_
Epoch 55/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1284 - acc: 0.8079 - val_
Epoch 56/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1282 - acc: 0.8080 - val_
Epoch 57/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1279 - acc: 0.8080 - val_
Epoch 58/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1277 - acc: 0.8080 - val_
Epoch 59/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1275 - acc: 0.8081 - val_
Epoch 60/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1274 - acc: 0.8081 - val_
Epoch 61/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1270 - acc: 0.8082 - val_
Epoch 62/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1268 - acc: 0.8082 - val_
Epoch 63/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1266 - acc: 0.8082 - val_
Epoch 64/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1264 - acc: 0.8083 - val_
Epoch 65/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1262 - acc: 0.8083 - val_
Epoch 66/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1259 - acc: 0.8083 - val_
Epoch 67/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1258 - acc: 0.8083 - val_
Epoch 68/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1255 - acc: 0.8084 - val_
Epoch 69/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1255 - acc: 0.8084 - val_
Epoch 70/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1251 - acc: 0.8085 - val_

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Epoch 71/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1251 - acc: 0.8085 - val_
Epoch 72/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1248 - acc: 0.8085 - val_1
Epoch 73/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1247 - acc: 0.8085 - val_
Epoch 74/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1245 - acc: 0.8086 - val_1
Epoch 75/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1244 - acc: 0.8086 - val_
Epoch 76/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1243 - acc: 0.8086 - val_1
Epoch 77/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1239 - acc: 0.8087 - val_
Epoch 78/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1239 - acc: 0.8087 - val_
Epoch 79/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1237 - acc: 0.8087 - val_
Epoch 80/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1235 - acc: 0.8087 - val_
Epoch 81/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1234 - acc: 0.8087 - val_
Epoch 82/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1233 - acc: 0.8088 - val_
Epoch 83/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1231 - acc: 0.8088 - val_
Epoch 84/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1230 - acc: 0.8088 - val_
Epoch 85/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1229 - acc: 0.8088 - val_1
Epoch 86/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1227 - acc: 0.8088 - val_
Epoch 87/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1225 - acc: 0.8089 - val_
Epoch 88/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1224 - acc: 0.8089 - val_
Epoch 89/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1223 - acc: 0.8089 - val_
Epoch 90/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1221 - acc: 0.8089 - val_
Epoch 91/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1221 - acc: 0.8090 - val_
Epoch 92/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1219 - acc: 0.8090 - val_
Epoch 93/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1217 - acc: 0.8090 - val_
Epoch 94/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1217 - acc: 0.8090 - val_

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Epoch 95/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1216 - acc: 0.8090 - val_
Epoch 96/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1214 - acc: 0.8091 - val_
Epoch 97/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1213 - acc: 0.8091 - val_
Epoch 98/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1212 - acc: 0.8091 - val_
Epoch 99/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1209 - acc: 0.8091 - val_
Epoch 100/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1209 - acc: 0.8092 - val_
Epoch 101/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1209 - acc: 0.8092 - val_
Epoch 102/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1207 - acc: 0.8092 - val_
Epoch 103/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1206 - acc: 0.8092 - val_
Epoch 104/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1206 - acc: 0.8092 - val_
Epoch 105/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1204 - acc: 0.8092 - val_
Epoch 106/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1203 - acc: 0.8092 - val_
Epoch 107/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1202 - acc: 0.8093 - val_
Epoch 108/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1200 - acc: 0.8093 - val_
Epoch 109/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1201 - acc: 0.8093 - val_
Epoch 110/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1200 - acc: 0.8093 - val_
Epoch 111/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1198 - acc: 0.8093 - val_
Epoch 112/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1198 - acc: 0.8093 - val_
Epoch 113/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1196 - acc: 0.8094 - val_
Epoch 114/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1196 - acc: 0.8094 - val_
Epoch 115/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1194 - acc: 0.8094 - val_
Epoch 116/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1193 - acc: 0.8094 - val_
Epoch 117/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1191 - acc: 0.8094 - val_
Epoch 118/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1193 - acc: 0.8094 - val_

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Epoch 119/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1190 - acc: 0.8095 - val_1
Epoch 120/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1190 - acc: 0.8095 - val_1
Epoch 121/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1189 - acc: 0.8095 - val_1
Epoch 122/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1188 - acc: 0.8095 - val_1
Epoch 123/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1188 - acc: 0.8095 - val_1
Epoch 124/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1185 - acc: 0.8095 - val_1
Epoch 125/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1185 - acc: 0.8095 - val_1
Epoch 126/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1185 - acc: 0.8095 - val_1
Epoch 127/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1184 - acc: 0.8096 - val_1
Epoch 128/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1183 - acc: 0.8096 - val_1
Epoch 129/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1182 - acc: 0.8096 - val_1
Epoch 130/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1183 - acc: 0.8096 - val_1
Epoch 131/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1182 - acc: 0.8096 - val_1
Epoch 132/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1181 - acc: 0.8096 - val_1
Epoch 133/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1180 - acc: 0.8096 - val_1
Epoch 134/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1178 - acc: 0.8097 - val_1
Epoch 135/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1179 - acc: 0.8096 - val_1
Epoch 136/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1177 - acc: 0.8097 - val_1
Epoch 137/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1176 - acc: 0.8097 - val_1
Epoch 138/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1176 - acc: 0.8097 - val_1
Epoch 139/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1175 - acc: 0.8097 - val_1
Epoch 140/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1175 - acc: 0.8097 - val_1
Epoch 141/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1174 - acc: 0.8097 - val_1
Epoch 142/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1173 - acc: 0.8097 - val_1

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Epoch 143/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1173 - acc: 0.8098 - val_
Epoch 144/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1171 - acc: 0.8098 - val_
Epoch 145/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1171 - acc: 0.8098 - val_
Epoch 146/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1170 - acc: 0.8098 - val_
Epoch 147/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1169 - acc: 0.8098 - val_
Epoch 148/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1170 - acc: 0.8098 - val_
Epoch 149/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1169 - acc: 0.8098 - val_
Epoch 150/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1168 - acc: 0.8098 - val_
Epoch 151/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1167 - acc: 0.8099 - val_
Epoch 152/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1166 - acc: 0.8099 - val_
Epoch 153/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1166 - acc: 0.8099 - val_
Epoch 154/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1165 - acc: 0.8099 - val_
Epoch 155/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1164 - acc: 0.8099 - val_
Epoch 156/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1165 - acc: 0.8099 - val_
Epoch 157/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1164 - acc: 0.8099 - val_
Epoch 158/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1163 - acc: 0.8099 - val_
Epoch 159/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1162 - acc: 0.8099 - val_
Epoch 160/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1162 - acc: 0.8099 - val_
Epoch 161/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1161 - acc: 0.8100 - val_
Epoch 162/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1161 - acc: 0.8099 - val_
Epoch 163/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1160 - acc: 0.8100 - val_
Epoch 164/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1160 - acc: 0.8100 - val_
Epoch 165/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1159 - acc: 0.8100 - val_
Epoch 166/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1159 - acc: 0.8100 - val_

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Epoch 167/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1158 - acc: 0.8100 - val_
Epoch 168/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1157 - acc: 0.8100 - val_
Epoch 169/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1156 - acc: 0.8100 - val_
Epoch 170/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1157 - acc: 0.8100 - val_
Epoch 171/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1156 - acc: 0.8100 - val_
Epoch 172/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1155 - acc: 0.8101 - val_
Epoch 173/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1156 - acc: 0.8100 - val_
Epoch 174/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1154 - acc: 0.8101 - val_
Epoch 175/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1153 - acc: 0.8101 - val_1
Epoch 176/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1153 - acc: 0.8101 - val_
Epoch 177/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1153 - acc: 0.8101 - val_1
Epoch 178/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1152 - acc: 0.8101 - val_1
Epoch 179/500
60000/60000 [=====] - 7s 108us/step - loss: 0.1151 - acc: 0.8101 - val_
Epoch 180/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1151 - acc: 0.8101 - val_1
Epoch 181/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1151 - acc: 0.8101 - val_
Epoch 182/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1150 - acc: 0.8101 - val_1
Epoch 183/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1149 - acc: 0.8102 - val_1
Epoch 184/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1150 - acc: 0.8101 - val_1
Epoch 185/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1149 - acc: 0.8102 - val_1
Epoch 186/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1149 - acc: 0.8102 - val_
Epoch 187/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1148 - acc: 0.8102 - val_
Epoch 188/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1148 - acc: 0.8102 - val_1
Epoch 189/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1147 - acc: 0.8102 - val_1
Epoch 190/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1146 - acc: 0.8102 - val_1

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Epoch 191/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1146 - acc: 0.8102 - val_1
Epoch 192/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1145 - acc: 0.8102 - val_1
Epoch 193/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1145 - acc: 0.8102 - val_1
Epoch 194/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1144 - acc: 0.8102 - val_1
Epoch 195/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1144 - acc: 0.8102 - val_1
Epoch 196/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1145 - acc: 0.8102 - val_1
Epoch 197/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1143 - acc: 0.8103 - val_1
Epoch 198/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1143 - acc: 0.8103 - val_1
Epoch 199/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1142 - acc: 0.8103 - val_1
Epoch 200/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1142 - acc: 0.8103 - val_1
Epoch 201/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1142 - acc: 0.8103 - val_1
Epoch 202/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1141 - acc: 0.8103 - val_1
Epoch 203/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1141 - acc: 0.8103 - val_1
Epoch 204/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1141 - acc: 0.8103 - val_1
Epoch 205/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1140 - acc: 0.8103 - val_1
Epoch 206/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1141 - acc: 0.8103 - val_1
Epoch 207/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1139 - acc: 0.8103 - val_1
Epoch 208/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1139 - acc: 0.8103 - val_1
Epoch 209/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1138 - acc: 0.8103 - val_1
Epoch 210/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1138 - acc: 0.8103 - val_1
Epoch 211/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1138 - acc: 0.8103 - val_1
Epoch 212/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1136 - acc: 0.8104 - val_1
Epoch 213/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1137 - acc: 0.8104 - val_1
Epoch 214/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1136 - acc: 0.8104 - val_1

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Epoch 215/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1136 - acc: 0.8104 - val_1
Epoch 216/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1136 - acc: 0.8104 - val_1
Epoch 217/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1136 - acc: 0.8104 - val_1
Epoch 218/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1134 - acc: 0.8104 - val_1
Epoch 219/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1135 - acc: 0.8104 - val_1
Epoch 220/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1133 - acc: 0.8104 - val_1
Epoch 221/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1134 - acc: 0.8104 - val_1
Epoch 222/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1133 - acc: 0.8104 - val_1
Epoch 223/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1133 - acc: 0.8104 - val_1
Epoch 224/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1132 - acc: 0.8104 - val_1
Epoch 225/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1132 - acc: 0.8104 - val_1
Epoch 226/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1132 - acc: 0.8104 - val_1
Epoch 227/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1132 - acc: 0.8105 - val_1
Epoch 228/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1131 - acc: 0.8105 - val_1
Epoch 229/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1131 - acc: 0.8105 - val_1
Epoch 230/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1131 - acc: 0.8105 - val_1
Epoch 231/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1130 - acc: 0.8105 - val_1
Epoch 232/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1130 - acc: 0.8105 - val_1
Epoch 233/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1128 - acc: 0.8105 - val_1
Epoch 234/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1128 - acc: 0.8105 - val_1
Epoch 235/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1129 - acc: 0.8105 - val_1
Epoch 236/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1128 - acc: 0.8105 - val_1
Epoch 237/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1128 - acc: 0.8105 - val_1
Epoch 238/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1128 - acc: 0.8105 - val_1

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Epoch 239/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1127 - acc: 0.8105 - val_1
Epoch 240/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1128 - acc: 0.8105 - val_1
Epoch 241/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1127 - acc: 0.8105 - val_1
Epoch 242/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1127 - acc: 0.8105 - val_1
Epoch 243/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1126 - acc: 0.8106 - val_1
Epoch 244/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1125 - acc: 0.8106 - val_1
Epoch 245/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1126 - acc: 0.8106 - val_1
Epoch 246/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1125 - acc: 0.8106 - val_1
Epoch 247/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1124 - acc: 0.8106 - val_1
Epoch 248/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1124 - acc: 0.8106 - val_1
Epoch 249/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1125 - acc: 0.8106 - val_1
Epoch 250/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1123 - acc: 0.8106 - val_1
Epoch 251/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1123 - acc: 0.8106 - val_1
Epoch 252/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1122 - acc: 0.8106 - val_1
Epoch 253/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1123 - acc: 0.8106 - val_1
Epoch 254/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1123 - acc: 0.8106 - val_1
Epoch 255/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1122 - acc: 0.8106 - val_1
Epoch 256/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1121 - acc: 0.8106 - val_1
Epoch 257/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1122 - acc: 0.8106 - val_1
Epoch 258/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1121 - acc: 0.8106 - val_1
Epoch 259/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1121 - acc: 0.8106 - val_1
Epoch 260/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1121 - acc: 0.8106 - val_1
Epoch 261/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1121 - acc: 0.8106 - val_1
Epoch 262/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1121 - acc: 0.8106 - val_1

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Epoch 263/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1120 - acc: 0.8107 - val_1
Epoch 264/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1120 - acc: 0.8107 - val_1
Epoch 265/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1119 - acc: 0.8107 - val_1
Epoch 266/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1119 - acc: 0.8107 - val_1
Epoch 267/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1119 - acc: 0.8107 - val_1
Epoch 268/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1119 - acc: 0.8107 - val_1
Epoch 269/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1119 - acc: 0.8107 - val_1
Epoch 270/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1118 - acc: 0.8107 - val_1
Epoch 271/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1117 - acc: 0.8107 - val_1
Epoch 272/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1117 - acc: 0.8107 - val_1
Epoch 273/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1117 - acc: 0.8107 - val_1
Epoch 274/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1117 - acc: 0.8107 - val_1
Epoch 275/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1116 - acc: 0.8107 - val_1
Epoch 276/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1115 - acc: 0.8107 - val_1
Epoch 277/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1115 - acc: 0.8107 - val_1
Epoch 278/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1117 - acc: 0.8107 - val_1
Epoch 279/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1115 - acc: 0.8107 - val_1
Epoch 280/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1115 - acc: 0.8107 - val_1
Epoch 281/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1115 - acc: 0.8107 - val_1
Epoch 282/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1114 - acc: 0.8108 - val_1
Epoch 283/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1114 - acc: 0.8108 - val_1
Epoch 284/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1114 - acc: 0.8108 - val_1
Epoch 285/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1113 - acc: 0.8108 - val_1
Epoch 286/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1114 - acc: 0.8108 - val_1

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Epoch 287/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1114 - acc: 0.8108 - val_1
Epoch 288/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1113 - acc: 0.8108 - val_1
Epoch 289/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1112 - acc: 0.8108 - val_1
Epoch 290/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1113 - acc: 0.8108 - val_1
Epoch 291/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1113 - acc: 0.8108 - val_1
Epoch 292/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1112 - acc: 0.8108 - val_1
Epoch 293/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1112 - acc: 0.8108 - val_1
Epoch 294/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1111 - acc: 0.8108 - val_1
Epoch 295/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1111 - acc: 0.8108 - val_1
Epoch 296/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1111 - acc: 0.8108 - val_1
Epoch 297/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1111 - acc: 0.8108 - val_1
Epoch 298/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1110 - acc: 0.8108 - val_1
Epoch 299/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1110 - acc: 0.8108 - val_1
Epoch 300/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1110 - acc: 0.8108 - val_1
Epoch 301/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1109 - acc: 0.8108 - val_1
Epoch 302/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1109 - acc: 0.8108 - val_1
Epoch 303/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1109 - acc: 0.8108 - val_1
Epoch 304/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1109 - acc: 0.8108 - val_1
Epoch 305/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1109 - acc: 0.8109 - val_1
Epoch 306/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1110 - acc: 0.8108 - val_1
Epoch 307/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1108 - acc: 0.8109 - val_1
Epoch 308/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1108 - acc: 0.8109 - val_1
Epoch 309/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1108 - acc: 0.8109 - val_1
Epoch 310/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1108 - acc: 0.8109 - val_1

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Epoch 311/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1107 - acc: 0.8109 - val_1
Epoch 312/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1106 - acc: 0.8109 - val_1
Epoch 313/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1106 - acc: 0.8109 - val_1
Epoch 314/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1106 - acc: 0.8109 - val_1
Epoch 315/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1106 - acc: 0.8109 - val_1
Epoch 316/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1105 - acc: 0.8109 - val_1
Epoch 317/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1106 - acc: 0.8109 - val_1
Epoch 318/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1105 - acc: 0.8109 - val_1
Epoch 319/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1105 - acc: 0.8109 - val_1
Epoch 320/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1105 - acc: 0.8109 - val_1
Epoch 321/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1104 - acc: 0.8109 - val_1
Epoch 322/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1104 - acc: 0.8109 - val_1
Epoch 323/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1104 - acc: 0.8109 - val_1
Epoch 324/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1105 - acc: 0.8109 - val_1
Epoch 325/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1103 - acc: 0.8109 - val_1
Epoch 326/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1104 - acc: 0.8109 - val_1
Epoch 327/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1104 - acc: 0.8109 - val_1
Epoch 328/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1103 - acc: 0.8109 - val_1
Epoch 329/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1103 - acc: 0.8109 - val_1
Epoch 330/500
60000/60000 [=====] - 8s 127us/step - loss: 0.1103 - acc: 0.8110 - val_1
Epoch 331/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1102 - acc: 0.8110 - val_1
Epoch 332/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1103 - acc: 0.8110 - val_1
Epoch 333/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1101 - acc: 0.8110 - val_1
Epoch 334/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1102 - acc: 0.8110 - val_1

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Epoch 335/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1102 - acc: 0.8110 - val_
Epoch 336/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1101 - acc: 0.8110 - val_
Epoch 337/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1101 - acc: 0.8110 - val_
Epoch 338/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1101 - acc: 0.8110 - val_
Epoch 339/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1101 - acc: 0.8110 - val_1
Epoch 340/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1101 - acc: 0.8110 - val_
Epoch 341/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1100 - acc: 0.8110 - val_
Epoch 342/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1100 - acc: 0.8110 - val_
Epoch 343/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1100 - acc: 0.8110 - val_1
Epoch 344/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1100 - acc: 0.8110 - val_
Epoch 345/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1098 - acc: 0.8110 - val_
Epoch 346/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1099 - acc: 0.8110 - val_
Epoch 347/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1099 - acc: 0.8110 - val_1
Epoch 348/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1099 - acc: 0.8110 - val_
Epoch 349/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1099 - acc: 0.8110 - val_1
Epoch 350/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1099 - acc: 0.8110 - val_1
Epoch 351/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1097 - acc: 0.8110 - val_
Epoch 352/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1099 - acc: 0.8110 - val_1
Epoch 353/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1098 - acc: 0.8110 - val_1
Epoch 354/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1098 - acc: 0.8110 - val_1
Epoch 355/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1098 - acc: 0.8110 - val_1
Epoch 356/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1097 - acc: 0.8110 - val_
Epoch 357/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1097 - acc: 0.8111 - val_1
Epoch 358/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1096 - acc: 0.8111 - val_1

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Epoch 359/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1096 - acc: 0.8111 - val_1

Epoch 360/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1097 - acc: 0.8111 - val_1

Epoch 361/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1096 - acc: 0.8111 - val_1

Epoch 362/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1096 - acc: 0.8111 - val_1

Epoch 363/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1096 - acc: 0.8111 - val_1

Epoch 364/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1096 - acc: 0.8111 - val_1

Epoch 365/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1096 - acc: 0.8111 - val_1

Epoch 366/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1095 - acc: 0.8111 - val_1

Epoch 367/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1096 - acc: 0.8111 - val_1

Epoch 368/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1095 - acc: 0.8111 - val_1

Epoch 369/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1095 - acc: 0.8111 - val_1

Epoch 370/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1094 - acc: 0.8111 - val_1

Epoch 371/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1093 - acc: 0.8111 - val_1

Epoch 372/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1095 - acc: 0.8111 - val_1

Epoch 373/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1093 - acc: 0.8111 - val_1

Epoch 374/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1093 - acc: 0.8111 - val_1

Epoch 375/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1094 - acc: 0.8111 - val_1

Epoch 376/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1094 - acc: 0.8111 - val_1

Epoch 377/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1093 - acc: 0.8111 - val_1

Epoch 378/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1093 - acc: 0.8111 - val_1

Epoch 379/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1093 - acc: 0.8111 - val_1

Epoch 380/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1093 - acc: 0.8111 - val_1

Epoch 381/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1092 - acc: 0.8111 - val_1

Epoch 382/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1092 - acc: 0.8111 - val_1

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Epoch 383/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1092 - acc: 0.8111 - val_1
Epoch 384/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1092 - acc: 0.8111 - val_1
Epoch 385/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1092 - acc: 0.8111 - val_1
Epoch 386/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1092 - acc: 0.8111 - val_1
Epoch 387/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1091 - acc: 0.8111 - val_1
Epoch 388/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1091 - acc: 0.8112 - val_1
Epoch 389/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1091 - acc: 0.8111 - val_1
Epoch 390/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1091 - acc: 0.8112 - val_1
Epoch 391/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1091 - acc: 0.8112 - val_1
Epoch 392/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1091 - acc: 0.8112 - val_1
Epoch 393/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1091 - acc: 0.8112 - val_1
Epoch 394/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1090 - acc: 0.8112 - val_1
Epoch 395/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1090 - acc: 0.8112 - val_1
Epoch 396/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1089 - acc: 0.8112 - val_1
Epoch 397/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1090 - acc: 0.8112 - val_1
Epoch 398/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1090 - acc: 0.8112 - val_1
Epoch 399/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1090 - acc: 0.8112 - val_1
Epoch 400/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1089 - acc: 0.8112 - val_1
Epoch 401/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1089 - acc: 0.8112 - val_1
Epoch 402/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1088 - acc: 0.8112 - val_1
Epoch 403/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1088 - acc: 0.8112 - val_1
Epoch 404/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1089 - acc: 0.8112 - val_1
Epoch 405/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1088 - acc: 0.8112 - val_1
Epoch 406/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1089 - acc: 0.8112 - val_1

```

Epoch 407/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1087 - acc: 0.8112 - val_1
Epoch 408/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1088 - acc: 0.8112 - val_1
Epoch 409/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1088 - acc: 0.8112 - val_1
Epoch 410/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1087 - acc: 0.8112 - val_1
Epoch 411/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1087 - acc: 0.8112 - val_1
Epoch 412/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1086 - acc: 0.8112 - val_1
Epoch 413/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1087 - acc: 0.8112 - val_1
Epoch 414/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1086 - acc: 0.8112 - val_1
Epoch 415/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1087 - acc: 0.8112 - val_1
Epoch 416/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1087 - acc: 0.8112 - val_1
Epoch 417/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1086 - acc: 0.8112 - val_1
Epoch 418/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1086 - acc: 0.8112 - val_1
Epoch 419/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1085 - acc: 0.8112 - val_1
Epoch 420/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1086 - acc: 0.8112 - val_1
Epoch 421/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1085 - acc: 0.8112 - val_1
Epoch 422/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1085 - acc: 0.8112 - val_1
Epoch 423/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1085 - acc: 0.8113 - val_1
Epoch 424/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1085 - acc: 0.8113 - val_1
Epoch 425/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1085 - acc: 0.8112 - val_1
Epoch 426/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1085 - acc: 0.8113 - val_1
Epoch 427/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1085 - acc: 0.8113 - val_1
Epoch 428/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1085 - acc: 0.8113 - val_1
Epoch 429/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1084 - acc: 0.8113 - val_1
Epoch 430/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1084 - acc: 0.8113 - val_1

Epoch 431/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1084 - acc: 0.8113 - val_
 Epoch 432/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1084 - acc: 0.8113 - val_l
 Epoch 433/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1084 - acc: 0.8113 - val_
 Epoch 434/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1084 - acc: 0.8113 - val_
 Epoch 435/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1083 - acc: 0.8113 - val_
 Epoch 436/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1083 - acc: 0.8113 - val_
 Epoch 437/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1083 - acc: 0.8113 - val_
 Epoch 438/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1082 - acc: 0.8113 - val_
 Epoch 439/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1082 - acc: 0.8113 - val_
 Epoch 440/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1083 - acc: 0.8113 - val_
 Epoch 441/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1083 - acc: 0.8113 - val_
 Epoch 442/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1082 - acc: 0.8113 - val_
 Epoch 443/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1081 - acc: 0.8113 - val_
 Epoch 444/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1082 - acc: 0.8113 - val_
 Epoch 445/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1082 - acc: 0.8113 - val_
 Epoch 446/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1082 - acc: 0.8113 - val_
 Epoch 447/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1080 - acc: 0.8113 - val_
 Epoch 448/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1082 - acc: 0.8113 - val_
 Epoch 449/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1081 - acc: 0.8113 - val_
 Epoch 450/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1081 - acc: 0.8113 - val_
 Epoch 451/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1082 - acc: 0.8113 - val_
 Epoch 452/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1081 - acc: 0.8113 - val_
 Epoch 453/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1081 - acc: 0.8113 - val_
 Epoch 454/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1080 - acc: 0.8113 - val_

Epoch 455/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1080 - acc: 0.8113 - val_
Epoch 456/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1079 - acc: 0.8113 - val_
Epoch 457/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1080 - acc: 0.8113 - val_
Epoch 458/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1079 - acc: 0.8113 - val_
Epoch 459/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1080 - acc: 0.8113 - val_
Epoch 460/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1080 - acc: 0.8113 - val_
Epoch 461/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1079 - acc: 0.8113 - val_
Epoch 462/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1080 - acc: 0.8113 - val_
Epoch 463/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1079 - acc: 0.8114 - val_
Epoch 464/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1079 - acc: 0.8113 - val_
Epoch 465/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1078 - acc: 0.8114 - val_
Epoch 466/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1079 - acc: 0.8113 - val_
Epoch 467/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1079 - acc: 0.8114 - val_l
Epoch 468/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1078 - acc: 0.8114 - val_
Epoch 469/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1078 - acc: 0.8114 - val_
Epoch 470/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1078 - acc: 0.8114 - val_
Epoch 471/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1078 - acc: 0.8114 - val_
Epoch 472/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1078 - acc: 0.8114 - val_
Epoch 473/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1077 - acc: 0.8114 - val_l
Epoch 474/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1079 - acc: 0.8114 - val_
Epoch 475/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1077 - acc: 0.8114 - val_
Epoch 476/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1078 - acc: 0.8114 - val_
Epoch 477/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1077 - acc: 0.8114 - val_
Epoch 478/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1077 - acc: 0.8114 - val_

```

Epoch 479/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1077 - acc: 0.8114 - val_
Epoch 480/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1076 - acc: 0.8114 - val_
Epoch 481/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1076 - acc: 0.8114 - val_
Epoch 482/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1076 - acc: 0.8114 - val_
Epoch 483/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1076 - acc: 0.8114 - val_
Epoch 484/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1076 - acc: 0.8114 - val_
Epoch 485/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1075 - acc: 0.8114 - val_
Epoch 486/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1076 - acc: 0.8114 - val_
Epoch 487/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1076 - acc: 0.8114 - val_
Epoch 488/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1076 - acc: 0.8114 - val_
Epoch 489/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1075 - acc: 0.8114 - val_
Epoch 490/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1076 - acc: 0.8114 - val_
Epoch 491/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1075 - acc: 0.8114 - val_
Epoch 492/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1076 - acc: 0.8114 - val_
Epoch 493/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1076 - acc: 0.8114 - val_
Epoch 494/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1075 - acc: 0.8114 - val_
Epoch 495/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1074 - acc: 0.8114 - val_
Epoch 496/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1075 - acc: 0.8114 - val_
Epoch 497/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1075 - acc: 0.8114 - val_
Epoch 498/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1074 - acc: 0.8114 - val_
Epoch 499/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1074 - acc: 0.8114 - val_
Epoch 500/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1074 - acc: 0.8114 - val_

```

In [6]: *# this is the size of our encoded representations*

encoding_dim = 10 *# 32 floats -> compression of factor 24.5, assuming the input is 784*


```

# this is our input placeholder
x = input_img = Input(shape=(784,))
# "encoded" is the encoded representation of the input
x = Dense(256, activation='relu')(x)
x = Dense(128, activation='relu')(x)
encoded = Dense(encoding_dim, activation='relu')(x)

# "decoded" is the lossy reconstruction of the input
x = Dense(128, activation='relu')(encoded)
x = Dense(256, activation='relu')(x)
decoded = Dense(784, activation='sigmoid')(x)

# this model maps an input to its reconstruction
autoencoder = Model(input_img, decoded)

encoder = Model(input_img, encoded)

# create a placeholder for an encoded (32-dimensional) input
encoded_input = Input(shape=(encoding_dim,))
# retrieve the last layer of the autoencoder model
dcd1 = autoencoder.layers[-1]
dcd2 = autoencoder.layers[-2]
dcd3 = autoencoder.layers[-3]

# create the decoder model
decoder = Model(encoded_input, dcd1(dcd2(dcd3(encoded_input))))

autoencoder.compile(optimizer='adadelta',
                    loss='binary_crossentropy',
                    metrics=['accuracy'])
history10 = autoencoder.fit(xtrain, xtrain,
                           epochs=500,
                           batch_size=256,
                           shuffle=True,
                           validation_data=(xtest, xtest),
                           callbacks=[TensorBoard(log_dir='/tmp/autoencoder/encoding_dim_')])
acc10 = autoencoder.evaluate(xtest,
                             xtest,
                             verbose=0)

```

Train on 60000 samples, validate on 10000 samples

Epoch 1/500

60000/60000 [=====] - 6s 102us/step - loss: 0.3452 - acc: 0.7501 - val_

Epoch 2/500

60000/60000 [=====] - 6s 95us/step - loss: 0.2568 - acc: 0.7957 - val_1

Epoch 3/500

60000/60000 [=====] - 6s 99us/step - loss: 0.2405 - acc: 0.7956 - val_1
Epoch 4/500
60000/60000 [=====] - 6s 98us/step - loss: 0.2238 - acc: 0.7950 - val_1
Epoch 5/500
60000/60000 [=====] - 6s 97us/step - loss: 0.2076 - acc: 0.7955 - val_1
Epoch 6/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1948 - acc: 0.7967 - val_1
Epoch 7/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1875 - acc: 0.7980 - val_1
Epoch 8/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1812 - acc: 0.7990 - val_1
Epoch 9/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1742 - acc: 0.8005 - val_1
Epoch 10/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1682 - acc: 0.8017 - val_1
Epoch 11/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1639 - acc: 0.8025 - val_1
Epoch 12/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1608 - acc: 0.8030 - val_1
Epoch 13/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1581 - acc: 0.8035 - val_1
Epoch 14/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1553 - acc: 0.8040 - val_1
Epoch 15/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1525 - acc: 0.8045 - val_1
Epoch 16/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1500 - acc: 0.8049 - val_1
Epoch 17/500
60000/60000 [=====] - 6s 95us/step - loss: 0.1479 - acc: 0.8053 - val_1
Epoch 18/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1460 - acc: 0.8056 - val_1
Epoch 19/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1445 - acc: 0.8059 - val_1
Epoch 20/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1432 - acc: 0.8061 - val_1
Epoch 21/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1419 - acc: 0.8063 - val_1
Epoch 22/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1408 - acc: 0.8064 - val_1
Epoch 23/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1398 - acc: 0.8066 - val_1
Epoch 24/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1389 - acc: 0.8067 - val_1
Epoch 25/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1379 - acc: 0.8069 - val_1
Epoch 26/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1372 - acc: 0.8070 - val_1
Epoch 27/500

60000/60000 [=====] - 6s 97us/step - loss: 0.1363 - acc: 0.8071 - val_1
 Epoch 28/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1357 - acc: 0.8072 - val_1
 Epoch 29/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1349 - acc: 0.8073 - val_1
 Epoch 30/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1343 - acc: 0.8074 - val_1
 Epoch 31/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1338 - acc: 0.8074 - val_1
 Epoch 32/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1332 - acc: 0.8075 - val_1
 Epoch 33/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1326 - acc: 0.8076 - val_1
 Epoch 34/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1321 - acc: 0.8077 - val_1
 Epoch 35/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1316 - acc: 0.8078 - val_1
 Epoch 36/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1311 - acc: 0.8079 - val_1
 Epoch 37/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1305 - acc: 0.8080 - val_1
 Epoch 38/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1302 - acc: 0.8080 - val_1
 Epoch 39/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1296 - acc: 0.8081 - val_1
 Epoch 40/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1292 - acc: 0.8081 - val_1
 Epoch 41/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1289 - acc: 0.8082 - val_1
 Epoch 42/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1284 - acc: 0.8082 - val_1
 Epoch 43/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1281 - acc: 0.8083 - val_1
 Epoch 44/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1276 - acc: 0.8084 - val_1
 Epoch 45/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1274 - acc: 0.8084 - val_1
 Epoch 46/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1270 - acc: 0.8085 - val_1
 Epoch 47/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1267 - acc: 0.8085 - val_1
 Epoch 48/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1263 - acc: 0.8086 - val_1
 Epoch 49/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1260 - acc: 0.8086 - val_1
 Epoch 50/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1256 - acc: 0.8087 - val_1
 Epoch 51/500

60000/60000 [=====] - 6s 97us/step - loss: 0.1253 - acc: 0.8088 - val_1
 Epoch 52/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1252 - acc: 0.8088 - val_1
 Epoch 53/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1248 - acc: 0.8088 - val_1
 Epoch 54/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1245 - acc: 0.8089 - val_1
 Epoch 55/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1242 - acc: 0.8089 - val_1
 Epoch 56/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1238 - acc: 0.8090 - val_1
 Epoch 57/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1236 - acc: 0.8090 - val_1
 Epoch 58/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1234 - acc: 0.8090 - val_1
 Epoch 59/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1232 - acc: 0.8091 - val_1
 Epoch 60/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1229 - acc: 0.8091 - val_1
 Epoch 61/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1227 - acc: 0.8092 - val_1
 Epoch 62/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1225 - acc: 0.8092 - val_1
 Epoch 63/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1220 - acc: 0.8093 - val_1
 Epoch 64/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1219 - acc: 0.8093 - val_1
 Epoch 65/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1215 - acc: 0.8093 - val_1
 Epoch 66/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1213 - acc: 0.8094 - val_1
 Epoch 67/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1211 - acc: 0.8094 - val_1
 Epoch 68/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1206 - acc: 0.8095 - val_1
 Epoch 69/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1203 - acc: 0.8096 - val_1
 Epoch 70/500
 60000/60000 [=====] - 6s 95us/step - loss: 0.1200 - acc: 0.8096 - val_1
 Epoch 71/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1196 - acc: 0.8097 - val_1
 Epoch 72/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1193 - acc: 0.8098 - val_1
 Epoch 73/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1191 - acc: 0.8098 - val_1
 Epoch 74/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1187 - acc: 0.8099 - val_1
 Epoch 75/500

60000/60000 [=====] - 6s 95us/step - loss: 0.1184 - acc: 0.8099 - val_1
 Epoch 76/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1182 - acc: 0.8100 - val_1
 Epoch 77/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1178 - acc: 0.8100 - val_1
 Epoch 78/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1177 - acc: 0.8100 - val_1
 Epoch 79/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1173 - acc: 0.8101 - val_1
 Epoch 80/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1172 - acc: 0.8101 - val_1
 Epoch 81/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1169 - acc: 0.8101 - val_1
 Epoch 82/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1167 - acc: 0.8102 - val_1
 Epoch 83/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1165 - acc: 0.8102 - val_1
 Epoch 84/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1163 - acc: 0.8102 - val_1
 Epoch 85/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1161 - acc: 0.8103 - val_1
 Epoch 86/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1159 - acc: 0.8103 - val_1
 Epoch 87/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1157 - acc: 0.8103 - val_1
 Epoch 88/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1155 - acc: 0.8104 - val_1
 Epoch 89/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1154 - acc: 0.8104 - val_1
 Epoch 90/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1151 - acc: 0.8104 - val_1
 Epoch 91/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1150 - acc: 0.8104 - val_1
 Epoch 92/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1148 - acc: 0.8105 - val_1
 Epoch 93/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1147 - acc: 0.8105 - val_1
 Epoch 94/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1146 - acc: 0.8105 - val_1
 Epoch 95/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1144 - acc: 0.8105 - val_1
 Epoch 96/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1141 - acc: 0.8106 - val_1
 Epoch 97/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1141 - acc: 0.8106 - val_1
 Epoch 98/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1140 - acc: 0.8106 - val_1
 Epoch 99/500

60000/60000 [=====] - 6s 96us/step - loss: 0.1137 - acc: 0.8106 - val_1
 Epoch 100/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1136 - acc: 0.8106 - val_1
 Epoch 101/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1134 - acc: 0.8107 - val_1
 Epoch 102/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1133 - acc: 0.8107 - val_1
 Epoch 103/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1133 - acc: 0.8107 - val_1
 Epoch 104/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1131 - acc: 0.8107 - val_1
 Epoch 105/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1129 - acc: 0.8107 - val_1
 Epoch 106/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1129 - acc: 0.8107 - val_1
 Epoch 107/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1127 - acc: 0.8107 - val_1
 Epoch 108/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1125 - acc: 0.8108 - val_1
 Epoch 109/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1124 - acc: 0.8108 - val_1
 Epoch 110/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1123 - acc: 0.8108 - val_1
 Epoch 111/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1123 - acc: 0.8108 - val_1
 Epoch 112/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1121 - acc: 0.8108 - val_1
 Epoch 113/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1120 - acc: 0.8109 - val_1
 Epoch 114/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1119 - acc: 0.8109 - val_1
 Epoch 115/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1118 - acc: 0.8109 - val_1
 Epoch 116/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1116 - acc: 0.8109 - val_1
 Epoch 117/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1115 - acc: 0.8109 - val_1
 Epoch 118/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1114 - acc: 0.8109 - val_1
 Epoch 119/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1114 - acc: 0.8109 - val_1
 Epoch 120/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1113 - acc: 0.8109 - val_1
 Epoch 121/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1112 - acc: 0.8110 - val_1
 Epoch 122/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1109 - acc: 0.8110 - val_1
 Epoch 123/500

60000/60000 [=====] - 6s 97us/step - loss: 0.1110 - acc: 0.8110 - val_l
 Epoch 124/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1108 - acc: 0.8110 - val_l
 Epoch 125/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1108 - acc: 0.8110 - val_l
 Epoch 126/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1107 - acc: 0.8110 - val_l
 Epoch 127/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1105 - acc: 0.8111 - val_l
 Epoch 128/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1105 - acc: 0.8111 - val_l
 Epoch 129/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1104 - acc: 0.8111 - val_l
 Epoch 130/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1102 - acc: 0.8111 - val_l
 Epoch 131/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1102 - acc: 0.8111 - val_l
 Epoch 132/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1102 - acc: 0.8111 - val_l
 Epoch 133/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1100 - acc: 0.8111 - val_l
 Epoch 134/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1099 - acc: 0.8111 - val_l
 Epoch 135/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1098 - acc: 0.8112 - val_l
 Epoch 136/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1098 - acc: 0.8112 - val_l
 Epoch 137/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1097 - acc: 0.8112 - val_l
 Epoch 138/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1096 - acc: 0.8112 - val_l
 Epoch 139/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1096 - acc: 0.8112 - val_l
 Epoch 140/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1094 - acc: 0.8112 - val_l
 Epoch 141/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1093 - acc: 0.8112 - val_l
 Epoch 142/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1092 - acc: 0.8112 - val_l
 Epoch 143/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1092 - acc: 0.8112 - val_l
 Epoch 144/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1092 - acc: 0.8112 - val_l
 Epoch 145/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1090 - acc: 0.8113 - val_l
 Epoch 146/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1089 - acc: 0.8113 - val_l
 Epoch 147/500

60000/60000 [=====] - 6s 98us/step - loss: 0.1089 - acc: 0.8113 - val_l
 Epoch 148/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1087 - acc: 0.8113 - val_l
 Epoch 149/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1087 - acc: 0.8113 - val_l
 Epoch 150/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1087 - acc: 0.8113 - val_l
 Epoch 151/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1086 - acc: 0.8113 - val_l
 Epoch 152/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1085 - acc: 0.8113 - val_l
 Epoch 153/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1085 - acc: 0.8113 - val_l
 Epoch 154/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1084 - acc: 0.8114 - val_l
 Epoch 155/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1083 - acc: 0.8114 - val_l
 Epoch 156/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1083 - acc: 0.8114 - val_l
 Epoch 157/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1080 - acc: 0.8114 - val_l
 Epoch 158/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1081 - acc: 0.8114 - val_l
 Epoch 159/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1080 - acc: 0.8114 - val_l
 Epoch 160/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1080 - acc: 0.8114 - val_l
 Epoch 161/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1079 - acc: 0.8114 - val_l
 Epoch 162/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1079 - acc: 0.8114 - val_l
 Epoch 163/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1078 - acc: 0.8114 - val_l
 Epoch 164/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1077 - acc: 0.8114 - val_l
 Epoch 165/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1077 - acc: 0.8114 - val_l
 Epoch 166/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1075 - acc: 0.8115 - val_l
 Epoch 167/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1076 - acc: 0.8115 - val_l
 Epoch 168/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1075 - acc: 0.8115 - val_l
 Epoch 169/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1074 - acc: 0.8115 - val_l
 Epoch 170/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1074 - acc: 0.8115 - val_l
 Epoch 171/500

60000/60000 [=====] - 6s 97us/step - loss: 0.1074 - acc: 0.8115 - val_1
 Epoch 172/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1072 - acc: 0.8115 - val_1
 Epoch 173/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1072 - acc: 0.8115 - val_1
 Epoch 174/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1071 - acc: 0.8115 - val_1
 Epoch 175/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1070 - acc: 0.8115 - val_1
 Epoch 176/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1069 - acc: 0.8115 - val_1
 Epoch 177/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1069 - acc: 0.8116 - val_1
 Epoch 178/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1069 - acc: 0.8115 - val_1
 Epoch 179/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1068 - acc: 0.8116 - val_1
 Epoch 180/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1068 - acc: 0.8116 - val_1
 Epoch 181/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1068 - acc: 0.8116 - val_1
 Epoch 182/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1067 - acc: 0.8116 - val_1
 Epoch 183/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1066 - acc: 0.8116 - val_1
 Epoch 184/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1066 - acc: 0.8116 - val_1
 Epoch 185/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1066 - acc: 0.8116 - val_1
 Epoch 186/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1064 - acc: 0.8116 - val_1
 Epoch 187/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1065 - acc: 0.8116 - val_1
 Epoch 188/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1065 - acc: 0.8116 - val_1
 Epoch 189/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1063 - acc: 0.8116 - val_1
 Epoch 190/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1063 - acc: 0.8116 - val_1
 Epoch 191/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1062 - acc: 0.8117 - val_1
 Epoch 192/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1063 - acc: 0.8116 - val_1
 Epoch 193/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1061 - acc: 0.8117 - val_1
 Epoch 194/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1061 - acc: 0.8117 - val_1
 Epoch 195/500

60000/60000 [=====] - 6s 97us/step - loss: 0.1061 - acc: 0.8117 - val_1
 Epoch 196/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1060 - acc: 0.8117 - val_1
 Epoch 197/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1059 - acc: 0.8117 - val_1
 Epoch 198/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1060 - acc: 0.8117 - val_1
 Epoch 199/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1058 - acc: 0.8117 - val_1
 Epoch 200/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1059 - acc: 0.8117 - val_1
 Epoch 201/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1058 - acc: 0.8117 - val_1
 Epoch 202/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1058 - acc: 0.8117 - val_1
 Epoch 203/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1057 - acc: 0.8117 - val_1
 Epoch 204/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1056 - acc: 0.8117 - val_1
 Epoch 205/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1056 - acc: 0.8117 - val_1
 Epoch 206/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1057 - acc: 0.8117 - val_1
 Epoch 207/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1055 - acc: 0.8118 - val_1
 Epoch 208/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1055 - acc: 0.8117 - val_1
 Epoch 209/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1055 - acc: 0.8118 - val_1
 Epoch 210/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1054 - acc: 0.8118 - val_1
 Epoch 211/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1054 - acc: 0.8118 - val_1
 Epoch 212/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1053 - acc: 0.8118 - val_1
 Epoch 213/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1052 - acc: 0.8118 - val_1
 Epoch 214/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1052 - acc: 0.8118 - val_1
 Epoch 215/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1052 - acc: 0.8118 - val_1
 Epoch 216/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1051 - acc: 0.8118 - val_1
 Epoch 217/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1051 - acc: 0.8118 - val_1
 Epoch 218/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1051 - acc: 0.8118 - val_1
 Epoch 219/500

60000/60000 [=====] - 6s 97us/step - loss: 0.1051 - acc: 0.8118 - val_1
 Epoch 220/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1049 - acc: 0.8118 - val_1
 Epoch 221/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1050 - acc: 0.8118 - val_1
 Epoch 222/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1050 - acc: 0.8118 - val_1
 Epoch 223/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1049 - acc: 0.8118 - val_1
 Epoch 224/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1048 - acc: 0.8119 - val_1
 Epoch 225/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1048 - acc: 0.8119 - val_1
 Epoch 226/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1047 - acc: 0.8119 - val_1
 Epoch 227/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1048 - acc: 0.8119 - val_1
 Epoch 228/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1046 - acc: 0.8119 - val_1
 Epoch 229/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1047 - acc: 0.8119 - val_1
 Epoch 230/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1047 - acc: 0.8119 - val_1
 Epoch 231/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1045 - acc: 0.8119 - val_1
 Epoch 232/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1046 - acc: 0.8119 - val_1
 Epoch 233/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1045 - acc: 0.8119 - val_1
 Epoch 234/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1045 - acc: 0.8119 - val_1
 Epoch 235/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1044 - acc: 0.8119 - val_1
 Epoch 236/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1044 - acc: 0.8119 - val_1
 Epoch 237/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1045 - acc: 0.8119 - val_1
 Epoch 238/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1043 - acc: 0.8119 - val_1
 Epoch 239/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1044 - acc: 0.8119 - val_1
 Epoch 240/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1042 - acc: 0.8119 - val_1
 Epoch 241/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1043 - acc: 0.8119 - val_1
 Epoch 242/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1042 - acc: 0.8119 - val_1
 Epoch 243/500

60000/60000 [=====] - 6s 97us/step - loss: 0.1041 - acc: 0.8120 - val_1
Epoch 244/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1042 - acc: 0.8120 - val_1
Epoch 245/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1042 - acc: 0.8119 - val_1
Epoch 246/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1041 - acc: 0.8120 - val_1
Epoch 247/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1041 - acc: 0.8120 - val_1
Epoch 248/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1040 - acc: 0.8120 - val_1
Epoch 249/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1039 - acc: 0.8120 - val_1
Epoch 250/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1040 - acc: 0.8120 - val_1
Epoch 251/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1040 - acc: 0.8120 - val_1
Epoch 252/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1038 - acc: 0.8120 - val_1
Epoch 253/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1038 - acc: 0.8120 - val_1
Epoch 254/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1038 - acc: 0.8120 - val_1
Epoch 255/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1039 - acc: 0.8120 - val_1
Epoch 256/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1038 - acc: 0.8120 - val_1
Epoch 257/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1037 - acc: 0.8120 - val_1
Epoch 258/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1037 - acc: 0.8120 - val_1
Epoch 259/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1036 - acc: 0.8120 - val_1
Epoch 260/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1037 - acc: 0.8120 - val_1
Epoch 261/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1035 - acc: 0.8120 - val_1
Epoch 262/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1036 - acc: 0.8120 - val_1
Epoch 263/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1035 - acc: 0.8121 - val_1
Epoch 264/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1035 - acc: 0.8120 - val_1
Epoch 265/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1035 - acc: 0.8120 - val_1
Epoch 266/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1033 - acc: 0.8121 - val_1
Epoch 267/500

60000/60000 [=====] - 6s 98us/step - loss: 0.1034 - acc: 0.8121 - val_1
 Epoch 268/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1034 - acc: 0.8121 - val_1
 Epoch 269/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1033 - acc: 0.8121 - val_1
 Epoch 270/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1033 - acc: 0.8121 - val_1
 Epoch 271/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1033 - acc: 0.8121 - val_1
 Epoch 272/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1033 - acc: 0.8121 - val_1
 Epoch 273/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1034 - acc: 0.8121 - val_1
 Epoch 274/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1031 - acc: 0.8121 - val_1
 Epoch 275/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1033 - acc: 0.8121 - val_1
 Epoch 276/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1031 - acc: 0.8121 - val_1
 Epoch 277/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1032 - acc: 0.8121 - val_1
 Epoch 278/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1031 - acc: 0.8121 - val_1
 Epoch 279/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1030 - acc: 0.8121 - val_1
 Epoch 280/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1031 - acc: 0.8121 - val_1
 Epoch 281/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1030 - acc: 0.8121 - val_1
 Epoch 282/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1030 - acc: 0.8121 - val_1
 Epoch 283/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1030 - acc: 0.8121 - val_1
 Epoch 284/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1029 - acc: 0.8121 - val_1
 Epoch 285/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1029 - acc: 0.8121 - val_1
 Epoch 286/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1029 - acc: 0.8121 - val_1
 Epoch 287/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1028 - acc: 0.8121 - val_1
 Epoch 288/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1028 - acc: 0.8121 - val_1
 Epoch 289/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1028 - acc: 0.8121 - val_1
 Epoch 290/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1028 - acc: 0.8121 - val_1
 Epoch 291/500

60000/60000 [=====] - 6s 98us/step - loss: 0.1028 - acc: 0.8122 - val_1
 Epoch 292/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1028 - acc: 0.8122 - val_1
 Epoch 293/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1027 - acc: 0.8122 - val_1
 Epoch 294/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1026 - acc: 0.8122 - val_1
 Epoch 295/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1027 - acc: 0.8122 - val_1
 Epoch 296/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1027 - acc: 0.8122 - val_1
 Epoch 297/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1025 - acc: 0.8122 - val_1
 Epoch 298/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1025 - acc: 0.8122 - val_1
 Epoch 299/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1026 - acc: 0.8122 - val_1
 Epoch 300/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1025 - acc: 0.8122 - val_1
 Epoch 301/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1025 - acc: 0.8122 - val_1
 Epoch 302/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1026 - acc: 0.8122 - val_1
 Epoch 303/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1026 - acc: 0.8122 - val_1
 Epoch 304/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1024 - acc: 0.8122 - val_1
 Epoch 305/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1024 - acc: 0.8122 - val_1
 Epoch 306/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1024 - acc: 0.8122 - val_1
 Epoch 307/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1024 - acc: 0.8122 - val_1
 Epoch 308/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1024 - acc: 0.8122 - val_1
 Epoch 309/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1022 - acc: 0.8122 - val_1
 Epoch 310/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1023 - acc: 0.8122 - val_1
 Epoch 311/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1023 - acc: 0.8122 - val_1
 Epoch 312/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1024 - acc: 0.8122 - val_1
 Epoch 313/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1021 - acc: 0.8122 - val_1
 Epoch 314/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1022 - acc: 0.8122 - val_1
 Epoch 315/500

60000/60000 [=====] - 6s 96us/step - loss: 0.1022 - acc: 0.8122 - val_1
 Epoch 316/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1021 - acc: 0.8123 - val_1
 Epoch 317/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1021 - acc: 0.8123 - val_1
 Epoch 318/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1020 - acc: 0.8123 - val_1
 Epoch 319/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1021 - acc: 0.8123 - val_1
 Epoch 320/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1020 - acc: 0.8123 - val_1
 Epoch 321/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1021 - acc: 0.8123 - val_1
 Epoch 322/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1020 - acc: 0.8123 - val_1
 Epoch 323/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1020 - acc: 0.8123 - val_1
 Epoch 324/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1020 - acc: 0.8123 - val_1
 Epoch 325/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1019 - acc: 0.8123 - val_1
 Epoch 326/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1020 - acc: 0.8123 - val_1
 Epoch 327/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1018 - acc: 0.8123 - val_1
 Epoch 328/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1019 - acc: 0.8123 - val_1
 Epoch 329/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1018 - acc: 0.8123 - val_1
 Epoch 330/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1019 - acc: 0.8123 - val_1
 Epoch 331/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1017 - acc: 0.8123 - val_1
 Epoch 332/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1018 - acc: 0.8123 - val_1
 Epoch 333/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1018 - acc: 0.8123 - val_1
 Epoch 334/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1017 - acc: 0.8123 - val_1
 Epoch 335/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1017 - acc: 0.8123 - val_1
 Epoch 336/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1018 - acc: 0.8123 - val_1
 Epoch 337/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1016 - acc: 0.8123 - val_1
 Epoch 338/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1017 - acc: 0.8123 - val_1
 Epoch 339/500

60000/60000 [=====] - 6s 98us/step - loss: 0.1017 - acc: 0.8123 - val_1
 Epoch 340/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1017 - acc: 0.8123 - val_1
 Epoch 341/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1015 - acc: 0.8123 - val_1
 Epoch 342/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1017 - acc: 0.8123 - val_1
 Epoch 343/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1016 - acc: 0.8123 - val_1
 Epoch 344/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1015 - acc: 0.8123 - val_1
 Epoch 345/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1015 - acc: 0.8123 - val_1
 Epoch 346/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1015 - acc: 0.8123 - val_1
 Epoch 347/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1014 - acc: 0.8124 - val_1
 Epoch 348/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1015 - acc: 0.8123 - val_1
 Epoch 349/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1014 - acc: 0.8124 - val_1
 Epoch 350/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1015 - acc: 0.8124 - val_1
 Epoch 351/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1014 - acc: 0.8124 - val_1
 Epoch 352/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1014 - acc: 0.8124 - val_1
 Epoch 353/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1015 - acc: 0.8124 - val_1
 Epoch 354/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1013 - acc: 0.8124 - val_1
 Epoch 355/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1013 - acc: 0.8124 - val_1
 Epoch 356/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1014 - acc: 0.8124 - val_1
 Epoch 357/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1013 - acc: 0.8124 - val_1
 Epoch 358/500
 60000/60000 [=====] - 6s 96us/step - loss: 0.1013 - acc: 0.8124 - val_1
 Epoch 359/500
 60000/60000 [=====] - 6s 98us/step - loss: 0.1012 - acc: 0.8124 - val_1
 Epoch 360/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1012 - acc: 0.8124 - val_1
 Epoch 361/500
 60000/60000 [=====] - 6s 97us/step - loss: 0.1012 - acc: 0.8124 - val_1
 Epoch 362/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1012 - acc: 0.8124 - val_1
 Epoch 363/500


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60000/60000 [=====] - 6s 98us/step - loss: 0.1012 - acc: 0.8124 - val_1
Epoch 364/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1011 - acc: 0.8124 - val_1
Epoch 365/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1011 - acc: 0.8124 - val_1
Epoch 366/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1012 - acc: 0.8124 - val_1
Epoch 367/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1010 - acc: 0.8124 - val_1
Epoch 368/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1012 - acc: 0.8124 - val_1
Epoch 369/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1011 - acc: 0.8124 - val_1
Epoch 370/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1010 - acc: 0.8124 - val_1
Epoch 371/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1011 - acc: 0.8124 - val_1
Epoch 372/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1011 - acc: 0.8124 - val_1
Epoch 373/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1010 - acc: 0.8124 - val_1
Epoch 374/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1010 - acc: 0.8124 - val_1
Epoch 375/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1010 - acc: 0.8124 - val_1
Epoch 376/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1009 - acc: 0.8124 - val_1
Epoch 377/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1009 - acc: 0.8124 - val_1
Epoch 378/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1008 - acc: 0.8124 - val_1
Epoch 379/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1009 - acc: 0.8124 - val_1
Epoch 380/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1008 - acc: 0.8124 - val_1
Epoch 381/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1009 - acc: 0.8124 - val_1
Epoch 382/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1008 - acc: 0.8125 - val_1
Epoch 383/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1008 - acc: 0.8124 - val_1
Epoch 384/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1007 - acc: 0.8125 - val_1
Epoch 385/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1008 - acc: 0.8125 - val_1
Epoch 386/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1008 - acc: 0.8125 - val_1
Epoch 387/500

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60000/60000 [=====] - 6s 97us/step - loss: 0.1007 - acc: 0.8125 - val_1
Epoch 388/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1007 - acc: 0.8125 - val_1
Epoch 389/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1007 - acc: 0.8125 - val_1
Epoch 390/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1007 - acc: 0.8125 - val_1
Epoch 391/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1007 - acc: 0.8125 - val_1
Epoch 392/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1007 - acc: 0.8125 - val_1
Epoch 393/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1006 - acc: 0.8125 - val_1
Epoch 394/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1006 - acc: 0.8125 - val_1
Epoch 395/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1006 - acc: 0.8125 - val_1
Epoch 396/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1006 - acc: 0.8125 - val_1
Epoch 397/500
60000/60000 [=====] - 6s 96us/step - loss: 0.1005 - acc: 0.8125 - val_1
Epoch 398/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1006 - acc: 0.8125 - val_1
Epoch 399/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1006 - acc: 0.8125 - val_1
Epoch 400/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1005 - acc: 0.8125 - val_1
Epoch 401/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1005 - acc: 0.8125 - val_1
Epoch 402/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1005 - acc: 0.8125 - val_1
Epoch 403/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1005 - acc: 0.8125 - val_1
Epoch 404/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1004 - acc: 0.8125 - val_1
Epoch 405/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1005 - acc: 0.8125 - val_1
Epoch 406/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1004 - acc: 0.8125 - val_1
Epoch 407/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1004 - acc: 0.8125 - val_1
Epoch 408/500
60000/60000 [=====] - 6s 98us/step - loss: 0.1004 - acc: 0.8125 - val_1
Epoch 409/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1004 - acc: 0.8125 - val_1
Epoch 410/500
60000/60000 [=====] - 6s 97us/step - loss: 0.1003 - acc: 0.8125 - val_1
Epoch 411/500

60000/60000 [=====] - 7s 116us/step - loss: 0.1004 - acc: 0.8125 - val_
 Epoch 412/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.1004 - acc: 0.8125 - val_
 Epoch 413/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1003 - acc: 0.8125 - val_
 Epoch 414/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.1003 - acc: 0.8125 - val_
 Epoch 415/500
 60000/60000 [=====] - 8s 139us/step - loss: 0.1003 - acc: 0.8125 - val_
 Epoch 416/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.1003 - acc: 0.8125 - val_
 Epoch 417/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1003 - acc: 0.8125 - val_
 Epoch 418/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.1002 - acc: 0.8125 - val_
 Epoch 419/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1003 - acc: 0.8125 - val_
 Epoch 420/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1002 - acc: 0.8125 - val_
 Epoch 421/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1002 - acc: 0.8125 - val_
 Epoch 422/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1002 - acc: 0.8125 - val_
 Epoch 423/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1002 - acc: 0.8125 - val_
 Epoch 424/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1001 - acc: 0.8125 - val_
 Epoch 425/500
 60000/60000 [=====] - 6s 99us/step - loss: 0.1002 - acc: 0.8125 - val_1
 Epoch 426/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1000 - acc: 0.8126 - val_
 Epoch 427/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1001 - acc: 0.8125 - val_
 Epoch 428/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1001 - acc: 0.8126 - val_
 Epoch 429/500
 60000/60000 [=====] - 6s 100us/step - loss: 0.1001 - acc: 0.8126 - val_
 Epoch 430/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1001 - acc: 0.8126 - val_
 Epoch 431/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1000 - acc: 0.8126 - val_
 Epoch 432/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1000 - acc: 0.8126 - val_
 Epoch 433/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1000 - acc: 0.8126 - val_
 Epoch 434/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.0999 - acc: 0.8126 - val_
 Epoch 435/500

60000/60000 [=====] - 6s 100us/step - loss: 0.1000 - acc: 0.8126 - val_
 Epoch 436/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.1000 - acc: 0.8126 - val_
 Epoch 437/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1000 - acc: 0.8126 - val_
 Epoch 438/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1000 - acc: 0.8126 - val_
 Epoch 439/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.0999 - acc: 0.8126 - val_
 Epoch 440/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.0999 - acc: 0.8126 - val_
 Epoch 441/500
 60000/60000 [=====] - 6s 101us/step - loss: 0.0998 - acc: 0.8126 - val_
 Epoch 442/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.0999 - acc: 0.8126 - val_
 Epoch 443/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.0999 - acc: 0.8126 - val_
 Epoch 444/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0999 - acc: 0.8126 - val_
 Epoch 445/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.0998 - acc: 0.8126 - val_
 Epoch 446/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0998 - acc: 0.8126 - val_
 Epoch 447/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.0999 - acc: 0.8126 - val_
 Epoch 448/500
 60000/60000 [=====] - 9s 144us/step - loss: 0.0999 - acc: 0.8126 - val_
 Epoch 449/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.0998 - acc: 0.8126 - val_
 Epoch 450/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0998 - acc: 0.8126 - val_
 Epoch 451/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.0998 - acc: 0.8126 - val_
 Epoch 452/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0998 - acc: 0.8126 - val_
 Epoch 453/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.0998 - acc: 0.8126 - val_
 Epoch 454/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.0997 - acc: 0.8126 - val_
 Epoch 455/500
 60000/60000 [=====] - 8s 137us/step - loss: 0.0997 - acc: 0.8126 - val_
 Epoch 456/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0997 - acc: 0.8126 - val_
 Epoch 457/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0997 - acc: 0.8126 - val_
 Epoch 458/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.0997 - acc: 0.8126 - val_
 Epoch 459/500

60000/60000 [=====] - 6s 108us/step - loss: 0.0997 - acc: 0.8126 - val_
 Epoch 460/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0997 - acc: 0.8126 - val_
 Epoch 461/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0997 - acc: 0.8126 - val_
 Epoch 462/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0996 - acc: 0.8126 - val_
 Epoch 463/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0997 - acc: 0.8126 - val_
 Epoch 464/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0996 - acc: 0.8126 - val_
 Epoch 465/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0996 - acc: 0.8126 - val_
 Epoch 466/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0996 - acc: 0.8126 - val_
 Epoch 467/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0995 - acc: 0.8126 - val_
 Epoch 468/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.0995 - acc: 0.8126 - val_
 Epoch 469/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.0995 - acc: 0.8126 - val_
 Epoch 470/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0995 - acc: 0.8126 - val_
 Epoch 471/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0995 - acc: 0.8126 - val_
 Epoch 472/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0995 - acc: 0.8126 - val_
 Epoch 473/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0996 - acc: 0.8126 - val_
 Epoch 474/500
 60000/60000 [=====] - 8s 136us/step - loss: 0.0996 - acc: 0.8126 - val_
 Epoch 475/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.0994 - acc: 0.8127 - val_
 Epoch 476/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.0995 - acc: 0.8126 - val_
 Epoch 477/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0995 - acc: 0.8126 - val_
 Epoch 478/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.0994 - acc: 0.8127 - val_
 Epoch 479/500
 60000/60000 [=====] - 9s 143us/step - loss: 0.0994 - acc: 0.8127 - val_
 Epoch 480/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.0994 - acc: 0.8127 - val_
 Epoch 481/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.0994 - acc: 0.8127 - val_
 Epoch 482/500
 60000/60000 [=====] - 7s 123us/step - loss: 0.0994 - acc: 0.8127 - val_
 Epoch 483/500

```

60000/60000 [=====] - 8s 127us/step - loss: 0.0993 - acc: 0.8127 - val_
Epoch 484/500
60000/60000 [=====] - 7s 116us/step - loss: 0.0993 - acc: 0.8127 - val_
Epoch 485/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0993 - acc: 0.8127 - val_
Epoch 486/500
60000/60000 [=====] - 9s 146us/step - loss: 0.0993 - acc: 0.8127 - val_
Epoch 487/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0992 - acc: 0.8127 - val_
Epoch 488/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0993 - acc: 0.8127 - val_
Epoch 489/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0993 - acc: 0.8127 - val_
Epoch 490/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0993 - acc: 0.8127 - val_
Epoch 491/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0993 - acc: 0.8127 - val_
Epoch 492/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0992 - acc: 0.8127 - val_
Epoch 493/500
60000/60000 [=====] - 9s 151us/step - loss: 0.0993 - acc: 0.8127 - val_
Epoch 494/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0993 - acc: 0.8127 - val_
Epoch 495/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0992 - acc: 0.8127 - val_
Epoch 496/500
60000/60000 [=====] - 7s 125us/step - loss: 0.0992 - acc: 0.8127 - val_
Epoch 497/500
60000/60000 [=====] - 7s 125us/step - loss: 0.0991 - acc: 0.8127 - val_
Epoch 498/500
60000/60000 [=====] - 7s 116us/step - loss: 0.0992 - acc: 0.8127 - val_
Epoch 499/500
60000/60000 [=====] - 7s 119us/step - loss: 0.0991 - acc: 0.8127 - val_
Epoch 500/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0991 - acc: 0.8127 - val_

```

```

In [7]: # this is the size of our encoded representations
        encoding_dim = 12 # 32 floats -> compression of factor 24.5, assuming the input is 784

        # this is our input placeholder
        x = input_img = Input(shape=(784,))
        # "encoded" is the encoded representation of the input
        x = Dense(256, activation='relu')(x)
        x = Dense(128, activation='relu')(x)
        encoded = Dense(encoding_dim, activation='relu')(x)

```

```

# "decoded" is the lossy reconstruction of the input
x = Dense(128, activation='relu')(encoded)
x = Dense(256, activation='relu')(x)
decoded = Dense(784, activation='sigmoid')(x)

# this model maps an input to its reconstruction
autoencoder = Model(input_img, decoded)

encoder = Model(input_img, encoded)

# create a placeholder for an encoded (32-dimensional) input
encoded_input = Input(shape=(encoding_dim,))
# retrieve the last layer of the autoencoder model
dcd1 = autoencoder.layers[-1]
dcd2 = autoencoder.layers[-2]
dcd3 = autoencoder.layers[-3]

# create the decoder model
decoder = Model(encoded_input, dcd1(dcd2(dcd3(encoded_input))))

autoencoder.compile(optimizer='adadelta',
                    loss='binary_crossentropy',
                    metrics=['accuracy'])
history12 = autoencoder.fit(xtrain, xtrain,
                           epochs=500,
                           batch_size=256,
                           shuffle=True,
                           validation_data=(xtest, xtest),
                           callbacks=[TensorBoard(log_dir='/tmp/autoencoder/encoding_dim_')])
acc12 = autoencoder.evaluate(xtest,
                             xtest,
                             verbose=0)

```

Train on 60000 samples, validate on 10000 samples

```

Epoch 1/500
60000/60000 [=====] - 8s 135us/step - loss: 0.3487 - acc: 0.7471 - val_
Epoch 2/500
60000/60000 [=====] - 8s 132us/step - loss: 0.2583 - acc: 0.7953 - val_
Epoch 3/500
60000/60000 [=====] - 9s 142us/step - loss: 0.2480 - acc: 0.7981 - val_
Epoch 4/500
60000/60000 [=====] - 8s 141us/step - loss: 0.2313 - acc: 0.7956 - val_
Epoch 5/500
60000/60000 [=====] - 8s 133us/step - loss: 0.2189 - acc: 0.7951 - val_
Epoch 6/500
60000/60000 [=====] - 8s 133us/step - loss: 0.2107 - acc: 0.7947 - val_
Epoch 7/500
60000/60000 [=====] - 7s 123us/step - loss: 0.2026 - acc: 0.7956 - val_

```

Epoch 8/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1925 - acc: 0.7964 - val_
Epoch 9/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1838 - acc: 0.7975 - val_
Epoch 10/500
60000/60000 [=====] - 8s 141us/step - loss: 0.1776 - acc: 0.7988 - val_
Epoch 11/500
60000/60000 [=====] - 8s 140us/step - loss: 0.1728 - acc: 0.7997 - val_
Epoch 12/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1688 - acc: 0.8006 - val_
Epoch 13/500
60000/60000 [=====] - 8s 139us/step - loss: 0.1654 - acc: 0.8013 - val_
Epoch 14/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1621 - acc: 0.8021 - val_
Epoch 15/500
60000/60000 [=====] - 8s 140us/step - loss: 0.1590 - acc: 0.8029 - val_
Epoch 16/500
60000/60000 [=====] - 8s 137us/step - loss: 0.1567 - acc: 0.8034 - val_
Epoch 17/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1544 - acc: 0.8039 - val_
Epoch 18/500
60000/60000 [=====] - 8s 136us/step - loss: 0.1521 - acc: 0.8043 - val_
Epoch 19/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1498 - acc: 0.8048 - val_
Epoch 20/500
60000/60000 [=====] - 8s 139us/step - loss: 0.1474 - acc: 0.8052 - val_
Epoch 21/500
60000/60000 [=====] - 8s 141us/step - loss: 0.1455 - acc: 0.8055 - val_
Epoch 22/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1438 - acc: 0.8058 - val_
Epoch 23/500
60000/60000 [=====] - 8s 137us/step - loss: 0.1425 - acc: 0.8060 - val_
Epoch 24/500
60000/60000 [=====] - 8s 137us/step - loss: 0.1410 - acc: 0.8063 - val_
Epoch 25/500
60000/60000 [=====] - 8s 126us/step - loss: 0.1397 - acc: 0.8065 - val_
Epoch 26/500
60000/60000 [=====] - 8s 127us/step - loss: 0.1383 - acc: 0.8068 - val_
Epoch 27/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1371 - acc: 0.8071 - val_
Epoch 28/500
60000/60000 [=====] - 8s 127us/step - loss: 0.1359 - acc: 0.8073 - val_
Epoch 29/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1348 - acc: 0.8075 - val_
Epoch 30/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1338 - acc: 0.8077 - val_
Epoch 31/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1331 - acc: 0.8078 - val_

Epoch 32/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1322 - acc: 0.8079 - val_
Epoch 33/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1315 - acc: 0.8080 - val_
Epoch 34/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1308 - acc: 0.8081 - val_
Epoch 35/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1302 - acc: 0.8082 - val_
Epoch 36/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1295 - acc: 0.8083 - val_
Epoch 37/500
60000/60000 [=====] - 8s 137us/step - loss: 0.1290 - acc: 0.8084 - val_
Epoch 38/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1283 - acc: 0.8085 - val_
Epoch 39/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1279 - acc: 0.8086 - val_
Epoch 40/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1275 - acc: 0.8086 - val_
Epoch 41/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1268 - acc: 0.8087 - val_
Epoch 42/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1264 - acc: 0.8088 - val_
Epoch 43/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1260 - acc: 0.8088 - val_
Epoch 44/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1255 - acc: 0.8089 - val_
Epoch 45/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1252 - acc: 0.8089 - val_
Epoch 46/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1249 - acc: 0.8090 - val_
Epoch 47/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1243 - acc: 0.8091 - val_
Epoch 48/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1240 - acc: 0.8091 - val_
Epoch 49/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1237 - acc: 0.8092 - val_
Epoch 50/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1233 - acc: 0.8092 - val_
Epoch 51/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1230 - acc: 0.8093 - val_
Epoch 52/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1227 - acc: 0.8093 - val_
Epoch 53/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1222 - acc: 0.8094 - val_
Epoch 54/500
60000/60000 [=====] - 6s 102us/step - loss: 0.1222 - acc: 0.8094 - val_
Epoch 55/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1218 - acc: 0.8094 - val_

```

Epoch 56/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1215 - acc: 0.8095 - val_
Epoch 57/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1213 - acc: 0.8095 - val_
Epoch 58/500
60000/60000 [=====] - 8s 141us/step - loss: 0.1210 - acc: 0.8095 - val_
Epoch 59/500
60000/60000 [=====] - 9s 142us/step - loss: 0.1207 - acc: 0.8096 - val_
Epoch 60/500
60000/60000 [=====] - 8s 141us/step - loss: 0.1205 - acc: 0.8096 - val_
Epoch 61/500
60000/60000 [=====] - 9s 143us/step - loss: 0.1201 - acc: 0.8097 - val_
Epoch 62/500
60000/60000 [=====] - 8s 136us/step - loss: 0.1200 - acc: 0.8097 - val_
Epoch 63/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1197 - acc: 0.8097 - val_
Epoch 64/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1194 - acc: 0.8098 - val_
Epoch 65/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1193 - acc: 0.8098 - val_
Epoch 66/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1191 - acc: 0.8098 - val_
Epoch 67/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1188 - acc: 0.8099 - val_
Epoch 68/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1186 - acc: 0.8099 - val_
Epoch 69/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1184 - acc: 0.8099 - val_
Epoch 70/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1182 - acc: 0.8099 - val_
Epoch 71/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1181 - acc: 0.8100 - val_
Epoch 72/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1178 - acc: 0.8100 - val_
Epoch 73/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1176 - acc: 0.8100 - val_
Epoch 74/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1174 - acc: 0.8100 - val_
Epoch 75/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1172 - acc: 0.8101 - val_
Epoch 76/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1170 - acc: 0.8101 - val_
Epoch 77/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1168 - acc: 0.8101 - val_
Epoch 78/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1168 - acc: 0.8101 - val_
Epoch 79/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1165 - acc: 0.8102 - val_

```

Epoch 80/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1163 - acc: 0.8102 - val_
 Epoch 81/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1163 - acc: 0.8102 - val_
 Epoch 82/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1160 - acc: 0.8103 - val_
 Epoch 83/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1160 - acc: 0.8102 - val_
 Epoch 84/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1158 - acc: 0.8103 - val_
 Epoch 85/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1155 - acc: 0.8103 - val_
 Epoch 86/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1155 - acc: 0.8103 - val_
 Epoch 87/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1153 - acc: 0.8103 - val_
 Epoch 88/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1151 - acc: 0.8104 - val_
 Epoch 89/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1150 - acc: 0.8104 - val_
 Epoch 90/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1149 - acc: 0.8104 - val_
 Epoch 91/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1147 - acc: 0.8104 - val_
 Epoch 92/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1146 - acc: 0.8104 - val_
 Epoch 93/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1145 - acc: 0.8105 - val_
 Epoch 94/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1142 - acc: 0.8105 - val_
 Epoch 95/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1142 - acc: 0.8105 - val_
 Epoch 96/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1140 - acc: 0.8105 - val_
 Epoch 97/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1140 - acc: 0.8105 - val_
 Epoch 98/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1138 - acc: 0.8106 - val_
 Epoch 99/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1137 - acc: 0.8106 - val_
 Epoch 100/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1136 - acc: 0.8106 - val_
 Epoch 101/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1135 - acc: 0.8106 - val_
 Epoch 102/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1133 - acc: 0.8106 - val_
 Epoch 103/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1132 - acc: 0.8106 - val_

```

Epoch 104/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1131 - acc: 0.8106 - val_
Epoch 105/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1130 - acc: 0.8107 - val_
Epoch 106/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1128 - acc: 0.8107 - val_
Epoch 107/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1128 - acc: 0.8107 - val_
Epoch 108/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1126 - acc: 0.8107 - val_
Epoch 109/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1126 - acc: 0.8107 - val_
Epoch 110/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1125 - acc: 0.8107 - val_
Epoch 111/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1124 - acc: 0.8107 - val_
Epoch 112/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1122 - acc: 0.8108 - val_
Epoch 113/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1122 - acc: 0.8108 - val_
Epoch 114/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1120 - acc: 0.8108 - val_
Epoch 115/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1120 - acc: 0.8108 - val_
Epoch 116/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1120 - acc: 0.8108 - val_
Epoch 117/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1117 - acc: 0.8108 - val_
Epoch 118/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1117 - acc: 0.8108 - val_
Epoch 119/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1116 - acc: 0.8109 - val_
Epoch 120/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1114 - acc: 0.8109 - val_
Epoch 121/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1114 - acc: 0.8109 - val_
Epoch 122/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1114 - acc: 0.8109 - val_
Epoch 123/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1112 - acc: 0.8109 - val_
Epoch 124/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1112 - acc: 0.8109 - val_
Epoch 125/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1110 - acc: 0.8109 - val_
Epoch 126/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1110 - acc: 0.8109 - val_
Epoch 127/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1108 - acc: 0.8110 - val_

```

Epoch 128/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1108 - acc: 0.8110 - val_
Epoch 129/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1107 - acc: 0.8110 - val_
Epoch 130/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1107 - acc: 0.8110 - val_
Epoch 131/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1105 - acc: 0.8110 - val_
Epoch 132/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1105 - acc: 0.8110 - val_
Epoch 133/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1104 - acc: 0.8110 - val_
Epoch 134/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1103 - acc: 0.8110 - val_
Epoch 135/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1102 - acc: 0.8110 - val_
Epoch 136/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1101 - acc: 0.8111 - val_
Epoch 137/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1101 - acc: 0.8111 - val_
Epoch 138/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1100 - acc: 0.8111 - val_
Epoch 139/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1100 - acc: 0.8111 - val_
Epoch 140/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1099 - acc: 0.8111 - val_
Epoch 141/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1099 - acc: 0.8111 - val_
Epoch 142/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1098 - acc: 0.8111 - val_
Epoch 143/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1096 - acc: 0.8111 - val_
Epoch 144/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1096 - acc: 0.8111 - val_
Epoch 145/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1096 - acc: 0.8111 - val_
Epoch 146/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1094 - acc: 0.8112 - val_
Epoch 147/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1094 - acc: 0.8112 - val_
Epoch 148/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1094 - acc: 0.8112 - val_
Epoch 149/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1093 - acc: 0.8112 - val_
Epoch 150/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1091 - acc: 0.8112 - val_
Epoch 151/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1092 - acc: 0.8112 - val_

Epoch 152/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1089 - acc: 0.8112 - val_
Epoch 153/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1091 - acc: 0.8112 - val_
Epoch 154/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1090 - acc: 0.8112 - val_
Epoch 155/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1089 - acc: 0.8112 - val_
Epoch 156/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1088 - acc: 0.8112 - val_
Epoch 157/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1087 - acc: 0.8113 - val_
Epoch 158/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1087 - acc: 0.8113 - val_
Epoch 159/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1086 - acc: 0.8113 - val_
Epoch 160/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1085 - acc: 0.8113 - val_
Epoch 161/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1085 - acc: 0.8113 - val_
Epoch 162/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1085 - acc: 0.8113 - val_
Epoch 163/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1085 - acc: 0.8113 - val_
Epoch 164/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1083 - acc: 0.8113 - val_
Epoch 165/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1083 - acc: 0.8113 - val_
Epoch 166/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1082 - acc: 0.8113 - val_
Epoch 167/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1081 - acc: 0.8113 - val_
Epoch 168/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1081 - acc: 0.8113 - val_
Epoch 169/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1081 - acc: 0.8113 - val_
Epoch 170/500
60000/60000 [=====] - 8s 131us/step - loss: 0.1080 - acc: 0.8114 - val_
Epoch 171/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1080 - acc: 0.8114 - val_
Epoch 172/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1079 - acc: 0.8114 - val_
Epoch 173/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1079 - acc: 0.8114 - val_
Epoch 174/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1077 - acc: 0.8114 - val_
Epoch 175/500
60000/60000 [=====] - 8s 140us/step - loss: 0.1078 - acc: 0.8114 - val_

Epoch 176/500
60000/60000 [=====] - 8s 126us/step - loss: 0.1077 - acc: 0.8114 - val_
Epoch 177/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1076 - acc: 0.8114 - val_
Epoch 178/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1074 - acc: 0.8114 - val_
Epoch 179/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1075 - acc: 0.8114 - val_
Epoch 180/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1075 - acc: 0.8114 - val_
Epoch 181/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1073 - acc: 0.8115 - val_
Epoch 182/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1073 - acc: 0.8115 - val_
Epoch 183/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1072 - acc: 0.8115 - val_
Epoch 184/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1073 - acc: 0.8115 - val_
Epoch 185/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1072 - acc: 0.8115 - val_
Epoch 186/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1072 - acc: 0.8115 - val_
Epoch 187/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1069 - acc: 0.8115 - val_
Epoch 188/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1071 - acc: 0.8115 - val_
Epoch 189/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1070 - acc: 0.8115 - val_
Epoch 190/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1069 - acc: 0.8115 - val_
Epoch 191/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1067 - acc: 0.8115 - val_
Epoch 192/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1069 - acc: 0.8115 - val_
Epoch 193/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1068 - acc: 0.8115 - val_
Epoch 194/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1066 - acc: 0.8116 - val_
Epoch 195/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1066 - acc: 0.8116 - val_
Epoch 196/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1066 - acc: 0.8116 - val_
Epoch 197/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1065 - acc: 0.8116 - val_
Epoch 198/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1064 - acc: 0.8116 - val_
Epoch 199/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1063 - acc: 0.8116 - val_

```

Epoch 200/500
60000/60000 [=====] - 7s 108us/step - loss: 0.1062 - acc: 0.8117 - val_
Epoch 201/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1062 - acc: 0.8117 - val_
Epoch 202/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1061 - acc: 0.8117 - val_
Epoch 203/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1060 - acc: 0.8117 - val_
Epoch 204/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1059 - acc: 0.8117 - val_
Epoch 205/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1058 - acc: 0.8117 - val_
Epoch 206/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1057 - acc: 0.8117 - val_
Epoch 207/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1057 - acc: 0.8117 - val_
Epoch 208/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1055 - acc: 0.8118 - val_
Epoch 209/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1056 - acc: 0.8118 - val_
Epoch 210/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1054 - acc: 0.8118 - val_
Epoch 211/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1053 - acc: 0.8118 - val_
Epoch 212/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1053 - acc: 0.8118 - val_
Epoch 213/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1051 - acc: 0.8118 - val_
Epoch 214/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1051 - acc: 0.8118 - val_
Epoch 215/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1051 - acc: 0.8119 - val_
Epoch 216/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1051 - acc: 0.8119 - val_
Epoch 217/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1049 - acc: 0.8119 - val_
Epoch 218/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1049 - acc: 0.8119 - val_
Epoch 219/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1048 - acc: 0.8119 - val_
Epoch 220/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1047 - acc: 0.8119 - val_
Epoch 221/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1046 - acc: 0.8119 - val_
Epoch 222/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1046 - acc: 0.8119 - val_
Epoch 223/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1045 - acc: 0.8119 - val_

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Epoch 224/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1044 - acc: 0.8119 - val_
Epoch 225/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1044 - acc: 0.8120 - val_
Epoch 226/500
60000/60000 [=====] - 7s 108us/step - loss: 0.1043 - acc: 0.8120 - val_
Epoch 227/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1042 - acc: 0.8120 - val_
Epoch 228/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1042 - acc: 0.8120 - val_
Epoch 229/500
60000/60000 [=====] - 8s 127us/step - loss: 0.1042 - acc: 0.8120 - val_
Epoch 230/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1041 - acc: 0.8120 - val_
Epoch 231/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1040 - acc: 0.8120 - val_
Epoch 232/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1040 - acc: 0.8120 - val_
Epoch 233/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1040 - acc: 0.8120 - val_
Epoch 234/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1038 - acc: 0.8120 - val_
Epoch 235/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1038 - acc: 0.8120 - val_
Epoch 236/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1038 - acc: 0.8120 - val_
Epoch 237/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1037 - acc: 0.8121 - val_
Epoch 238/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1036 - acc: 0.8121 - val_
Epoch 239/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1036 - acc: 0.8121 - val_
Epoch 240/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1035 - acc: 0.8121 - val_
Epoch 241/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1035 - acc: 0.8121 - val_
Epoch 242/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1034 - acc: 0.8121 - val_
Epoch 243/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1034 - acc: 0.8121 - val_
Epoch 244/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1034 - acc: 0.8121 - val_
Epoch 245/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1033 - acc: 0.8121 - val_
Epoch 246/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1032 - acc: 0.8121 - val_
Epoch 247/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1031 - acc: 0.8121 - val_

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Epoch 248/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1031 - acc: 0.8121 - val_
Epoch 249/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1031 - acc: 0.8121 - val_
Epoch 250/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1031 - acc: 0.8121 - val_
Epoch 251/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1030 - acc: 0.8122 - val_
Epoch 252/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1030 - acc: 0.8121 - val_
Epoch 253/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1029 - acc: 0.8122 - val_
Epoch 254/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1030 - acc: 0.8122 - val_
Epoch 255/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1028 - acc: 0.8122 - val_
Epoch 256/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1028 - acc: 0.8122 - val_
Epoch 257/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1027 - acc: 0.8122 - val_
Epoch 258/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1027 - acc: 0.8122 - val_
Epoch 259/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1026 - acc: 0.8122 - val_
Epoch 260/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1027 - acc: 0.8122 - val_
Epoch 261/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1025 - acc: 0.8122 - val_
Epoch 262/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1025 - acc: 0.8122 - val_
Epoch 263/500
60000/60000 [=====] - 7s 108us/step - loss: 0.1025 - acc: 0.8122 - val_
Epoch 264/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1023 - acc: 0.8122 - val_
Epoch 265/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1025 - acc: 0.8122 - val_
Epoch 266/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1024 - acc: 0.8122 - val_
Epoch 267/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1023 - acc: 0.8123 - val_
Epoch 268/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1023 - acc: 0.8123 - val_
Epoch 269/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1023 - acc: 0.8123 - val_
Epoch 270/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1022 - acc: 0.8123 - val_
Epoch 271/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1023 - acc: 0.8123 - val_

Epoch 272/500
60000/60000 [=====] - 7s 108us/step - loss: 0.1020 - acc: 0.8123 - val_
Epoch 273/500
60000/60000 [=====] - 7s 108us/step - loss: 0.1021 - acc: 0.8123 - val_
Epoch 274/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1021 - acc: 0.8123 - val_
Epoch 275/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1020 - acc: 0.8123 - val_
Epoch 276/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1020 - acc: 0.8123 - val_
Epoch 277/500
60000/60000 [=====] - 8s 127us/step - loss: 0.1019 - acc: 0.8123 - val_
Epoch 278/500
60000/60000 [=====] - 8s 138us/step - loss: 0.1019 - acc: 0.8123 - val_
Epoch 279/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1019 - acc: 0.8123 - val_
Epoch 280/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1018 - acc: 0.8123 - val_
Epoch 281/500
60000/60000 [=====] - 9s 150us/step - loss: 0.1017 - acc: 0.8123 - val_
Epoch 282/500
60000/60000 [=====] - 8s 125us/step - loss: 0.1018 - acc: 0.8123 - val_
Epoch 283/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1017 - acc: 0.8123 - val_
Epoch 284/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1017 - acc: 0.8123 - val_
Epoch 285/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1016 - acc: 0.8123 - val_
Epoch 286/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1016 - acc: 0.8123 - val_
Epoch 287/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1015 - acc: 0.8123 - val_
Epoch 288/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1015 - acc: 0.8123 - val_
Epoch 289/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1015 - acc: 0.8124 - val_
Epoch 290/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1015 - acc: 0.8124 - val_
Epoch 291/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1015 - acc: 0.8124 - val_
Epoch 292/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1015 - acc: 0.8124 - val_
Epoch 293/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1013 - acc: 0.8124 - val_
Epoch 294/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1014 - acc: 0.8124 - val_
Epoch 295/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1013 - acc: 0.8124 - val_

Epoch 296/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.1013 - acc: 0.8124 - val_
 Epoch 297/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.1013 - acc: 0.8124 - val_
 Epoch 298/500
 60000/60000 [=====] - 9s 143us/step - loss: 0.1012 - acc: 0.8124 - val_
 Epoch 299/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.1013 - acc: 0.8124 - val_
 Epoch 300/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1012 - acc: 0.8124 - val_
 Epoch 301/500
 60000/60000 [=====] - 7s 125us/step - loss: 0.1011 - acc: 0.8124 - val_
 Epoch 302/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1010 - acc: 0.8124 - val_
 Epoch 303/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1011 - acc: 0.8124 - val_
 Epoch 304/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.1010 - acc: 0.8124 - val_
 Epoch 305/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1009 - acc: 0.8124 - val_
 Epoch 306/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.1009 - acc: 0.8124 - val_
 Epoch 307/500
 60000/60000 [=====] - 9s 148us/step - loss: 0.1009 - acc: 0.8124 - val_
 Epoch 308/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.1010 - acc: 0.8124 - val_
 Epoch 309/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1009 - acc: 0.8124 - val_
 Epoch 310/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.1009 - acc: 0.8124 - val_
 Epoch 311/500
 60000/60000 [=====] - 8s 139us/step - loss: 0.1008 - acc: 0.8124 - val_
 Epoch 312/500
 60000/60000 [=====] - 9s 148us/step - loss: 0.1008 - acc: 0.8124 - val_
 Epoch 313/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.1007 - acc: 0.8125 - val_
 Epoch 314/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1006 - acc: 0.8125 - val_
 Epoch 315/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.1007 - acc: 0.8125 - val_
 Epoch 316/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1007 - acc: 0.8125 - val_
 Epoch 317/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1006 - acc: 0.8125 - val_
 Epoch 318/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1006 - acc: 0.8125 - val_
 Epoch 319/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1006 - acc: 0.8125 - val_

Epoch 320/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1006 - acc: 0.8125 - val_
Epoch 321/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1006 - acc: 0.8125 - val_
Epoch 322/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1004 - acc: 0.8125 - val_
Epoch 323/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1005 - acc: 0.8125 - val_
Epoch 324/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1004 - acc: 0.8125 - val_
Epoch 325/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1004 - acc: 0.8125 - val_
Epoch 326/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1003 - acc: 0.8125 - val_
Epoch 327/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1003 - acc: 0.8125 - val_
Epoch 328/500
60000/60000 [=====] - 8s 137us/step - loss: 0.1004 - acc: 0.8125 - val_
Epoch 329/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1003 - acc: 0.8125 - val_
Epoch 330/500
60000/60000 [=====] - 8s 126us/step - loss: 0.1002 - acc: 0.8125 - val_
Epoch 331/500
60000/60000 [=====] - 9s 144us/step - loss: 0.1003 - acc: 0.8125 - val_
Epoch 332/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1003 - acc: 0.8125 - val_
Epoch 333/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1002 - acc: 0.8125 - val_
Epoch 334/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1002 - acc: 0.8125 - val_
Epoch 335/500
60000/60000 [=====] - 9s 148us/step - loss: 0.1001 - acc: 0.8125 - val_
Epoch 336/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1002 - acc: 0.8125 - val_
Epoch 337/500
60000/60000 [=====] - 7s 125us/step - loss: 0.1001 - acc: 0.8125 - val_
Epoch 338/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1001 - acc: 0.8125 - val_
Epoch 339/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1000 - acc: 0.8126 - val_
Epoch 340/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1000 - acc: 0.8126 - val_
Epoch 341/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1000 - acc: 0.8125 - val_
Epoch 342/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0999 - acc: 0.8126 - val_
Epoch 343/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1000 - acc: 0.8126 - val_

Epoch 344/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0999 - acc: 0.8126 - val_
 Epoch 345/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0999 - acc: 0.8126 - val_
 Epoch 346/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0999 - acc: 0.8126 - val_
 Epoch 347/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0998 - acc: 0.8126 - val_
 Epoch 348/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0998 - acc: 0.8126 - val_
 Epoch 349/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.0998 - acc: 0.8126 - val_
 Epoch 350/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.0998 - acc: 0.8126 - val_
 Epoch 351/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0997 - acc: 0.8126 - val_
 Epoch 352/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.0998 - acc: 0.8126 - val_
 Epoch 353/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.0997 - acc: 0.8126 - val_
 Epoch 354/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.0997 - acc: 0.8126 - val_
 Epoch 355/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0998 - acc: 0.8126 - val_
 Epoch 356/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0996 - acc: 0.8126 - val_
 Epoch 357/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0996 - acc: 0.8126 - val_
 Epoch 358/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0995 - acc: 0.8126 - val_
 Epoch 359/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.0996 - acc: 0.8126 - val_
 Epoch 360/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0995 - acc: 0.8126 - val_
 Epoch 361/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.0996 - acc: 0.8126 - val_
 Epoch 362/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.0995 - acc: 0.8126 - val_
 Epoch 363/500
 60000/60000 [=====] - 8s 125us/step - loss: 0.0995 - acc: 0.8126 - val_
 Epoch 364/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0994 - acc: 0.8126 - val_
 Epoch 365/500
 60000/60000 [=====] - 10s 161us/step - loss: 0.0994 - acc: 0.8126 - val_
 Epoch 366/500
 60000/60000 [=====] - 10s 167us/step - loss: 0.0994 - acc: 0.8126 - val_
 Epoch 367/500
 60000/60000 [=====] - 9s 143us/step - loss: 0.0993 - acc: 0.8126 - val_

Epoch 368/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0994 - acc: 0.8126 - val_
Epoch 369/500
60000/60000 [=====] - 7s 119us/step - loss: 0.0994 - acc: 0.8126 - val_
Epoch 370/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0993 - acc: 0.8126 - val_
Epoch 371/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0993 - acc: 0.8126 - val_
Epoch 372/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0994 - acc: 0.8126 - val_
Epoch 373/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0993 - acc: 0.8126 - val_
Epoch 374/500
60000/60000 [=====] - 10s 162us/step - loss: 0.0993 - acc: 0.8127 - val_
Epoch 375/500
60000/60000 [=====] - 8s 135us/step - loss: 0.0992 - acc: 0.8127 - val_
Epoch 376/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0992 - acc: 0.8127 - val_
Epoch 377/500
60000/60000 [=====] - 9s 158us/step - loss: 0.0992 - acc: 0.8126 - val_
Epoch 378/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0992 - acc: 0.8127 - val_
Epoch 379/500
60000/60000 [=====] - 9s 157us/step - loss: 0.0992 - acc: 0.8127 - val_
Epoch 380/500
60000/60000 [=====] - 10s 167us/step - loss: 0.0990 - acc: 0.8127 - val_
Epoch 381/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0991 - acc: 0.8127 - val_
Epoch 382/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0991 - acc: 0.8127 - val_
Epoch 383/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0990 - acc: 0.8127 - val_
Epoch 384/500
60000/60000 [=====] - 7s 108us/step - loss: 0.0989 - acc: 0.8127 - val_
Epoch 385/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0990 - acc: 0.8127 - val_
Epoch 386/500
60000/60000 [=====] - 7s 121us/step - loss: 0.0991 - acc: 0.8127 - val_
Epoch 387/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0989 - acc: 0.8127 - val_
Epoch 388/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0989 - acc: 0.8127 - val_
Epoch 389/500
60000/60000 [=====] - 9s 149us/step - loss: 0.0989 - acc: 0.8127 - val_
Epoch 390/500
60000/60000 [=====] - 11s 178us/step - loss: 0.0989 - acc: 0.8127 - val_
Epoch 391/500
60000/60000 [=====] - 9s 148us/step - loss: 0.0989 - acc: 0.8127 - val_

```

Epoch 392/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0989 - acc: 0.8127 - val_
Epoch 393/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0989 - acc: 0.8127 - val_
Epoch 394/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0988 - acc: 0.8127 - val_
Epoch 395/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0988 - acc: 0.8127 - val_
Epoch 396/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0987 - acc: 0.8127 - val_
Epoch 397/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0988 - acc: 0.8127 - val_
Epoch 398/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0987 - acc: 0.8127 - val_
Epoch 399/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0987 - acc: 0.8127 - val_
Epoch 400/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0987 - acc: 0.8127 - val_
Epoch 401/500
60000/60000 [=====] - 7s 114us/step - loss: 0.0986 - acc: 0.8127 - val_
Epoch 402/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0987 - acc: 0.8127 - val_
Epoch 403/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0987 - acc: 0.8127 - val_
Epoch 404/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0986 - acc: 0.8127 - val_
Epoch 405/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0986 - acc: 0.8127 - val_
Epoch 406/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0985 - acc: 0.8127 - val_
Epoch 407/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0987 - acc: 0.8127 - val_
Epoch 408/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0986 - acc: 0.8127 - val_
Epoch 409/500
60000/60000 [=====] - 6s 108us/step - loss: 0.0985 - acc: 0.8127 - val_
Epoch 410/500
60000/60000 [=====] - 6s 108us/step - loss: 0.0985 - acc: 0.8128 - val_
Epoch 411/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0985 - acc: 0.8127 - val_
Epoch 412/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0985 - acc: 0.8128 - val_
Epoch 413/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0984 - acc: 0.8128 - val_
Epoch 414/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0985 - acc: 0.8128 - val_
Epoch 415/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0985 - acc: 0.8128 - val_

```


Epoch 416/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0984 - acc: 0.8128 - val_
Epoch 417/500
60000/60000 [=====] - 7s 121us/step - loss: 0.0984 - acc: 0.8128 - val_
Epoch 418/500
60000/60000 [=====] - 7s 120us/step - loss: 0.0984 - acc: 0.8128 - val_
Epoch 419/500
60000/60000 [=====] - 7s 120us/step - loss: 0.0984 - acc: 0.8128 - val_
Epoch 420/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0984 - acc: 0.8128 - val_
Epoch 421/500
60000/60000 [=====] - 7s 114us/step - loss: 0.0983 - acc: 0.8128 - val_
Epoch 422/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0984 - acc: 0.8128 - val_
Epoch 423/500
60000/60000 [=====] - 7s 116us/step - loss: 0.0982 - acc: 0.8128 - val_
Epoch 424/500
60000/60000 [=====] - 7s 115us/step - loss: 0.0983 - acc: 0.8128 - val_
Epoch 425/500
60000/60000 [=====] - 7s 114us/step - loss: 0.0982 - acc: 0.8128 - val_
Epoch 426/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0983 - acc: 0.8128 - val_
Epoch 427/500
60000/60000 [=====] - 7s 115us/step - loss: 0.0983 - acc: 0.8128 - val_
Epoch 428/500
60000/60000 [=====] - 7s 121us/step - loss: 0.0982 - acc: 0.8128 - val_
Epoch 429/500
60000/60000 [=====] - 6s 107us/step - loss: 0.0981 - acc: 0.8128 - val_
Epoch 430/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0982 - acc: 0.8128 - val_
Epoch 431/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0981 - acc: 0.8128 - val_
Epoch 432/500
60000/60000 [=====] - 7s 121us/step - loss: 0.0983 - acc: 0.8128 - val_
Epoch 433/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0982 - acc: 0.8128 - val_
Epoch 434/500
60000/60000 [=====] - 9s 142us/step - loss: 0.0981 - acc: 0.8128 - val_
Epoch 435/500
60000/60000 [=====] - 9s 148us/step - loss: 0.0981 - acc: 0.8128 - val_
Epoch 436/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0980 - acc: 0.8128 - val_
Epoch 437/500
60000/60000 [=====] - 9s 153us/step - loss: 0.0982 - acc: 0.8128 - val_
Epoch 438/500
60000/60000 [=====] - 10s 167us/step - loss: 0.0981 - acc: 0.8128 - val_
Epoch 439/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0980 - acc: 0.8128 - val_

Epoch 440/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0980 - acc: 0.8128 - val_
Epoch 441/500
60000/60000 [=====] - 9s 146us/step - loss: 0.0980 - acc: 0.8128 - val_
Epoch 442/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0979 - acc: 0.8128 - val_
Epoch 443/500
60000/60000 [=====] - 8s 140us/step - loss: 0.0980 - acc: 0.8128 - val_
Epoch 444/500
60000/60000 [=====] - 10s 174us/step - loss: 0.0980 - acc: 0.8128 - val_
Epoch 445/500
60000/60000 [=====] - 7s 121us/step - loss: 0.0980 - acc: 0.8128 - val_
Epoch 446/500
60000/60000 [=====] - 7s 114us/step - loss: 0.0979 - acc: 0.8128 - val_
Epoch 447/500
60000/60000 [=====] - 7s 116us/step - loss: 0.0978 - acc: 0.8128 - val_
Epoch 448/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0979 - acc: 0.8128 - val_
Epoch 449/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0979 - acc: 0.8128 - val_
Epoch 450/500
60000/60000 [=====] - 7s 115us/step - loss: 0.0979 - acc: 0.8128 - val_
Epoch 451/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0979 - acc: 0.8128 - val_
Epoch 452/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0978 - acc: 0.8128 - val_
Epoch 453/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0979 - acc: 0.8128 - val_
Epoch 454/500
60000/60000 [=====] - 7s 115us/step - loss: 0.0977 - acc: 0.8129 - val_
Epoch 455/500
60000/60000 [=====] - 7s 116us/step - loss: 0.0978 - acc: 0.8128 - val_
Epoch 456/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0977 - acc: 0.8128 - val_
Epoch 457/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0977 - acc: 0.8129 - val_
Epoch 458/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0977 - acc: 0.8129 - val_
Epoch 459/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0977 - acc: 0.8128 - val_
Epoch 460/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0977 - acc: 0.8129 - val_
Epoch 461/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0976 - acc: 0.8129 - val_
Epoch 462/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0977 - acc: 0.8129 - val_
Epoch 463/500
60000/60000 [=====] - 7s 115us/step - loss: 0.0977 - acc: 0.8129 - val_

Epoch 464/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0976 - acc: 0.8129 - val_
 Epoch 465/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0976 - acc: 0.8129 - val_
 Epoch 466/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0977 - acc: 0.8129 - val_
 Epoch 467/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0976 - acc: 0.8129 - val_
 Epoch 468/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0975 - acc: 0.8129 - val_
 Epoch 469/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0975 - acc: 0.8129 - val_
 Epoch 470/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0976 - acc: 0.8129 - val_
 Epoch 471/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0975 - acc: 0.8129 - val_
 Epoch 472/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0976 - acc: 0.8129 - val_
 Epoch 473/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.0975 - acc: 0.8129 - val_
 Epoch 474/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0974 - acc: 0.8129 - val_
 Epoch 475/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0974 - acc: 0.8129 - val_
 Epoch 476/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0975 - acc: 0.8129 - val_
 Epoch 477/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.0974 - acc: 0.8129 - val_
 Epoch 478/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0974 - acc: 0.8129 - val_
 Epoch 479/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.0974 - acc: 0.8129 - val_
 Epoch 480/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0974 - acc: 0.8129 - val_
 Epoch 481/500
 60000/60000 [=====] - 7s 108us/step - loss: 0.0975 - acc: 0.8129 - val_
 Epoch 482/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.0974 - acc: 0.8129 - val_
 Epoch 483/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.0974 - acc: 0.8129 - val_
 Epoch 484/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.0974 - acc: 0.8129 - val_
 Epoch 485/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.0973 - acc: 0.8129 - val_
 Epoch 486/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.0973 - acc: 0.8129 - val_
 Epoch 487/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.0974 - acc: 0.8129 - val_

```

Epoch 488/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0973 - acc: 0.8129 - val_
Epoch 489/500
60000/60000 [=====] - 6s 107us/step - loss: 0.0973 - acc: 0.8129 - val_
Epoch 490/500
60000/60000 [=====] - 6s 108us/step - loss: 0.0973 - acc: 0.8129 - val_
Epoch 491/500
60000/60000 [=====] - 6s 108us/step - loss: 0.0973 - acc: 0.8129 - val_
Epoch 492/500
60000/60000 [=====] - 6s 107us/step - loss: 0.0973 - acc: 0.8129 - val_
Epoch 493/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0972 - acc: 0.8129 - val_
Epoch 494/500
60000/60000 [=====] - 7s 121us/step - loss: 0.0972 - acc: 0.8129 - val_
Epoch 495/500
60000/60000 [=====] - 9s 147us/step - loss: 0.0971 - acc: 0.8129 - val_
Epoch 496/500
60000/60000 [=====] - 7s 121us/step - loss: 0.0972 - acc: 0.8129 - val_
Epoch 497/500
60000/60000 [=====] - 7s 118us/step - loss: 0.0972 - acc: 0.8129 - val_
Epoch 498/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0971 - acc: 0.8129 - val_
Epoch 499/500
60000/60000 [=====] - 7s 121us/step - loss: 0.0972 - acc: 0.8129 - val_
Epoch 500/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0971 - acc: 0.8129 - val_

```

```

In [8]: # this is the size of our encoded representations
        encoding_dim = 14 # 32 floats -> compression of factor 24.5, assuming the input is 784

        # this is our input placeholder
        x = input_img = Input(shape=(784,))
        # "encoded" is the encoded representation of the input
        x = Dense(256, activation='relu')(x)
        x = Dense(128, activation='relu')(x)
        encoded = Dense(encoding_dim, activation='relu')(x)

        # "decoded" is the lossy reconstruction of the input
        x = Dense(128, activation='relu')(encoded)
        x = Dense(256, activation='relu')(x)
        decoded = Dense(784, activation='sigmoid')(x)

        # this model maps an input to its reconstruction
        autoencoder = Model(input_img, decoded)

        encoder = Model(input_img, encoded)

```

```

# create a placeholder for an encoded (32-dimensional) input
encoded_input = Input(shape=(encoding_dim,))
# retrieve the last layer of the autoencoder model
dcd1 = autoencoder.layers[-1]
dcd2 = autoencoder.layers[-2]
dcd3 = autoencoder.layers[-3]

# create the decoder model
decoder = Model(encoded_input, dcd1(dcd2(dcd3(encoded_input))))

autoencoder.compile(optimizer='adadelta',
                    loss='binary_crossentropy',
                    metrics=['accuracy'])
history14 = autoencoder.fit(xtrain, xtrain,
                           epochs=500,
                           batch_size=256,
                           shuffle=True,
                           validation_data=(xtest, xtest),
                           callbacks=[TensorBoard(log_dir='/tmp/autoencoder/encoding_dim_')])
acc14 = autoencoder.evaluate(xtest,
                             xtest,
                             verbose=0)

```

Train on 60000 samples, validate on 10000 samples

```

Epoch 1/500
60000/60000 [=====] - 7s 125us/step - loss: 0.3489 - acc: 0.7484 - val_
Epoch 2/500
60000/60000 [=====] - 7s 110us/step - loss: 0.2571 - acc: 0.7955 - val_
Epoch 3/500
60000/60000 [=====] - 7s 111us/step - loss: 0.2392 - acc: 0.7954 - val_
Epoch 4/500
60000/60000 [=====] - 7s 110us/step - loss: 0.2227 - acc: 0.7949 - val_
Epoch 5/500
60000/60000 [=====] - 7s 110us/step - loss: 0.2092 - acc: 0.7949 - val_
Epoch 6/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1983 - acc: 0.7961 - val_
Epoch 7/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1908 - acc: 0.7969 - val_
Epoch 8/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1841 - acc: 0.7979 - val_
Epoch 9/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1780 - acc: 0.7989 - val_
Epoch 10/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1725 - acc: 0.8000 - val_
Epoch 11/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1680 - acc: 0.8009 - val_
Epoch 12/500

```

60000/60000 [=====] - 7s 109us/step - loss: 0.1639 - acc: 0.8018 - val_
Epoch 13/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1602 - acc: 0.8026 - val_
Epoch 14/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1567 - acc: 0.8034 - val_
Epoch 15/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1537 - acc: 0.8040 - val_
Epoch 16/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1511 - acc: 0.8046 - val_
Epoch 17/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1487 - acc: 0.8051 - val_
Epoch 18/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1466 - acc: 0.8055 - val_
Epoch 19/500
60000/60000 [=====] - 8s 139us/step - loss: 0.1444 - acc: 0.8059 - val_
Epoch 20/500
60000/60000 [=====] - 8s 138us/step - loss: 0.1425 - acc: 0.8063 - val_
Epoch 21/500
60000/60000 [=====] - 9s 150us/step - loss: 0.1406 - acc: 0.8067 - val_
Epoch 22/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1390 - acc: 0.8069 - val_
Epoch 23/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1375 - acc: 0.8072 - val_
Epoch 24/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1361 - acc: 0.8074 - val_
Epoch 25/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1346 - acc: 0.8077 - val_
Epoch 26/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1332 - acc: 0.8080 - val_
Epoch 27/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1320 - acc: 0.8082 - val_
Epoch 28/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1307 - acc: 0.8084 - val_
Epoch 29/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1297 - acc: 0.8086 - val_
Epoch 30/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1288 - acc: 0.8087 - val_
Epoch 31/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1278 - acc: 0.8089 - val_
Epoch 32/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1270 - acc: 0.8090 - val_
Epoch 33/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1263 - acc: 0.8091 - val_
Epoch 34/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1255 - acc: 0.8093 - val_
Epoch 35/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1249 - acc: 0.8093 - val_
Epoch 36/500

60000/60000 [=====] - 9s 146us/step - loss: 0.1242 - acc: 0.8094 - val_
Epoch 37/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1236 - acc: 0.8095 - val_
Epoch 38/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1230 - acc: 0.8096 - val_
Epoch 39/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1225 - acc: 0.8097 - val_
Epoch 40/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1221 - acc: 0.8097 - val_
Epoch 41/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1215 - acc: 0.8098 - val_
Epoch 42/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1211 - acc: 0.8099 - val_
Epoch 43/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1206 - acc: 0.8100 - val_
Epoch 44/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1201 - acc: 0.8100 - val_
Epoch 45/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1198 - acc: 0.8101 - val_
Epoch 46/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1194 - acc: 0.8101 - val_
Epoch 47/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1190 - acc: 0.8102 - val_
Epoch 48/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1186 - acc: 0.8102 - val_
Epoch 49/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1183 - acc: 0.8103 - val_
Epoch 50/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1179 - acc: 0.8103 - val_
Epoch 51/500
60000/60000 [=====] - 8s 135us/step - loss: 0.1177 - acc: 0.8103 - val_
Epoch 52/500
60000/60000 [=====] - 8s 137us/step - loss: 0.1172 - acc: 0.8104 - val_
Epoch 53/500
60000/60000 [=====] - 8s 135us/step - loss: 0.1169 - acc: 0.8105 - val_
Epoch 54/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1166 - acc: 0.8105 - val_
Epoch 55/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1163 - acc: 0.8105 - val_
Epoch 56/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1161 - acc: 0.8106 - val_
Epoch 57/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1157 - acc: 0.8106 - val_
Epoch 58/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1154 - acc: 0.8107 - val_
Epoch 59/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1152 - acc: 0.8107 - val_
Epoch 60/500

60000/60000 [=====] - 7s 119us/step - loss: 0.1149 - acc: 0.8107 - val_
Epoch 61/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1147 - acc: 0.8107 - val_
Epoch 62/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1144 - acc: 0.8108 - val_
Epoch 63/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1142 - acc: 0.8108 - val_
Epoch 64/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1139 - acc: 0.8109 - val_
Epoch 65/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1138 - acc: 0.8109 - val_
Epoch 66/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1135 - acc: 0.8109 - val_
Epoch 67/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1133 - acc: 0.8109 - val_
Epoch 68/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1131 - acc: 0.8110 - val_
Epoch 69/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1129 - acc: 0.8110 - val_
Epoch 70/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1126 - acc: 0.8110 - val_
Epoch 71/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1125 - acc: 0.8110 - val_
Epoch 72/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1122 - acc: 0.8111 - val_
Epoch 73/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1121 - acc: 0.8111 - val_
Epoch 74/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1119 - acc: 0.8111 - val_
Epoch 75/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1117 - acc: 0.8112 - val_
Epoch 76/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1114 - acc: 0.8112 - val_
Epoch 77/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1114 - acc: 0.8112 - val_
Epoch 78/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1111 - acc: 0.8112 - val_
Epoch 79/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1111 - acc: 0.8112 - val_
Epoch 80/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1108 - acc: 0.8113 - val_
Epoch 81/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1106 - acc: 0.8113 - val_
Epoch 82/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1105 - acc: 0.8113 - val_
Epoch 83/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1103 - acc: 0.8113 - val_
Epoch 84/500

60000/60000 [=====] - 7s 114us/step - loss: 0.1102 - acc: 0.8113 - val_
 Epoch 85/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1100 - acc: 0.8114 - val_
 Epoch 86/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1099 - acc: 0.8114 - val_
 Epoch 87/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1097 - acc: 0.8114 - val_
 Epoch 88/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1095 - acc: 0.8114 - val_
 Epoch 89/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1094 - acc: 0.8115 - val_
 Epoch 90/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1092 - acc: 0.8115 - val_
 Epoch 91/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1091 - acc: 0.8115 - val_
 Epoch 92/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1090 - acc: 0.8115 - val_
 Epoch 93/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.1088 - acc: 0.8115 - val_
 Epoch 94/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1088 - acc: 0.8115 - val_
 Epoch 95/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1086 - acc: 0.8115 - val_
 Epoch 96/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1085 - acc: 0.8116 - val_
 Epoch 97/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1084 - acc: 0.8116 - val_
 Epoch 98/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1082 - acc: 0.8116 - val_
 Epoch 99/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1081 - acc: 0.8116 - val_
 Epoch 100/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1080 - acc: 0.8116 - val_
 Epoch 101/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1078 - acc: 0.8117 - val_
 Epoch 102/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1077 - acc: 0.8117 - val_
 Epoch 103/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1077 - acc: 0.8117 - val_
 Epoch 104/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1074 - acc: 0.8117 - val_
 Epoch 105/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1074 - acc: 0.8117 - val_
 Epoch 106/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1073 - acc: 0.8117 - val_
 Epoch 107/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1072 - acc: 0.8117 - val_
 Epoch 108/500

60000/60000 [=====] - 7s 112us/step - loss: 0.1070 - acc: 0.8118 - val_
 Epoch 109/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1069 - acc: 0.8118 - val_
 Epoch 110/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1070 - acc: 0.8118 - val_
 Epoch 111/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1067 - acc: 0.8118 - val_
 Epoch 112/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1067 - acc: 0.8118 - val_
 Epoch 113/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1065 - acc: 0.8118 - val_
 Epoch 114/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1064 - acc: 0.8118 - val_
 Epoch 115/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1063 - acc: 0.8119 - val_
 Epoch 116/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1063 - acc: 0.8119 - val_
 Epoch 117/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1061 - acc: 0.8119 - val_
 Epoch 118/500
 60000/60000 [=====] - 7s 123us/step - loss: 0.1061 - acc: 0.8119 - val_
 Epoch 119/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.1059 - acc: 0.8119 - val_
 Epoch 120/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1059 - acc: 0.8119 - val_
 Epoch 121/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1058 - acc: 0.8119 - val_
 Epoch 122/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1057 - acc: 0.8119 - val_
 Epoch 123/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1056 - acc: 0.8120 - val_
 Epoch 124/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1055 - acc: 0.8120 - val_
 Epoch 125/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1054 - acc: 0.8120 - val_
 Epoch 126/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1054 - acc: 0.8120 - val_
 Epoch 127/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1053 - acc: 0.8120 - val_
 Epoch 128/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1052 - acc: 0.8120 - val_
 Epoch 129/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1051 - acc: 0.8120 - val_
 Epoch 130/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1050 - acc: 0.8120 - val_
 Epoch 131/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1048 - acc: 0.8120 - val_
 Epoch 132/500

60000/60000 [=====] - 7s 113us/step - loss: 0.1049 - acc: 0.8120 - val_
 Epoch 133/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1048 - acc: 0.8120 - val_
 Epoch 134/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1047 - acc: 0.8121 - val_
 Epoch 135/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1046 - acc: 0.8121 - val_
 Epoch 136/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1045 - acc: 0.8121 - val_
 Epoch 137/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1045 - acc: 0.8121 - val_
 Epoch 138/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1044 - acc: 0.8121 - val_
 Epoch 139/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.1043 - acc: 0.8121 - val_
 Epoch 140/500
 60000/60000 [=====] - 7s 125us/step - loss: 0.1042 - acc: 0.8121 - val_
 Epoch 141/500
 60000/60000 [=====] - 8s 141us/step - loss: 0.1042 - acc: 0.8121 - val_
 Epoch 142/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.1040 - acc: 0.8121 - val_
 Epoch 143/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.1041 - acc: 0.8121 - val_
 Epoch 144/500
 60000/60000 [=====] - 9s 143us/step - loss: 0.1040 - acc: 0.8122 - val_
 Epoch 145/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1039 - acc: 0.8122 - val_
 Epoch 146/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1039 - acc: 0.8122 - val_
 Epoch 147/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1038 - acc: 0.8122 - val_
 Epoch 148/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1037 - acc: 0.8122 - val_
 Epoch 149/500
 60000/60000 [=====] - 9s 147us/step - loss: 0.1037 - acc: 0.8122 - val_
 Epoch 150/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.1035 - acc: 0.8122 - val_
 Epoch 151/500
 60000/60000 [=====] - 9s 151us/step - loss: 0.1034 - acc: 0.8122 - val_
 Epoch 152/500
 60000/60000 [=====] - 9s 149us/step - loss: 0.1034 - acc: 0.8122 - val_
 Epoch 153/500
 60000/60000 [=====] - 8s 130us/step - loss: 0.1033 - acc: 0.8122 - val_
 Epoch 154/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1033 - acc: 0.8122 - val_
 Epoch 155/500
 60000/60000 [=====] - 8s 137us/step - loss: 0.1032 - acc: 0.8122 - val_
 Epoch 156/500

60000/60000 [=====] - 8s 141us/step - loss: 0.1032 - acc: 0.8122 - val_
 Epoch 157/500
 60000/60000 [=====] - 8s 130us/step - loss: 0.1031 - acc: 0.8123 - val_
 Epoch 158/500
 60000/60000 [=====] - 8s 142us/step - loss: 0.1031 - acc: 0.8123 - val_
 Epoch 159/500
 60000/60000 [=====] - 8s 140us/step - loss: 0.1029 - acc: 0.8123 - val_
 Epoch 160/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.1029 - acc: 0.8123 - val_
 Epoch 161/500
 60000/60000 [=====] - 9s 155us/step - loss: 0.1029 - acc: 0.8123 - val_
 Epoch 162/500
 60000/60000 [=====] - 8s 135us/step - loss: 0.1029 - acc: 0.8123 - val_
 Epoch 163/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1027 - acc: 0.8123 - val_
 Epoch 164/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1027 - acc: 0.8123 - val_
 Epoch 165/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1026 - acc: 0.8123 - val_
 Epoch 166/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1026 - acc: 0.8123 - val_
 Epoch 167/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1025 - acc: 0.8123 - val_
 Epoch 168/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1025 - acc: 0.8123 - val_
 Epoch 169/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1024 - acc: 0.8123 - val_
 Epoch 170/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.1024 - acc: 0.8123 - val_
 Epoch 171/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1023 - acc: 0.8124 - val_
 Epoch 172/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.1022 - acc: 0.8124 - val_
 Epoch 173/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1021 - acc: 0.8124 - val_
 Epoch 174/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1022 - acc: 0.8124 - val_
 Epoch 175/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1021 - acc: 0.8124 - val_
 Epoch 176/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1020 - acc: 0.8124 - val_
 Epoch 177/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1020 - acc: 0.8124 - val_
 Epoch 178/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1019 - acc: 0.8124 - val_
 Epoch 179/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1019 - acc: 0.8124 - val_
 Epoch 180/500

60000/60000 [=====] - 7s 111us/step - loss: 0.1018 - acc: 0.8124 - val_
 Epoch 181/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1017 - acc: 0.8124 - val_
 Epoch 182/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1017 - acc: 0.8124 - val_
 Epoch 183/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1016 - acc: 0.8125 - val_
 Epoch 184/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1014 - acc: 0.8125 - val_
 Epoch 185/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1015 - acc: 0.8125 - val_
 Epoch 186/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1014 - acc: 0.8125 - val_
 Epoch 187/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1013 - acc: 0.8125 - val_
 Epoch 188/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1012 - acc: 0.8125 - val_
 Epoch 189/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1011 - acc: 0.8125 - val_
 Epoch 190/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1010 - acc: 0.8125 - val_
 Epoch 191/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1009 - acc: 0.8126 - val_
 Epoch 192/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1009 - acc: 0.8126 - val_
 Epoch 193/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.1008 - acc: 0.8126 - val_
 Epoch 194/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1007 - acc: 0.8126 - val_
 Epoch 195/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1005 - acc: 0.8126 - val_
 Epoch 196/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1005 - acc: 0.8126 - val_
 Epoch 197/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1004 - acc: 0.8126 - val_
 Epoch 198/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1003 - acc: 0.8126 - val_
 Epoch 199/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1002 - acc: 0.8127 - val_
 Epoch 200/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1001 - acc: 0.8127 - val_
 Epoch 201/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1001 - acc: 0.8127 - val_
 Epoch 202/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0999 - acc: 0.8127 - val_
 Epoch 203/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1000 - acc: 0.8127 - val_
 Epoch 204/500

60000/60000 [=====] - 7s 112us/step - loss: 0.0999 - acc: 0.8127 - val_
Epoch 205/500
60000/60000 [=====] - 7s 114us/step - loss: 0.0998 - acc: 0.8127 - val_
Epoch 206/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0997 - acc: 0.8127 - val_
Epoch 207/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0996 - acc: 0.8127 - val_
Epoch 208/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0996 - acc: 0.8127 - val_
Epoch 209/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0995 - acc: 0.8127 - val_
Epoch 210/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0994 - acc: 0.8128 - val_
Epoch 211/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0993 - acc: 0.8128 - val_
Epoch 212/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0993 - acc: 0.8128 - val_
Epoch 213/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0993 - acc: 0.8128 - val_
Epoch 214/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0993 - acc: 0.8128 - val_
Epoch 215/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0991 - acc: 0.8128 - val_
Epoch 216/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0991 - acc: 0.8128 - val_
Epoch 217/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0990 - acc: 0.8128 - val_
Epoch 218/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0990 - acc: 0.8128 - val_
Epoch 219/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0988 - acc: 0.8128 - val_
Epoch 220/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0987 - acc: 0.8128 - val_
Epoch 221/500
60000/60000 [=====] - 7s 116us/step - loss: 0.0989 - acc: 0.8128 - val_
Epoch 222/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0988 - acc: 0.8128 - val_
Epoch 223/500
60000/60000 [=====] - 7s 114us/step - loss: 0.0986 - acc: 0.8129 - val_
Epoch 224/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0986 - acc: 0.8129 - val_
Epoch 225/500
60000/60000 [=====] - 7s 114us/step - loss: 0.0985 - acc: 0.8129 - val_
Epoch 226/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0985 - acc: 0.8129 - val_
Epoch 227/500
60000/60000 [=====] - 7s 114us/step - loss: 0.0985 - acc: 0.8129 - val_
Epoch 228/500

60000/60000 [=====] - 7s 116us/step - loss: 0.0984 - acc: 0.8129 - val_
 Epoch 229/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0983 - acc: 0.8129 - val_
 Epoch 230/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0983 - acc: 0.8129 - val_
 Epoch 231/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0982 - acc: 0.8129 - val_
 Epoch 232/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0982 - acc: 0.8129 - val_
 Epoch 233/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0981 - acc: 0.8129 - val_
 Epoch 234/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.0981 - acc: 0.8129 - val_
 Epoch 235/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.0980 - acc: 0.8129 - val_
 Epoch 236/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0978 - acc: 0.8130 - val_
 Epoch 237/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.0980 - acc: 0.8129 - val_
 Epoch 238/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.0979 - acc: 0.8130 - val_
 Epoch 239/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0978 - acc: 0.8130 - val_
 Epoch 240/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0977 - acc: 0.8130 - val_
 Epoch 241/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0977 - acc: 0.8130 - val_
 Epoch 242/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0975 - acc: 0.8130 - val_
 Epoch 243/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.0976 - acc: 0.8130 - val_
 Epoch 244/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0974 - acc: 0.8130 - val_
 Epoch 245/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0974 - acc: 0.8130 - val_
 Epoch 246/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0973 - acc: 0.8130 - val_
 Epoch 247/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0973 - acc: 0.8130 - val_
 Epoch 248/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0972 - acc: 0.8130 - val_
 Epoch 249/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0972 - acc: 0.8130 - val_
 Epoch 250/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0971 - acc: 0.8131 - val_
 Epoch 251/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0971 - acc: 0.8131 - val_
 Epoch 252/500

60000/60000 [=====] - 7s 110us/step - loss: 0.0970 - acc: 0.8131 - val_
 Epoch 253/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0969 - acc: 0.8131 - val_
 Epoch 254/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0969 - acc: 0.8131 - val_
 Epoch 255/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0969 - acc: 0.8131 - val_
 Epoch 256/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0968 - acc: 0.8131 - val_
 Epoch 257/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0967 - acc: 0.8131 - val_
 Epoch 258/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0968 - acc: 0.8131 - val_
 Epoch 259/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0966 - acc: 0.8131 - val_
 Epoch 260/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0965 - acc: 0.8131 - val_
 Epoch 261/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0965 - acc: 0.8131 - val_
 Epoch 262/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0965 - acc: 0.8131 - val_
 Epoch 263/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0965 - acc: 0.8131 - val_
 Epoch 264/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.0964 - acc: 0.8132 - val_
 Epoch 265/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0962 - acc: 0.8132 - val_
 Epoch 266/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0964 - acc: 0.8131 - val_
 Epoch 267/500
 60000/60000 [=====] - 8s 140us/step - loss: 0.0962 - acc: 0.8132 - val_
 Epoch 268/500
 60000/60000 [=====] - 10s 160us/step - loss: 0.0962 - acc: 0.8132 - val_
 Epoch 269/500
 60000/60000 [=====] - 9s 157us/step - loss: 0.0962 - acc: 0.8132 - val_
 Epoch 270/500
 60000/60000 [=====] - 9s 147us/step - loss: 0.0961 - acc: 0.8132 - val_
 Epoch 271/500
 60000/60000 [=====] - 8s 130us/step - loss: 0.0961 - acc: 0.8132 - val_
 Epoch 272/500
 60000/60000 [=====] - 9s 147us/step - loss: 0.0960 - acc: 0.8132 - val_
 Epoch 273/500
 60000/60000 [=====] - 9s 144us/step - loss: 0.0960 - acc: 0.8132 - val_
 Epoch 274/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.0959 - acc: 0.8132 - val_
 Epoch 275/500
 60000/60000 [=====] - 8s 139us/step - loss: 0.0959 - acc: 0.8132 - val_
 Epoch 276/500

60000/60000 [=====] - 8s 138us/step - loss: 0.0958 - acc: 0.8132 - val_
 Epoch 277/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.0958 - acc: 0.8132 - val_
 Epoch 278/500
 60000/60000 [=====] - 9s 150us/step - loss: 0.0958 - acc: 0.8132 - val_
 Epoch 279/500
 60000/60000 [=====] - 9s 151us/step - loss: 0.0957 - acc: 0.8132 - val_
 Epoch 280/500
 60000/60000 [=====] - 9s 151us/step - loss: 0.0957 - acc: 0.8132 - val_
 Epoch 281/500
 60000/60000 [=====] - 10s 161us/step - loss: 0.0957 - acc: 0.8132 - val_
 Epoch 282/500
 60000/60000 [=====] - 8s 141us/step - loss: 0.0956 - acc: 0.8132 - val_
 Epoch 283/500
 60000/60000 [=====] - 11s 175us/step - loss: 0.0956 - acc: 0.8133 - val_
 Epoch 284/500
 60000/60000 [=====] - 8s 141us/step - loss: 0.0955 - acc: 0.8133 - val_
 Epoch 285/500
 60000/60000 [=====] - 9s 149us/step - loss: 0.0955 - acc: 0.8133 - val_
 Epoch 286/500
 60000/60000 [=====] - 9s 143us/step - loss: 0.0954 - acc: 0.8133 - val_
 Epoch 287/500
 60000/60000 [=====] - 9s 146us/step - loss: 0.0954 - acc: 0.8133 - val_
 Epoch 288/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0954 - acc: 0.8133 - val_
 Epoch 289/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0953 - acc: 0.8133 - val_
 Epoch 290/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0952 - acc: 0.8133 - val_
 Epoch 291/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0952 - acc: 0.8133 - val_
 Epoch 292/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0952 - acc: 0.8133 - val_
 Epoch 293/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0951 - acc: 0.8133 - val_
 Epoch 294/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0951 - acc: 0.8133 - val_
 Epoch 295/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0951 - acc: 0.8133 - val_
 Epoch 296/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0951 - acc: 0.8133 - val_
 Epoch 297/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.0950 - acc: 0.8133 - val_
 Epoch 298/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0950 - acc: 0.8133 - val_
 Epoch 299/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0949 - acc: 0.8133 - val_
 Epoch 300/500

60000/60000 [=====] - 7s 116us/step - loss: 0.0948 - acc: 0.8133 - val_
 Epoch 301/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0949 - acc: 0.8133 - val_
 Epoch 302/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0949 - acc: 0.8133 - val_
 Epoch 303/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0948 - acc: 0.8133 - val_
 Epoch 304/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0949 - acc: 0.8133 - val_
 Epoch 305/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0948 - acc: 0.8133 - val_
 Epoch 306/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0948 - acc: 0.8133 - val_
 Epoch 307/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0947 - acc: 0.8134 - val_
 Epoch 308/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0947 - acc: 0.8134 - val_
 Epoch 309/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0947 - acc: 0.8134 - val_
 Epoch 310/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0945 - acc: 0.8134 - val_
 Epoch 311/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0946 - acc: 0.8134 - val_
 Epoch 312/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0945 - acc: 0.8134 - val_
 Epoch 313/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0944 - acc: 0.8134 - val_
 Epoch 314/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0945 - acc: 0.8134 - val_
 Epoch 315/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0945 - acc: 0.8134 - val_
 Epoch 316/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0945 - acc: 0.8134 - val_
 Epoch 317/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0944 - acc: 0.8134 - val_
 Epoch 318/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0943 - acc: 0.8134 - val_
 Epoch 319/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0944 - acc: 0.8134 - val_
 Epoch 320/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0943 - acc: 0.8134 - val_
 Epoch 321/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0942 - acc: 0.8134 - val_
 Epoch 322/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0943 - acc: 0.8134 - val_
 Epoch 323/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0942 - acc: 0.8134 - val_
 Epoch 324/500

60000/60000 [=====] - 7s 118us/step - loss: 0.0942 - acc: 0.8134 - val_
 Epoch 325/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0941 - acc: 0.8134 - val_
 Epoch 326/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0941 - acc: 0.8134 - val_
 Epoch 327/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.0940 - acc: 0.8134 - val_
 Epoch 328/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0940 - acc: 0.8134 - val_
 Epoch 329/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0940 - acc: 0.8134 - val_
 Epoch 330/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0940 - acc: 0.8134 - val_
 Epoch 331/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0940 - acc: 0.8134 - val_
 Epoch 332/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0940 - acc: 0.8134 - val_
 Epoch 333/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0939 - acc: 0.8134 - val_
 Epoch 334/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0939 - acc: 0.8134 - val_
 Epoch 335/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0939 - acc: 0.8134 - val_
 Epoch 336/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0938 - acc: 0.8135 - val_
 Epoch 337/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0939 - acc: 0.8134 - val_
 Epoch 338/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.0937 - acc: 0.8135 - val_
 Epoch 339/500
 60000/60000 [=====] - 9s 148us/step - loss: 0.0937 - acc: 0.8135 - val_
 Epoch 340/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.0937 - acc: 0.8135 - val_
 Epoch 341/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.0937 - acc: 0.8135 - val_
 Epoch 342/500
 60000/60000 [=====] - 7s 123us/step - loss: 0.0937 - acc: 0.8135 - val_
 Epoch 343/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0936 - acc: 0.8135 - val_
 Epoch 344/500
 60000/60000 [=====] - 7s 123us/step - loss: 0.0936 - acc: 0.8135 - val_
 Epoch 345/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0936 - acc: 0.8135 - val_
 Epoch 346/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0936 - acc: 0.8135 - val_
 Epoch 347/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0935 - acc: 0.8135 - val_
 Epoch 348/500

60000/60000 [=====] - 7s 120us/step - loss: 0.0936 - acc: 0.8135 - val_
 Epoch 349/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0934 - acc: 0.8135 - val_
 Epoch 350/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0935 - acc: 0.8135 - val_
 Epoch 351/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0935 - acc: 0.8135 - val_
 Epoch 352/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.0934 - acc: 0.8135 - val_
 Epoch 353/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0934 - acc: 0.8135 - val_
 Epoch 354/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0933 - acc: 0.8135 - val_
 Epoch 355/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0934 - acc: 0.8135 - val_
 Epoch 356/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0933 - acc: 0.8135 - val_
 Epoch 357/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0933 - acc: 0.8135 - val_
 Epoch 358/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0932 - acc: 0.8135 - val_
 Epoch 359/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0933 - acc: 0.8135 - val_
 Epoch 360/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0932 - acc: 0.8135 - val_
 Epoch 361/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.0932 - acc: 0.8135 - val_
 Epoch 362/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0932 - acc: 0.8135 - val_
 Epoch 363/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0932 - acc: 0.8135 - val_
 Epoch 364/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0931 - acc: 0.8135 - val_
 Epoch 365/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0931 - acc: 0.8135 - val_
 Epoch 366/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0931 - acc: 0.8135 - val_
 Epoch 367/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0931 - acc: 0.8135 - val_
 Epoch 368/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0931 - acc: 0.8135 - val_
 Epoch 369/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0930 - acc: 0.8135 - val_
 Epoch 370/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0930 - acc: 0.8135 - val_
 Epoch 371/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0929 - acc: 0.8136 - val_
 Epoch 372/500

60000/60000 [=====] - 7s 116us/step - loss: 0.0930 - acc: 0.8136 - val_
 Epoch 373/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0929 - acc: 0.8136 - val_
 Epoch 374/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0929 - acc: 0.8135 - val_
 Epoch 375/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0929 - acc: 0.8136 - val_
 Epoch 376/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0929 - acc: 0.8136 - val_
 Epoch 377/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0929 - acc: 0.8136 - val_
 Epoch 378/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0928 - acc: 0.8136 - val_
 Epoch 379/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0928 - acc: 0.8136 - val_
 Epoch 380/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0928 - acc: 0.8136 - val_
 Epoch 381/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0927 - acc: 0.8136 - val_
 Epoch 382/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0928 - acc: 0.8136 - val_
 Epoch 383/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0927 - acc: 0.8136 - val_
 Epoch 384/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0927 - acc: 0.8136 - val_
 Epoch 385/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0926 - acc: 0.8136 - val_
 Epoch 386/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0927 - acc: 0.8136 - val_
 Epoch 387/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0926 - acc: 0.8136 - val_
 Epoch 388/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0925 - acc: 0.8136 - val_
 Epoch 389/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0926 - acc: 0.8136 - val_
 Epoch 390/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0926 - acc: 0.8136 - val_
 Epoch 391/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0925 - acc: 0.8136 - val_
 Epoch 392/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0925 - acc: 0.8136 - val_
 Epoch 393/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0926 - acc: 0.8136 - val_
 Epoch 394/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0925 - acc: 0.8136 - val_
 Epoch 395/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0924 - acc: 0.8136 - val_
 Epoch 396/500

60000/60000 [=====] - 7s 118us/step - loss: 0.0925 - acc: 0.8136 - val_
 Epoch 397/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0924 - acc: 0.8136 - val_
 Epoch 398/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0924 - acc: 0.8136 - val_
 Epoch 399/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0923 - acc: 0.8136 - val_
 Epoch 400/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0923 - acc: 0.8136 - val_
 Epoch 401/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0924 - acc: 0.8136 - val_
 Epoch 402/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0924 - acc: 0.8136 - val_
 Epoch 403/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0924 - acc: 0.8136 - val_
 Epoch 404/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0923 - acc: 0.8136 - val_
 Epoch 405/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0922 - acc: 0.8136 - val_
 Epoch 406/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0923 - acc: 0.8136 - val_
 Epoch 407/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0922 - acc: 0.8136 - val_
 Epoch 408/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0923 - acc: 0.8136 - val_
 Epoch 409/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0922 - acc: 0.8136 - val_
 Epoch 410/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0922 - acc: 0.8136 - val_
 Epoch 411/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0921 - acc: 0.8136 - val_
 Epoch 412/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0922 - acc: 0.8136 - val_
 Epoch 413/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0922 - acc: 0.8136 - val_
 Epoch 414/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0921 - acc: 0.8136 - val_
 Epoch 415/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0920 - acc: 0.8136 - val_
 Epoch 416/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0921 - acc: 0.8136 - val_
 Epoch 417/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0920 - acc: 0.8137 - val_
 Epoch 418/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0920 - acc: 0.8136 - val_
 Epoch 419/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0920 - acc: 0.8136 - val_
 Epoch 420/500

60000/60000 [=====] - 7s 119us/step - loss: 0.0920 - acc: 0.8137 - val_
 Epoch 421/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0920 - acc: 0.8137 - val_
 Epoch 422/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0919 - acc: 0.8137 - val_
 Epoch 423/500
 60000/60000 [=====] - 9s 144us/step - loss: 0.0919 - acc: 0.8137 - val_
 Epoch 424/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.0919 - acc: 0.8137 - val_
 Epoch 425/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0919 - acc: 0.8137 - val_
 Epoch 426/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0919 - acc: 0.8137 - val_
 Epoch 427/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0919 - acc: 0.8137 - val_
 Epoch 428/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0919 - acc: 0.8137 - val_
 Epoch 429/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.0918 - acc: 0.8137 - val_
 Epoch 430/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.0919 - acc: 0.8137 - val_
 Epoch 431/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0918 - acc: 0.8137 - val_
 Epoch 432/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0918 - acc: 0.8137 - val_
 Epoch 433/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0918 - acc: 0.8137 - val_
 Epoch 434/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0918 - acc: 0.8137 - val_
 Epoch 435/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0918 - acc: 0.8137 - val_
 Epoch 436/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0917 - acc: 0.8137 - val_
 Epoch 437/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0918 - acc: 0.8137 - val_
 Epoch 438/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0917 - acc: 0.8137 - val_
 Epoch 439/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0917 - acc: 0.8137 - val_
 Epoch 440/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0917 - acc: 0.8137 - val_
 Epoch 441/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0916 - acc: 0.8137 - val_
 Epoch 442/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0917 - acc: 0.8137 - val_
 Epoch 443/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0916 - acc: 0.8137 - val_
 Epoch 444/500

60000/60000 [=====] - 7s 119us/step - loss: 0.0916 - acc: 0.8137 - val_
Epoch 445/500
60000/60000 [=====] - 7s 118us/step - loss: 0.0915 - acc: 0.8137 - val_
Epoch 446/500
60000/60000 [=====] - 7s 118us/step - loss: 0.0917 - acc: 0.8137 - val_
Epoch 447/500
60000/60000 [=====] - 7s 119us/step - loss: 0.0916 - acc: 0.8137 - val_
Epoch 448/500
60000/60000 [=====] - 7s 118us/step - loss: 0.0915 - acc: 0.8137 - val_
Epoch 449/500
60000/60000 [=====] - 7s 119us/step - loss: 0.0915 - acc: 0.8137 - val_
Epoch 450/500
60000/60000 [=====] - 7s 120us/step - loss: 0.0915 - acc: 0.8137 - val_
Epoch 451/500
60000/60000 [=====] - 7s 117us/step - loss: 0.0915 - acc: 0.8137 - val_
Epoch 452/500
60000/60000 [=====] - 7s 120us/step - loss: 0.0915 - acc: 0.8137 - val_
Epoch 453/500
60000/60000 [=====] - 7s 119us/step - loss: 0.0915 - acc: 0.8137 - val_
Epoch 454/500
60000/60000 [=====] - 7s 119us/step - loss: 0.0915 - acc: 0.8137 - val_
Epoch 455/500
60000/60000 [=====] - 7s 117us/step - loss: 0.0915 - acc: 0.8137 - val_
Epoch 456/500
60000/60000 [=====] - 7s 118us/step - loss: 0.0914 - acc: 0.8137 - val_
Epoch 457/500
60000/60000 [=====] - 7s 117us/step - loss: 0.0914 - acc: 0.8137 - val_
Epoch 458/500
60000/60000 [=====] - 7s 119us/step - loss: 0.0914 - acc: 0.8137 - val_
Epoch 459/500
60000/60000 [=====] - 7s 117us/step - loss: 0.0914 - acc: 0.8137 - val_
Epoch 460/500
60000/60000 [=====] - 7s 120us/step - loss: 0.0913 - acc: 0.8137 - val_
Epoch 461/500
60000/60000 [=====] - 7s 117us/step - loss: 0.0913 - acc: 0.8137 - val_
Epoch 462/500
60000/60000 [=====] - 7s 120us/step - loss: 0.0913 - acc: 0.8137 - val_
Epoch 463/500
60000/60000 [=====] - 7s 118us/step - loss: 0.0914 - acc: 0.8137 - val_
Epoch 464/500
60000/60000 [=====] - 7s 120us/step - loss: 0.0913 - acc: 0.8137 - val_
Epoch 465/500
60000/60000 [=====] - 7s 115us/step - loss: 0.0913 - acc: 0.8137 - val_
Epoch 466/500
60000/60000 [=====] - 7s 116us/step - loss: 0.0913 - acc: 0.8137 - val_
Epoch 467/500
60000/60000 [=====] - 7s 117us/step - loss: 0.0913 - acc: 0.8137 - val_
Epoch 468/500

60000/60000 [=====] - 7s 116us/step - loss: 0.0913 - acc: 0.8137 - val_
 Epoch 469/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0912 - acc: 0.8137 - val_
 Epoch 470/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0912 - acc: 0.8137 - val_
 Epoch 471/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0912 - acc: 0.8137 - val_
 Epoch 472/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0912 - acc: 0.8137 - val_
 Epoch 473/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0913 - acc: 0.8137 - val_
 Epoch 474/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0912 - acc: 0.8137 - val_
 Epoch 475/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0912 - acc: 0.8137 - val_
 Epoch 476/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0911 - acc: 0.8138 - val_
 Epoch 477/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0912 - acc: 0.8137 - val_
 Epoch 478/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0911 - acc: 0.8137 - val_
 Epoch 479/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0911 - acc: 0.8137 - val_
 Epoch 480/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0911 - acc: 0.8137 - val_
 Epoch 481/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0910 - acc: 0.8138 - val_
 Epoch 482/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0911 - acc: 0.8138 - val_
 Epoch 483/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0910 - acc: 0.8138 - val_
 Epoch 484/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0911 - acc: 0.8138 - val_
 Epoch 485/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0910 - acc: 0.8138 - val_
 Epoch 486/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0910 - acc: 0.8138 - val_
 Epoch 487/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0911 - acc: 0.8137 - val_
 Epoch 488/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0909 - acc: 0.8138 - val_
 Epoch 489/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0910 - acc: 0.8138 - val_
 Epoch 490/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0909 - acc: 0.8138 - val_
 Epoch 491/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0910 - acc: 0.8138 - val_
 Epoch 492/500

```

60000/60000 [=====] - 7s 116us/step - loss: 0.0909 - acc: 0.8138 - val_
Epoch 493/500
60000/60000 [=====] - 7s 119us/step - loss: 0.0910 - acc: 0.8138 - val_
Epoch 494/500
60000/60000 [=====] - 7s 117us/step - loss: 0.0910 - acc: 0.8138 - val_
Epoch 495/500
60000/60000 [=====] - 7s 117us/step - loss: 0.0909 - acc: 0.8138 - val_
Epoch 496/500
60000/60000 [=====] - 7s 118us/step - loss: 0.0909 - acc: 0.8138 - val_
Epoch 497/500
60000/60000 [=====] - 7s 121us/step - loss: 0.0908 - acc: 0.8138 - val_
Epoch 498/500
60000/60000 [=====] - 7s 118us/step - loss: 0.0908 - acc: 0.8138 - val_
Epoch 499/500
60000/60000 [=====] - 7s 118us/step - loss: 0.0908 - acc: 0.8138 - val_
Epoch 500/500
60000/60000 [=====] - 7s 117us/step - loss: 0.0908 - acc: 0.8138 - val_

```

In [9]: *# this is the size of our encoded representations*

```
encoding_dim = 16 # 32 floats -> compression of factor 24.5, assuming the input is 784
```

```
# this is our input placeholder
```

```
x = input_img = Input(shape=(784,))
```

```
# "encoded" is the encoded representation of the input
```

```
x = Dense(256, activation='relu')(x)
```

```
x = Dense(128, activation='relu')(x)
```

```
encoded = Dense(encoding_dim, activation='relu')(x)
```

```
# "decoded" is the lossy reconstruction of the input
```

```
x = Dense(128, activation='relu')(encoded)
```

```
x = Dense(256, activation='relu')(x)
```

```
decoded = Dense(784, activation='sigmoid')(x)
```

```
# this model maps an input to its reconstruction
```

```
autoencoder = Model(input_img, decoded)
```

```
encoder = Model(input_img, encoded)
```

```
# create a placeholder for an encoded (32-dimensional) input
```

```
encoded_input = Input(shape=(encoding_dim,))
```

```
# retrieve the last layer of the autoencoder model
```

```
dcd1 = autoencoder.layers[-1]
```

```
dcd2 = autoencoder.layers[-2]
```

```
dcd3 = autoencoder.layers[-3]
```

```
# create the decoder model
```

```

decoder = Model(encoded_input, dcd1(dcd2(dcd3(encoded_input))))

autoencoder.compile(optimizer='adadelat',
                    loss='binary_crossentropy',
                    metrics=['accuracy'])
history16 = autoencoder.fit(xtrain, xtrain,
                           epochs=500,
                           batch_size=256,
                           shuffle=True,
                           validation_data=(xtest, xtest),
                           callbacks=[TensorBoard(log_dir='/tmp/autoencoder/encoding_dim_
acc16 = autoencoder.evaluate(xtest,
                             xtest,
                             verbose=0)

```

Train on 60000 samples, validate on 10000 samples

```

Epoch 1/500
60000/60000 [=====] - 7s 121us/step - loss: 0.3324 - acc: 0.7535 - val_
Epoch 2/500
60000/60000 [=====] - 7s 119us/step - loss: 0.2541 - acc: 0.7960 - val_
Epoch 3/500
60000/60000 [=====] - 7s 117us/step - loss: 0.2299 - acc: 0.7936 - val_
Epoch 4/500
60000/60000 [=====] - 7s 117us/step - loss: 0.2114 - acc: 0.7938 - val_
Epoch 5/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1987 - acc: 0.7960 - val_
Epoch 6/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1884 - acc: 0.7974 - val_
Epoch 7/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1806 - acc: 0.7985 - val_
Epoch 8/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1747 - acc: 0.7996 - val_
Epoch 9/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1697 - acc: 0.8007 - val_
Epoch 10/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1650 - acc: 0.8017 - val_
Epoch 11/500
60000/60000 [=====] - 8s 131us/step - loss: 0.1608 - acc: 0.8025 - val_
Epoch 12/500
60000/60000 [=====] - 8s 139us/step - loss: 0.1572 - acc: 0.8033 - val_
Epoch 13/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1543 - acc: 0.8038 - val_
Epoch 14/500
60000/60000 [=====] - 8s 133us/step - loss: 0.1522 - acc: 0.8043 - val_
Epoch 15/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1501 - acc: 0.8046 - val_
Epoch 16/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1484 - acc: 0.8050 - val_

```

```

Epoch 17/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1467 - acc: 0.8053 - val_
Epoch 18/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1453 - acc: 0.8055 - val_
Epoch 19/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1439 - acc: 0.8058 - val_
Epoch 20/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1427 - acc: 0.8060 - val_
Epoch 21/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1413 - acc: 0.8063 - val_
Epoch 22/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1405 - acc: 0.8064 - val_
Epoch 23/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1394 - acc: 0.8066 - val_
Epoch 24/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1384 - acc: 0.8067 - val_
Epoch 25/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1375 - acc: 0.8069 - val_
Epoch 26/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1367 - acc: 0.8070 - val_
Epoch 27/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1358 - acc: 0.8071 - val_
Epoch 28/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1352 - acc: 0.8072 - val_
Epoch 29/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1342 - acc: 0.8074 - val_
Epoch 30/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1337 - acc: 0.8075 - val_
Epoch 31/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1330 - acc: 0.8075 - val_
Epoch 32/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1323 - acc: 0.8076 - val_
Epoch 33/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1317 - acc: 0.8077 - val_
Epoch 34/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1311 - acc: 0.8078 - val_
Epoch 35/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1305 - acc: 0.8079 - val_
Epoch 36/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1301 - acc: 0.8080 - val_
Epoch 37/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1296 - acc: 0.8080 - val_
Epoch 38/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1291 - acc: 0.8081 - val_
Epoch 39/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1286 - acc: 0.8082 - val_
Epoch 40/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1280 - acc: 0.8083 - val_

```

```

Epoch 41/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1275 - acc: 0.8084 - val_
Epoch 42/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1271 - acc: 0.8085 - val_
Epoch 43/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1265 - acc: 0.8086 - val_
Epoch 44/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1258 - acc: 0.8087 - val_
Epoch 45/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1252 - acc: 0.8088 - val_
Epoch 46/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1246 - acc: 0.8090 - val_
Epoch 47/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1240 - acc: 0.8091 - val_
Epoch 48/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1234 - acc: 0.8091 - val_
Epoch 49/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1229 - acc: 0.8092 - val_
Epoch 50/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1226 - acc: 0.8093 - val_
Epoch 51/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1220 - acc: 0.8094 - val_
Epoch 52/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1216 - acc: 0.8095 - val_
Epoch 53/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1210 - acc: 0.8096 - val_
Epoch 54/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1207 - acc: 0.8096 - val_
Epoch 55/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1202 - acc: 0.8097 - val_
Epoch 56/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1197 - acc: 0.8098 - val_
Epoch 57/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1193 - acc: 0.8099 - val_
Epoch 58/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1189 - acc: 0.8100 - val_
Epoch 59/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1186 - acc: 0.8100 - val_
Epoch 60/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1181 - acc: 0.8101 - val_
Epoch 61/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1178 - acc: 0.8101 - val_
Epoch 62/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1175 - acc: 0.8102 - val_
Epoch 63/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1171 - acc: 0.8102 - val_
Epoch 64/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1168 - acc: 0.8103 - val_

```

```

Epoch 65/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1165 - acc: 0.8103 - val_
Epoch 66/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1163 - acc: 0.8103 - val_
Epoch 67/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1160 - acc: 0.8104 - val_
Epoch 68/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1158 - acc: 0.8104 - val_
Epoch 69/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1156 - acc: 0.8104 - val_
Epoch 70/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1153 - acc: 0.8105 - val_
Epoch 71/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1151 - acc: 0.8105 - val_
Epoch 72/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1148 - acc: 0.8106 - val_
Epoch 73/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1146 - acc: 0.8106 - val_
Epoch 74/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1144 - acc: 0.8106 - val_
Epoch 75/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1142 - acc: 0.8107 - val_
Epoch 76/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1140 - acc: 0.8107 - val_
Epoch 77/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1138 - acc: 0.8107 - val_
Epoch 78/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1135 - acc: 0.8107 - val_
Epoch 79/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1133 - acc: 0.8108 - val_
Epoch 80/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1132 - acc: 0.8108 - val_
Epoch 81/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1130 - acc: 0.8108 - val_
Epoch 82/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1128 - acc: 0.8108 - val_
Epoch 83/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1127 - acc: 0.8109 - val_
Epoch 84/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1126 - acc: 0.8109 - val_
Epoch 85/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1123 - acc: 0.8109 - val_
Epoch 86/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1122 - acc: 0.8109 - val_
Epoch 87/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1119 - acc: 0.8110 - val_
Epoch 88/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1119 - acc: 0.8110 - val_

```

```

Epoch 89/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1117 - acc: 0.8110 - val_
Epoch 90/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1117 - acc: 0.8110 - val_
Epoch 91/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1114 - acc: 0.8110 - val_
Epoch 92/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1113 - acc: 0.8111 - val_
Epoch 93/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1111 - acc: 0.8111 - val_
Epoch 94/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1109 - acc: 0.8111 - val_
Epoch 95/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1109 - acc: 0.8111 - val_
Epoch 96/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1107 - acc: 0.8111 - val_
Epoch 97/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1105 - acc: 0.8111 - val_
Epoch 98/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1105 - acc: 0.8112 - val_
Epoch 99/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1104 - acc: 0.8112 - val_
Epoch 100/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1101 - acc: 0.8112 - val_
Epoch 101/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1099 - acc: 0.8112 - val_
Epoch 102/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1100 - acc: 0.8112 - val_
Epoch 103/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1099 - acc: 0.8112 - val_
Epoch 104/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1097 - acc: 0.8113 - val_
Epoch 105/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1098 - acc: 0.8113 - val_
Epoch 106/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1095 - acc: 0.8113 - val_
Epoch 107/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1094 - acc: 0.8113 - val_
Epoch 108/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1093 - acc: 0.8113 - val_
Epoch 109/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1092 - acc: 0.8113 - val_
Epoch 110/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1090 - acc: 0.8114 - val_
Epoch 111/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1089 - acc: 0.8114 - val_
Epoch 112/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1088 - acc: 0.8114 - val_

```

Epoch 113/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1087 - acc: 0.8114 - val_
Epoch 114/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1086 - acc: 0.8114 - val_
Epoch 115/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1084 - acc: 0.8114 - val_
Epoch 116/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1084 - acc: 0.8114 - val_
Epoch 117/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1083 - acc: 0.8114 - val_
Epoch 118/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1082 - acc: 0.8115 - val_
Epoch 119/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1081 - acc: 0.8115 - val_
Epoch 120/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1080 - acc: 0.8115 - val_
Epoch 121/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1080 - acc: 0.8115 - val_
Epoch 122/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1078 - acc: 0.8115 - val_
Epoch 123/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1078 - acc: 0.8115 - val_
Epoch 124/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1075 - acc: 0.8116 - val_
Epoch 125/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1075 - acc: 0.8116 - val_
Epoch 126/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1075 - acc: 0.8116 - val_
Epoch 127/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1073 - acc: 0.8116 - val_
Epoch 128/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1072 - acc: 0.8116 - val_
Epoch 129/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1070 - acc: 0.8116 - val_
Epoch 130/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1070 - acc: 0.8117 - val_
Epoch 131/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1069 - acc: 0.8117 - val_
Epoch 132/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1068 - acc: 0.8117 - val_
Epoch 133/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1066 - acc: 0.8117 - val_
Epoch 134/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1065 - acc: 0.8117 - val_
Epoch 135/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1064 - acc: 0.8117 - val_
Epoch 136/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1063 - acc: 0.8118 - val_

Epoch 137/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1060 - acc: 0.8118 - val_
Epoch 138/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1060 - acc: 0.8118 - val_
Epoch 139/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1058 - acc: 0.8118 - val_
Epoch 140/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1058 - acc: 0.8118 - val_
Epoch 141/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1057 - acc: 0.8118 - val_
Epoch 142/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1056 - acc: 0.8119 - val_
Epoch 143/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1054 - acc: 0.8119 - val_
Epoch 144/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1054 - acc: 0.8119 - val_
Epoch 145/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1052 - acc: 0.8119 - val_
Epoch 146/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1050 - acc: 0.8119 - val_
Epoch 147/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1050 - acc: 0.8120 - val_
Epoch 148/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1049 - acc: 0.8120 - val_
Epoch 149/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1049 - acc: 0.8120 - val_
Epoch 150/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1047 - acc: 0.8120 - val_
Epoch 151/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1046 - acc: 0.8120 - val_
Epoch 152/500
60000/60000 [=====] - 8s 137us/step - loss: 0.1045 - acc: 0.8120 - val_
Epoch 153/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1045 - acc: 0.8120 - val_
Epoch 154/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1043 - acc: 0.8121 - val_
Epoch 155/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1042 - acc: 0.8121 - val_
Epoch 156/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1042 - acc: 0.8121 - val_
Epoch 157/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1041 - acc: 0.8121 - val_
Epoch 158/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1040 - acc: 0.8121 - val_
Epoch 159/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1039 - acc: 0.8121 - val_
Epoch 160/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1037 - acc: 0.8121 - val_

Epoch 161/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1037 - acc: 0.8122 - val_
Epoch 162/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1036 - acc: 0.8122 - val_
Epoch 163/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1035 - acc: 0.8122 - val_
Epoch 164/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1034 - acc: 0.8122 - val_
Epoch 165/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1033 - acc: 0.8122 - val_
Epoch 166/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1032 - acc: 0.8122 - val_
Epoch 167/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1031 - acc: 0.8122 - val_
Epoch 168/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1029 - acc: 0.8123 - val_
Epoch 169/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1030 - acc: 0.8123 - val_
Epoch 170/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1029 - acc: 0.8123 - val_
Epoch 171/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1027 - acc: 0.8123 - val_
Epoch 172/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1026 - acc: 0.8123 - val_
Epoch 173/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1025 - acc: 0.8123 - val_
Epoch 174/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1024 - acc: 0.8123 - val_
Epoch 175/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1023 - acc: 0.8124 - val_
Epoch 176/500
60000/60000 [=====] - 7s 108us/step - loss: 0.1023 - acc: 0.8124 - val_
Epoch 177/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1022 - acc: 0.8124 - val_
Epoch 178/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1020 - acc: 0.8124 - val_
Epoch 179/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1020 - acc: 0.8124 - val_
Epoch 180/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1019 - acc: 0.8124 - val_
Epoch 181/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1018 - acc: 0.8124 - val_
Epoch 182/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1018 - acc: 0.8124 - val_
Epoch 183/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1016 - acc: 0.8124 - val_
Epoch 184/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1016 - acc: 0.8125 - val_

```

Epoch 185/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1015 - acc: 0.8125 - val_
Epoch 186/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1015 - acc: 0.8125 - val_
Epoch 187/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1013 - acc: 0.8125 - val_
Epoch 188/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1013 - acc: 0.8125 - val_
Epoch 189/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1012 - acc: 0.8125 - val_
Epoch 190/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1012 - acc: 0.8125 - val_
Epoch 191/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1010 - acc: 0.8125 - val_
Epoch 192/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1009 - acc: 0.8125 - val_
Epoch 193/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1009 - acc: 0.8126 - val_
Epoch 194/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1009 - acc: 0.8125 - val_
Epoch 195/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1008 - acc: 0.8126 - val_
Epoch 196/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1007 - acc: 0.8126 - val_
Epoch 197/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1006 - acc: 0.8126 - val_
Epoch 198/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1006 - acc: 0.8126 - val_
Epoch 199/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1004 - acc: 0.8126 - val_
Epoch 200/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1004 - acc: 0.8126 - val_
Epoch 201/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1005 - acc: 0.8126 - val_
Epoch 202/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1004 - acc: 0.8126 - val_
Epoch 203/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1002 - acc: 0.8126 - val_
Epoch 204/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1003 - acc: 0.8126 - val_
Epoch 205/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1000 - acc: 0.8127 - val_
Epoch 206/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1001 - acc: 0.8127 - val_
Epoch 207/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1000 - acc: 0.8127 - val_
Epoch 208/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0999 - acc: 0.8127 - val_

```

Epoch 209/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0998 - acc: 0.8127 - val_
Epoch 210/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0999 - acc: 0.8127 - val_
Epoch 211/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0997 - acc: 0.8127 - val_
Epoch 212/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0997 - acc: 0.8127 - val_
Epoch 213/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0996 - acc: 0.8127 - val_
Epoch 214/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0995 - acc: 0.8127 - val_
Epoch 215/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0995 - acc: 0.8127 - val_
Epoch 216/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0994 - acc: 0.8127 - val_
Epoch 217/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0993 - acc: 0.8127 - val_
Epoch 218/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0993 - acc: 0.8128 - val_
Epoch 219/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0993 - acc: 0.8128 - val_
Epoch 220/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0992 - acc: 0.8128 - val_
Epoch 221/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0991 - acc: 0.8128 - val_
Epoch 222/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0992 - acc: 0.8128 - val_
Epoch 223/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0990 - acc: 0.8128 - val_
Epoch 224/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0990 - acc: 0.8128 - val_
Epoch 225/500
60000/60000 [=====] - 7s 116us/step - loss: 0.0989 - acc: 0.8128 - val_
Epoch 226/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0989 - acc: 0.8128 - val_
Epoch 227/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0988 - acc: 0.8128 - val_
Epoch 228/500
60000/60000 [=====] - 7s 116us/step - loss: 0.0987 - acc: 0.8128 - val_
Epoch 229/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0987 - acc: 0.8128 - val_
Epoch 230/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0986 - acc: 0.8128 - val_
Epoch 231/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0987 - acc: 0.8128 - val_
Epoch 232/500
60000/60000 [=====] - 7s 117us/step - loss: 0.0985 - acc: 0.8129 - val_

Epoch 233/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0984 - acc: 0.8129 - val_
Epoch 234/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0984 - acc: 0.8129 - val_
Epoch 235/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0984 - acc: 0.8129 - val_
Epoch 236/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0983 - acc: 0.8129 - val_
Epoch 237/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0982 - acc: 0.8129 - val_
Epoch 238/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0981 - acc: 0.8129 - val_
Epoch 239/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0980 - acc: 0.8129 - val_
Epoch 240/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0980 - acc: 0.8129 - val_
Epoch 241/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0979 - acc: 0.8129 - val_
Epoch 242/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0979 - acc: 0.8129 - val_
Epoch 243/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0978 - acc: 0.8129 - val_
Epoch 244/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0977 - acc: 0.8130 - val_
Epoch 245/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0977 - acc: 0.8130 - val_
Epoch 246/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0975 - acc: 0.8130 - val_
Epoch 247/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0975 - acc: 0.8130 - val_
Epoch 248/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0975 - acc: 0.8130 - val_
Epoch 249/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0974 - acc: 0.8130 - val_
Epoch 250/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0973 - acc: 0.8130 - val_
Epoch 251/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0972 - acc: 0.8130 - val_
Epoch 252/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0971 - acc: 0.8130 - val_
Epoch 253/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0971 - acc: 0.8130 - val_
Epoch 254/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0970 - acc: 0.8130 - val_
Epoch 255/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0969 - acc: 0.8131 - val_
Epoch 256/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0970 - acc: 0.8131 - val_

Epoch 257/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0969 - acc: 0.8131 - val_
Epoch 258/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0968 - acc: 0.8131 - val_
Epoch 259/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0967 - acc: 0.8131 - val_
Epoch 260/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0968 - acc: 0.8131 - val_
Epoch 261/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0966 - acc: 0.8131 - val_
Epoch 262/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0966 - acc: 0.8131 - val_
Epoch 263/500
60000/60000 [=====] - 7s 118us/step - loss: 0.0965 - acc: 0.8131 - val_
Epoch 264/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0966 - acc: 0.8131 - val_
Epoch 265/500
60000/60000 [=====] - 7s 122us/step - loss: 0.0964 - acc: 0.8131 - val_
Epoch 266/500
60000/60000 [=====] - 7s 114us/step - loss: 0.0964 - acc: 0.8131 - val_
Epoch 267/500
60000/60000 [=====] - 7s 125us/step - loss: 0.0963 - acc: 0.8131 - val_
Epoch 268/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0962 - acc: 0.8132 - val_
Epoch 269/500
60000/60000 [=====] - 7s 122us/step - loss: 0.0963 - acc: 0.8131 - val_
Epoch 270/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0962 - acc: 0.8132 - val_
Epoch 271/500
60000/60000 [=====] - 8s 137us/step - loss: 0.0962 - acc: 0.8132 - val_
Epoch 272/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0960 - acc: 0.8132 - val_
Epoch 273/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0961 - acc: 0.8132 - val_
Epoch 274/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0959 - acc: 0.8132 - val_
Epoch 275/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0959 - acc: 0.8132 - val_
Epoch 276/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0958 - acc: 0.8132 - val_
Epoch 277/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0958 - acc: 0.8132 - val_
Epoch 278/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0959 - acc: 0.8132 - val_
Epoch 279/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0957 - acc: 0.8132 - val_
Epoch 280/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0958 - acc: 0.8132 - val_

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Epoch 281/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0957 - acc: 0.8132 - val_
Epoch 282/500
60000/60000 [=====] - 6s 105us/step - loss: 0.0957 - acc: 0.8132 - val_
Epoch 283/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0956 - acc: 0.8132 - val_
Epoch 284/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0956 - acc: 0.8132 - val_
Epoch 285/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0956 - acc: 0.8132 - val_
Epoch 286/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0955 - acc: 0.8132 - val_
Epoch 287/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0954 - acc: 0.8132 - val_
Epoch 288/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0953 - acc: 0.8133 - val_
Epoch 289/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0953 - acc: 0.8133 - val_
Epoch 290/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0953 - acc: 0.8133 - val_
Epoch 291/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0953 - acc: 0.8133 - val_
Epoch 292/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0952 - acc: 0.8133 - val_
Epoch 293/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0952 - acc: 0.8133 - val_
Epoch 294/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0952 - acc: 0.8133 - val_
Epoch 295/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0951 - acc: 0.8133 - val_
Epoch 296/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0952 - acc: 0.8133 - val_
Epoch 297/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0949 - acc: 0.8133 - val_
Epoch 298/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0950 - acc: 0.8133 - val_
Epoch 299/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0949 - acc: 0.8133 - val_
Epoch 300/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0949 - acc: 0.8133 - val_
Epoch 301/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0949 - acc: 0.8133 - val_
Epoch 302/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0948 - acc: 0.8133 - val_
Epoch 303/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0949 - acc: 0.8133 - val_
Epoch 304/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0948 - acc: 0.8133 - val_

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Epoch 305/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0947 - acc: 0.8133 - val_
Epoch 306/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0947 - acc: 0.8133 - val_
Epoch 307/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0948 - acc: 0.8133 - val_
Epoch 308/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0946 - acc: 0.8133 - val_
Epoch 309/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0946 - acc: 0.8133 - val_
Epoch 310/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0947 - acc: 0.8133 - val_
Epoch 311/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0945 - acc: 0.8133 - val_
Epoch 312/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0946 - acc: 0.8133 - val_
Epoch 313/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0945 - acc: 0.8134 - val_
Epoch 314/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0944 - acc: 0.8134 - val_
Epoch 315/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0943 - acc: 0.8134 - val_
Epoch 316/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0944 - acc: 0.8134 - val_
Epoch 317/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0944 - acc: 0.8134 - val_
Epoch 318/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0944 - acc: 0.8134 - val_
Epoch 319/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0943 - acc: 0.8134 - val_
Epoch 320/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0942 - acc: 0.8134 - val_
Epoch 321/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0942 - acc: 0.8134 - val_
Epoch 322/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0942 - acc: 0.8134 - val_
Epoch 323/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0942 - acc: 0.8134 - val_
Epoch 324/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0941 - acc: 0.8134 - val_
Epoch 325/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0942 - acc: 0.8134 - val_
Epoch 326/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0941 - acc: 0.8134 - val_
Epoch 327/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0941 - acc: 0.8134 - val_
Epoch 328/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0940 - acc: 0.8134 - val_

```


Epoch 329/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0940 - acc: 0.8134 - val_
Epoch 330/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0939 - acc: 0.8134 - val_
Epoch 331/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0940 - acc: 0.8134 - val_
Epoch 332/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0939 - acc: 0.8134 - val_
Epoch 333/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0938 - acc: 0.8134 - val_
Epoch 334/500
60000/60000 [=====] - 6s 105us/step - loss: 0.0938 - acc: 0.8134 - val_
Epoch 335/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0939 - acc: 0.8134 - val_
Epoch 336/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0937 - acc: 0.8134 - val_
Epoch 337/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0938 - acc: 0.8134 - val_
Epoch 338/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0937 - acc: 0.8134 - val_
Epoch 339/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0937 - acc: 0.8134 - val_
Epoch 340/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0936 - acc: 0.8134 - val_
Epoch 341/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0935 - acc: 0.8135 - val_
Epoch 342/500
60000/60000 [=====] - 6s 105us/step - loss: 0.0936 - acc: 0.8135 - val_
Epoch 343/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0936 - acc: 0.8135 - val_
Epoch 344/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0936 - acc: 0.8135 - val_
Epoch 345/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0935 - acc: 0.8135 - val_
Epoch 346/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0935 - acc: 0.8135 - val_
Epoch 347/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0934 - acc: 0.8135 - val_
Epoch 348/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0935 - acc: 0.8135 - val_
Epoch 349/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0934 - acc: 0.8135 - val_
Epoch 350/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0933 - acc: 0.8135 - val_
Epoch 351/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0933 - acc: 0.8135 - val_
Epoch 352/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0933 - acc: 0.8135 - val_

```

Epoch 353/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0932 - acc: 0.8135 - val_
Epoch 354/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0932 - acc: 0.8135 - val_
Epoch 355/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0932 - acc: 0.8135 - val_
Epoch 356/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0932 - acc: 0.8135 - val_
Epoch 357/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0930 - acc: 0.8135 - val_
Epoch 358/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0932 - acc: 0.8135 - val_
Epoch 359/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0931 - acc: 0.8135 - val_
Epoch 360/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0931 - acc: 0.8135 - val_
Epoch 361/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0929 - acc: 0.8135 - val_
Epoch 362/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0930 - acc: 0.8135 - val_
Epoch 363/500
60000/60000 [=====] - 6s 107us/step - loss: 0.0930 - acc: 0.8135 - val_
Epoch 364/500
60000/60000 [=====] - 6s 105us/step - loss: 0.0929 - acc: 0.8135 - val_
Epoch 365/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0929 - acc: 0.8135 - val_
Epoch 366/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0928 - acc: 0.8135 - val_
Epoch 367/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0927 - acc: 0.8136 - val_
Epoch 368/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0927 - acc: 0.8136 - val_
Epoch 369/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0928 - acc: 0.8136 - val_
Epoch 370/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0926 - acc: 0.8136 - val_
Epoch 371/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0926 - acc: 0.8136 - val_
Epoch 372/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0926 - acc: 0.8136 - val_
Epoch 373/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0926 - acc: 0.8136 - val_
Epoch 374/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0926 - acc: 0.8136 - val_
Epoch 375/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0925 - acc: 0.8136 - val_
Epoch 376/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0925 - acc: 0.8136 - val_

```

Epoch 377/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0924 - acc: 0.8136 - val_
Epoch 378/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0924 - acc: 0.8136 - val_
Epoch 379/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0924 - acc: 0.8136 - val_
Epoch 380/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0923 - acc: 0.8136 - val_
Epoch 381/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0922 - acc: 0.8136 - val_
Epoch 382/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0923 - acc: 0.8136 - val_
Epoch 383/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0922 - acc: 0.8136 - val_
Epoch 384/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0922 - acc: 0.8136 - val_
Epoch 385/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0922 - acc: 0.8136 - val_
Epoch 386/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0921 - acc: 0.8136 - val_
Epoch 387/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0921 - acc: 0.8136 - val_
Epoch 388/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0921 - acc: 0.8136 - val_
Epoch 389/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0920 - acc: 0.8136 - val_
Epoch 390/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0920 - acc: 0.8136 - val_
Epoch 391/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0920 - acc: 0.8136 - val_
Epoch 392/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0920 - acc: 0.8136 - val_
Epoch 393/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0920 - acc: 0.8137 - val_
Epoch 394/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0919 - acc: 0.8137 - val_
Epoch 395/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0919 - acc: 0.8137 - val_
Epoch 396/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0918 - acc: 0.8137 - val_
Epoch 397/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0919 - acc: 0.8137 - val_
Epoch 398/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0918 - acc: 0.8137 - val_
Epoch 399/500
60000/60000 [=====] - 6s 105us/step - loss: 0.0917 - acc: 0.8137 - val_
Epoch 400/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0917 - acc: 0.8137 - val_

Epoch 401/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0918 - acc: 0.8137 - val_
Epoch 402/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0916 - acc: 0.8137 - val_
Epoch 403/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0916 - acc: 0.8137 - val_
Epoch 404/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0917 - acc: 0.8137 - val_
Epoch 405/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0916 - acc: 0.8137 - val_
Epoch 406/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0915 - acc: 0.8137 - val_
Epoch 407/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0915 - acc: 0.8137 - val_
Epoch 408/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0916 - acc: 0.8137 - val_
Epoch 409/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0916 - acc: 0.8137 - val_
Epoch 410/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0915 - acc: 0.8137 - val_
Epoch 411/500
60000/60000 [=====] - 6s 108us/step - loss: 0.0915 - acc: 0.8137 - val_
Epoch 412/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0914 - acc: 0.8137 - val_
Epoch 413/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0914 - acc: 0.8137 - val_
Epoch 414/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0914 - acc: 0.8137 - val_
Epoch 415/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0914 - acc: 0.8137 - val_
Epoch 416/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0914 - acc: 0.8137 - val_
Epoch 417/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0913 - acc: 0.8137 - val_
Epoch 418/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0913 - acc: 0.8137 - val_
Epoch 419/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0912 - acc: 0.8137 - val_
Epoch 420/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0912 - acc: 0.8137 - val_
Epoch 421/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0912 - acc: 0.8137 - val_
Epoch 422/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0911 - acc: 0.8137 - val_
Epoch 423/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0912 - acc: 0.8137 - val_
Epoch 424/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0911 - acc: 0.8137 - val_

```

Epoch 425/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0911 - acc: 0.8137 - val_
Epoch 426/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0911 - acc: 0.8137 - val_
Epoch 427/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0912 - acc: 0.8137 - val_
Epoch 428/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0911 - acc: 0.8137 - val_
Epoch 429/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0910 - acc: 0.8138 - val_
Epoch 430/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0911 - acc: 0.8137 - val_
Epoch 431/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0909 - acc: 0.8138 - val_
Epoch 432/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0910 - acc: 0.8138 - val_
Epoch 433/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0909 - acc: 0.8138 - val_
Epoch 434/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0909 - acc: 0.8138 - val_
Epoch 435/500
60000/60000 [=====] - 6s 108us/step - loss: 0.0909 - acc: 0.8138 - val_
Epoch 436/500
60000/60000 [=====] - 7s 109us/step - loss: 0.0908 - acc: 0.8138 - val_
Epoch 437/500
60000/60000 [=====] - 6s 105us/step - loss: 0.0908 - acc: 0.8138 - val_
Epoch 438/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0909 - acc: 0.8138 - val_
Epoch 439/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0909 - acc: 0.8138 - val_
Epoch 440/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0908 - acc: 0.8138 - val_
Epoch 441/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0908 - acc: 0.8138 - val_
Epoch 442/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0908 - acc: 0.8138 - val_
Epoch 443/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0907 - acc: 0.8138 - val_
Epoch 444/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0907 - acc: 0.8138 - val_
Epoch 445/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0907 - acc: 0.8138 - val_
Epoch 446/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0907 - acc: 0.8138 - val_
Epoch 447/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0906 - acc: 0.8138 - val_
Epoch 448/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0906 - acc: 0.8138 - val_

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Epoch 449/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0906 - acc: 0.8138 - val_
Epoch 450/500
60000/60000 [=====] - 7s 112us/step - loss: 0.0906 - acc: 0.8138 - val_
Epoch 451/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0905 - acc: 0.8138 - val_
Epoch 452/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0906 - acc: 0.8138 - val_
Epoch 453/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0905 - acc: 0.8138 - val_
Epoch 454/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0905 - acc: 0.8138 - val_
Epoch 455/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0905 - acc: 0.8138 - val_
Epoch 456/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0905 - acc: 0.8138 - val_
Epoch 457/500
60000/60000 [=====] - 6s 103us/step - loss: 0.0905 - acc: 0.8138 - val_
Epoch 458/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0904 - acc: 0.8138 - val_
Epoch 459/500
60000/60000 [=====] - 7s 114us/step - loss: 0.0904 - acc: 0.8138 - val_
Epoch 460/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0904 - acc: 0.8138 - val_
Epoch 461/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0903 - acc: 0.8138 - val_
Epoch 462/500
60000/60000 [=====] - 6s 104us/step - loss: 0.0904 - acc: 0.8138 - val_
Epoch 463/500
60000/60000 [=====] - 6s 105us/step - loss: 0.0903 - acc: 0.8138 - val_
Epoch 464/500
60000/60000 [=====] - 7s 113us/step - loss: 0.0903 - acc: 0.8138 - val_
Epoch 465/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0903 - acc: 0.8138 - val_
Epoch 466/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0903 - acc: 0.8138 - val_
Epoch 467/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0903 - acc: 0.8138 - val_
Epoch 468/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0903 - acc: 0.8138 - val_
Epoch 469/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0902 - acc: 0.8138 - val_
Epoch 470/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0902 - acc: 0.8138 - val_
Epoch 471/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0902 - acc: 0.8138 - val_
Epoch 472/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0901 - acc: 0.8138 - val_

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Epoch 473/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0901 - acc: 0.8139 - val_
Epoch 474/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0902 - acc: 0.8138 - val_
Epoch 475/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0901 - acc: 0.8138 - val_
Epoch 476/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0901 - acc: 0.8139 - val_
Epoch 477/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0901 - acc: 0.8139 - val_
Epoch 478/500
60000/60000 [=====] - 7s 110us/step - loss: 0.0901 - acc: 0.8139 - val_
Epoch 479/500
60000/60000 [=====] - 7s 111us/step - loss: 0.0900 - acc: 0.8139 - val_
Epoch 480/500
60000/60000 [=====] - 7s 114us/step - loss: 0.0901 - acc: 0.8138 - val_
Epoch 481/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0900 - acc: 0.8139 - val_
Epoch 482/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0900 - acc: 0.8139 - val_
Epoch 483/500
60000/60000 [=====] - 6s 108us/step - loss: 0.0900 - acc: 0.8139 - val_
Epoch 484/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0899 - acc: 0.8139 - val_
Epoch 485/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0899 - acc: 0.8139 - val_
Epoch 486/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0899 - acc: 0.8139 - val_
Epoch 487/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0899 - acc: 0.8139 - val_
Epoch 488/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0899 - acc: 0.8139 - val_
Epoch 489/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0899 - acc: 0.8139 - val_
Epoch 490/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0898 - acc: 0.8139 - val_
Epoch 491/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0898 - acc: 0.8139 - val_
Epoch 492/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0898 - acc: 0.8139 - val_
Epoch 493/500
60000/60000 [=====] - 6s 105us/step - loss: 0.0898 - acc: 0.8139 - val_
Epoch 494/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0898 - acc: 0.8139 - val_
Epoch 495/500
60000/60000 [=====] - 6s 100us/step - loss: 0.0898 - acc: 0.8139 - val_
Epoch 496/500
60000/60000 [=====] - 6s 101us/step - loss: 0.0898 - acc: 0.8139 - val_

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Epoch 497/500
60000/60000 [=====] - 6s 102us/step - loss: 0.0898 - acc: 0.8139 - val_1
Epoch 498/500
60000/60000 [=====] - 6s 99us/step - loss: 0.0898 - acc: 0.8139 - val_1
Epoch 499/500
60000/60000 [=====] - 6s 98us/step - loss: 0.0897 - acc: 0.8139 - val_1
Epoch 500/500
60000/60000 [=====] - 6s 99us/step - loss: 0.0897 - acc: 0.8139 - val_1

```

```

In [10]: # this is the size of our encoded representations
encoding_dim = 18 # 32 floats -> compression of factor 24.5, assuming the input is 784

# this is our input placeholder
x = input_img = Input(shape=(784,))
# "encoded" is the encoded representation of the input
x = Dense(256, activation='relu')(x)
x = Dense(128, activation='relu')(x)
encoded = Dense(encoding_dim, activation='relu')(x)

# "decoded" is the lossy reconstruction of the input
x = Dense(128, activation='relu')(encoded)
x = Dense(256, activation='relu')(x)
decoded = Dense(784, activation='sigmoid')(x)

# this model maps an input to its reconstruction
autoencoder = Model(input_img, decoded)

encoder = Model(input_img, encoded)

# create a placeholder for an encoded (32-dimensional) input
encoded_input = Input(shape=(encoding_dim,))
# retrieve the last layer of the autoencoder model
dcd1 = autoencoder.layers[-1]
dcd2 = autoencoder.layers[-2]
dcd3 = autoencoder.layers[-3]

# create the decoder model
decoder = Model(encoded_input, dcd1(dcd2(dcd3(encoded_input))))

autoencoder.compile(optimizer='adadelta',
                    loss='binary_crossentropy',
                    metrics=['accuracy'])
history18 = autoencoder.fit(xtrain, xtrain,
                            epochs=500,
                            batch_size=256,
                            shuffle=True,

```



```

        validation_data=(xtest, xtest),
        callbacks=[TensorBoard(log_dir='/tmp/autoencoder/encoding_dim')]
    acc18 = autoencoder.evaluate(xtest,
                                xtest,
                                verbose=0)

```

Train on 60000 samples, validate on 10000 samples

```

Epoch 1/500
60000/60000 [=====] - 6s 104us/step - loss: 0.3329 - acc: 0.7520 - val_
Epoch 2/500
60000/60000 [=====] - 6s 99us/step - loss: 0.2570 - acc: 0.7959 - val_
Epoch 3/500
60000/60000 [=====] - 6s 100us/step - loss: 0.2412 - acc: 0.7964 - val_
Epoch 4/500
60000/60000 [=====] - 6s 100us/step - loss: 0.2213 - acc: 0.7948 - val_
Epoch 5/500
60000/60000 [=====] - 6s 100us/step - loss: 0.2021 - acc: 0.7964 - val_
Epoch 6/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1897 - acc: 0.7974 - val_
Epoch 7/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1832 - acc: 0.7981 - val_
Epoch 8/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1777 - acc: 0.7991 - val_
Epoch 9/500
60000/60000 [=====] - 6s 99us/step - loss: 0.1715 - acc: 0.8005 - val_
Epoch 10/500
60000/60000 [=====] - 6s 101us/step - loss: 0.1652 - acc: 0.8018 - val_
Epoch 11/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1596 - acc: 0.8030 - val_
Epoch 12/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1548 - acc: 0.8040 - val_
Epoch 13/500
60000/60000 [=====] - 6s 100us/step - loss: 0.1513 - acc: 0.8047 - val_
Epoch 14/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1486 - acc: 0.8053 - val_
Epoch 15/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1463 - acc: 0.8057 - val_
Epoch 16/500
60000/60000 [=====] - 7s 108us/step - loss: 0.1445 - acc: 0.8060 - val_
Epoch 17/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1423 - acc: 0.8065 - val_
Epoch 18/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1403 - acc: 0.8068 - val_
Epoch 19/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1381 - acc: 0.8073 - val_
Epoch 20/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1357 - acc: 0.8077 - val_
Epoch 21/500

```

```

60000/60000 [=====] - 7s 116us/step - loss: 0.1336 - acc: 0.8081 - val_
Epoch 22/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1316 - acc: 0.8084 - val_
Epoch 23/500
60000/60000 [=====] - 9s 144us/step - loss: 0.1301 - acc: 0.8087 - val_
Epoch 24/500
60000/60000 [=====] - 9s 155us/step - loss: 0.1290 - acc: 0.8088 - val_
Epoch 25/500
60000/60000 [=====] - 9s 154us/step - loss: 0.1276 - acc: 0.8091 - val_
Epoch 26/500
60000/60000 [=====] - 9s 147us/step - loss: 0.1268 - acc: 0.8092 - val_
Epoch 27/500
60000/60000 [=====] - 8s 126us/step - loss: 0.1259 - acc: 0.8093 - val_
Epoch 28/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1248 - acc: 0.8095 - val_
Epoch 29/500
60000/60000 [=====] - 8s 138us/step - loss: 0.1240 - acc: 0.8096 - val_
Epoch 30/500
60000/60000 [=====] - 8s 137us/step - loss: 0.1231 - acc: 0.8098 - val_
Epoch 31/500
60000/60000 [=====] - 9s 143us/step - loss: 0.1223 - acc: 0.8099 - val_
Epoch 32/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1214 - acc: 0.8100 - val_
Epoch 33/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1207 - acc: 0.8101 - val_
Epoch 34/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1200 - acc: 0.8102 - val_
Epoch 35/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1194 - acc: 0.8103 - val_
Epoch 36/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1186 - acc: 0.8104 - val_
Epoch 37/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1182 - acc: 0.8105 - val_
Epoch 38/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1175 - acc: 0.8106 - val_
Epoch 39/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1170 - acc: 0.8107 - val_
Epoch 40/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1164 - acc: 0.8108 - val_
Epoch 41/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1159 - acc: 0.8108 - val_
Epoch 42/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1153 - acc: 0.8109 - val_
Epoch 43/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1148 - acc: 0.8110 - val_
Epoch 44/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1142 - acc: 0.8111 - val_
Epoch 45/500

```

60000/60000 [=====] - 7s 110us/step - loss: 0.1137 - acc: 0.8111 - val_
 Epoch 46/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1132 - acc: 0.8112 - val_
 Epoch 47/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1127 - acc: 0.8113 - val_
 Epoch 48/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1124 - acc: 0.8114 - val_
 Epoch 49/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1119 - acc: 0.8114 - val_
 Epoch 50/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1115 - acc: 0.8114 - val_
 Epoch 51/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1112 - acc: 0.8115 - val_
 Epoch 52/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1107 - acc: 0.8116 - val_
 Epoch 53/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1103 - acc: 0.8116 - val_
 Epoch 54/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1100 - acc: 0.8117 - val_
 Epoch 55/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1098 - acc: 0.8117 - val_
 Epoch 56/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1096 - acc: 0.8117 - val_
 Epoch 57/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1091 - acc: 0.8118 - val_
 Epoch 58/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1088 - acc: 0.8118 - val_
 Epoch 59/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1086 - acc: 0.8118 - val_
 Epoch 60/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.1083 - acc: 0.8119 - val_
 Epoch 61/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.1082 - acc: 0.8119 - val_
 Epoch 62/500
 60000/60000 [=====] - 9s 157us/step - loss: 0.1078 - acc: 0.8119 - val_
 Epoch 63/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.1076 - acc: 0.8119 - val_
 Epoch 64/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1074 - acc: 0.8120 - val_
 Epoch 65/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.1071 - acc: 0.8120 - val_
 Epoch 66/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.1069 - acc: 0.8120 - val_
 Epoch 67/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1065 - acc: 0.8121 - val_
 Epoch 68/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.1064 - acc: 0.8121 - val_
 Epoch 69/500

60000/60000 [=====] - 7s 114us/step - loss: 0.1063 - acc: 0.8121 - val_
 Epoch 70/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1061 - acc: 0.8121 - val_
 Epoch 71/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1059 - acc: 0.8122 - val_
 Epoch 72/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1056 - acc: 0.8122 - val_
 Epoch 73/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1054 - acc: 0.8122 - val_
 Epoch 74/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1054 - acc: 0.8122 - val_
 Epoch 75/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1051 - acc: 0.8122 - val_
 Epoch 76/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1049 - acc: 0.8123 - val_
 Epoch 77/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1048 - acc: 0.8123 - val_
 Epoch 78/500
 60000/60000 [=====] - 8s 125us/step - loss: 0.1045 - acc: 0.8123 - val_
 Epoch 79/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.1045 - acc: 0.8123 - val_
 Epoch 80/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.1042 - acc: 0.8124 - val_
 Epoch 81/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1041 - acc: 0.8124 - val_
 Epoch 82/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1039 - acc: 0.8124 - val_
 Epoch 83/500
 60000/60000 [=====] - 10s 161us/step - loss: 0.1038 - acc: 0.8124 - val_
 Epoch 84/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1036 - acc: 0.8124 - val_
 Epoch 85/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1034 - acc: 0.8125 - val_
 Epoch 86/500
 60000/60000 [=====] - 7s 108us/step - loss: 0.1034 - acc: 0.8124 - val_
 Epoch 87/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1032 - acc: 0.8125 - val_
 Epoch 88/500
 60000/60000 [=====] - 7s 108us/step - loss: 0.1031 - acc: 0.8125 - val_
 Epoch 89/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1029 - acc: 0.8125 - val_
 Epoch 90/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1027 - acc: 0.8125 - val_
 Epoch 91/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1026 - acc: 0.8125 - val_
 Epoch 92/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1024 - acc: 0.8125 - val_
 Epoch 93/500

60000/60000 [=====] - 7s 109us/step - loss: 0.1023 - acc: 0.8126 - val_
Epoch 94/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1022 - acc: 0.8126 - val_
Epoch 95/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1022 - acc: 0.8126 - val_
Epoch 96/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1020 - acc: 0.8126 - val_
Epoch 97/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1019 - acc: 0.8126 - val_
Epoch 98/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1016 - acc: 0.8126 - val_
Epoch 99/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1016 - acc: 0.8127 - val_
Epoch 100/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1015 - acc: 0.8127 - val_
Epoch 101/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1015 - acc: 0.8127 - val_
Epoch 102/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1013 - acc: 0.8127 - val_
Epoch 103/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1012 - acc: 0.8127 - val_
Epoch 104/500
60000/60000 [=====] - 8s 130us/step - loss: 0.1011 - acc: 0.8127 - val_
Epoch 105/500
60000/60000 [=====] - 8s 130us/step - loss: 0.1009 - acc: 0.8127 - val_
Epoch 106/500
60000/60000 [=====] - 11s 181us/step - loss: 0.1008 - acc: 0.8127 - val_
Epoch 107/500
60000/60000 [=====] - 9s 145us/step - loss: 0.1008 - acc: 0.8127 - val_
Epoch 108/500
60000/60000 [=====] - 9s 150us/step - loss: 0.1006 - acc: 0.8128 - val_
Epoch 109/500
60000/60000 [=====] - 8s 136us/step - loss: 0.1006 - acc: 0.8128 - val_
Epoch 110/500
60000/60000 [=====] - 10s 161us/step - loss: 0.1005 - acc: 0.8128 - val_
Epoch 111/500
60000/60000 [=====] - 11s 180us/step - loss: 0.1003 - acc: 0.8128 - val_
Epoch 112/500
60000/60000 [=====] - 10s 166us/step - loss: 0.1003 - acc: 0.8128 - val_
Epoch 113/500
60000/60000 [=====] - 9s 143us/step - loss: 0.1002 - acc: 0.8128 - val_
Epoch 114/500
60000/60000 [=====] - 8s 141us/step - loss: 0.1001 - acc: 0.8128 - val_
Epoch 115/500
60000/60000 [=====] - 9s 150us/step - loss: 0.1000 - acc: 0.8128 - val_
Epoch 116/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0999 - acc: 0.8128 - val_
Epoch 117/500

60000/60000 [=====] - 8s 138us/step - loss: 0.0998 - acc: 0.8129 - val_
 Epoch 118/500
 60000/60000 [=====] - 9s 144us/step - loss: 0.0998 - acc: 0.8128 - val_
 Epoch 119/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.0996 - acc: 0.8129 - val_
 Epoch 120/500
 60000/60000 [=====] - 9s 148us/step - loss: 0.0995 - acc: 0.8129 - val_
 Epoch 121/500
 60000/60000 [=====] - 10s 163us/step - loss: 0.0995 - acc: 0.8129 - val_
 Epoch 122/500
 60000/60000 [=====] - 10s 161us/step - loss: 0.0993 - acc: 0.8129 - val_
 Epoch 123/500
 60000/60000 [=====] - 9s 157us/step - loss: 0.0994 - acc: 0.8129 - val_
 Epoch 124/500
 60000/60000 [=====] - 10s 168us/step - loss: 0.0992 - acc: 0.8129 - val_
 Epoch 125/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0991 - acc: 0.8129 - val_
 Epoch 126/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.0991 - acc: 0.8129 - val_
 Epoch 127/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.0990 - acc: 0.8129 - val_
 Epoch 128/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.0988 - acc: 0.8130 - val_
 Epoch 129/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.0988 - acc: 0.8130 - val_
 Epoch 130/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.0988 - acc: 0.8130 - val_
 Epoch 131/500
 60000/60000 [=====] - 9s 147us/step - loss: 0.0986 - acc: 0.8130 - val_
 Epoch 132/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.0986 - acc: 0.8130 - val_
 Epoch 133/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.0985 - acc: 0.8130 - val_
 Epoch 134/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.0985 - acc: 0.8130 - val_
 Epoch 135/500
 60000/60000 [=====] - 8s 140us/step - loss: 0.0984 - acc: 0.8130 - val_
 Epoch 136/500
 60000/60000 [=====] - 8s 136us/step - loss: 0.0983 - acc: 0.8130 - val_
 Epoch 137/500
 60000/60000 [=====] - 9s 150us/step - loss: 0.0983 - acc: 0.8130 - val_
 Epoch 138/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.0982 - acc: 0.8130 - val_
 Epoch 139/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0981 - acc: 0.8130 - val_
 Epoch 140/500
 60000/60000 [=====] - 9s 144us/step - loss: 0.0982 - acc: 0.8130 - val_
 Epoch 141/500

60000/60000 [=====] - 9s 145us/step - loss: 0.0980 - acc: 0.8131 - val_
 Epoch 142/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0979 - acc: 0.8131 - val_
 Epoch 143/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0979 - acc: 0.8131 - val_
 Epoch 144/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0978 - acc: 0.8131 - val_
 Epoch 145/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.0977 - acc: 0.8131 - val_
 Epoch 146/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.0977 - acc: 0.8131 - val_
 Epoch 147/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.0976 - acc: 0.8131 - val_
 Epoch 148/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0975 - acc: 0.8131 - val_
 Epoch 149/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.0974 - acc: 0.8131 - val_
 Epoch 150/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.0974 - acc: 0.8131 - val_
 Epoch 151/500
 60000/60000 [=====] - 7s 123us/step - loss: 0.0974 - acc: 0.8131 - val_
 Epoch 152/500
 60000/60000 [=====] - 8s 125us/step - loss: 0.0972 - acc: 0.8131 - val_
 Epoch 153/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.0972 - acc: 0.8131 - val_
 Epoch 154/500
 60000/60000 [=====] - 7s 125us/step - loss: 0.0971 - acc: 0.8131 - val_
 Epoch 155/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0971 - acc: 0.8131 - val_
 Epoch 156/500
 60000/60000 [=====] - 7s 125us/step - loss: 0.0970 - acc: 0.8131 - val_
 Epoch 157/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0970 - acc: 0.8131 - val_
 Epoch 158/500
 60000/60000 [=====] - 7s 125us/step - loss: 0.0969 - acc: 0.8132 - val_
 Epoch 159/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.0968 - acc: 0.8132 - val_
 Epoch 160/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0968 - acc: 0.8132 - val_
 Epoch 161/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0967 - acc: 0.8132 - val_
 Epoch 162/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.0967 - acc: 0.8132 - val_
 Epoch 163/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0967 - acc: 0.8132 - val_
 Epoch 164/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.0966 - acc: 0.8132 - val_
 Epoch 165/500

60000/60000 [=====] - 8s 126us/step - loss: 0.0965 - acc: 0.8132 - val_
 Epoch 166/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0964 - acc: 0.8132 - val_
 Epoch 167/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.0965 - acc: 0.8132 - val_
 Epoch 168/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.0964 - acc: 0.8132 - val_
 Epoch 169/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.0963 - acc: 0.8132 - val_
 Epoch 170/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.0964 - acc: 0.8132 - val_
 Epoch 171/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0962 - acc: 0.8132 - val_
 Epoch 172/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.0962 - acc: 0.8132 - val_
 Epoch 173/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0962 - acc: 0.8132 - val_
 Epoch 174/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.0961 - acc: 0.8133 - val_
 Epoch 175/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0961 - acc: 0.8132 - val_
 Epoch 176/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.0960 - acc: 0.8133 - val_
 Epoch 177/500
 60000/60000 [=====] - 8s 125us/step - loss: 0.0960 - acc: 0.8133 - val_
 Epoch 178/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0959 - acc: 0.8133 - val_
 Epoch 179/500
 60000/60000 [=====] - 8s 141us/step - loss: 0.0958 - acc: 0.8133 - val_
 Epoch 180/500
 60000/60000 [=====] - 8s 141us/step - loss: 0.0959 - acc: 0.8133 - val_
 Epoch 181/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0958 - acc: 0.8133 - val_
 Epoch 182/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.0957 - acc: 0.8133 - val_
 Epoch 183/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0956 - acc: 0.8133 - val_
 Epoch 184/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0956 - acc: 0.8133 - val_
 Epoch 185/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0956 - acc: 0.8133 - val_
 Epoch 186/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0955 - acc: 0.8133 - val_
 Epoch 187/500
 60000/60000 [=====] - 9s 145us/step - loss: 0.0954 - acc: 0.8133 - val_
 Epoch 188/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0955 - acc: 0.8133 - val_
 Epoch 189/500

60000/60000 [=====] - 7s 114us/step - loss: 0.0954 - acc: 0.8133 - val_
 Epoch 190/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.0953 - acc: 0.8133 - val_
 Epoch 191/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.0953 - acc: 0.8133 - val_
 Epoch 192/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.0953 - acc: 0.8133 - val_
 Epoch 193/500
 60000/60000 [=====] - 8s 136us/step - loss: 0.0952 - acc: 0.8133 - val_
 Epoch 194/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0951 - acc: 0.8134 - val_
 Epoch 195/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.0952 - acc: 0.8133 - val_
 Epoch 196/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.0952 - acc: 0.8134 - val_
 Epoch 197/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0951 - acc: 0.8134 - val_
 Epoch 198/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0949 - acc: 0.8134 - val_
 Epoch 199/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.0949 - acc: 0.8134 - val_
 Epoch 200/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0949 - acc: 0.8134 - val_
 Epoch 201/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0948 - acc: 0.8134 - val_
 Epoch 202/500
 60000/60000 [=====] - 8s 130us/step - loss: 0.0948 - acc: 0.8134 - val_
 Epoch 203/500
 60000/60000 [=====] - 7s 125us/step - loss: 0.0948 - acc: 0.8134 - val_
 Epoch 204/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0946 - acc: 0.8134 - val_
 Epoch 205/500
 60000/60000 [=====] - 9s 142us/step - loss: 0.0947 - acc: 0.8134 - val_
 Epoch 206/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.0946 - acc: 0.8134 - val_
 Epoch 207/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0945 - acc: 0.8134 - val_
 Epoch 208/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.0945 - acc: 0.8134 - val_
 Epoch 209/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.0945 - acc: 0.8134 - val_
 Epoch 210/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0944 - acc: 0.8134 - val_
 Epoch 211/500
 60000/60000 [=====] - 8s 135us/step - loss: 0.0943 - acc: 0.8134 - val_
 Epoch 212/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.0943 - acc: 0.8134 - val_
 Epoch 213/500

60000/60000 [=====] - 7s 120us/step - loss: 0.0942 - acc: 0.8135 - val_
 Epoch 214/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.0941 - acc: 0.8135 - val_
 Epoch 215/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.0941 - acc: 0.8135 - val_
 Epoch 216/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.0941 - acc: 0.8135 - val_
 Epoch 217/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.0941 - acc: 0.8135 - val_
 Epoch 218/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.0939 - acc: 0.8135 - val_
 Epoch 219/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0939 - acc: 0.8135 - val_
 Epoch 220/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.0938 - acc: 0.8135 - val_
 Epoch 221/500
 60000/60000 [=====] - 9s 149us/step - loss: 0.0937 - acc: 0.8135 - val_
 Epoch 222/500
 60000/60000 [=====] - 12s 205us/step - loss: 0.0938 - acc: 0.8135 - val_
 Epoch 223/500
 60000/60000 [=====] - 10s 159us/step - loss: 0.0937 - acc: 0.8135 - val_
 Epoch 224/500
 60000/60000 [=====] - 9s 158us/step - loss: 0.0936 - acc: 0.8135 - val_
 Epoch 225/500
 60000/60000 [=====] - 9s 146us/step - loss: 0.0936 - acc: 0.8135 - val_
 Epoch 226/500
 60000/60000 [=====] - 10s 159us/step - loss: 0.0935 - acc: 0.8135 - val_
 Epoch 227/500
 60000/60000 [=====] - 10s 170us/step - loss: 0.0935 - acc: 0.8136 - val_
 Epoch 228/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.0934 - acc: 0.8136 - val_
 Epoch 229/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.0933 - acc: 0.8136 - val_
 Epoch 230/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.0934 - acc: 0.8136 - val_
 Epoch 231/500
 60000/60000 [=====] - 8s 137us/step - loss: 0.0933 - acc: 0.8136 - val_
 Epoch 232/500
 60000/60000 [=====] - 9s 149us/step - loss: 0.0932 - acc: 0.8136 - val_
 Epoch 233/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.0931 - acc: 0.8136 - val_
 Epoch 234/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0931 - acc: 0.8136 - val_
 Epoch 235/500
 60000/60000 [=====] - 8s 125us/step - loss: 0.0931 - acc: 0.8136 - val_
 Epoch 236/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.0931 - acc: 0.8136 - val_
 Epoch 237/500

60000/60000 [=====] - 8s 129us/step - loss: 0.0929 - acc: 0.8136 - val_
 Epoch 238/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0931 - acc: 0.8136 - val_
 Epoch 239/500
 60000/60000 [=====] - 8s 135us/step - loss: 0.0930 - acc: 0.8136 - val_
 Epoch 240/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0929 - acc: 0.8136 - val_
 Epoch 241/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.0929 - acc: 0.8136 - val_
 Epoch 242/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.0928 - acc: 0.8136 - val_
 Epoch 243/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.0928 - acc: 0.8136 - val_
 Epoch 244/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.0928 - acc: 0.8136 - val_
 Epoch 245/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0926 - acc: 0.8137 - val_
 Epoch 246/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.0926 - acc: 0.8137 - val_
 Epoch 247/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.0926 - acc: 0.8137 - val_
 Epoch 248/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.0926 - acc: 0.8137 - val_
 Epoch 249/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.0925 - acc: 0.8137 - val_
 Epoch 250/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0925 - acc: 0.8137 - val_
 Epoch 251/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.0924 - acc: 0.8137 - val_
 Epoch 252/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.0925 - acc: 0.8137 - val_
 Epoch 253/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.0924 - acc: 0.8137 - val_
 Epoch 254/500
 60000/60000 [=====] - 9s 153us/step - loss: 0.0923 - acc: 0.8137 - val_
 Epoch 255/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.0923 - acc: 0.8137 - val_
 Epoch 256/500
 60000/60000 [=====] - 9s 149us/step - loss: 0.0922 - acc: 0.8137 - val_
 Epoch 257/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.0922 - acc: 0.8137 - val_
 Epoch 258/500
 60000/60000 [=====] - 8s 137us/step - loss: 0.0922 - acc: 0.8137 - val_
 Epoch 259/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0922 - acc: 0.8137 - val_
 Epoch 260/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0922 - acc: 0.8137 - val_
 Epoch 261/500

60000/60000 [=====] - 7s 111us/step - loss: 0.0920 - acc: 0.8137 - val_
 Epoch 262/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.0921 - acc: 0.8137 - val_
 Epoch 263/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.0921 - acc: 0.8137 - val_
 Epoch 264/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0920 - acc: 0.8137 - val_
 Epoch 265/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0919 - acc: 0.8137 - val_
 Epoch 266/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0919 - acc: 0.8137 - val_
 Epoch 267/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.0919 - acc: 0.8137 - val_
 Epoch 268/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.0919 - acc: 0.8137 - val_
 Epoch 269/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.0918 - acc: 0.8137 - val_
 Epoch 270/500
 60000/60000 [=====] - 8s 140us/step - loss: 0.0919 - acc: 0.8137 - val_
 Epoch 271/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.0918 - acc: 0.8137 - val_
 Epoch 272/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0918 - acc: 0.8138 - val_
 Epoch 273/500
 60000/60000 [=====] - 9s 144us/step - loss: 0.0917 - acc: 0.8138 - val_
 Epoch 274/500
 60000/60000 [=====] - 9s 157us/step - loss: 0.0917 - acc: 0.8138 - val_
 Epoch 275/500
 60000/60000 [=====] - 10s 159us/step - loss: 0.0917 - acc: 0.8138 - val_
 Epoch 276/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.0916 - acc: 0.8138 - val_
 Epoch 277/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0916 - acc: 0.8138 - val_
 Epoch 278/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0916 - acc: 0.8138 - val_
 Epoch 279/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.0915 - acc: 0.8138 - val_
 Epoch 280/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.0915 - acc: 0.8138 - val_
 Epoch 281/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.0915 - acc: 0.8138 - val_
 Epoch 282/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.0914 - acc: 0.8138 - val_
 Epoch 283/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.0915 - acc: 0.8138 - val_
 Epoch 284/500
 60000/60000 [=====] - 8s 141us/step - loss: 0.0914 - acc: 0.8138 - val_
 Epoch 285/500

60000/60000 [=====] - 7s 119us/step - loss: 0.0913 - acc: 0.8138 - val_
 Epoch 286/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0914 - acc: 0.8138 - val_
 Epoch 287/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0913 - acc: 0.8138 - val_
 Epoch 288/500
 60000/60000 [=====] - 9s 149us/step - loss: 0.0913 - acc: 0.8138 - val_
 Epoch 289/500
 60000/60000 [=====] - 9s 155us/step - loss: 0.0912 - acc: 0.8138 - val_
 Epoch 290/500
 60000/60000 [=====] - 8s 140us/step - loss: 0.0912 - acc: 0.8138 - val_
 Epoch 291/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0912 - acc: 0.8138 - val_
 Epoch 292/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0912 - acc: 0.8138 - val_
 Epoch 293/500
 60000/60000 [=====] - 8s 135us/step - loss: 0.0910 - acc: 0.8138 - val_
 Epoch 294/500
 60000/60000 [=====] - 9s 145us/step - loss: 0.0911 - acc: 0.8138 - val_
 Epoch 295/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.0911 - acc: 0.8138 - val_
 Epoch 296/500
 60000/60000 [=====] - 9s 151us/step - loss: 0.0910 - acc: 0.8138 - val_
 Epoch 297/500
 60000/60000 [=====] - 8s 130us/step - loss: 0.0910 - acc: 0.8138 - val_
 Epoch 298/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.0910 - acc: 0.8138 - val_
 Epoch 299/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0910 - acc: 0.8138 - val_
 Epoch 300/500
 60000/60000 [=====] - 8s 125us/step - loss: 0.0910 - acc: 0.8138 - val_
 Epoch 301/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.0909 - acc: 0.8138 - val_
 Epoch 302/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0909 - acc: 0.8138 - val_
 Epoch 303/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0908 - acc: 0.8139 - val_
 Epoch 304/500
 60000/60000 [=====] - 9s 144us/step - loss: 0.0909 - acc: 0.8138 - val_
 Epoch 305/500
 60000/60000 [=====] - 8s 135us/step - loss: 0.0908 - acc: 0.8138 - val_
 Epoch 306/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0908 - acc: 0.8138 - val_
 Epoch 307/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.0907 - acc: 0.8139 - val_
 Epoch 308/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0908 - acc: 0.8138 - val_
 Epoch 309/500

60000/60000 [=====] - 7s 125us/step - loss: 0.0907 - acc: 0.8139 - val_
 Epoch 310/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.0907 - acc: 0.8139 - val_
 Epoch 311/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.0907 - acc: 0.8139 - val_
 Epoch 312/500
 60000/60000 [=====] - 8s 130us/step - loss: 0.0907 - acc: 0.8139 - val_
 Epoch 313/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.0906 - acc: 0.8139 - val_
 Epoch 314/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.0906 - acc: 0.8139 - val_
 Epoch 315/500
 60000/60000 [=====] - 8s 139us/step - loss: 0.0906 - acc: 0.8139 - val_
 Epoch 316/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0905 - acc: 0.8139 - val_
 Epoch 317/500
 60000/60000 [=====] - 8s 125us/step - loss: 0.0905 - acc: 0.8139 - val_
 Epoch 318/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.0905 - acc: 0.8139 - val_
 Epoch 319/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.0905 - acc: 0.8139 - val_
 Epoch 320/500
 60000/60000 [=====] - 8s 130us/step - loss: 0.0905 - acc: 0.8139 - val_
 Epoch 321/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0905 - acc: 0.8139 - val_
 Epoch 322/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0904 - acc: 0.8139 - val_
 Epoch 323/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0904 - acc: 0.8139 - val_
 Epoch 324/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0904 - acc: 0.8139 - val_
 Epoch 325/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0903 - acc: 0.8139 - val_
 Epoch 326/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.0903 - acc: 0.8139 - val_
 Epoch 327/500
 60000/60000 [=====] - 9s 149us/step - loss: 0.0903 - acc: 0.8139 - val_
 Epoch 328/500
 60000/60000 [=====] - 9s 143us/step - loss: 0.0904 - acc: 0.8139 - val_
 Epoch 329/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.0903 - acc: 0.8139 - val_
 Epoch 330/500
 60000/60000 [=====] - 11s 190us/step - loss: 0.0903 - acc: 0.8139 - val_
 Epoch 331/500
 60000/60000 [=====] - 9s 142us/step - loss: 0.0902 - acc: 0.8139 - val_
 Epoch 332/500
 60000/60000 [=====] - 8s 125us/step - loss: 0.0903 - acc: 0.8139 - val_
 Epoch 333/500

60000/60000 [=====] - 7s 114us/step - loss: 0.0902 - acc: 0.8139 - val_
 Epoch 334/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0902 - acc: 0.8139 - val_
 Epoch 335/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0902 - acc: 0.8139 - val_
 Epoch 336/500
 60000/60000 [=====] - 9s 150us/step - loss: 0.0901 - acc: 0.8139 - val_
 Epoch 337/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.0902 - acc: 0.8139 - val_
 Epoch 338/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.0901 - acc: 0.8139 - val_
 Epoch 339/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.0900 - acc: 0.8139 - val_
 Epoch 340/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.0901 - acc: 0.8139 - val_
 Epoch 341/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.0901 - acc: 0.8139 - val_
 Epoch 342/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.0900 - acc: 0.8139 - val_
 Epoch 343/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0900 - acc: 0.8139 - val_
 Epoch 344/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0899 - acc: 0.8139 - val_
 Epoch 345/500
 60000/60000 [=====] - 8s 141us/step - loss: 0.0899 - acc: 0.8139 - val_
 Epoch 346/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0900 - acc: 0.8139 - val_
 Epoch 347/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0899 - acc: 0.8139 - val_
 Epoch 348/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0900 - acc: 0.8139 - val_
 Epoch 349/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0899 - acc: 0.8139 - val_
 Epoch 350/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0899 - acc: 0.8139 - val_
 Epoch 351/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0898 - acc: 0.8139 - val_
 Epoch 352/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0898 - acc: 0.8139 - val_
 Epoch 353/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0898 - acc: 0.8139 - val_
 Epoch 354/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0898 - acc: 0.8139 - val_
 Epoch 355/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0897 - acc: 0.8139 - val_
 Epoch 356/500
 60000/60000 [=====] - 8s 125us/step - loss: 0.0897 - acc: 0.8140 - val_
 Epoch 357/500

60000/60000 [=====] - 7s 111us/step - loss: 0.0897 - acc: 0.8139 - val_
 Epoch 358/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.0898 - acc: 0.8139 - val_
 Epoch 359/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0897 - acc: 0.8140 - val_
 Epoch 360/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0897 - acc: 0.8139 - val_
 Epoch 361/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0897 - acc: 0.8140 - val_
 Epoch 362/500
 60000/60000 [=====] - 9s 142us/step - loss: 0.0897 - acc: 0.8140 - val_
 Epoch 363/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0896 - acc: 0.8140 - val_
 Epoch 364/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.0897 - acc: 0.8140 - val_
 Epoch 365/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0895 - acc: 0.8140 - val_
 Epoch 366/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0895 - acc: 0.8140 - val_
 Epoch 367/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0895 - acc: 0.8140 - val_
 Epoch 368/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0895 - acc: 0.8140 - val_
 Epoch 369/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0896 - acc: 0.8140 - val_
 Epoch 370/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.0895 - acc: 0.8140 - val_
 Epoch 371/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.0895 - acc: 0.8140 - val_
 Epoch 372/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0894 - acc: 0.8140 - val_
 Epoch 373/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0895 - acc: 0.8140 - val_
 Epoch 374/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0894 - acc: 0.8140 - val_
 Epoch 375/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0894 - acc: 0.8140 - val_
 Epoch 376/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.0893 - acc: 0.8140 - val_
 Epoch 377/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.0895 - acc: 0.8140 - val_
 Epoch 378/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.0893 - acc: 0.8140 - val_
 Epoch 379/500
 60000/60000 [=====] - 8s 136us/step - loss: 0.0893 - acc: 0.8140 - val_
 Epoch 380/500
 60000/60000 [=====] - 8s 130us/step - loss: 0.0893 - acc: 0.8140 - val_
 Epoch 381/500

60000/60000 [=====] - 8s 135us/step - loss: 0.0893 - acc: 0.8140 - val_
 Epoch 382/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.0893 - acc: 0.8140 - val_
 Epoch 383/500
 60000/60000 [=====] - 9s 142us/step - loss: 0.0893 - acc: 0.8140 - val_
 Epoch 384/500
 60000/60000 [=====] - 8s 135us/step - loss: 0.0892 - acc: 0.8140 - val_
 Epoch 385/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0893 - acc: 0.8140 - val_
 Epoch 386/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.0892 - acc: 0.8140 - val_
 Epoch 387/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0892 - acc: 0.8140 - val_
 Epoch 388/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.0891 - acc: 0.8140 - val_
 Epoch 389/500
 60000/60000 [=====] - 7s 123us/step - loss: 0.0892 - acc: 0.8140 - val_
 Epoch 390/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0890 - acc: 0.8140 - val_
 Epoch 391/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0892 - acc: 0.8140 - val_
 Epoch 392/500
 60000/60000 [=====] - 8s 135us/step - loss: 0.0891 - acc: 0.8140 - val_
 Epoch 393/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0891 - acc: 0.8140 - val_
 Epoch 394/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0891 - acc: 0.8140 - val_
 Epoch 395/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0891 - acc: 0.8140 - val_
 Epoch 396/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0891 - acc: 0.8140 - val_
 Epoch 397/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0891 - acc: 0.8140 - val_
 Epoch 398/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0890 - acc: 0.8140 - val_
 Epoch 399/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0890 - acc: 0.8140 - val_
 Epoch 400/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0890 - acc: 0.8140 - val_
 Epoch 401/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0890 - acc: 0.8140 - val_
 Epoch 402/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0890 - acc: 0.8140 - val_
 Epoch 403/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0890 - acc: 0.8140 - val_
 Epoch 404/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0890 - acc: 0.8140 - val_
 Epoch 405/500

60000/60000 [=====] - 7s 112us/step - loss: 0.0889 - acc: 0.8140 - val_
 Epoch 406/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.0890 - acc: 0.8140 - val_
 Epoch 407/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0889 - acc: 0.8140 - val_
 Epoch 408/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0889 - acc: 0.8140 - val_
 Epoch 409/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0889 - acc: 0.8140 - val_
 Epoch 410/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0889 - acc: 0.8140 - val_
 Epoch 411/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0888 - acc: 0.8140 - val_
 Epoch 412/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0888 - acc: 0.8140 - val_
 Epoch 413/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0888 - acc: 0.8140 - val_
 Epoch 414/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.0888 - acc: 0.8140 - val_
 Epoch 415/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0888 - acc: 0.8140 - val_
 Epoch 416/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0887 - acc: 0.8140 - val_
 Epoch 417/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0887 - acc: 0.8140 - val_
 Epoch 418/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0887 - acc: 0.8141 - val_
 Epoch 419/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0887 - acc: 0.8141 - val_
 Epoch 420/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.0887 - acc: 0.8140 - val_
 Epoch 421/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.0887 - acc: 0.8141 - val_
 Epoch 422/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.0887 - acc: 0.8141 - val_
 Epoch 423/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0887 - acc: 0.8141 - val_
 Epoch 424/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0886 - acc: 0.8141 - val_
 Epoch 425/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0886 - acc: 0.8141 - val_
 Epoch 426/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0886 - acc: 0.8141 - val_
 Epoch 427/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.0887 - acc: 0.8141 - val_
 Epoch 428/500
 60000/60000 [=====] - 8s 140us/step - loss: 0.0886 - acc: 0.8141 - val_
 Epoch 429/500

```

60000/60000 [=====] - 8s 137us/step - loss: 0.0886 - acc: 0.8141 - val_
Epoch 430/500
60000/60000 [=====] - 7s 125us/step - loss: 0.0886 - acc: 0.8141 - val_
Epoch 431/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0886 - acc: 0.8141 - val_
Epoch 432/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0886 - acc: 0.8141 - val_
Epoch 433/500
60000/60000 [=====] - 7s 121us/step - loss: 0.0885 - acc: 0.8141 - val_
Epoch 434/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0885 - acc: 0.8141 - val_
Epoch 435/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0885 - acc: 0.8141 - val_
Epoch 436/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0885 - acc: 0.8141 - val_
Epoch 437/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0886 - acc: 0.8141 - val_
Epoch 438/500
60000/60000 [=====] - 8s 137us/step - loss: 0.0885 - acc: 0.8141 - val_
Epoch 439/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0884 - acc: 0.8141 - val_
Epoch 440/500
60000/60000 [=====] - 10s 170us/step - loss: 0.0885 - acc: 0.8141 - val_
Epoch 441/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0884 - acc: 0.8141 - val_
Epoch 442/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0884 - acc: 0.8141 - val_
Epoch 443/500
60000/60000 [=====] - 10s 162us/step - loss: 0.0884 - acc: 0.8141 - val_
Epoch 444/500
60000/60000 [=====] - 9s 148us/step - loss: 0.0883 - acc: 0.8141 - val_
Epoch 445/500
60000/60000 [=====] - 9s 146us/step - loss: 0.0884 - acc: 0.8141 - val_
Epoch 446/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0884 - acc: 0.8141 - val_
Epoch 447/500
60000/60000 [=====] - 9s 147us/step - loss: 0.0883 - acc: 0.8141 - val_
Epoch 448/500
60000/60000 [=====] - 9s 146us/step - loss: 0.0883 - acc: 0.8141 - val_
Epoch 449/500
60000/60000 [=====] - 9s 156us/step - loss: 0.0883 - acc: 0.8141 - val_
Epoch 450/500
60000/60000 [=====] - 10s 163us/step - loss: 0.0884 - acc: 0.8141 - val_
Epoch 451/500
60000/60000 [=====] - 10s 170us/step - loss: 0.0883 - acc: 0.8141 - val_
Epoch 452/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0883 - acc: 0.8141 - val_
Epoch 453/500

```

60000/60000 [=====] - 8s 141us/step - loss: 0.0883 - acc: 0.8141 - val_
 Epoch 454/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.0883 - acc: 0.8141 - val_
 Epoch 455/500
 60000/60000 [=====] - 8s 137us/step - loss: 0.0882 - acc: 0.8141 - val_
 Epoch 456/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.0884 - acc: 0.8141 - val_
 Epoch 457/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.0882 - acc: 0.8141 - val_
 Epoch 458/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0882 - acc: 0.8141 - val_
 Epoch 459/500
 60000/60000 [=====] - 9s 152us/step - loss: 0.0882 - acc: 0.8141 - val_
 Epoch 460/500
 60000/60000 [=====] - 8s 136us/step - loss: 0.0883 - acc: 0.8141 - val_
 Epoch 461/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.0882 - acc: 0.8141 - val_
 Epoch 462/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0881 - acc: 0.8141 - val_
 Epoch 463/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0881 - acc: 0.8141 - val_
 Epoch 464/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.0881 - acc: 0.8141 - val_
 Epoch 465/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0881 - acc: 0.8141 - val_
 Epoch 466/500
 60000/60000 [=====] - 9s 149us/step - loss: 0.0881 - acc: 0.8141 - val_
 Epoch 467/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.0881 - acc: 0.8141 - val_
 Epoch 468/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0881 - acc: 0.8141 - val_
 Epoch 469/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0880 - acc: 0.8141 - val_
 Epoch 470/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0881 - acc: 0.8141 - val_
 Epoch 471/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.0881 - acc: 0.8141 - val_
 Epoch 472/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.0880 - acc: 0.8141 - val_
 Epoch 473/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.0881 - acc: 0.8141 - val_
 Epoch 474/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.0880 - acc: 0.8141 - val_
 Epoch 475/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.0881 - acc: 0.8141 - val_
 Epoch 476/500
 60000/60000 [=====] - 8s 136us/step - loss: 0.0880 - acc: 0.8141 - val_
 Epoch 477/500

60000/60000 [=====] - 8s 136us/step - loss: 0.0879 - acc: 0.8141 - val_
 Epoch 478/500
 60000/60000 [=====] - 8s 136us/step - loss: 0.0880 - acc: 0.8141 - val_
 Epoch 479/500
 60000/60000 [=====] - 8s 139us/step - loss: 0.0879 - acc: 0.8141 - val_
 Epoch 480/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.0879 - acc: 0.8141 - val_
 Epoch 481/500
 60000/60000 [=====] - 9s 152us/step - loss: 0.0879 - acc: 0.8141 - val_
 Epoch 482/500
 60000/60000 [=====] - 9s 152us/step - loss: 0.0879 - acc: 0.8141 - val_
 Epoch 483/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0879 - acc: 0.8141 - val_
 Epoch 484/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0878 - acc: 0.8141 - val_
 Epoch 485/500
 60000/60000 [=====] - 8s 136us/step - loss: 0.0879 - acc: 0.8141 - val_
 Epoch 486/500
 60000/60000 [=====] - 8s 137us/step - loss: 0.0879 - acc: 0.8141 - val_
 Epoch 487/500
 60000/60000 [=====] - 8s 141us/step - loss: 0.0878 - acc: 0.8141 - val_
 Epoch 488/500
 60000/60000 [=====] - 8s 135us/step - loss: 0.0879 - acc: 0.8141 - val_
 Epoch 489/500
 60000/60000 [=====] - 10s 169us/step - loss: 0.0879 - acc: 0.8141 - val_
 Epoch 490/500
 60000/60000 [=====] - 8s 139us/step - loss: 0.0879 - acc: 0.8141 - val_
 Epoch 491/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0878 - acc: 0.8141 - val_
 Epoch 492/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0878 - acc: 0.8141 - val_
 Epoch 493/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0878 - acc: 0.8141 - val_
 Epoch 494/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0878 - acc: 0.8141 - val_
 Epoch 495/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0878 - acc: 0.8141 - val_
 Epoch 496/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0879 - acc: 0.8141 - val_
 Epoch 497/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.0877 - acc: 0.8141 - val_
 Epoch 498/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.0877 - acc: 0.8141 - val_
 Epoch 499/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.0877 - acc: 0.8141 - val_
 Epoch 500/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.0877 - acc: 0.8141 - val_

```

In [61]: import matplotlib.pyplot as plt

x_axis = [2, 4, 6, 8, 10, 12, 14, 16, 18]

acc_stuff = [acc2[1],
             acc4[1],
             acc6[1],
             acc8[1],
             acc10[1],
             acc12[1],
             acc14[1],
             acc16[1],
             acc18[1]]

loss_stuff = [acc2[0],
              acc4[0],
              acc6[0],
              acc8[0],
              acc10[0],
              acc12[0],
              acc14[0],
              acc16[0],
              acc18[0]]

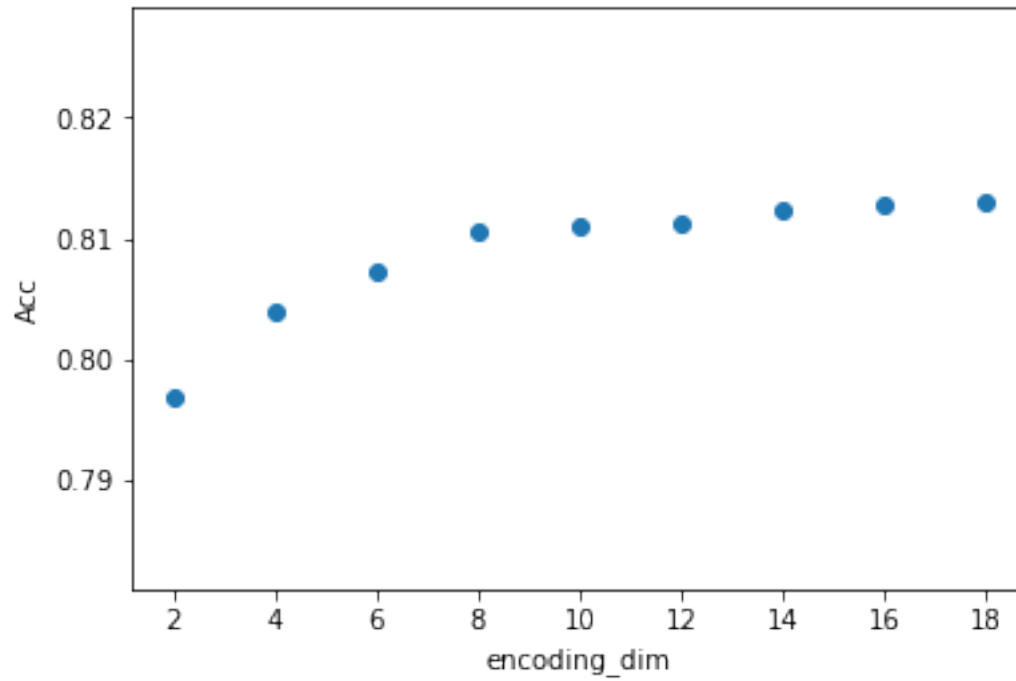
plt.scatter(x_axis, acc_stuff)
plt.xlabel('encoding_dim')
plt.ylabel('Acc')

```

```

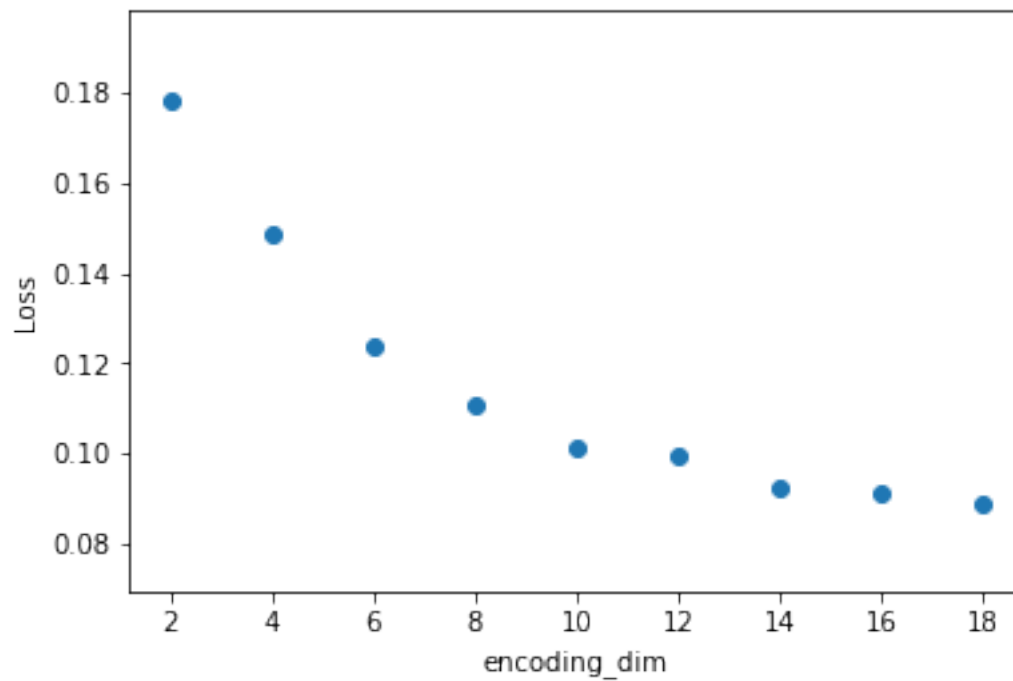
Out[61]: Text(0,0.5,'Acc')

```



```
In [35]: plt.scatter(x_axis, loss_stuff)
plt.xlabel('encoding_dim')
plt.ylabel('Loss')
```

```
Out[35]: Text(0,0.5, 'Loss')
```



```
In [74]: history2
```

```
Out[74]: <keras.callbacks.History at 0xb2e397c50>
```

0.0.2 Part 2

At this point, I realized that I should have assigned `autoencoder.fit` to another `xtest` and `xtrain` names because I do not know how to recall the `xtest` and `xtrain` values stored inside `history2`, `history4`, `history6` ...

```
In [80]: xtest6 = xtest
        xtrain6 = xtrain
```

```
In [81]: # this is the size of our encoded representations
        encoding_dim = 6 # 32 floats -> compression of factor 24.5, assuming the input is 784

        # this is our input placeholder
        x = Input(shape=(784,))
        # "encoded" is the encoded representation of the input
        x = Dense(256, activation='relu')(x)
        x = Dense(128, activation='relu')(x)
        encoded = Dense(encoding_dim, activation='relu')(x)

        # "decoded" is the lossy reconstruction of the input
        x = Dense(128, activation='relu')(encoded)
        x = Dense(256, activation='relu')(x)
        decoded = Dense(784, activation='sigmoid')(x)

        # this model maps an input to its reconstruction
        autoencoder = Model(input_img, decoded)

        encoder = Model(input_img, encoded)

        # create a placeholder for an encoded (32-dimensional) input
        encoded_input = Input(shape=(encoding_dim,))
        # retrieve the last layer of the autoencoder model
        dcd1 = autoencoder.layers[-1]
        dcd2 = autoencoder.layers[-2]
        dcd3 = autoencoder.layers[-3]

        # create the decoder model
        decoder = Model(encoded_input, dcd1(dcd2(dcd3(encoded_input))))

        autoencoder.compile(optimizer='adadelta',
                             loss='binary_crossentropy',
```



```

        metrics=['accuracy'])
autoencoder.fit(xtrain6, xtrain6,
               epochs=500,
               batch_size=256,
               shuffle=True,
               validation_data=(xtest6, xtest6),
               callbacks=[TensorBoard(log_dir='/tmp/autoencoder/encoding_dim

```

Train on 60000 samples, validate on 10000 samples

```

Epoch 1/500
60000/60000 [=====] - 8s 130us/step - loss: 0.3357 - acc: 0.7508 - val_
Epoch 2/500
60000/60000 [=====] - 7s 125us/step - loss: 0.2566 - acc: 0.7955 - val_
Epoch 3/500
60000/60000 [=====] - 7s 122us/step - loss: 0.2402 - acc: 0.7942 - val_
Epoch 4/500
60000/60000 [=====] - 7s 118us/step - loss: 0.2247 - acc: 0.7935 - val_
Epoch 5/500
60000/60000 [=====] - 8s 134us/step - loss: 0.2102 - acc: 0.7953 - val_
Epoch 6/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1981 - acc: 0.7968 - val_
Epoch 7/500
60000/60000 [=====] - 8s 138us/step - loss: 0.1896 - acc: 0.7980 - val_
Epoch 8/500
60000/60000 [=====] - 9s 143us/step - loss: 0.1844 - acc: 0.7985 - val_
Epoch 9/500
60000/60000 [=====] - 8s 135us/step - loss: 0.1805 - acc: 0.7989 - val_
Epoch 10/500
60000/60000 [=====] - 8s 135us/step - loss: 0.1770 - acc: 0.7992 - val_
Epoch 11/500
60000/60000 [=====] - 10s 175us/step - loss: 0.1739 - acc: 0.7997 - val_
Epoch 12/500
60000/60000 [=====] - 9s 143us/step - loss: 0.1710 - acc: 0.8001 - val_
Epoch 13/500
60000/60000 [=====] - 10s 171us/step - loss: 0.1685 - acc: 0.8005 - val_
Epoch 14/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1664 - acc: 0.8008 - val_
Epoch 15/500
60000/60000 [=====] - 10s 158us/step - loss: 0.1645 - acc: 0.8011 - val_
Epoch 16/500
60000/60000 [=====] - 8s 138us/step - loss: 0.1631 - acc: 0.8014 - val_
Epoch 17/500
60000/60000 [=====] - 9s 149us/step - loss: 0.1614 - acc: 0.8017 - val_
Epoch 18/500
60000/60000 [=====] - 9s 147us/step - loss: 0.1601 - acc: 0.8020 - val_
Epoch 19/500
60000/60000 [=====] - 8s 138us/step - loss: 0.1590 - acc: 0.8022 - val_
Epoch 20/500

```

60000/60000 [=====] - 9s 152us/step - loss: 0.1579 - acc: 0.8024 - val_
Epoch 21/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1570 - acc: 0.8026 - val_
Epoch 22/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1561 - acc: 0.8028 - val_
Epoch 23/500
60000/60000 [=====] - 8s 137us/step - loss: 0.1553 - acc: 0.8029 - val_
Epoch 24/500
60000/60000 [=====] - 9s 149us/step - loss: 0.1546 - acc: 0.8031 - val_
Epoch 25/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1539 - acc: 0.8032 - val_
Epoch 26/500
60000/60000 [=====] - 8s 126us/step - loss: 0.1532 - acc: 0.8033 - val_
Epoch 27/500
60000/60000 [=====] - 8s 130us/step - loss: 0.1525 - acc: 0.8035 - val_
Epoch 28/500
60000/60000 [=====] - 8s 135us/step - loss: 0.1519 - acc: 0.8036 - val_
Epoch 29/500
60000/60000 [=====] - 9s 146us/step - loss: 0.1513 - acc: 0.8037 - val_
Epoch 30/500
60000/60000 [=====] - 8s 131us/step - loss: 0.1507 - acc: 0.8039 - val_
Epoch 31/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1504 - acc: 0.8039 - val_
Epoch 32/500
60000/60000 [=====] - 8s 125us/step - loss: 0.1498 - acc: 0.8040 - val_
Epoch 33/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1493 - acc: 0.8041 - val_
Epoch 34/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1489 - acc: 0.8042 - val_
Epoch 35/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1485 - acc: 0.8043 - val_
Epoch 36/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1480 - acc: 0.8044 - val_
Epoch 37/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1475 - acc: 0.8045 - val_
Epoch 38/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1473 - acc: 0.8045 - val_
Epoch 39/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1468 - acc: 0.8046 - val_
Epoch 40/500
60000/60000 [=====] - 8s 126us/step - loss: 0.1465 - acc: 0.8047 - val_
Epoch 41/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1462 - acc: 0.8047 - val_
Epoch 42/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1459 - acc: 0.8048 - val_
Epoch 43/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1455 - acc: 0.8048 - val_
Epoch 44/500

60000/60000 [=====] - 7s 121us/step - loss: 0.1453 - acc: 0.8049 - val_
Epoch 45/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1447 - acc: 0.8050 - val_
Epoch 46/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1445 - acc: 0.8050 - val_
Epoch 47/500
60000/60000 [=====] - 8s 130us/step - loss: 0.1443 - acc: 0.8051 - val_
Epoch 48/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1441 - acc: 0.8051 - val_
Epoch 49/500
60000/60000 [=====] - 9s 157us/step - loss: 0.1435 - acc: 0.8052 - val_
Epoch 50/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1436 - acc: 0.8051 - val_
Epoch 51/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1432 - acc: 0.8052 - val_
Epoch 52/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1430 - acc: 0.8053 - val_
Epoch 53/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1427 - acc: 0.8053 - val_
Epoch 54/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1425 - acc: 0.8054 - val_
Epoch 55/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1423 - acc: 0.8054 - val_
Epoch 56/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1420 - acc: 0.8054 - val_
Epoch 57/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1418 - acc: 0.8055 - val_
Epoch 58/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1416 - acc: 0.8055 - val_
Epoch 59/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1414 - acc: 0.8056 - val_
Epoch 60/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1412 - acc: 0.8056 - val_
Epoch 61/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1409 - acc: 0.8056 - val_
Epoch 62/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1408 - acc: 0.8056 - val_
Epoch 63/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1406 - acc: 0.8057 - val_
Epoch 64/500
60000/60000 [=====] - 8s 126us/step - loss: 0.1404 - acc: 0.8057 - val_
Epoch 65/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1403 - acc: 0.8057 - val_
Epoch 66/500
60000/60000 [=====] - 10s 165us/step - loss: 0.1400 - acc: 0.8058 - val_
Epoch 67/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1398 - acc: 0.8058 - val_
Epoch 68/500

60000/60000 [=====] - 8s 133us/step - loss: 0.1398 - acc: 0.8058 - val_
Epoch 69/500
60000/60000 [=====] - 8s 138us/step - loss: 0.1395 - acc: 0.8059 - val_
Epoch 70/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1392 - acc: 0.8059 - val_
Epoch 71/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1392 - acc: 0.8059 - val_
Epoch 72/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1390 - acc: 0.8060 - val_
Epoch 73/500
60000/60000 [=====] - 8s 126us/step - loss: 0.1388 - acc: 0.8060 - val_
Epoch 74/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1387 - acc: 0.8060 - val_
Epoch 75/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1387 - acc: 0.8060 - val_
Epoch 76/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1384 - acc: 0.8061 - val_
Epoch 77/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1382 - acc: 0.8061 - val_
Epoch 78/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1381 - acc: 0.8061 - val_
Epoch 79/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1379 - acc: 0.8061 - val_
Epoch 80/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1378 - acc: 0.8062 - val_
Epoch 81/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1377 - acc: 0.8062 - val_
Epoch 82/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1376 - acc: 0.8062 - val_
Epoch 83/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1374 - acc: 0.8062 - val_
Epoch 84/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1374 - acc: 0.8062 - val_
Epoch 85/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1372 - acc: 0.8063 - val_
Epoch 86/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1370 - acc: 0.8063 - val_
Epoch 87/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1369 - acc: 0.8063 - val_
Epoch 88/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1368 - acc: 0.8064 - val_
Epoch 89/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1366 - acc: 0.8064 - val_
Epoch 90/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1366 - acc: 0.8064 - val_
Epoch 91/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1363 - acc: 0.8064 - val_
Epoch 92/500

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60000/60000 [=====] - 7s 109us/step - loss: 0.1364 - acc: 0.8064 - val_
Epoch 93/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1362 - acc: 0.8065 - val_
Epoch 94/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1361 - acc: 0.8065 - val_
Epoch 95/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1360 - acc: 0.8065 - val_
Epoch 96/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1358 - acc: 0.8066 - val_
Epoch 97/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1357 - acc: 0.8065 - val_
Epoch 98/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1357 - acc: 0.8066 - val_
Epoch 99/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1355 - acc: 0.8066 - val_
Epoch 100/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1355 - acc: 0.8066 - val_
Epoch 101/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1354 - acc: 0.8066 - val_
Epoch 102/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1351 - acc: 0.8067 - val_
Epoch 103/500
60000/60000 [=====] - 10s 159us/step - loss: 0.1351 - acc: 0.8067 - val_
Epoch 104/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1350 - acc: 0.8067 - val_
Epoch 105/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1349 - acc: 0.8067 - val_
Epoch 106/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1347 - acc: 0.8067 - val_
Epoch 107/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1347 - acc: 0.8068 - val_
Epoch 108/500
60000/60000 [=====] - 8s 131us/step - loss: 0.1347 - acc: 0.8067 - val_
Epoch 109/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1345 - acc: 0.8068 - val_
Epoch 110/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1343 - acc: 0.8068 - val_
Epoch 111/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1344 - acc: 0.8068 - val_
Epoch 112/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1343 - acc: 0.8068 - val_
Epoch 113/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1341 - acc: 0.8069 - val_
Epoch 114/500
60000/60000 [=====] - 7s 108us/step - loss: 0.1339 - acc: 0.8069 - val_
Epoch 115/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1339 - acc: 0.8069 - val_
Epoch 116/500

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60000/60000 [=====] - 7s 113us/step - loss: 0.1339 - acc: 0.8069 - val_
 Epoch 117/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.1337 - acc: 0.8069 - val_
 Epoch 118/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1337 - acc: 0.8069 - val_
 Epoch 119/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1335 - acc: 0.8070 - val_
 Epoch 120/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.1335 - acc: 0.8070 - val_
 Epoch 121/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.1334 - acc: 0.8070 - val_
 Epoch 122/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1332 - acc: 0.8070 - val_
 Epoch 123/500
 60000/60000 [=====] - 8s 136us/step - loss: 0.1333 - acc: 0.8070 - val_
 Epoch 124/500
 60000/60000 [=====] - 9s 155us/step - loss: 0.1331 - acc: 0.8070 - val_
 Epoch 125/500
 60000/60000 [=====] - 8s 140us/step - loss: 0.1331 - acc: 0.8070 - val_
 Epoch 126/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.1329 - acc: 0.8071 - val_
 Epoch 127/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1328 - acc: 0.8071 - val_
 Epoch 128/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.1329 - acc: 0.8071 - val_
 Epoch 129/500
 60000/60000 [=====] - 8s 135us/step - loss: 0.1326 - acc: 0.8071 - val_
 Epoch 130/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1327 - acc: 0.8071 - val_
 Epoch 131/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1325 - acc: 0.8071 - val_
 Epoch 132/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1326 - acc: 0.8071 - val_
 Epoch 133/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.1323 - acc: 0.8072 - val_
 Epoch 134/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.1323 - acc: 0.8072 - val_
 Epoch 135/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.1323 - acc: 0.8072 - val_
 Epoch 136/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1322 - acc: 0.8072 - val_
 Epoch 137/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.1321 - acc: 0.8072 - val_
 Epoch 138/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.1321 - acc: 0.8072 - val_
 Epoch 139/500
 60000/60000 [=====] - 8s 130us/step - loss: 0.1319 - acc: 0.8072 - val_
 Epoch 140/500

60000/60000 [=====] - 7s 124us/step - loss: 0.1319 - acc: 0.8073 - val_
 Epoch 141/500
 60000/60000 [=====] - 9s 152us/step - loss: 0.1319 - acc: 0.8072 - val_
 Epoch 142/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.1316 - acc: 0.8073 - val_
 Epoch 143/500
 60000/60000 [=====] - 7s 125us/step - loss: 0.1316 - acc: 0.8073 - val_
 Epoch 144/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.1316 - acc: 0.8073 - val_
 Epoch 145/500
 60000/60000 [=====] - 9s 155us/step - loss: 0.1315 - acc: 0.8073 - val_
 Epoch 146/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1314 - acc: 0.8073 - val_
 Epoch 147/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.1314 - acc: 0.8073 - val_
 Epoch 148/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1313 - acc: 0.8073 - val_
 Epoch 149/500
 60000/60000 [=====] - 7s 123us/step - loss: 0.1312 - acc: 0.8074 - val_
 Epoch 150/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.1311 - acc: 0.8074 - val_
 Epoch 151/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1311 - acc: 0.8074 - val_
 Epoch 152/500
 60000/60000 [=====] - 8s 137us/step - loss: 0.1310 - acc: 0.8074 - val_
 Epoch 153/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.1310 - acc: 0.8074 - val_
 Epoch 154/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.1308 - acc: 0.8075 - val_
 Epoch 155/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1308 - acc: 0.8074 - val_
 Epoch 156/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1307 - acc: 0.8075 - val_
 Epoch 157/500
 60000/60000 [=====] - 8s 141us/step - loss: 0.1307 - acc: 0.8075 - val_
 Epoch 158/500
 60000/60000 [=====] - 8s 137us/step - loss: 0.1306 - acc: 0.8075 - val_
 Epoch 159/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.1305 - acc: 0.8075 - val_
 Epoch 160/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.1305 - acc: 0.8075 - val_
 Epoch 161/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1304 - acc: 0.8075 - val_
 Epoch 162/500
 60000/60000 [=====] - 8s 125us/step - loss: 0.1304 - acc: 0.8075 - val_
 Epoch 163/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1303 - acc: 0.8075 - val_
 Epoch 164/500

60000/60000 [=====] - 8s 133us/step - loss: 0.1303 - acc: 0.8075 - val_
 Epoch 165/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1301 - acc: 0.8076 - val_
 Epoch 166/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1301 - acc: 0.8076 - val_
 Epoch 167/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1301 - acc: 0.8076 - val_
 Epoch 168/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1300 - acc: 0.8076 - val_
 Epoch 169/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.1300 - acc: 0.8076 - val_
 Epoch 170/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1299 - acc: 0.8076 - val_
 Epoch 171/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1298 - acc: 0.8076 - val_
 Epoch 172/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1298 - acc: 0.8076 - val_
 Epoch 173/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.1298 - acc: 0.8076 - val_
 Epoch 174/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1297 - acc: 0.8076 - val_
 Epoch 175/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1295 - acc: 0.8077 - val_
 Epoch 176/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1295 - acc: 0.8077 - val_
 Epoch 177/500
 60000/60000 [=====] - 7s 125us/step - loss: 0.1294 - acc: 0.8077 - val_
 Epoch 178/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.1294 - acc: 0.8077 - val_
 Epoch 179/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.1293 - acc: 0.8077 - val_
 Epoch 180/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1292 - acc: 0.8077 - val_
 Epoch 181/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1292 - acc: 0.8077 - val_
 Epoch 182/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.1292 - acc: 0.8077 - val_
 Epoch 183/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1291 - acc: 0.8078 - val_
 Epoch 184/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.1291 - acc: 0.8077 - val_
 Epoch 185/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1290 - acc: 0.8078 - val_
 Epoch 186/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1290 - acc: 0.8078 - val_
 Epoch 187/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.1289 - acc: 0.8078 - val_
 Epoch 188/500

60000/60000 [=====] - 9s 142us/step - loss: 0.1288 - acc: 0.8078 - val_
Epoch 189/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1289 - acc: 0.8078 - val_
Epoch 190/500
60000/60000 [=====] - 8s 140us/step - loss: 0.1286 - acc: 0.8078 - val_
Epoch 191/500
60000/60000 [=====] - 8s 133us/step - loss: 0.1288 - acc: 0.8078 - val_
Epoch 192/500
60000/60000 [=====] - 8s 136us/step - loss: 0.1286 - acc: 0.8078 - val_
Epoch 193/500
60000/60000 [=====] - 8s 142us/step - loss: 0.1286 - acc: 0.8078 - val_
Epoch 194/500
60000/60000 [=====] - 8s 135us/step - loss: 0.1286 - acc: 0.8078 - val_
Epoch 195/500
60000/60000 [=====] - 8s 140us/step - loss: 0.1284 - acc: 0.8079 - val_
Epoch 196/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1285 - acc: 0.8079 - val_
Epoch 197/500
60000/60000 [=====] - 9s 152us/step - loss: 0.1284 - acc: 0.8079 - val_
Epoch 198/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1284 - acc: 0.8079 - val_
Epoch 199/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1283 - acc: 0.8079 - val_
Epoch 200/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1282 - acc: 0.8079 - val_
Epoch 201/500
60000/60000 [=====] - 9s 145us/step - loss: 0.1284 - acc: 0.8079 - val_
Epoch 202/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1280 - acc: 0.8079 - val_
Epoch 203/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1282 - acc: 0.8079 - val_
Epoch 204/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1281 - acc: 0.8079 - val_
Epoch 205/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1280 - acc: 0.8079 - val_
Epoch 206/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1280 - acc: 0.8079 - val_
Epoch 207/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1280 - acc: 0.8079 - val_
Epoch 208/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1278 - acc: 0.8080 - val_
Epoch 209/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1279 - acc: 0.8080 - val_
Epoch 210/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1277 - acc: 0.8080 - val_
Epoch 211/500
60000/60000 [=====] - 8s 141us/step - loss: 0.1277 - acc: 0.8080 - val_
Epoch 212/500

60000/60000 [=====] - 7s 114us/step - loss: 0.1278 - acc: 0.8080 - val_
 Epoch 213/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1277 - acc: 0.8080 - val_
 Epoch 214/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1276 - acc: 0.8080 - val_
 Epoch 215/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1276 - acc: 0.8080 - val_
 Epoch 216/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1276 - acc: 0.8080 - val_
 Epoch 217/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1274 - acc: 0.8080 - val_
 Epoch 218/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1274 - acc: 0.8080 - val_
 Epoch 219/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1274 - acc: 0.8081 - val_
 Epoch 220/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1274 - acc: 0.8080 - val_
 Epoch 221/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1273 - acc: 0.8081 - val_
 Epoch 222/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1272 - acc: 0.8081 - val_
 Epoch 223/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1272 - acc: 0.8081 - val_
 Epoch 224/500
 60000/60000 [=====] - 6s 102us/step - loss: 0.1272 - acc: 0.8081 - val_
 Epoch 225/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1271 - acc: 0.8081 - val_
 Epoch 226/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1272 - acc: 0.8081 - val_
 Epoch 227/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1270 - acc: 0.8081 - val_
 Epoch 228/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1271 - acc: 0.8081 - val_
 Epoch 229/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1270 - acc: 0.8081 - val_
 Epoch 230/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1269 - acc: 0.8081 - val_
 Epoch 231/500
 60000/60000 [=====] - 6s 103us/step - loss: 0.1269 - acc: 0.8081 - val_
 Epoch 232/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1268 - acc: 0.8081 - val_
 Epoch 233/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1268 - acc: 0.8081 - val_
 Epoch 234/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1268 - acc: 0.8081 - val_
 Epoch 235/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1267 - acc: 0.8082 - val_
 Epoch 236/500

60000/60000 [=====] - 7s 125us/step - loss: 0.1267 - acc: 0.8082 - val_
 Epoch 237/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1267 - acc: 0.8082 - val_
 Epoch 238/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1266 - acc: 0.8082 - val_
 Epoch 239/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.1266 - acc: 0.8082 - val_
 Epoch 240/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1265 - acc: 0.8082 - val_
 Epoch 241/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1264 - acc: 0.8082 - val_
 Epoch 242/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1265 - acc: 0.8082 - val_
 Epoch 243/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1264 - acc: 0.8082 - val_
 Epoch 244/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1264 - acc: 0.8082 - val_
 Epoch 245/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1264 - acc: 0.8082 - val_
 Epoch 246/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1263 - acc: 0.8082 - val_
 Epoch 247/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1263 - acc: 0.8082 - val_
 Epoch 248/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1263 - acc: 0.8083 - val_
 Epoch 249/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1263 - acc: 0.8083 - val_
 Epoch 250/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1261 - acc: 0.8083 - val_
 Epoch 251/500
 60000/60000 [=====] - 7s 108us/step - loss: 0.1262 - acc: 0.8082 - val_
 Epoch 252/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1262 - acc: 0.8082 - val_
 Epoch 253/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1261 - acc: 0.8083 - val_
 Epoch 254/500
 60000/60000 [=====] - 7s 108us/step - loss: 0.1260 - acc: 0.8083 - val_
 Epoch 255/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1260 - acc: 0.8083 - val_
 Epoch 256/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1259 - acc: 0.8083 - val_
 Epoch 257/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1259 - acc: 0.8083 - val_
 Epoch 258/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1258 - acc: 0.8083 - val_
 Epoch 259/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1259 - acc: 0.8083 - val_
 Epoch 260/500

60000/60000 [=====] - 6s 107us/step - loss: 0.1259 - acc: 0.8083 - val_
 Epoch 261/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1258 - acc: 0.8083 - val_
 Epoch 262/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1258 - acc: 0.8083 - val_
 Epoch 263/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.1257 - acc: 0.8083 - val_
 Epoch 264/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1256 - acc: 0.8084 - val_
 Epoch 265/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1257 - acc: 0.8083 - val_
 Epoch 266/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1255 - acc: 0.8084 - val_
 Epoch 267/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1256 - acc: 0.8083 - val_
 Epoch 268/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1254 - acc: 0.8084 - val_
 Epoch 269/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1255 - acc: 0.8084 - val_
 Epoch 270/500
 60000/60000 [=====] - 7s 108us/step - loss: 0.1255 - acc: 0.8084 - val_
 Epoch 271/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1254 - acc: 0.8084 - val_
 Epoch 272/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1254 - acc: 0.8084 - val_
 Epoch 273/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1255 - acc: 0.8084 - val_
 Epoch 274/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1253 - acc: 0.8084 - val_
 Epoch 275/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1254 - acc: 0.8084 - val_
 Epoch 276/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1253 - acc: 0.8084 - val_
 Epoch 277/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1252 - acc: 0.8084 - val_
 Epoch 278/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1253 - acc: 0.8084 - val_
 Epoch 279/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1252 - acc: 0.8084 - val_
 Epoch 280/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.1252 - acc: 0.8084 - val_
 Epoch 281/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1252 - acc: 0.8084 - val_
 Epoch 282/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.1250 - acc: 0.8084 - val_
 Epoch 283/500
 60000/60000 [=====] - 9s 152us/step - loss: 0.1251 - acc: 0.8084 - val_
 Epoch 284/500

60000/60000 [=====] - 8s 133us/step - loss: 0.1251 - acc: 0.8084 - val_
 Epoch 285/500
 60000/60000 [=====] - 9s 151us/step - loss: 0.1249 - acc: 0.8085 - val_
 Epoch 286/500
 60000/60000 [=====] - 7s 125us/step - loss: 0.1250 - acc: 0.8084 - val_
 Epoch 287/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.1249 - acc: 0.8085 - val_
 Epoch 288/500
 60000/60000 [=====] - 7s 123us/step - loss: 0.1250 - acc: 0.8085 - val_
 Epoch 289/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1249 - acc: 0.8085 - val_
 Epoch 290/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1248 - acc: 0.8085 - val_
 Epoch 291/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.1249 - acc: 0.8085 - val_
 Epoch 292/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.1247 - acc: 0.8085 - val_
 Epoch 293/500
 60000/60000 [=====] - 8s 139us/step - loss: 0.1248 - acc: 0.8085 - val_
 Epoch 294/500
 60000/60000 [=====] - 9s 143us/step - loss: 0.1247 - acc: 0.8085 - val_
 Epoch 295/500
 60000/60000 [=====] - 9s 146us/step - loss: 0.1248 - acc: 0.8085 - val_
 Epoch 296/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.1247 - acc: 0.8085 - val_
 Epoch 297/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1246 - acc: 0.8085 - val_
 Epoch 298/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1246 - acc: 0.8085 - val_
 Epoch 299/500
 60000/60000 [=====] - 8s 136us/step - loss: 0.1246 - acc: 0.8085 - val_
 Epoch 300/500
 60000/60000 [=====] - 9s 142us/step - loss: 0.1245 - acc: 0.8085 - val_
 Epoch 301/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.1246 - acc: 0.8085 - val_
 Epoch 302/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.1244 - acc: 0.8085 - val_
 Epoch 303/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.1245 - acc: 0.8085 - val_
 Epoch 304/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1245 - acc: 0.8085 - val_
 Epoch 305/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1244 - acc: 0.8086 - val_
 Epoch 306/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1245 - acc: 0.8086 - val_
 Epoch 307/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1244 - acc: 0.8086 - val_
 Epoch 308/500

60000/60000 [=====] - 6s 105us/step - loss: 0.1243 - acc: 0.8086 - val_
 Epoch 309/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1244 - acc: 0.8086 - val_
 Epoch 310/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1242 - acc: 0.8086 - val_
 Epoch 311/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1242 - acc: 0.8086 - val_
 Epoch 312/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1243 - acc: 0.8086 - val_
 Epoch 313/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1242 - acc: 0.8086 - val_
 Epoch 314/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1243 - acc: 0.8086 - val_
 Epoch 315/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1242 - acc: 0.8086 - val_
 Epoch 316/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1240 - acc: 0.8086 - val_
 Epoch 317/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1241 - acc: 0.8086 - val_
 Epoch 318/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1241 - acc: 0.8086 - val_
 Epoch 319/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1241 - acc: 0.8086 - val_
 Epoch 320/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1241 - acc: 0.8086 - val_
 Epoch 321/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1241 - acc: 0.8086 - val_
 Epoch 322/500
 60000/60000 [=====] - 6s 104us/step - loss: 0.1239 - acc: 0.8087 - val_
 Epoch 323/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1240 - acc: 0.8086 - val_
 Epoch 324/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1239 - acc: 0.8086 - val_
 Epoch 325/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1239 - acc: 0.8087 - val_
 Epoch 326/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1239 - acc: 0.8086 - val_
 Epoch 327/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1238 - acc: 0.8087 - val_
 Epoch 328/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1239 - acc: 0.8087 - val_
 Epoch 329/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1237 - acc: 0.8087 - val_
 Epoch 330/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1237 - acc: 0.8087 - val_
 Epoch 331/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1238 - acc: 0.8087 - val_
 Epoch 332/500

60000/60000 [=====] - 7s 120us/step - loss: 0.1236 - acc: 0.8087 - val_
 Epoch 333/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1237 - acc: 0.8087 - val_
 Epoch 334/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1237 - acc: 0.8087 - val_
 Epoch 335/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.1235 - acc: 0.8087 - val_
 Epoch 336/500
 60000/60000 [=====] - 8s 125us/step - loss: 0.1236 - acc: 0.8087 - val_
 Epoch 337/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1236 - acc: 0.8087 - val_
 Epoch 338/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1235 - acc: 0.8087 - val_
 Epoch 339/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.1235 - acc: 0.8087 - val_
 Epoch 340/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.1235 - acc: 0.8087 - val_
 Epoch 341/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1235 - acc: 0.8087 - val_
 Epoch 342/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1234 - acc: 0.8087 - val_
 Epoch 343/500
 60000/60000 [=====] - 10s 162us/step - loss: 0.1234 - acc: 0.8087 - val_
 Epoch 344/500
 60000/60000 [=====] - 8s 141us/step - loss: 0.1234 - acc: 0.8087 - val_
 Epoch 345/500
 60000/60000 [=====] - 8s 139us/step - loss: 0.1233 - acc: 0.8087 - val_
 Epoch 346/500
 60000/60000 [=====] - 10s 162us/step - loss: 0.1235 - acc: 0.8087 - val_
 Epoch 347/500
 60000/60000 [=====] - 9s 146us/step - loss: 0.1234 - acc: 0.8087 - val_
 Epoch 348/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.1232 - acc: 0.8088 - val_
 Epoch 349/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1233 - acc: 0.8087 - val_
 Epoch 350/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1233 - acc: 0.8087 - val_
 Epoch 351/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1232 - acc: 0.8088 - val_
 Epoch 352/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1234 - acc: 0.8087 - val_
 Epoch 353/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1231 - acc: 0.8088 - val_
 Epoch 354/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1232 - acc: 0.8088 - val_
 Epoch 355/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1231 - acc: 0.8088 - val_
 Epoch 356/500

60000/60000 [=====] - 7s 117us/step - loss: 0.1231 - acc: 0.8088 - val_
 Epoch 357/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1231 - acc: 0.8088 - val_
 Epoch 358/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1230 - acc: 0.8088 - val_
 Epoch 359/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.1230 - acc: 0.8088 - val_
 Epoch 360/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1231 - acc: 0.8088 - val_
 Epoch 361/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1231 - acc: 0.8088 - val_
 Epoch 362/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1229 - acc: 0.8088 - val_
 Epoch 363/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1229 - acc: 0.8088 - val_
 Epoch 364/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1228 - acc: 0.8088 - val_
 Epoch 365/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1229 - acc: 0.8088 - val_
 Epoch 366/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1230 - acc: 0.8088 - val_
 Epoch 367/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1228 - acc: 0.8088 - val_
 Epoch 368/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.1229 - acc: 0.8088 - val_
 Epoch 369/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.1228 - acc: 0.8088 - val_
 Epoch 370/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1228 - acc: 0.8088 - val_
 Epoch 371/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1228 - acc: 0.8088 - val_
 Epoch 372/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.1227 - acc: 0.8088 - val_
 Epoch 373/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.1227 - acc: 0.8088 - val_
 Epoch 374/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1228 - acc: 0.8088 - val_
 Epoch 375/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.1226 - acc: 0.8089 - val_
 Epoch 376/500
 60000/60000 [=====] - 9s 147us/step - loss: 0.1227 - acc: 0.8088 - val_
 Epoch 377/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.1226 - acc: 0.8089 - val_
 Epoch 378/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.1227 - acc: 0.8088 - val_
 Epoch 379/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.1226 - acc: 0.8089 - val_
 Epoch 380/500

60000/60000 [=====] - 9s 144us/step - loss: 0.1226 - acc: 0.8089 - val_
 Epoch 381/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.1226 - acc: 0.8089 - val_
 Epoch 382/500
 60000/60000 [=====] - 8s 130us/step - loss: 0.1226 - acc: 0.8089 - val_
 Epoch 383/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.1225 - acc: 0.8089 - val_
 Epoch 384/500
 60000/60000 [=====] - 7s 123us/step - loss: 0.1224 - acc: 0.8089 - val_
 Epoch 385/500
 60000/60000 [=====] - 8s 139us/step - loss: 0.1225 - acc: 0.8089 - val_
 Epoch 386/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.1224 - acc: 0.8089 - val_
 Epoch 387/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1224 - acc: 0.8089 - val_
 Epoch 388/500
 60000/60000 [=====] - 9s 151us/step - loss: 0.1224 - acc: 0.8089 - val_
 Epoch 389/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1224 - acc: 0.8089 - val_
 Epoch 390/500
 60000/60000 [=====] - 8s 130us/step - loss: 0.1224 - acc: 0.8089 - val_
 Epoch 391/500
 60000/60000 [=====] - 7s 124us/step - loss: 0.1223 - acc: 0.8089 - val_
 Epoch 392/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1224 - acc: 0.8089 - val_
 Epoch 393/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1223 - acc: 0.8089 - val_
 Epoch 394/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1222 - acc: 0.8089 - val_
 Epoch 395/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1222 - acc: 0.8089 - val_
 Epoch 396/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.1223 - acc: 0.8089 - val_
 Epoch 397/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.1222 - acc: 0.8089 - val_
 Epoch 398/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.1222 - acc: 0.8089 - val_
 Epoch 399/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.1221 - acc: 0.8089 - val_
 Epoch 400/500
 60000/60000 [=====] - 8s 139us/step - loss: 0.1222 - acc: 0.8089 - val_
 Epoch 401/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.1222 - acc: 0.8089 - val_
 Epoch 402/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1221 - acc: 0.8090 - val_
 Epoch 403/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1220 - acc: 0.8090 - val_
 Epoch 404/500

60000/60000 [=====] - 7s 125us/step - loss: 0.1221 - acc: 0.8089 - val_
 Epoch 405/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.1221 - acc: 0.8090 - val_
 Epoch 406/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.1220 - acc: 0.8090 - val_
 Epoch 407/500
 60000/60000 [=====] - 7s 112us/step - loss: 0.1221 - acc: 0.8089 - val_
 Epoch 408/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1219 - acc: 0.8090 - val_
 Epoch 409/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1220 - acc: 0.8090 - val_
 Epoch 410/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1219 - acc: 0.8090 - val_
 Epoch 411/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1220 - acc: 0.8090 - val_
 Epoch 412/500
 60000/60000 [=====] - 8s 140us/step - loss: 0.1219 - acc: 0.8090 - val_
 Epoch 413/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1219 - acc: 0.8090 - val_
 Epoch 414/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1220 - acc: 0.8090 - val_
 Epoch 415/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1218 - acc: 0.8090 - val_
 Epoch 416/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.1219 - acc: 0.8090 - val_
 Epoch 417/500
 60000/60000 [=====] - 8s 136us/step - loss: 0.1219 - acc: 0.8090 - val_
 Epoch 418/500
 60000/60000 [=====] - 8s 135us/step - loss: 0.1217 - acc: 0.8090 - val_
 Epoch 419/500
 60000/60000 [=====] - 7s 123us/step - loss: 0.1218 - acc: 0.8090 - val_
 Epoch 420/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.1217 - acc: 0.8090 - val_
 Epoch 421/500
 60000/60000 [=====] - 9s 144us/step - loss: 0.1218 - acc: 0.8090 - val_
 Epoch 422/500
 60000/60000 [=====] - 8s 132us/step - loss: 0.1217 - acc: 0.8090 - val_
 Epoch 423/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1217 - acc: 0.8090 - val_
 Epoch 424/500
 60000/60000 [=====] - 9s 152us/step - loss: 0.1217 - acc: 0.8090 - val_
 Epoch 425/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.1216 - acc: 0.8090 - val_
 Epoch 426/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.1216 - acc: 0.8090 - val_
 Epoch 427/500
 60000/60000 [=====] - 7s 119us/step - loss: 0.1216 - acc: 0.8090 - val_
 Epoch 428/500

60000/60000 [=====] - 7s 120us/step - loss: 0.1216 - acc: 0.8090 - val_
 Epoch 429/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.1215 - acc: 0.8091 - val_
 Epoch 430/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.1216 - acc: 0.8090 - val_
 Epoch 431/500
 60000/60000 [=====] - 7s 121us/step - loss: 0.1216 - acc: 0.8090 - val_
 Epoch 432/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.1216 - acc: 0.8090 - val_
 Epoch 433/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.1214 - acc: 0.8091 - val_
 Epoch 434/500
 60000/60000 [=====] - 7s 114us/step - loss: 0.1215 - acc: 0.8090 - val_
 Epoch 435/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1215 - acc: 0.8091 - val_
 Epoch 436/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1215 - acc: 0.8091 - val_
 Epoch 437/500
 60000/60000 [=====] - 8s 127us/step - loss: 0.1214 - acc: 0.8091 - val_
 Epoch 438/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.1214 - acc: 0.8091 - val_
 Epoch 439/500
 60000/60000 [=====] - 8s 126us/step - loss: 0.1215 - acc: 0.8090 - val_
 Epoch 440/500
 60000/60000 [=====] - 7s 115us/step - loss: 0.1213 - acc: 0.8091 - val_
 Epoch 441/500
 60000/60000 [=====] - 8s 139us/step - loss: 0.1214 - acc: 0.8091 - val_
 Epoch 442/500
 60000/60000 [=====] - 7s 122us/step - loss: 0.1213 - acc: 0.8091 - val_
 Epoch 443/500
 60000/60000 [=====] - 8s 129us/step - loss: 0.1213 - acc: 0.8091 - val_
 Epoch 444/500
 60000/60000 [=====] - 8s 128us/step - loss: 0.1214 - acc: 0.8091 - val_
 Epoch 445/500
 60000/60000 [=====] - 8s 136us/step - loss: 0.1213 - acc: 0.8091 - val_
 Epoch 446/500
 60000/60000 [=====] - 8s 138us/step - loss: 0.1213 - acc: 0.8091 - val_
 Epoch 447/500
 60000/60000 [=====] - 7s 111us/step - loss: 0.1213 - acc: 0.8091 - val_
 Epoch 448/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1212 - acc: 0.8091 - val_
 Epoch 449/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.1212 - acc: 0.8091 - val_
 Epoch 450/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1212 - acc: 0.8091 - val_
 Epoch 451/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.1213 - acc: 0.8091 - val_
 Epoch 452/500

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60000/60000 [=====] - 7s 114us/step - loss: 0.1212 - acc: 0.8091 - val_
Epoch 453/500
60000/60000 [=====] - 8s 131us/step - loss: 0.1211 - acc: 0.8091 - val_
Epoch 454/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1211 - acc: 0.8091 - val_
Epoch 455/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1212 - acc: 0.8091 - val_
Epoch 456/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1211 - acc: 0.8091 - val_
Epoch 457/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1211 - acc: 0.8091 - val_
Epoch 458/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1210 - acc: 0.8091 - val_
Epoch 459/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1210 - acc: 0.8091 - val_
Epoch 460/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1210 - acc: 0.8091 - val_
Epoch 461/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1210 - acc: 0.8091 - val_
Epoch 462/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1210 - acc: 0.8091 - val_
Epoch 463/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1209 - acc: 0.8091 - val_
Epoch 464/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1210 - acc: 0.8091 - val_
Epoch 465/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1210 - acc: 0.8091 - val_
Epoch 466/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1209 - acc: 0.8091 - val_
Epoch 467/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1209 - acc: 0.8092 - val_
Epoch 468/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1210 - acc: 0.8091 - val_
Epoch 469/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1208 - acc: 0.8092 - val_
Epoch 470/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1209 - acc: 0.8092 - val_
Epoch 471/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1209 - acc: 0.8092 - val_
Epoch 472/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1209 - acc: 0.8091 - val_
Epoch 473/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1208 - acc: 0.8092 - val_
Epoch 474/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1207 - acc: 0.8092 - val_
Epoch 475/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1207 - acc: 0.8092 - val_
Epoch 476/500

```

60000/60000 [=====] - 6s 106us/step - loss: 0.1209 - acc: 0.8092 - val_
 Epoch 477/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1208 - acc: 0.8092 - val_
 Epoch 478/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1206 - acc: 0.8092 - val_
 Epoch 479/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1208 - acc: 0.8092 - val_
 Epoch 480/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1208 - acc: 0.8092 - val_
 Epoch 481/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1206 - acc: 0.8092 - val_
 Epoch 482/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.1207 - acc: 0.8092 - val_
 Epoch 483/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1206 - acc: 0.8092 - val_
 Epoch 484/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.1206 - acc: 0.8092 - val_
 Epoch 485/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1205 - acc: 0.8092 - val_
 Epoch 486/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1206 - acc: 0.8092 - val_
 Epoch 487/500
 60000/60000 [=====] - 7s 120us/step - loss: 0.1206 - acc: 0.8092 - val_
 Epoch 488/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1206 - acc: 0.8092 - val_
 Epoch 489/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1205 - acc: 0.8092 - val_
 Epoch 490/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1205 - acc: 0.8092 - val_
 Epoch 491/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.1205 - acc: 0.8092 - val_
 Epoch 492/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1205 - acc: 0.8092 - val_
 Epoch 493/500
 60000/60000 [=====] - 7s 113us/step - loss: 0.1205 - acc: 0.8092 - val_
 Epoch 494/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1205 - acc: 0.8092 - val_
 Epoch 495/500
 60000/60000 [=====] - 8s 136us/step - loss: 0.1204 - acc: 0.8092 - val_
 Epoch 496/500
 60000/60000 [=====] - 8s 134us/step - loss: 0.1204 - acc: 0.8092 - val_
 Epoch 497/500
 60000/60000 [=====] - 8s 131us/step - loss: 0.1205 - acc: 0.8092 - val_
 Epoch 498/500
 60000/60000 [=====] - 8s 133us/step - loss: 0.1204 - acc: 0.8092 - val_
 Epoch 499/500
 60000/60000 [=====] - 8s 139us/step - loss: 0.1203 - acc: 0.8092 - val_
 Epoch 500/500

60000/60000 [=====] - 8s 139us/step - loss: 0.1205 - acc: 0.8092 - val_

Out[81]: <keras.callbacks.History at 0x1c4b8705f8>

```
In [89]: encoded_imgs = encoder.predict(xtest6)
         decoded_imgs = decoder.predict(encoded_imgs)
         import matplotlib.pyplot as plt

         n = 20 # how many digits we will display
         plt.figure(figsize=(40, 4))
         for i in range(n):
             # display original
             ax = plt.subplot(2, n, i + 1)
             plt.imshow(xtest6[i].reshape(28, 28))
             plt.gray()
             ax.get_xaxis().set_visible(False)
             ax.get_yaxis().set_visible(False)

             # display reconstruction
             ax = plt.subplot(2, n, i + 1 + n)
             plt.imshow(decoded_imgs[i].reshape(28, 28))
             plt.gray()
             ax.get_xaxis().set_visible(False)
             ax.get_yaxis().set_visible(False)
         plt.show()
```



```
In [90]: import keras
         from keras.datasets import mnist
         from keras.models import Sequential
         from keras.optimizers import RMSprop
         from keras.layers import Dense, Dropout, Flatten
         from keras.layers import Conv2D, MaxPooling2D
         from keras import backend
         from keras import utils as np_utils

         import numpy as np
         import matplotlib.pyplot as plt
         %matplotlib inline
```

```
In [95]: (x_train, y_train), (x_test, y_test) = mnist.load_data()
```

```

# Here, I replaced the x_train and x_test with xtrain6 and xtest6 #
x_train = xtrain6.reshape(60000, 784)
x_test = xtest6.reshape(10000, 784)
#####

x_train = x_train.astype('float32')
x_test = x_test.astype('float32')
x_train /= 255
x_test /= 255

batch_size = 128
num_classes = 10
epochs = 500

# 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(10, 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))

# Get training and test loss histories
training_loss = history.history['loss']
test_loss = history.history['val_loss']

# Create count of the number of epochs
epoch_count = range(1, len(training_loss) + 1)

# Visualize loss history
plt.plot(epoch_count, training_loss, 'r--')
plt.plot(epoch_count, test_loss, 'b-')
plt.legend(['Training Loss', 'Test Loss'])

```

```
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.show();
```

Layer (type)	Output Shape	Param #
dense_70 (Dense)	(None, 512)	401920
dropout_3 (Dropout)	(None, 512)	0
dense_71 (Dense)	(None, 512)	262656
dropout_4 (Dropout)	(None, 512)	0
dense_72 (Dense)	(None, 10)	5130

Total params: 669,706

Trainable params: 669,706

Non-trainable params: 0

Train on 60000 samples, validate on 10000 samples

Epoch 1/500

60000/60000 [=====] - 9s 153us/step - loss: 0.8790 - acc: 0.7241 - val_

Epoch 2/500

60000/60000 [=====] - 8s 135us/step - loss: 0.3795 - acc: 0.8872 - val_

Epoch 3/500

60000/60000 [=====] - 9s 143us/step - loss: 0.2931 - acc: 0.9123 - val_

Epoch 4/500

60000/60000 [=====] - 9s 146us/step - loss: 0.2336 - acc: 0.9292 - val_

Epoch 5/500

60000/60000 [=====] - 9s 157us/step - loss: 0.1924 - acc: 0.9420 - val_

Epoch 6/500

60000/60000 [=====] - 10s 171us/step - loss: 0.1620 - acc: 0.9510 - val_

Epoch 7/500

60000/60000 [=====] - 11s 184us/step - loss: 0.1413 - acc: 0.9571 - val_

Epoch 8/500

60000/60000 [=====] - 9s 150us/step - loss: 0.1263 - acc: 0.9619 - val_

Epoch 9/500

60000/60000 [=====] - 8s 142us/step - loss: 0.1137 - acc: 0.9654 - val_

Epoch 10/500

60000/60000 [=====] - 9s 148us/step - loss: 0.1026 - acc: 0.9691 - val_

Epoch 11/500

60000/60000 [=====] - 9s 143us/step - loss: 0.0943 - acc: 0.9714 - val_

Epoch 12/500

60000/60000 [=====] - 8s 139us/step - loss: 0.0881 - acc: 0.9733 - val_

Epoch 13/500

60000/60000 [=====] - 8s 140us/step - loss: 0.0823 - acc: 0.9754 - val_


```

Epoch 14/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0763 - acc: 0.9768 - val_
Epoch 15/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0726 - acc: 0.9780 - val_
Epoch 16/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0675 - acc: 0.9792 - val_
Epoch 17/500
60000/60000 [=====] - 8s 137us/step - loss: 0.0649 - acc: 0.9796 - val_
Epoch 18/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0611 - acc: 0.9814 - val_
Epoch 19/500
60000/60000 [=====] - 8s 137us/step - loss: 0.0574 - acc: 0.9822 - val_
Epoch 20/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0552 - acc: 0.9829 - val_
Epoch 21/500
60000/60000 [=====] - 8s 137us/step - loss: 0.0529 - acc: 0.9836 - val_
Epoch 22/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0507 - acc: 0.9844 - val_
Epoch 23/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0491 - acc: 0.9849 - val_
Epoch 24/500
60000/60000 [=====] - 10s 160us/step - loss: 0.0455 - acc: 0.9858 - val_
Epoch 25/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0439 - acc: 0.9866 - val_
Epoch 26/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0429 - acc: 0.9868 - val_
Epoch 27/500
60000/60000 [=====] - 9s 154us/step - loss: 0.0397 - acc: 0.9882 - val_
Epoch 28/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0387 - acc: 0.9884 - val_
Epoch 29/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0383 - acc: 0.9883 - val_
Epoch 30/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0390 - acc: 0.9879 - val_
Epoch 31/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0362 - acc: 0.9889 - val_
Epoch 32/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0335 - acc: 0.9891 - val_
Epoch 33/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0327 - acc: 0.9902 - val_
Epoch 34/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0323 - acc: 0.9901 - val_
Epoch 35/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0324 - acc: 0.9901 - val_
Epoch 36/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0304 - acc: 0.9905 - val_
Epoch 37/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0293 - acc: 0.9907 - val_

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Epoch 38/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0296 - acc: 0.9904 - val_
Epoch 39/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0285 - acc: 0.9907 - val_
Epoch 40/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0272 - acc: 0.9912 - val_
Epoch 41/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0248 - acc: 0.9922 - val_
Epoch 42/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0261 - acc: 0.9919 - val_
Epoch 43/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0246 - acc: 0.9925 - val_
Epoch 44/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0256 - acc: 0.9918 - val_
Epoch 45/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0241 - acc: 0.9926 - val_
Epoch 46/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0226 - acc: 0.9929 - val_
Epoch 47/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0233 - acc: 0.9926 - val_
Epoch 48/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0228 - acc: 0.9931 - val_
Epoch 49/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0225 - acc: 0.9930 - val_
Epoch 50/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0229 - acc: 0.9931 - val_
Epoch 51/500
60000/60000 [=====] - 8s 140us/step - loss: 0.0210 - acc: 0.9931 - val_
Epoch 52/500
60000/60000 [=====] - 9s 151us/step - loss: 0.0207 - acc: 0.9935 - val_
Epoch 53/500
60000/60000 [=====] - 9s 148us/step - loss: 0.0199 - acc: 0.9940 - val_
Epoch 54/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0197 - acc: 0.9938 - val_
Epoch 55/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0193 - acc: 0.9939 - val_
Epoch 56/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0200 - acc: 0.9937 - val_
Epoch 57/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0190 - acc: 0.9940 - val_
Epoch 58/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0193 - acc: 0.9942 - val_
Epoch 59/500
60000/60000 [=====] - 9s 147us/step - loss: 0.0191 - acc: 0.9942 - val_
Epoch 60/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0182 - acc: 0.9944 - val_
Epoch 61/500
60000/60000 [=====] - 8s 140us/step - loss: 0.0179 - acc: 0.9950 - val_

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Epoch 62/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0183 - acc: 0.9945 - val_
Epoch 63/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0181 - acc: 0.9945 - val_
Epoch 64/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0171 - acc: 0.9949 - val_
Epoch 65/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0156 - acc: 0.9955 - val_
Epoch 66/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0166 - acc: 0.9954 - val_
Epoch 67/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0158 - acc: 0.9955 - val_
Epoch 68/500
60000/60000 [=====] - 8s 125us/step - loss: 0.0169 - acc: 0.9951 - val_
Epoch 69/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0158 - acc: 0.9955 - val_
Epoch 70/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0151 - acc: 0.9957 - val_
Epoch 71/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0160 - acc: 0.9956 - val_
Epoch 72/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0159 - acc: 0.9954 - val_
Epoch 73/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0146 - acc: 0.9957 - val_
Epoch 74/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0141 - acc: 0.9958 - val_
Epoch 75/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0148 - acc: 0.9953 - val_
Epoch 76/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0160 - acc: 0.9954 - val_
Epoch 77/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0137 - acc: 0.9957 - val_
Epoch 78/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0139 - acc: 0.9958 - val_
Epoch 79/500
60000/60000 [=====] - 9s 151us/step - loss: 0.0134 - acc: 0.9958 - val_
Epoch 80/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0136 - acc: 0.9961 - val_
Epoch 81/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0138 - acc: 0.9959 - val_
Epoch 82/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0134 - acc: 0.9959 - val_
Epoch 83/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0146 - acc: 0.9957 - val_
Epoch 84/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0134 - acc: 0.9962 - val_
Epoch 85/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0129 - acc: 0.9964 - val_

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Epoch 86/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0127 - acc: 0.9963 - val_
Epoch 87/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0126 - acc: 0.9962 - val_
Epoch 88/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0125 - acc: 0.9964 - val_
Epoch 89/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0135 - acc: 0.9964 - val_
Epoch 90/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0132 - acc: 0.9960 - val_
Epoch 91/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0128 - acc: 0.9967 - val_
Epoch 92/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0117 - acc: 0.9963 - val_
Epoch 93/500
60000/60000 [=====] - 9s 150us/step - loss: 0.0134 - acc: 0.9965 - val_
Epoch 94/500
60000/60000 [=====] - 9s 148us/step - loss: 0.0120 - acc: 0.9964 - val_
Epoch 95/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0131 - acc: 0.9963 - val_
Epoch 96/500
60000/60000 [=====] - 9s 154us/step - loss: 0.0124 - acc: 0.9965 - val_
Epoch 97/500
60000/60000 [=====] - 9s 152us/step - loss: 0.0131 - acc: 0.9964 - val_
Epoch 98/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0117 - acc: 0.9967 - val_
Epoch 99/500
60000/60000 [=====] - 9s 142us/step - loss: 0.0122 - acc: 0.9967 - val_
Epoch 100/500
60000/60000 [=====] - 9s 146us/step - loss: 0.0122 - acc: 0.9965 - val_
Epoch 101/500
60000/60000 [=====] - 9s 145us/step - loss: 0.0129 - acc: 0.9966 - val_
Epoch 102/500
60000/60000 [=====] - 8s 137us/step - loss: 0.0113 - acc: 0.9968 - val_
Epoch 103/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0120 - acc: 0.9965 - val_
Epoch 104/500
60000/60000 [=====] - 9s 155us/step - loss: 0.0116 - acc: 0.9965 - val_
Epoch 105/500
60000/60000 [=====] - 9s 151us/step - loss: 0.0115 - acc: 0.9969 - val_
Epoch 106/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0125 - acc: 0.9966 - val_
Epoch 107/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0119 - acc: 0.9968 - val_
Epoch 108/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0104 - acc: 0.9971 - val_
Epoch 109/500
60000/60000 [=====] - 8s 135us/step - loss: 0.0126 - acc: 0.9969 - val_

```

```

Epoch 110/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0119 - acc: 0.9965 - val_
Epoch 111/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0118 - acc: 0.9968 - val_
Epoch 112/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0114 - acc: 0.9968 - val_
Epoch 113/500
60000/60000 [=====] - 7s 125us/step - loss: 0.0103 - acc: 0.9971 - val_
Epoch 114/500
60000/60000 [=====] - 8s 125us/step - loss: 0.0113 - acc: 0.9968 - val_
Epoch 115/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0119 - acc: 0.9966 - val_
Epoch 116/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0113 - acc: 0.9972 - val_
Epoch 117/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0109 - acc: 0.9971 - val_
Epoch 118/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0113 - acc: 0.9968 - val_
Epoch 119/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0107 - acc: 0.9968 - val_
Epoch 120/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0118 - acc: 0.9972 - val_
Epoch 121/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0103 - acc: 0.9971 - val_
Epoch 122/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0123 - acc: 0.9967 - val_
Epoch 123/500
60000/60000 [=====] - 7s 125us/step - loss: 0.0113 - acc: 0.9968 - val_
Epoch 124/500
60000/60000 [=====] - 8s 125us/step - loss: 0.0102 - acc: 0.9976 - val_
Epoch 125/500
60000/60000 [=====] - 8s 125us/step - loss: 0.0116 - acc: 0.9970 - val_
Epoch 126/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0108 - acc: 0.9972 - val_
Epoch 127/500
60000/60000 [=====] - 7s 122us/step - loss: 0.0103 - acc: 0.9975 - val_
Epoch 128/500
60000/60000 [=====] - 7s 122us/step - loss: 0.0107 - acc: 0.9972 - val_
Epoch 129/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0111 - acc: 0.9973 - val_
Epoch 130/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0120 - acc: 0.9969 - val_
Epoch 131/500
60000/60000 [=====] - 9s 142us/step - loss: 0.0105 - acc: 0.9973 - val_
Epoch 132/500
60000/60000 [=====] - 7s 122us/step - loss: 0.0095 - acc: 0.9974 - val_
Epoch 133/500
60000/60000 [=====] - 7s 121us/step - loss: 0.0103 - acc: 0.9973 - val_

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Epoch 134/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0096 - acc: 0.9976 - val_
Epoch 135/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0105 - acc: 0.9972 - val_
Epoch 136/500
60000/60000 [=====] - 9s 145us/step - loss: 0.0097 - acc: 0.9975 - val_
Epoch 137/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0108 - acc: 0.9974 - val_
Epoch 138/500
60000/60000 [=====] - 8s 140us/step - loss: 0.0119 - acc: 0.9970 - val_
Epoch 139/500
60000/60000 [=====] - 10s 164us/step - loss: 0.0089 - acc: 0.9977 - val_
Epoch 140/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0107 - acc: 0.9972 - val_
Epoch 141/500
60000/60000 [=====] - 9s 156us/step - loss: 0.0107 - acc: 0.9972 - val_
Epoch 142/500
60000/60000 [=====] - 11s 176us/step - loss: 0.0103 - acc: 0.9975 - val_
Epoch 143/500
60000/60000 [=====] - 9s 158us/step - loss: 0.0131 - acc: 0.9969 - val_
Epoch 144/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0103 - acc: 0.9974 - val_
Epoch 145/500
60000/60000 [=====] - 10s 174us/step - loss: 0.0104 - acc: 0.9974 - val_
Epoch 146/500
60000/60000 [=====] - 10s 163us/step - loss: 0.0104 - acc: 0.9974 - val_
Epoch 147/500
60000/60000 [=====] - 9s 158us/step - loss: 0.0091 - acc: 0.9976 - val_
Epoch 148/500
60000/60000 [=====] - 9s 151us/step - loss: 0.0095 - acc: 0.9976 - val_
Epoch 149/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0106 - acc: 0.9972 - val_
Epoch 150/500
60000/60000 [=====] - 9s 158us/step - loss: 0.0091 - acc: 0.9974 - val_
Epoch 151/500
60000/60000 [=====] - 9s 142us/step - loss: 0.0116 - acc: 0.9972 - val_
Epoch 152/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0098 - acc: 0.9975 - val_
Epoch 153/500
60000/60000 [=====] - 8s 135us/step - loss: 0.0096 - acc: 0.9977 - val_
Epoch 154/500
60000/60000 [=====] - 9s 142us/step - loss: 0.0117 - acc: 0.9971 - val_
Epoch 155/500
60000/60000 [=====] - 9s 158us/step - loss: 0.0091 - acc: 0.9976 - val_
Epoch 156/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0095 - acc: 0.9976 - val_
Epoch 157/500
60000/60000 [=====] - 9s 157us/step - loss: 0.0086 - acc: 0.9977 - val_

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Epoch 158/500
60000/60000 [=====] - 9s 142us/step - loss: 0.0108 - acc: 0.9974 - val_
Epoch 159/500
60000/60000 [=====] - 9s 147us/step - loss: 0.0107 - acc: 0.9976 - val_
Epoch 160/500
60000/60000 [=====] - 9s 145us/step - loss: 0.0104 - acc: 0.9976 - val_
Epoch 161/500
60000/60000 [=====] - 9s 154us/step - loss: 0.0101 - acc: 0.9974 - val_
Epoch 162/500
60000/60000 [=====] - 9s 154us/step - loss: 0.0098 - acc: 0.9976 - val_
Epoch 163/500
60000/60000 [=====] - 9s 147us/step - loss: 0.0085 - acc: 0.9978 - val_
Epoch 164/500
60000/60000 [=====] - 9s 157us/step - loss: 0.0091 - acc: 0.9978 - val_
Epoch 165/500
60000/60000 [=====] - 8s 135us/step - loss: 0.0100 - acc: 0.9977 - val_
Epoch 166/500
60000/60000 [=====] - 9s 150us/step - loss: 0.0107 - acc: 0.9974 - val_
Epoch 167/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0105 - acc: 0.9975 - val_
Epoch 168/500
60000/60000 [=====] - 7s 121us/step - loss: 0.0090 - acc: 0.9975 - val_
Epoch 169/500
60000/60000 [=====] - 9s 147us/step - loss: 0.0105 - acc: 0.9980 - val_
Epoch 170/500
60000/60000 [=====] - 8s 140us/step - loss: 0.0104 - acc: 0.9974 - val_
Epoch 171/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0103 - acc: 0.9976 - val_
Epoch 172/500
60000/60000 [=====] - 8s 125us/step - loss: 0.0099 - acc: 0.9976 - val_
Epoch 173/500
60000/60000 [=====] - 9s 145us/step - loss: 0.0113 - acc: 0.9972 - val_
Epoch 174/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0092 - acc: 0.9978 - val_
Epoch 175/500
60000/60000 [=====] - 8s 135us/step - loss: 0.0108 - acc: 0.9978 - val_
Epoch 176/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0113 - acc: 0.9977 - val_
Epoch 177/500
60000/60000 [=====] - 8s 135us/step - loss: 0.0086 - acc: 0.9979 - val_
Epoch 178/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0099 - acc: 0.9978 - val_
Epoch 179/500
60000/60000 [=====] - 9s 154us/step - loss: 0.0102 - acc: 0.9976 - val_
Epoch 180/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0082 - acc: 0.9977 - val_
Epoch 181/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0094 - acc: 0.9977 - val_

Epoch 182/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0123 - acc: 0.9972 - val_
Epoch 183/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0095 - acc: 0.9978 - val_
Epoch 184/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0099 - acc: 0.9978 - val_
Epoch 185/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0103 - acc: 0.9977 - val_
Epoch 186/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0091 - acc: 0.9980 - val_
Epoch 187/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0093 - acc: 0.9979 - val_
Epoch 188/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0089 - acc: 0.9981 - val_
Epoch 189/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0092 - acc: 0.9976 - val_
Epoch 190/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0128 - acc: 0.9973 - val_
Epoch 191/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0102 - acc: 0.9977 - val_
Epoch 192/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0110 - acc: 0.9976 - val_
Epoch 193/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0087 - acc: 0.9980 - val_
Epoch 194/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0097 - acc: 0.9979 - val_
Epoch 195/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0099 - acc: 0.9974 - val_
Epoch 196/500
60000/60000 [=====] - 10s 161us/step - loss: 0.0091 - acc: 0.9977 - val_
Epoch 197/500
60000/60000 [=====] - 9s 145us/step - loss: 0.0076 - acc: 0.9980 - val_
Epoch 198/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0104 - acc: 0.9976 - val_
Epoch 199/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0103 - acc: 0.9979 - val_
Epoch 200/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0089 - acc: 0.9977 - val_
Epoch 201/500
60000/60000 [=====] - 8s 135us/step - loss: 0.0077 - acc: 0.9980 - val_
Epoch 202/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0101 - acc: 0.9978 - val_
Epoch 203/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0092 - acc: 0.9981 - val_
Epoch 204/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0090 - acc: 0.9981 - val_
Epoch 205/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0085 - acc: 0.9982 - val_


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Epoch 206/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0083 - acc: 0.9980 - val_
Epoch 207/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0099 - acc: 0.9983 - val_
Epoch 208/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0088 - acc: 0.9980 - val_
Epoch 209/500
60000/60000 [=====] - 8s 135us/step - loss: 0.0093 - acc: 0.9980 - val_
Epoch 210/500
60000/60000 [=====] - 8s 135us/step - loss: 0.0105 - acc: 0.9980 - val_
Epoch 211/500
60000/60000 [=====] - 8s 135us/step - loss: 0.0091 - acc: 0.9979 - val_
Epoch 212/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0108 - acc: 0.9978 - val_
Epoch 213/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0081 - acc: 0.9979 - val_
Epoch 214/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0082 - acc: 0.9980 - val_
Epoch 215/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0089 - acc: 0.9980 - val_
Epoch 216/500
60000/60000 [=====] - 8s 135us/step - loss: 0.0090 - acc: 0.9980 - val_
Epoch 217/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0084 - acc: 0.9981 - val_
Epoch 218/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0087 - acc: 0.9978 - val_
Epoch 219/500
60000/60000 [=====] - 8s 137us/step - loss: 0.0087 - acc: 0.9981 - val_
Epoch 220/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0090 - acc: 0.9982 - val_
Epoch 221/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0081 - acc: 0.9982 - val_
Epoch 222/500
60000/60000 [=====] - 8s 135us/step - loss: 0.0076 - acc: 0.9983 - val_
Epoch 223/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0079 - acc: 0.9983 - val_
Epoch 224/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0104 - acc: 0.9978 - val_
Epoch 225/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0082 - acc: 0.9981 - val_
Epoch 226/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0090 - acc: 0.9981 - val_
Epoch 227/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0092 - acc: 0.9980 - val_
Epoch 228/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0086 - acc: 0.9982 - val_
Epoch 229/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0088 - acc: 0.9980 - val_

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Epoch 230/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0090 - acc: 0.9982 - val_
Epoch 231/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0083 - acc: 0.9982 - val_
Epoch 232/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0097 - acc: 0.9979 - val_
Epoch 233/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0096 - acc: 0.9979 - val_
Epoch 234/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0101 - acc: 0.9980 - val_
Epoch 235/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0103 - acc: 0.9978 - val_
Epoch 236/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0095 - acc: 0.9980 - val_
Epoch 237/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0104 - acc: 0.9977 - val_
Epoch 238/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0086 - acc: 0.9981 - val_
Epoch 239/500
60000/60000 [=====] - 9s 149us/step - loss: 0.0084 - acc: 0.9981 - val_
Epoch 240/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0095 - acc: 0.9980 - val_
Epoch 241/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0103 - acc: 0.9978 - val_
Epoch 242/500
60000/60000 [=====] - 8s 142us/step - loss: 0.0102 - acc: 0.9981 - val_
Epoch 243/500
60000/60000 [=====] - 9s 145us/step - loss: 0.0096 - acc: 0.9980 - val_
Epoch 244/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0098 - acc: 0.9980 - val_
Epoch 245/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0091 - acc: 0.9979 - val_
Epoch 246/500
60000/60000 [=====] - 8s 125us/step - loss: 0.0086 - acc: 0.9983 - val_
Epoch 247/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0094 - acc: 0.9983 - val_
Epoch 248/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0072 - acc: 0.9983 - val_
Epoch 249/500
60000/60000 [=====] - 10s 162us/step - loss: 0.0102 - acc: 0.9979 - val_
Epoch 250/500
60000/60000 [=====] - 9s 155us/step - loss: 0.0085 - acc: 0.9981 - val_
Epoch 251/500
60000/60000 [=====] - 9s 157us/step - loss: 0.0092 - acc: 0.9980 - val_
Epoch 252/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0079 - acc: 0.9985 - val_
Epoch 253/500
60000/60000 [=====] - 8s 140us/step - loss: 0.0107 - acc: 0.9978 - val_

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Epoch 254/500
60000/60000 [=====] - 9s 142us/step - loss: 0.0092 - acc: 0.9980 - val_
Epoch 255/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0098 - acc: 0.9982 - val_
Epoch 256/500
60000/60000 [=====] - 8s 140us/step - loss: 0.0090 - acc: 0.9981 - val_
Epoch 257/500
60000/60000 [=====] - 8s 140us/step - loss: 0.0099 - acc: 0.9980 - val_
Epoch 258/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0085 - acc: 0.9981 - val_
Epoch 259/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0098 - acc: 0.9982 - val_
Epoch 260/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0080 - acc: 0.9983 - val_
Epoch 261/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0081 - acc: 0.9982 - val_
Epoch 262/500
60000/60000 [=====] - 9s 145us/step - loss: 0.0099 - acc: 0.9981 - val_
Epoch 263/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0076 - acc: 0.9986 - val_
Epoch 264/500
60000/60000 [=====] - 9s 151us/step - loss: 0.0090 - acc: 0.9980 - val_
Epoch 265/500
60000/60000 [=====] - 9s 155us/step - loss: 0.0102 - acc: 0.9980 - val_
Epoch 266/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0106 - acc: 0.9980 - val_
Epoch 267/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0077 - acc: 0.9982 - val_
Epoch 268/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0091 - acc: 0.9982 - val_
Epoch 269/500
60000/60000 [=====] - 9s 142us/step - loss: 0.0095 - acc: 0.9979 - val_
Epoch 270/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0097 - acc: 0.9980 - val_
Epoch 271/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0083 - acc: 0.9983 - val_
Epoch 272/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0086 - acc: 0.9984 - val_
Epoch 273/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0111 - acc: 0.9979 - val_
Epoch 274/500
60000/60000 [=====] - 9s 150us/step - loss: 0.0094 - acc: 0.9980 - val_
Epoch 275/500
60000/60000 [=====] - 9s 145us/step - loss: 0.0073 - acc: 0.9986 - val_
Epoch 276/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0100 - acc: 0.9980 - val_
Epoch 277/500
60000/60000 [=====] - 9s 147us/step - loss: 0.0093 - acc: 0.9983 - val_

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Epoch 278/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0088 - acc: 0.9983 - val_
Epoch 279/500
60000/60000 [=====] - 8s 142us/step - loss: 0.0109 - acc: 0.9980 - val_
Epoch 280/500
60000/60000 [=====] - 9s 149us/step - loss: 0.0091 - acc: 0.9981 - val_
Epoch 281/500
60000/60000 [=====] - 9s 151us/step - loss: 0.0089 - acc: 0.9982 - val_
Epoch 282/500
60000/60000 [=====] - 10s 166us/step - loss: 0.0092 - acc: 0.9983 - val_
Epoch 283/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0100 - acc: 0.9981 - val_
Epoch 284/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0095 - acc: 0.9982 - val_
Epoch 285/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0090 - acc: 0.9983 - val_
Epoch 286/500
60000/60000 [=====] - 9s 147us/step - loss: 0.0077 - acc: 0.9984 - val_
Epoch 287/500
60000/60000 [=====] - 8s 135us/step - loss: 0.0085 - acc: 0.9983 - val_
Epoch 288/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0088 - acc: 0.9983 - val_
Epoch 289/500
60000/60000 [=====] - 9s 148us/step - loss: 0.0103 - acc: 0.9981 - val_
Epoch 290/500
60000/60000 [=====] - 9s 150us/step - loss: 0.0082 - acc: 0.9983 - val_
Epoch 291/500
60000/60000 [=====] - 8s 140us/step - loss: 0.0084 - acc: 0.9982 - val_
Epoch 292/500
60000/60000 [=====] - 8s 137us/step - loss: 0.0084 - acc: 0.9984 - val_
Epoch 293/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0094 - acc: 0.9982 - val_
Epoch 294/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0073 - acc: 0.9984 - val_
Epoch 295/500
60000/60000 [=====] - 8s 140us/step - loss: 0.0092 - acc: 0.9983 - val_
Epoch 296/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0076 - acc: 0.9983 - val_
Epoch 297/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0098 - acc: 0.9982 - val_
Epoch 298/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0075 - acc: 0.9984 - val_
Epoch 299/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0096 - acc: 0.9983 - val_
Epoch 300/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0081 - acc: 0.9983 - val_
Epoch 301/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0075 - acc: 0.9985 - val_

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Epoch 302/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0086 - acc: 0.9981 - val_
Epoch 303/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0090 - acc: 0.9982 - val_
Epoch 304/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0090 - acc: 0.9983 - val_
Epoch 305/500
60000/60000 [=====] - 8s 140us/step - loss: 0.0075 - acc: 0.9983 - val_
Epoch 306/500
60000/60000 [=====] - 10s 165us/step - loss: 0.0086 - acc: 0.9983 - val_
Epoch 307/500
60000/60000 [=====] - 10s 171us/step - loss: 0.0101 - acc: 0.9981 - val_
Epoch 308/500
60000/60000 [=====] - 9s 155us/step - loss: 0.0091 - acc: 0.9982 - val_
Epoch 309/500
60000/60000 [=====] - 10s 160us/step - loss: 0.0089 - acc: 0.9983 - val_
Epoch 310/500
60000/60000 [=====] - 9s 146us/step - loss: 0.0100 - acc: 0.9979 - val_
Epoch 311/500
60000/60000 [=====] - 8s 137us/step - loss: 0.0087 - acc: 0.9983 - val_
Epoch 312/500
60000/60000 [=====] - 8s 140us/step - loss: 0.0083 - acc: 0.9982 - val_
Epoch 313/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0095 - acc: 0.9983 - val_
Epoch 314/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0079 - acc: 0.9983 - val_
Epoch 315/500
60000/60000 [=====] - 9s 154us/step - loss: 0.0091 - acc: 0.9981 - val_
Epoch 316/500
60000/60000 [=====] - 9s 152us/step - loss: 0.0092 - acc: 0.9982 - val_
Epoch 317/500
60000/60000 [=====] - 9s 142us/step - loss: 0.0093 - acc: 0.9983 - val_
Epoch 318/500
60000/60000 [=====] - 9s 142us/step - loss: 0.0068 - acc: 0.9987 - val_
Epoch 319/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0091 - acc: 0.9980 - val_
Epoch 320/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0066 - acc: 0.9986 - val_
Epoch 321/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0079 - acc: 0.9984 - val_
Epoch 322/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0091 - acc: 0.9983 - val_
Epoch 323/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0079 - acc: 0.9985 - val_
Epoch 324/500
60000/60000 [=====] - 8s 140us/step - loss: 0.0085 - acc: 0.9985 - val_
Epoch 325/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0083 - acc: 0.9982 - val_

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Epoch 326/500
60000/60000 [=====] - 10s 169us/step - loss: 0.0078 - acc: 0.9986 - val_
Epoch 327/500
60000/60000 [=====] - 10s 175us/step - loss: 0.0082 - acc: 0.9985 - val_
Epoch 328/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0087 - acc: 0.9983 - val_
Epoch 329/500
60000/60000 [=====] - 9s 145us/step - loss: 0.0088 - acc: 0.9983 - val_
Epoch 330/500
60000/60000 [=====] - 10s 167us/step - loss: 0.0102 - acc: 0.9983 - val_
Epoch 331/500
60000/60000 [=====] - 9s 146us/step - loss: 0.0089 - acc: 0.9982 - val_
Epoch 332/500
60000/60000 [=====] - 9s 146us/step - loss: 0.0094 - acc: 0.9981 - val_
Epoch 333/500
60000/60000 [=====] - 9s 148us/step - loss: 0.0074 - acc: 0.9985 - val_
Epoch 334/500
60000/60000 [=====] - 9s 152us/step - loss: 0.0080 - acc: 0.9984 - val_
Epoch 335/500
60000/60000 [=====] - 9s 150us/step - loss: 0.0086 - acc: 0.9984 - val_
Epoch 336/500
60000/60000 [=====] - 9s 152us/step - loss: 0.0089 - acc: 0.9981 - val_
Epoch 337/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0069 - acc: 0.9986 - val_
Epoch 338/500
60000/60000 [=====] - 9s 149us/step - loss: 0.0102 - acc: 0.9983 - val_
Epoch 339/500
60000/60000 [=====] - 9s 152us/step - loss: 0.0092 - acc: 0.9981 - val_
Epoch 340/500
60000/60000 [=====] - 9s 151us/step - loss: 0.0094 - acc: 0.9982 - val_
Epoch 341/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0085 - acc: 0.9982 - val_
Epoch 342/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0097 - acc: 0.9983 - val_
Epoch 343/500
60000/60000 [=====] - 7s 125us/step - loss: 0.0079 - acc: 0.9984 - val_
Epoch 344/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0089 - acc: 0.9983 - val_
Epoch 345/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0078 - acc: 0.9985 - val_
Epoch 346/500
60000/60000 [=====] - 7s 125us/step - loss: 0.0090 - acc: 0.9984 - val_
Epoch 347/500
60000/60000 [=====] - 8s 125us/step - loss: 0.0089 - acc: 0.9982 - val_
Epoch 348/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0088 - acc: 0.9985 - val_
Epoch 349/500
60000/60000 [=====] - 7s 122us/step - loss: 0.0099 - acc: 0.9982 - val_

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Epoch 350/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0103 - acc: 0.9983 - val_
Epoch 351/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0077 - acc: 0.9984 - val_
Epoch 352/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0083 - acc: 0.9984 - val_
Epoch 353/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0099 - acc: 0.9981 - val_
Epoch 354/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0086 - acc: 0.9983 - val_
Epoch 355/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0105 - acc: 0.9981 - val_
Epoch 356/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0102 - acc: 0.9982 - val_
Epoch 357/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0100 - acc: 0.9983 - val_
Epoch 358/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0074 - acc: 0.9986 - val_
Epoch 359/500
60000/60000 [=====] - 8s 125us/step - loss: 0.0083 - acc: 0.9982 - val_
Epoch 360/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0101 - acc: 0.9981 - val_
Epoch 361/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0097 - acc: 0.9984 - val_
Epoch 362/500
60000/60000 [=====] - 8s 125us/step - loss: 0.0118 - acc: 0.9980 - val_
Epoch 363/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0078 - acc: 0.9983 - val_
Epoch 364/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0081 - acc: 0.9983 - val_
Epoch 365/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0088 - acc: 0.9984 - val_
Epoch 366/500
60000/60000 [=====] - 8s 125us/step - loss: 0.0093 - acc: 0.9985 - val_
Epoch 367/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0087 - acc: 0.9985 - val_
Epoch 368/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0091 - acc: 0.9983 - val_
Epoch 369/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0080 - acc: 0.9985 - val_
Epoch 370/500
60000/60000 [=====] - 7s 122us/step - loss: 0.0081 - acc: 0.9986 - val_
Epoch 371/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0084 - acc: 0.9983 - val_
Epoch 372/500
60000/60000 [=====] - 7s 122us/step - loss: 0.0081 - acc: 0.9984 - val_
Epoch 373/500
60000/60000 [=====] - 7s 121us/step - loss: 0.0087 - acc: 0.9985 - val_

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Epoch 374/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0085 - acc: 0.9983 - val_
Epoch 375/500
60000/60000 [=====] - 7s 125us/step - loss: 0.0097 - acc: 0.9983 - val_
Epoch 376/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0098 - acc: 0.9981 - val_
Epoch 377/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0071 - acc: 0.9986 - val_
Epoch 378/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0079 - acc: 0.9985 - val_
Epoch 379/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0106 - acc: 0.9981 - val_
Epoch 380/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0097 - acc: 0.9983 - val_
Epoch 381/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0094 - acc: 0.9980 - val_
Epoch 382/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0072 - acc: 0.9987 - val_
Epoch 383/500
60000/60000 [=====] - 9s 150us/step - loss: 0.0084 - acc: 0.9984 - val_
Epoch 384/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0089 - acc: 0.9985 - val_
Epoch 385/500
60000/60000 [=====] - 8s 137us/step - loss: 0.0082 - acc: 0.9986 - val_
Epoch 386/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0081 - acc: 0.9984 - val_
Epoch 387/500
60000/60000 [=====] - 9s 142us/step - loss: 0.0088 - acc: 0.9985 - val_
Epoch 388/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0101 - acc: 0.9981 - val_
Epoch 389/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0091 - acc: 0.9981 - val_
Epoch 390/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0092 - acc: 0.9985 - val_
Epoch 391/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0082 - acc: 0.9985 - val_
Epoch 392/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0095 - acc: 0.9983 - val_
Epoch 393/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0083 - acc: 0.9987 - val_
Epoch 394/500
60000/60000 [=====] - 9s 145us/step - loss: 0.0105 - acc: 0.9981 - val_
Epoch 395/500
60000/60000 [=====] - 9s 156us/step - loss: 0.0092 - acc: 0.9984 - val_
Epoch 396/500
60000/60000 [=====] - 9s 154us/step - loss: 0.0084 - acc: 0.9986 - val_
Epoch 397/500
60000/60000 [=====] - 9s 148us/step - loss: 0.0092 - acc: 0.9985 - val_


```

Epoch 398/500
60000/60000 [=====] - 9s 146us/step - loss: 0.0099 - acc: 0.9980 - val_
Epoch 399/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0067 - acc: 0.9986 - val_
Epoch 400/500
60000/60000 [=====] - 7s 125us/step - loss: 0.0093 - acc: 0.9985 - val_
Epoch 401/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0100 - acc: 0.9983 - val_
Epoch 402/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0085 - acc: 0.9982 - val_
Epoch 403/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0097 - acc: 0.9983 - val_
Epoch 404/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0086 - acc: 0.9985 - val_
Epoch 405/500
60000/60000 [=====] - 9s 145us/step - loss: 0.0081 - acc: 0.9983 - val_
Epoch 406/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0081 - acc: 0.9986 - val_
Epoch 407/500
60000/60000 [=====] - 9s 155us/step - loss: 0.0071 - acc: 0.9985 - val_
Epoch 408/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0082 - acc: 0.9983 - val_
Epoch 409/500
60000/60000 [=====] - 9s 146us/step - loss: 0.0097 - acc: 0.9982 - val_
Epoch 410/500
60000/60000 [=====] - 9s 153us/step - loss: 0.0109 - acc: 0.9980 - val_
Epoch 411/500
60000/60000 [=====] - 10s 160us/step - loss: 0.0090 - acc: 0.9984 - val_
Epoch 412/500
60000/60000 [=====] - 10s 159us/step - loss: 0.0077 - acc: 0.9986 - val_
Epoch 413/500
60000/60000 [=====] - 9s 149us/step - loss: 0.0101 - acc: 0.9983 - val_
Epoch 414/500
60000/60000 [=====] - 9s 143us/step - loss: 0.0079 - acc: 0.9983 - val_
Epoch 415/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0081 - acc: 0.9987 - val_
Epoch 416/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0079 - acc: 0.9985 - val_
Epoch 417/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0100 - acc: 0.9982 - val_
Epoch 418/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0093 - acc: 0.9984 - val_
Epoch 419/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0104 - acc: 0.9982 - val_
Epoch 420/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0084 - acc: 0.9986 - val_
Epoch 421/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0083 - acc: 0.9987 - val_

```

```

Epoch 422/500
60000/60000 [=====] - 8s 125us/step - loss: 0.0095 - acc: 0.9981 - val_
Epoch 423/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0097 - acc: 0.9982 - val_
Epoch 424/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0084 - acc: 0.9983 - val_
Epoch 425/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0090 - acc: 0.9982 - val_
Epoch 426/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0096 - acc: 0.9983 - val_
Epoch 427/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0096 - acc: 0.9983 - val_
Epoch 428/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0108 - acc: 0.9981 - val_
Epoch 429/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0101 - acc: 0.9983 - val_
Epoch 430/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0102 - acc: 0.9984 - val_
Epoch 431/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0092 - acc: 0.9983 - val_
Epoch 432/500
60000/60000 [=====] - 8s 125us/step - loss: 0.0073 - acc: 0.9986 - val_
Epoch 433/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0087 - acc: 0.9986 - val_
Epoch 434/500
60000/60000 [=====] - 7s 125us/step - loss: 0.0098 - acc: 0.9983 - val_
Epoch 435/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0088 - acc: 0.9984 - val_
Epoch 436/500
60000/60000 [=====] - 8s 137us/step - loss: 0.0095 - acc: 0.9984 - val_
Epoch 437/500
60000/60000 [=====] - 9s 154us/step - loss: 0.0081 - acc: 0.9986 - val_
Epoch 438/500
60000/60000 [=====] - 8s 136us/step - loss: 0.0097 - acc: 0.9984 - val_
Epoch 439/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0085 - acc: 0.9984 - val_
Epoch 440/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0103 - acc: 0.9981 - val_
Epoch 441/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0093 - acc: 0.9984 - val_
Epoch 442/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0100 - acc: 0.9983 - val_
Epoch 443/500
60000/60000 [=====] - 9s 146us/step - loss: 0.0091 - acc: 0.9986 - val_
Epoch 444/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0094 - acc: 0.9985 - val_
Epoch 445/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0072 - acc: 0.9988 - val_

```

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Epoch 446/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0079 - acc: 0.9987 - val_
Epoch 447/500
60000/60000 [=====] - 9s 146us/step - loss: 0.0092 - acc: 0.9985 - val_
Epoch 448/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0101 - acc: 0.9981 - val_
Epoch 449/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0096 - acc: 0.9985 - val_
Epoch 450/500
60000/60000 [=====] - 8s 137us/step - loss: 0.0083 - acc: 0.9984 - val_
Epoch 451/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0065 - acc: 0.9988 - val_
Epoch 452/500
60000/60000 [=====] - 8s 129us/step - loss: 0.0094 - acc: 0.9983 - val_
Epoch 453/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0077 - acc: 0.9986 - val_
Epoch 454/500
60000/60000 [=====] - 8s 139us/step - loss: 0.0086 - acc: 0.9985 - val_
Epoch 455/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0092 - acc: 0.9984 - val_
Epoch 456/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0087 - acc: 0.9984 - val_
Epoch 457/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0091 - acc: 0.9983 - val_
Epoch 458/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0084 - acc: 0.9984 - val_
Epoch 459/500
60000/60000 [=====] - 7s 118us/step - loss: 0.0071 - acc: 0.9987 - val_
Epoch 460/500
60000/60000 [=====] - 7s 121us/step - loss: 0.0114 - acc: 0.9981 - val_
Epoch 461/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0085 - acc: 0.9984 - val_
Epoch 462/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0088 - acc: 0.9986 - val_
Epoch 463/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0081 - acc: 0.9984 - val_
Epoch 464/500
60000/60000 [=====] - 7s 120us/step - loss: 0.0115 - acc: 0.9983 - val_
Epoch 465/500
60000/60000 [=====] - 7s 121us/step - loss: 0.0084 - acc: 0.9986 - val_
Epoch 466/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0096 - acc: 0.9982 - val_
Epoch 467/500
60000/60000 [=====] - 8s 125us/step - loss: 0.0090 - acc: 0.9985 - val_
Epoch 468/500
60000/60000 [=====] - 7s 123us/step - loss: 0.0104 - acc: 0.9983 - val_
Epoch 469/500
60000/60000 [=====] - 7s 122us/step - loss: 0.0083 - acc: 0.9984 - val_

```

```

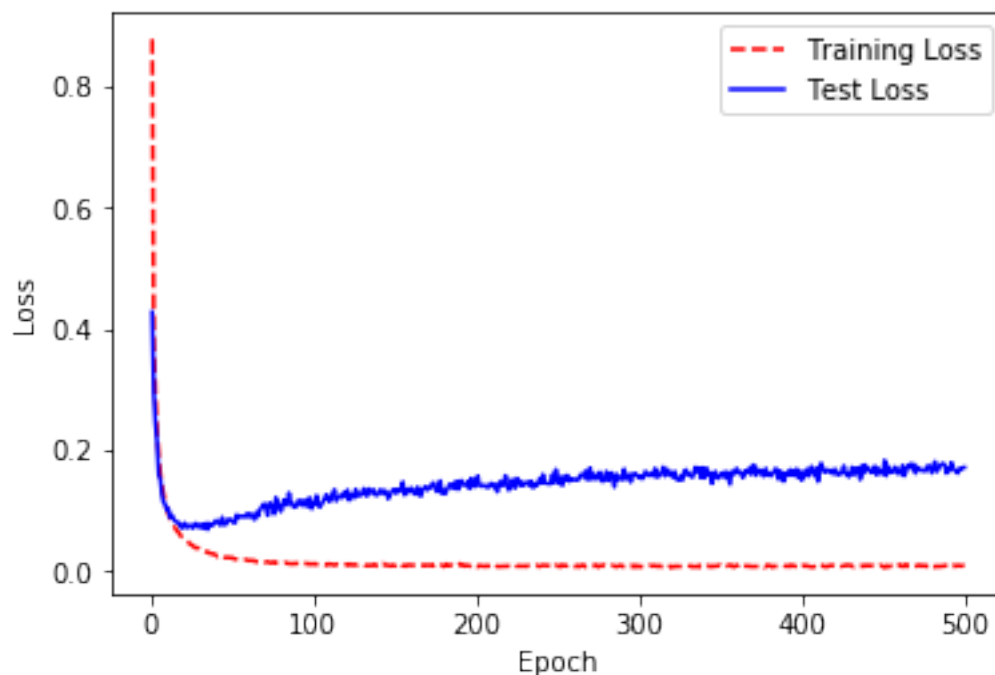
Epoch 470/500
60000/60000 [=====] - 8s 142us/step - loss: 0.0090 - acc: 0.9985 - val_
Epoch 471/500
60000/60000 [=====] - 8s 138us/step - loss: 0.0088 - acc: 0.9986 - val_
Epoch 472/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0106 - acc: 0.9981 - val_
Epoch 473/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0103 - acc: 0.9982 - val_
Epoch 474/500
60000/60000 [=====] - 8s 137us/step - loss: 0.0087 - acc: 0.9984 - val_
Epoch 475/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0092 - acc: 0.9984 - val_
Epoch 476/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0102 - acc: 0.9983 - val_
Epoch 477/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0085 - acc: 0.9984 - val_
Epoch 478/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0079 - acc: 0.9986 - val_
Epoch 479/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0106 - acc: 0.9982 - val_
Epoch 480/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0075 - acc: 0.9987 - val_
Epoch 481/500
60000/60000 [=====] - 8s 137us/step - loss: 0.0072 - acc: 0.9985 - val_
Epoch 482/500
60000/60000 [=====] - 9s 155us/step - loss: 0.0085 - acc: 0.9984 - val_
Epoch 483/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0090 - acc: 0.9984 - val_
Epoch 484/500
60000/60000 [=====] - 7s 124us/step - loss: 0.0077 - acc: 0.9986 - val_
Epoch 485/500
60000/60000 [=====] - 8s 133us/step - loss: 0.0085 - acc: 0.9987 - val_
Epoch 486/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0091 - acc: 0.9983 - val_
Epoch 487/500
60000/60000 [=====] - 8s 127us/step - loss: 0.0086 - acc: 0.9985 - val_
Epoch 488/500
60000/60000 [=====] - 8s 126us/step - loss: 0.0095 - acc: 0.9986 - val_
Epoch 489/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0101 - acc: 0.9985 - val_
Epoch 490/500
60000/60000 [=====] - 8s 131us/step - loss: 0.0105 - acc: 0.9982 - val_
Epoch 491/500
60000/60000 [=====] - 8s 141us/step - loss: 0.0077 - acc: 0.9985 - val_
Epoch 492/500
60000/60000 [=====] - 8s 128us/step - loss: 0.0075 - acc: 0.9986 - val_
Epoch 493/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0097 - acc: 0.9983 - val_

```

```

Epoch 494/500
60000/60000 [=====] - 8s 132us/step - loss: 0.0081 - acc: 0.9987 - val_
Epoch 495/500
60000/60000 [=====] - 8s 134us/step - loss: 0.0095 - acc: 0.9985 - val_
Epoch 496/500
60000/60000 [=====] - 9s 147us/step - loss: 0.0102 - acc: 0.9983 - val_
Epoch 497/500
60000/60000 [=====] - 9s 154us/step - loss: 0.0093 - acc: 0.9985 - val_
Epoch 498/500
60000/60000 [=====] - 8s 130us/step - loss: 0.0090 - acc: 0.9985 - val_
Epoch 499/500
60000/60000 [=====] - 8s 137us/step - loss: 0.0099 - acc: 0.9983 - val_
Epoch 500/500
60000/60000 [=====] - 9s 144us/step - loss: 0.0090 - acc: 0.9983 - val_

```



Conclusion for Part 2: It performed just as well as the image that had no noise in the previous assignment. The line graph illustration is consistent with the `plt.show()` we made in the beginning of Part 2.

0.0.3 Part 3

```
In [138]: (xtrain, ytrain), (xtest, ytest) = mnist.load_data()
```

```

##### Assign noise #####
noise = np.random.normal(0, 50, [28,28])
xtrain_noise = xtrain - noise
xtest_noise = xtest - noise
#####

xtrain_noise = xtrain_noise.astype('float32') / 255.
xtest_noise = xtest_noise.astype('float32') / 255.
xtrain_noise = xtrain_noise.reshape((len(xtrain_noise), np.prod(xtrain_noise.shape[1:])))
xtest_noise = xtest_noise.reshape((len(xtest_noise), np.prod(xtest_noise.shape[1:])))
xtrain_noise.shape, xtest_noise.shape

xtrain_control = xtrain.astype('float32') / 255.
xtest_control = xtest.astype('float32') / 255.
xtrain_control = xtrain_control.reshape((len(xtrain_control), np.prod(xtrain_control.shape[1:])))
xtest_control = xtest_control.reshape((len(xtest_control), np.prod(xtest_control.shape[1:])))
xtrain_control.shape, xtest_control.shape

```

Out[138]: ((60000, 784), (10000, 784))

```

In [139]: # this is the size of our encoded representations
encoding_dim = 6 # 32 floats -> compression of factor 24.5, assuming the input is 784

# this is our input placeholder
x = input_img = Input(shape=(784,))
# "encoded" is the encoded representation of the input
x = Dense(256, activation='relu')(x)
x = Dense(128, activation='relu')(x)
encoded = Dense(encoding_dim, activation='relu')(x)

# "decoded" is the lossy reconstruction of the input
x = Dense(128, activation='relu')(encoded)
x = Dense(256, activation='relu')(x)
decoded = Dense(784, activation='sigmoid')(x)

# this model maps an input to its reconstruction
autoencoder = Model(input_img, decoded)

encoder = Model(input_img, encoded)

# create a placeholder for an encoded (32-dimensional) input
encoded_input = Input(shape=(encoding_dim,))
# retrieve the last layer of the autoencoder model
dcd1 = autoencoder.layers[-1]
dcd2 = autoencoder.layers[-2]
dcd3 = autoencoder.layers[-3]

# create the decoder model

```

```

decoder = Model(encoded_input, dcd1(dcd2(dcd3(encoded_input))))

autoencoder.compile(optimizer='adadelta',
                    loss='binary_crossentropy',
                    metrics=['accuracy'])
autoencoder.fit(xtrain_noise, xtrain_control,
                epochs=500,
                batch_size=256,
                shuffle=True,
                validation_data=(xtest_noise, xtest_control),
                callbacks=[TensorBoard(log_dir='/tmp/autoencoder/encoding_di
acc6_noise = autoencoder.evaluate(xtest_noise,
                                xtest_control,
                                verbose=0)

```

Train on 60000 samples, validate on 10000 samples

```

Epoch 1/500
60000/60000 [=====] - 8s 138us/step - loss: 0.3465 - acc: 0.7517 - val_
Epoch 2/500
60000/60000 [=====] - 7s 121us/step - loss: 0.2531 - acc: 0.7988 - val_
Epoch 3/500
60000/60000 [=====] - 8s 133us/step - loss: 0.2424 - acc: 0.7956 - val_
Epoch 4/500
60000/60000 [=====] - 9s 157us/step - loss: 0.2255 - acc: 0.7951 - val_
Epoch 5/500
60000/60000 [=====] - 9s 150us/step - loss: 0.2135 - acc: 0.7954 - val_
Epoch 6/500
60000/60000 [=====] - 8s 138us/step - loss: 0.2071 - acc: 0.7950 - val_
Epoch 7/500
60000/60000 [=====] - 8s 127us/step - loss: 0.2021 - acc: 0.7950 - val_
Epoch 8/500
60000/60000 [=====] - 8s 140us/step - loss: 0.1979 - acc: 0.7953 - val_
Epoch 9/500
60000/60000 [=====] - 8s 140us/step - loss: 0.1946 - acc: 0.7956 - val_
Epoch 10/500
60000/60000 [=====] - 8s 127us/step - loss: 0.1916 - acc: 0.7960 - val_
Epoch 11/500
60000/60000 [=====] - 8s 138us/step - loss: 0.1891 - acc: 0.7964 - val_
Epoch 12/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1866 - acc: 0.7967 - val_
Epoch 13/500
60000/60000 [=====] - 7s 125us/step - loss: 0.1847 - acc: 0.7970 - val_
Epoch 14/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1831 - acc: 0.7972 - val_
Epoch 15/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1814 - acc: 0.7975 - val_
Epoch 16/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1803 - acc: 0.7976 - val_

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Epoch 17/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1789 - acc: 0.7978 - val_
Epoch 18/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1779 - acc: 0.7980 - val_
Epoch 19/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1768 - acc: 0.7982 - val_
Epoch 20/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1760 - acc: 0.7984 - val_
Epoch 21/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1751 - acc: 0.7986 - val_
Epoch 22/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1743 - acc: 0.7987 - val_
Epoch 23/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1736 - acc: 0.7989 - val_
Epoch 24/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1729 - acc: 0.7991 - val_
Epoch 25/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1722 - acc: 0.7992 - val_
Epoch 26/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1716 - acc: 0.7993 - val_
Epoch 27/500
60000/60000 [=====] - 8s 140us/step - loss: 0.1710 - acc: 0.7995 - val_
Epoch 28/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1703 - acc: 0.7996 - val_
Epoch 29/500
60000/60000 [=====] - 8s 131us/step - loss: 0.1697 - acc: 0.7997 - val_
Epoch 30/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1691 - acc: 0.7999 - val_
Epoch 31/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1684 - acc: 0.8000 - val_
Epoch 32/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1674 - acc: 0.8002 - val_
Epoch 33/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1660 - acc: 0.8004 - val_
Epoch 34/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1648 - acc: 0.8007 - val_
Epoch 35/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1635 - acc: 0.8010 - val_
Epoch 36/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1624 - acc: 0.8012 - val_
Epoch 37/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1614 - acc: 0.8015 - val_
Epoch 38/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1604 - acc: 0.8018 - val_
Epoch 39/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1596 - acc: 0.8020 - val_
Epoch 40/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1588 - acc: 0.8022 - val_

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Epoch 41/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1581 - acc: 0.8023 - val_
Epoch 42/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1572 - acc: 0.8025 - val_
Epoch 43/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1566 - acc: 0.8027 - val_
Epoch 44/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1560 - acc: 0.8028 - val_
Epoch 45/500
60000/60000 [=====] - 8s 127us/step - loss: 0.1553 - acc: 0.8029 - val_
Epoch 46/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1548 - acc: 0.8030 - val_
Epoch 47/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1544 - acc: 0.8031 - val_
Epoch 48/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1539 - acc: 0.8032 - val_
Epoch 49/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1534 - acc: 0.8033 - val_
Epoch 50/500
60000/60000 [=====] - 9s 144us/step - loss: 0.1531 - acc: 0.8033 - val_
Epoch 51/500
60000/60000 [=====] - 8s 136us/step - loss: 0.1527 - acc: 0.8034 - val_
Epoch 52/500
60000/60000 [=====] - 8s 126us/step - loss: 0.1522 - acc: 0.8035 - val_
Epoch 53/500
60000/60000 [=====] - 8s 128us/step - loss: 0.1519 - acc: 0.8035 - val_
Epoch 54/500
60000/60000 [=====] - 8s 141us/step - loss: 0.1517 - acc: 0.8036 - val_
Epoch 55/500
60000/60000 [=====] - 8s 141us/step - loss: 0.1513 - acc: 0.8036 - val_
Epoch 56/500
60000/60000 [=====] - 8s 126us/step - loss: 0.1509 - acc: 0.8037 - val_
Epoch 57/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1507 - acc: 0.8037 - val_
Epoch 58/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1504 - acc: 0.8038 - val_
Epoch 59/500
60000/60000 [=====] - 8s 133us/step - loss: 0.1501 - acc: 0.8038 - val_
Epoch 60/500
60000/60000 [=====] - 9s 154us/step - loss: 0.1497 - acc: 0.8039 - val_
Epoch 61/500
60000/60000 [=====] - 8s 141us/step - loss: 0.1497 - acc: 0.8039 - val_
Epoch 62/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1494 - acc: 0.8039 - val_
Epoch 63/500
60000/60000 [=====] - 8s 139us/step - loss: 0.1491 - acc: 0.8040 - val_
Epoch 64/500
60000/60000 [=====] - 9s 143us/step - loss: 0.1489 - acc: 0.8040 - val_

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Epoch 65/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1486 - acc: 0.8041 - val_
Epoch 66/500
60000/60000 [=====] - 9s 149us/step - loss: 0.1485 - acc: 0.8041 - val_
Epoch 67/500
60000/60000 [=====] - 8s 137us/step - loss: 0.1481 - acc: 0.8042 - val_
Epoch 68/500
60000/60000 [=====] - 8s 141us/step - loss: 0.1479 - acc: 0.8042 - val_
Epoch 69/500
60000/60000 [=====] - 9s 158us/step - loss: 0.1475 - acc: 0.8043 - val_
Epoch 70/500
60000/60000 [=====] - 9s 143us/step - loss: 0.1476 - acc: 0.8042 - val_
Epoch 71/500
60000/60000 [=====] - 8s 138us/step - loss: 0.1474 - acc: 0.8043 - val_
Epoch 72/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1472 - acc: 0.8043 - val_
Epoch 73/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1469 - acc: 0.8043 - val_
Epoch 74/500
60000/60000 [=====] - 8s 136us/step - loss: 0.1467 - acc: 0.8044 - val_
Epoch 75/500
60000/60000 [=====] - 9s 153us/step - loss: 0.1465 - acc: 0.8044 - val_
Epoch 76/500
60000/60000 [=====] - 8s 130us/step - loss: 0.1462 - acc: 0.8045 - val_
Epoch 77/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1458 - acc: 0.8046 - val_
Epoch 78/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1452 - acc: 0.8047 - val_
Epoch 79/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1446 - acc: 0.8049 - val_
Epoch 80/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1438 - acc: 0.8051 - val_
Epoch 81/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1435 - acc: 0.8052 - val_
Epoch 82/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1430 - acc: 0.8053 - val_
Epoch 83/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1424 - acc: 0.8055 - val_
Epoch 84/500
60000/60000 [=====] - 9s 144us/step - loss: 0.1419 - acc: 0.8056 - val_
Epoch 85/500
60000/60000 [=====] - 8s 135us/step - loss: 0.1416 - acc: 0.8056 - val_
Epoch 86/500
60000/60000 [=====] - 8s 137us/step - loss: 0.1413 - acc: 0.8057 - val_
Epoch 87/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1410 - acc: 0.8058 - val_
Epoch 88/500
60000/60000 [=====] - 9s 142us/step - loss: 0.1406 - acc: 0.8058 - val_

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Epoch 89/500
60000/60000 [=====] - 8s 139us/step - loss: 0.1403 - acc: 0.8059 - val_
Epoch 90/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1402 - acc: 0.8059 - val_
Epoch 91/500
60000/60000 [=====] - 8s 131us/step - loss: 0.1398 - acc: 0.8060 - val_
Epoch 92/500
60000/60000 [=====] - 8s 139us/step - loss: 0.1395 - acc: 0.8061 - val_
Epoch 93/500
60000/60000 [=====] - 9s 152us/step - loss: 0.1393 - acc: 0.8061 - val_
Epoch 94/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1391 - acc: 0.8061 - val_
Epoch 95/500
60000/60000 [=====] - 8s 131us/step - loss: 0.1389 - acc: 0.8062 - val_
Epoch 96/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1386 - acc: 0.8062 - val_
Epoch 97/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1385 - acc: 0.8063 - val_
Epoch 98/500
60000/60000 [=====] - 8s 131us/step - loss: 0.1381 - acc: 0.8063 - val_
Epoch 99/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1381 - acc: 0.8063 - val_
Epoch 100/500
60000/60000 [=====] - 7s 125us/step - loss: 0.1379 - acc: 0.8063 - val_
Epoch 101/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1377 - acc: 0.8064 - val_
Epoch 102/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1376 - acc: 0.8064 - val_
Epoch 103/500
60000/60000 [=====] - 8s 135us/step - loss: 0.1374 - acc: 0.8065 - val_
Epoch 104/500
60000/60000 [=====] - 8s 131us/step - loss: 0.1371 - acc: 0.8065 - val_
Epoch 105/500
60000/60000 [=====] - 8s 135us/step - loss: 0.1371 - acc: 0.8065 - val_
Epoch 106/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1369 - acc: 0.8065 - val_
Epoch 107/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1367 - acc: 0.8066 - val_
Epoch 108/500
60000/60000 [=====] - 8s 130us/step - loss: 0.1366 - acc: 0.8066 - val_
Epoch 109/500
60000/60000 [=====] - 9s 142us/step - loss: 0.1365 - acc: 0.8066 - val_
Epoch 110/500
60000/60000 [=====] - 8s 128us/step - loss: 0.1363 - acc: 0.8066 - val_
Epoch 111/500
60000/60000 [=====] - 8s 127us/step - loss: 0.1362 - acc: 0.8067 - val_
Epoch 112/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1359 - acc: 0.8067 - val_

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Epoch 113/500
60000/60000 [=====] - 8s 133us/step - loss: 0.1359 - acc: 0.8067 - val_
Epoch 114/500
60000/60000 [=====] - 8s 137us/step - loss: 0.1358 - acc: 0.8067 - val_
Epoch 115/500
60000/60000 [=====] - 8s 140us/step - loss: 0.1355 - acc: 0.8068 - val_
Epoch 116/500
60000/60000 [=====] - 12s 195us/step - loss: 0.1354 - acc: 0.8068 - val_
Epoch 117/500
60000/60000 [=====] - 10s 162us/step - loss: 0.1353 - acc: 0.8068 - val_
Epoch 118/500
60000/60000 [=====] - 10s 161us/step - loss: 0.1352 - acc: 0.8068 - val_
Epoch 119/500
60000/60000 [=====] - 8s 138us/step - loss: 0.1351 - acc: 0.8069 - val_
Epoch 120/500
60000/60000 [=====] - 9s 145us/step - loss: 0.1350 - acc: 0.8069 - val_
Epoch 121/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1347 - acc: 0.8069 - val_
Epoch 122/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1347 - acc: 0.8069 - val_
Epoch 123/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1345 - acc: 0.8070 - val_
Epoch 124/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1345 - acc: 0.8070 - val_
Epoch 125/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1343 - acc: 0.8070 - val_
Epoch 126/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1342 - acc: 0.8070 - val_
Epoch 127/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1341 - acc: 0.8070 - val_
Epoch 128/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1340 - acc: 0.8070 - val_
Epoch 129/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1338 - acc: 0.8071 - val_
Epoch 130/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1338 - acc: 0.8071 - val_
Epoch 131/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1337 - acc: 0.8071 - val_
Epoch 132/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1337 - acc: 0.8071 - val_
Epoch 133/500
60000/60000 [=====] - 8s 128us/step - loss: 0.1334 - acc: 0.8072 - val_
Epoch 134/500
60000/60000 [=====] - 8s 140us/step - loss: 0.1334 - acc: 0.8072 - val_
Epoch 135/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1331 - acc: 0.8072 - val_
Epoch 136/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1331 - acc: 0.8072 - val_

Epoch 137/500
60000/60000 [=====] - 7s 125us/step - loss: 0.1330 - acc: 0.8072 - val_
Epoch 138/500
60000/60000 [=====] - 9s 151us/step - loss: 0.1330 - acc: 0.8072 - val_
Epoch 139/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1328 - acc: 0.8073 - val_
Epoch 140/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1327 - acc: 0.8073 - val_
Epoch 141/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1326 - acc: 0.8073 - val_
Epoch 142/500
60000/60000 [=====] - 8s 127us/step - loss: 0.1326 - acc: 0.8073 - val_
Epoch 143/500
60000/60000 [=====] - 8s 125us/step - loss: 0.1324 - acc: 0.8073 - val_
Epoch 144/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1323 - acc: 0.8074 - val_
Epoch 145/500
60000/60000 [=====] - 8s 127us/step - loss: 0.1323 - acc: 0.8073 - val_
Epoch 146/500
60000/60000 [=====] - 8s 126us/step - loss: 0.1322 - acc: 0.8074 - val_
Epoch 147/500
60000/60000 [=====] - 8s 139us/step - loss: 0.1321 - acc: 0.8074 - val_
Epoch 148/500
60000/60000 [=====] - 8s 127us/step - loss: 0.1320 - acc: 0.8074 - val_
Epoch 149/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1319 - acc: 0.8074 - val_
Epoch 150/500
60000/60000 [=====] - 9s 154us/step - loss: 0.1319 - acc: 0.8074 - val_
Epoch 151/500
60000/60000 [=====] - 9s 150us/step - loss: 0.1316 - acc: 0.8075 - val_
Epoch 152/500
60000/60000 [=====] - 8s 141us/step - loss: 0.1317 - acc: 0.8075 - val_
Epoch 153/500
60000/60000 [=====] - 9s 142us/step - loss: 0.1315 - acc: 0.8075 - val_
Epoch 154/500
60000/60000 [=====] - 9s 155us/step - loss: 0.1313 - acc: 0.8075 - val_
Epoch 155/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1314 - acc: 0.8075 - val_
Epoch 156/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1313 - acc: 0.8075 - val_
Epoch 157/500
60000/60000 [=====] - 8s 125us/step - loss: 0.1311 - acc: 0.8076 - val_
Epoch 158/500
60000/60000 [=====] - 9s 142us/step - loss: 0.1311 - acc: 0.8076 - val_
Epoch 159/500
60000/60000 [=====] - 8s 141us/step - loss: 0.1311 - acc: 0.8076 - val_
Epoch 160/500
60000/60000 [=====] - 9s 152us/step - loss: 0.1310 - acc: 0.8076 - val_

Epoch 161/500
60000/60000 [=====] - 9s 152us/step - loss: 0.1309 - acc: 0.8076 - val_
Epoch 162/500
60000/60000 [=====] - 10s 161us/step - loss: 0.1308 - acc: 0.8076 - val_
Epoch 163/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1309 - acc: 0.8076 - val_
Epoch 164/500
60000/60000 [=====] - 8s 136us/step - loss: 0.1306 - acc: 0.8077 - val_
Epoch 165/500
60000/60000 [=====] - 9s 143us/step - loss: 0.1307 - acc: 0.8076 - val_
Epoch 166/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1306 - acc: 0.8077 - val_
Epoch 167/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1304 - acc: 0.8077 - val_
Epoch 168/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1302 - acc: 0.8077 - val_
Epoch 169/500
60000/60000 [=====] - 9s 156us/step - loss: 0.1303 - acc: 0.8077 - val_
Epoch 170/500
60000/60000 [=====] - 8s 130us/step - loss: 0.1303 - acc: 0.8077 - val_
Epoch 171/500
60000/60000 [=====] - 8s 139us/step - loss: 0.1301 - acc: 0.8077 - val_
Epoch 172/500
60000/60000 [=====] - 9s 149us/step - loss: 0.1300 - acc: 0.8078 - val_
Epoch 173/500
60000/60000 [=====] - 9s 146us/step - loss: 0.1300 - acc: 0.8078 - val_
Epoch 174/500
60000/60000 [=====] - 9s 153us/step - loss: 0.1299 - acc: 0.8078 - val_
Epoch 175/500
60000/60000 [=====] - 9s 142us/step - loss: 0.1299 - acc: 0.8078 - val_
Epoch 176/500
60000/60000 [=====] - 9s 144us/step - loss: 0.1298 - acc: 0.8078 - val_
Epoch 177/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1297 - acc: 0.8078 - val_
Epoch 178/500
60000/60000 [=====] - 8s 135us/step - loss: 0.1296 - acc: 0.8078 - val_
Epoch 179/500
60000/60000 [=====] - 8s 127us/step - loss: 0.1297 - acc: 0.8078 - val_
Epoch 180/500
60000/60000 [=====] - 9s 149us/step - loss: 0.1294 - acc: 0.8079 - val_
Epoch 181/500
60000/60000 [=====] - 8s 138us/step - loss: 0.1295 - acc: 0.8078 - val_
Epoch 182/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1294 - acc: 0.8079 - val_
Epoch 183/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1293 - acc: 0.8079 - val_
Epoch 184/500
60000/60000 [=====] - 8s 139us/step - loss: 0.1293 - acc: 0.8079 - val_

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Epoch 185/500
60000/60000 [=====] - 8s 126us/step - loss: 0.1291 - acc: 0.8079 - val_
Epoch 186/500
60000/60000 [=====] - 8s 135us/step - loss: 0.1292 - acc: 0.8079 - val_
Epoch 187/500
60000/60000 [=====] - 8s 125us/step - loss: 0.1290 - acc: 0.8079 - val_
Epoch 188/500
60000/60000 [=====] - 8s 141us/step - loss: 0.1291 - acc: 0.8079 - val_
Epoch 189/500
60000/60000 [=====] - 8s 141us/step - loss: 0.1289 - acc: 0.8079 - val_
Epoch 190/500
60000/60000 [=====] - 8s 127us/step - loss: 0.1289 - acc: 0.8079 - val_
Epoch 191/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1288 - acc: 0.8080 - val_
Epoch 192/500
60000/60000 [=====] - 8s 128us/step - loss: 0.1288 - acc: 0.8079 - val_
Epoch 193/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1287 - acc: 0.8080 - val_
Epoch 194/500
60000/60000 [=====] - 8s 139us/step - loss: 0.1286 - acc: 0.8080 - val_
Epoch 195/500
60000/60000 [=====] - 9s 145us/step - loss: 0.1285 - acc: 0.8080 - val_
Epoch 196/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1285 - acc: 0.8080 - val_
Epoch 197/500
60000/60000 [=====] - 8s 139us/step - loss: 0.1285 - acc: 0.8080 - val_
Epoch 198/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1284 - acc: 0.8080 - val_
Epoch 199/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1284 - acc: 0.8080 - val_
Epoch 200/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1282 - acc: 0.8081 - val_
Epoch 201/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1281 - acc: 0.8081 - val_
Epoch 202/500
60000/60000 [=====] - 8s 127us/step - loss: 0.1281 - acc: 0.8081 - val_
Epoch 203/500
60000/60000 [=====] - 8s 128us/step - loss: 0.1281 - acc: 0.8081 - val_
Epoch 204/500
60000/60000 [=====] - 8s 130us/step - loss: 0.1281 - acc: 0.8081 - val_
Epoch 205/500
60000/60000 [=====] - 8s 133us/step - loss: 0.1279 - acc: 0.8081 - val_
Epoch 206/500
60000/60000 [=====] - 8s 135us/step - loss: 0.1278 - acc: 0.8081 - val_
Epoch 207/500
60000/60000 [=====] - 7s 121us/step - loss: 0.1279 - acc: 0.8081 - val_
Epoch 208/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1278 - acc: 0.8081 - val_

```

Epoch 209/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1277 - acc: 0.8082 - val_
Epoch 210/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1277 - acc: 0.8081 - val_
Epoch 211/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1276 - acc: 0.8082 - val_
Epoch 212/500
60000/60000 [=====] - 9s 148us/step - loss: 0.1276 - acc: 0.8082 - val_
Epoch 213/500
60000/60000 [=====] - 8s 136us/step - loss: 0.1276 - acc: 0.8082 - val_
Epoch 214/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1275 - acc: 0.8082 - val_
Epoch 215/500
60000/60000 [=====] - 8s 129us/step - loss: 0.1275 - acc: 0.8082 - val_
Epoch 216/500
60000/60000 [=====] - 8s 134us/step - loss: 0.1274 - acc: 0.8082 - val_
Epoch 217/500
60000/60000 [=====] - 8s 133us/step - loss: 0.1273 - acc: 0.8082 - val_
Epoch 218/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1272 - acc: 0.8082 - val_
Epoch 219/500
60000/60000 [=====] - 8s 127us/step - loss: 0.1273 - acc: 0.8082 - val_
Epoch 220/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1271 - acc: 0.8082 - val_
Epoch 221/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1271 - acc: 0.8083 - val_
Epoch 222/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1271 - acc: 0.8083 - val_
Epoch 223/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1270 - acc: 0.8083 - val_
Epoch 224/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1269 - acc: 0.8083 - val_
Epoch 225/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1270 - acc: 0.8083 - val_
Epoch 226/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1268 - acc: 0.8083 - val_
Epoch 227/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1268 - acc: 0.8083 - val_
Epoch 228/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1268 - acc: 0.8083 - val_
Epoch 229/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1268 - acc: 0.8083 - val_
Epoch 230/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1267 - acc: 0.8083 - val_
Epoch 231/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1267 - acc: 0.8083 - val_
Epoch 232/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1266 - acc: 0.8083 - val_

Epoch 233/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1266 - acc: 0.8083 - val_
Epoch 234/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1265 - acc: 0.8083 - val_
Epoch 235/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1265 - acc: 0.8084 - val_
Epoch 236/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1263 - acc: 0.8084 - val_
Epoch 237/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1264 - acc: 0.8084 - val_
Epoch 238/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1263 - acc: 0.8084 - val_
Epoch 239/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1262 - acc: 0.8084 - val_
Epoch 240/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1263 - acc: 0.8084 - val_
Epoch 241/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1262 - acc: 0.8084 - val_
Epoch 242/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1262 - acc: 0.8084 - val_
Epoch 243/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1261 - acc: 0.8084 - val_
Epoch 244/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1260 - acc: 0.8084 - val_
Epoch 245/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1261 - acc: 0.8084 - val_
Epoch 246/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1259 - acc: 0.8085 - val_
Epoch 247/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1259 - acc: 0.8085 - val_
Epoch 248/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1259 - acc: 0.8085 - val_
Epoch 249/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1258 - acc: 0.8085 - val_
Epoch 250/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1258 - acc: 0.8085 - val_
Epoch 251/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1258 - acc: 0.8085 - val_
Epoch 252/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1257 - acc: 0.8085 - val_
Epoch 253/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1257 - acc: 0.8085 - val_
Epoch 254/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1256 - acc: 0.8085 - val_
Epoch 255/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1255 - acc: 0.8085 - val_
Epoch 256/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1257 - acc: 0.8085 - val_

Epoch 257/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1256 - acc: 0.8085 - val_
Epoch 258/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1255 - acc: 0.8085 - val_
Epoch 259/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1254 - acc: 0.8085 - val_
Epoch 260/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1254 - acc: 0.8085 - val_
Epoch 261/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1254 - acc: 0.8085 - val_
Epoch 262/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1253 - acc: 0.8086 - val_
Epoch 263/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1253 - acc: 0.8086 - val_
Epoch 264/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1253 - acc: 0.8086 - val_
Epoch 265/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1252 - acc: 0.8086 - val_
Epoch 266/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1251 - acc: 0.8086 - val_
Epoch 267/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1252 - acc: 0.8086 - val_
Epoch 268/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1251 - acc: 0.8086 - val_
Epoch 269/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1251 - acc: 0.8086 - val_
Epoch 270/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1250 - acc: 0.8086 - val_
Epoch 271/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1250 - acc: 0.8086 - val_
Epoch 272/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1249 - acc: 0.8086 - val_
Epoch 273/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1250 - acc: 0.8086 - val_
Epoch 274/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1249 - acc: 0.8086 - val_
Epoch 275/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1249 - acc: 0.8086 - val_
Epoch 276/500
60000/60000 [=====] - 7s 108us/step - loss: 0.1248 - acc: 0.8086 - val_
Epoch 277/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1248 - acc: 0.8086 - val_
Epoch 278/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1247 - acc: 0.8087 - val_
Epoch 279/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1247 - acc: 0.8087 - val_
Epoch 280/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1247 - acc: 0.8087 - val_

Epoch 281/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1247 - acc: 0.8087 - val_
 Epoch 282/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1246 - acc: 0.8087 - val_
 Epoch 283/500
 60000/60000 [=====] - 7s 117us/step - loss: 0.1247 - acc: 0.8087 - val_
 Epoch 284/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1245 - acc: 0.8087 - val_
 Epoch 285/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1245 - acc: 0.8087 - val_
 Epoch 286/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1244 - acc: 0.8087 - val_
 Epoch 287/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.1245 - acc: 0.8087 - val_
 Epoch 288/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1244 - acc: 0.8087 - val_
 Epoch 289/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1243 - acc: 0.8087 - val_
 Epoch 290/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1243 - acc: 0.8087 - val_
 Epoch 291/500
 60000/60000 [=====] - 6s 105us/step - loss: 0.1242 - acc: 0.8088 - val_
 Epoch 292/500
 60000/60000 [=====] - 7s 118us/step - loss: 0.1243 - acc: 0.8087 - val_
 Epoch 293/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1242 - acc: 0.8087 - val_
 Epoch 294/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1242 - acc: 0.8088 - val_
 Epoch 295/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1242 - acc: 0.8087 - val_
 Epoch 296/500
 60000/60000 [=====] - 6s 106us/step - loss: 0.1242 - acc: 0.8087 - val_
 Epoch 297/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.1241 - acc: 0.8088 - val_
 Epoch 298/500
 60000/60000 [=====] - 7s 110us/step - loss: 0.1241 - acc: 0.8088 - val_
 Epoch 299/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1241 - acc: 0.8088 - val_
 Epoch 300/500
 60000/60000 [=====] - 7s 109us/step - loss: 0.1241 - acc: 0.8088 - val_
 Epoch 301/500
 60000/60000 [=====] - 7s 116us/step - loss: 0.1241 - acc: 0.8088 - val_
 Epoch 302/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1240 - acc: 0.8088 - val_
 Epoch 303/500
 60000/60000 [=====] - 6s 108us/step - loss: 0.1239 - acc: 0.8088 - val_
 Epoch 304/500
 60000/60000 [=====] - 6s 107us/step - loss: 0.1239 - acc: 0.8088 - val_

Epoch 305/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1239 - acc: 0.8088 - val_
Epoch 306/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1239 - acc: 0.8088 - val_
Epoch 307/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1240 - acc: 0.8088 - val_
Epoch 308/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1237 - acc: 0.8088 - val_
Epoch 309/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1237 - acc: 0.8088 - val_
Epoch 310/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1237 - acc: 0.8088 - val_
Epoch 311/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1237 - acc: 0.8088 - val_
Epoch 312/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1237 - acc: 0.8088 - val_
Epoch 313/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1235 - acc: 0.8089 - val_
Epoch 314/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1237 - acc: 0.8088 - val_
Epoch 315/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1235 - acc: 0.8089 - val_
Epoch 316/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1235 - acc: 0.8089 - val_
Epoch 317/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1236 - acc: 0.8089 - val_
Epoch 318/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1236 - acc: 0.8088 - val_
Epoch 319/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1234 - acc: 0.8089 - val_
Epoch 320/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1234 - acc: 0.8089 - val_
Epoch 321/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1233 - acc: 0.8089 - val_
Epoch 322/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1235 - acc: 0.8089 - val_
Epoch 323/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1233 - acc: 0.8089 - val_
Epoch 324/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1233 - acc: 0.8089 - val_
Epoch 325/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1233 - acc: 0.8089 - val_
Epoch 326/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1233 - acc: 0.8089 - val_
Epoch 327/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1232 - acc: 0.8089 - val_
Epoch 328/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1233 - acc: 0.8089 - val_

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Epoch 329/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1232 - acc: 0.8089 - val_
Epoch 330/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1231 - acc: 0.8089 - val_
Epoch 331/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1232 - acc: 0.8089 - val_
Epoch 332/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1231 - acc: 0.8089 - val_
Epoch 333/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1230 - acc: 0.8089 - val_
Epoch 334/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1230 - acc: 0.8090 - val_
Epoch 335/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1231 - acc: 0.8089 - val_
Epoch 336/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1231 - acc: 0.8089 - val_
Epoch 337/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1230 - acc: 0.8090 - val_
Epoch 338/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1230 - acc: 0.8090 - val_
Epoch 339/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1229 - acc: 0.8090 - val_
Epoch 340/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1230 - acc: 0.8090 - val_
Epoch 341/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1229 - acc: 0.8090 - val_
Epoch 342/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1228 - acc: 0.8090 - val_
Epoch 343/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1228 - acc: 0.8090 - val_
Epoch 344/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1228 - acc: 0.8090 - val_
Epoch 345/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1229 - acc: 0.8090 - val_
Epoch 346/500
60000/60000 [=====] - 7s 118us/step - loss: 0.1228 - acc: 0.8090 - val_
Epoch 347/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1227 - acc: 0.8090 - val_
Epoch 348/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1227 - acc: 0.8090 - val_
Epoch 349/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1227 - acc: 0.8090 - val_
Epoch 350/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1225 - acc: 0.8090 - val_
Epoch 351/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1227 - acc: 0.8090 - val_
Epoch 352/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1226 - acc: 0.8090 - val_

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Epoch 353/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1226 - acc: 0.8090 - val_
Epoch 354/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1225 - acc: 0.8090 - val_
Epoch 355/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1224 - acc: 0.8090 - val_
Epoch 356/500
60000/60000 [=====] - 6s 103us/step - loss: 0.1225 - acc: 0.8090 - val_
Epoch 357/500
60000/60000 [=====] - 7s 120us/step - loss: 0.1225 - acc: 0.8090 - val_
Epoch 358/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1224 - acc: 0.8090 - val_
Epoch 359/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1225 - acc: 0.8090 - val_
Epoch 360/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1224 - acc: 0.8091 - val_
Epoch 361/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1223 - acc: 0.8091 - val_
Epoch 362/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1224 - acc: 0.8091 - val_
Epoch 363/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1223 - acc: 0.8091 - val_
Epoch 364/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1224 - acc: 0.8091 - val_
Epoch 365/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1222 - acc: 0.8091 - val_
Epoch 366/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1224 - acc: 0.8091 - val_
Epoch 367/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1222 - acc: 0.8091 - val_
Epoch 368/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1222 - acc: 0.8091 - val_
Epoch 369/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1221 - acc: 0.8091 - val_
Epoch 370/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1222 - acc: 0.8091 - val_
Epoch 371/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1222 - acc: 0.8091 - val_
Epoch 372/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1221 - acc: 0.8091 - val_
Epoch 373/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1220 - acc: 0.8091 - val_
Epoch 374/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1222 - acc: 0.8091 - val_
Epoch 375/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1220 - acc: 0.8091 - val_
Epoch 376/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1220 - acc: 0.8091 - val_

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Epoch 377/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1220 - acc: 0.8091 - val_
Epoch 378/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1220 - acc: 0.8091 - val_
Epoch 379/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1220 - acc: 0.8091 - val_
Epoch 380/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1220 - acc: 0.8091 - val_
Epoch 381/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1219 - acc: 0.8091 - val_
Epoch 382/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1220 - acc: 0.8091 - val_
Epoch 383/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1219 - acc: 0.8091 - val_
Epoch 384/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1218 - acc: 0.8091 - val_
Epoch 385/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1218 - acc: 0.8091 - val_
Epoch 386/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1218 - acc: 0.8091 - val_
Epoch 387/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1217 - acc: 0.8092 - val_
Epoch 388/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1218 - acc: 0.8092 - val_
Epoch 389/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1218 - acc: 0.8092 - val_
Epoch 390/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1216 - acc: 0.8092 - val_
Epoch 391/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1217 - acc: 0.8092 - val_
Epoch 392/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1217 - acc: 0.8092 - val_
Epoch 393/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1217 - acc: 0.8092 - val_
Epoch 394/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1215 - acc: 0.8092 - val_
Epoch 395/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1217 - acc: 0.8092 - val_
Epoch 396/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1216 - acc: 0.8092 - val_
Epoch 397/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1216 - acc: 0.8092 - val_
Epoch 398/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1215 - acc: 0.8092 - val_
Epoch 399/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1215 - acc: 0.8092 - val_
Epoch 400/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1215 - acc: 0.8092 - val_

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Epoch 401/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1216 - acc: 0.8092 - val_
Epoch 402/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1214 - acc: 0.8092 - val_
Epoch 403/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1215 - acc: 0.8092 - val_
Epoch 404/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1214 - acc: 0.8092 - val_
Epoch 405/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1214 - acc: 0.8092 - val_
Epoch 406/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1214 - acc: 0.8092 - val_
Epoch 407/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1214 - acc: 0.8092 - val_
Epoch 408/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1214 - acc: 0.8092 - val_
Epoch 409/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1214 - acc: 0.8092 - val_
Epoch 410/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1214 - acc: 0.8092 - val_
Epoch 411/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1214 - acc: 0.8092 - val_
Epoch 412/500
60000/60000 [=====] - 6s 108us/step - loss: 0.1214 - acc: 0.8092 - val_
Epoch 413/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1212 - acc: 0.8092 - val_
Epoch 414/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1213 - acc: 0.8092 - val_
Epoch 415/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1213 - acc: 0.8092 - val_
Epoch 416/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1212 - acc: 0.8093 - val_
Epoch 417/500
60000/60000 [=====] - 7s 110us/step - loss: 0.1213 - acc: 0.8092 - val_
Epoch 418/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1212 - acc: 0.8093 - val_
Epoch 419/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1210 - acc: 0.8093 - val_
Epoch 420/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1211 - acc: 0.8093 - val_
Epoch 421/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1211 - acc: 0.8093 - val_
Epoch 422/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1210 - acc: 0.8093 - val_
Epoch 423/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1211 - acc: 0.8093 - val_
Epoch 424/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1211 - acc: 0.8093 - val_

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Epoch 425/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1210 - acc: 0.8093 - val_
Epoch 426/500
60000/60000 [=====] - 6s 104us/step - loss: 0.1210 - acc: 0.8093 - val_
Epoch 427/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1211 - acc: 0.8093 - val_
Epoch 428/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1210 - acc: 0.8093 - val_
Epoch 429/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1210 - acc: 0.8093 - val_
Epoch 430/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1210 - acc: 0.8093 - val_
Epoch 431/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1209 - acc: 0.8093 - val_
Epoch 432/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1209 - acc: 0.8093 - val_
Epoch 433/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1208 - acc: 0.8093 - val_
Epoch 434/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1208 - acc: 0.8093 - val_
Epoch 435/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1209 - acc: 0.8093 - val_
Epoch 436/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1209 - acc: 0.8093 - val_
Epoch 437/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1208 - acc: 0.8093 - val_
Epoch 438/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1208 - acc: 0.8093 - val_
Epoch 439/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1207 - acc: 0.8093 - val_
Epoch 440/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1207 - acc: 0.8093 - val_
Epoch 441/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1208 - acc: 0.8093 - val_
Epoch 442/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1207 - acc: 0.8093 - val_
Epoch 443/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1208 - acc: 0.8093 - val_
Epoch 444/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1206 - acc: 0.8094 - val_
Epoch 445/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1206 - acc: 0.8094 - val_
Epoch 446/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1206 - acc: 0.8093 - val_
Epoch 447/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1206 - acc: 0.8094 - val_
Epoch 448/500
60000/60000 [=====] - 6s 105us/step - loss: 0.1206 - acc: 0.8093 - val_

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Epoch 449/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1206 - acc: 0.8094 - val_
Epoch 450/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1206 - acc: 0.8094 - val_
Epoch 451/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1206 - acc: 0.8093 - val_
Epoch 452/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1206 - acc: 0.8094 - val_
Epoch 453/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1206 - acc: 0.8094 - val_
Epoch 454/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1205 - acc: 0.8094 - val_
Epoch 455/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1204 - acc: 0.8094 - val_
Epoch 456/500
60000/60000 [=====] - 7s 108us/step - loss: 0.1204 - acc: 0.8094 - val_
Epoch 457/500
60000/60000 [=====] - 6s 106us/step - loss: 0.1205 - acc: 0.8094 - val_
Epoch 458/500
60000/60000 [=====] - 6s 107us/step - loss: 0.1204 - acc: 0.8094 - val_
Epoch 459/500
60000/60000 [=====] - 7s 109us/step - loss: 0.1205 - acc: 0.8094 - val_
Epoch 460/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1204 - acc: 0.8094 - val_
Epoch 461/500
60000/60000 [=====] - 7s 124us/step - loss: 0.1204 - acc: 0.8094 - val_
Epoch 462/500
60000/60000 [=====] - 8s 128us/step - loss: 0.1203 - acc: 0.8094 - val_
Epoch 463/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1202 - acc: 0.8094 - val_
Epoch 464/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1203 - acc: 0.8094 - val_
Epoch 465/500
60000/60000 [=====] - 8s 132us/step - loss: 0.1203 - acc: 0.8094 - val_
Epoch 466/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1203 - acc: 0.8094 - val_
Epoch 467/500
60000/60000 [=====] - 8s 128us/step - loss: 0.1202 - acc: 0.8094 - val_
Epoch 468/500
60000/60000 [=====] - 8s 131us/step - loss: 0.1202 - acc: 0.8094 - val_
Epoch 469/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1203 - acc: 0.8094 - val_
Epoch 470/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1203 - acc: 0.8094 - val_
Epoch 471/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1201 - acc: 0.8094 - val_
Epoch 472/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1202 - acc: 0.8094 - val_

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Epoch 473/500
60000/60000 [=====] - 7s 115us/step - loss: 0.1202 - acc: 0.8094 - val_
Epoch 474/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1202 - acc: 0.8094 - val_
Epoch 475/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1202 - acc: 0.8094 - val_
Epoch 476/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1203 - acc: 0.8094 - val_
Epoch 477/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1201 - acc: 0.8095 - val_
Epoch 478/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1201 - acc: 0.8094 - val_
Epoch 479/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1200 - acc: 0.8094 - val_
Epoch 480/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1201 - acc: 0.8094 - val_
Epoch 481/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1200 - acc: 0.8094 - val_
Epoch 482/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1201 - acc: 0.8094 - val_
Epoch 483/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1201 - acc: 0.8094 - val_
Epoch 484/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1200 - acc: 0.8094 - val_
Epoch 485/500
60000/60000 [=====] - 7s 123us/step - loss: 0.1199 - acc: 0.8095 - val_
Epoch 486/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1200 - acc: 0.8094 - val_
Epoch 487/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1199 - acc: 0.8095 - val_
Epoch 488/500
60000/60000 [=====] - 7s 111us/step - loss: 0.1199 - acc: 0.8095 - val_
Epoch 489/500
60000/60000 [=====] - 7s 122us/step - loss: 0.1199 - acc: 0.8095 - val_
Epoch 490/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1199 - acc: 0.8095 - val_
Epoch 491/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1200 - acc: 0.8095 - val_
Epoch 492/500
60000/60000 [=====] - 7s 113us/step - loss: 0.1199 - acc: 0.8095 - val_
Epoch 493/500
60000/60000 [=====] - 7s 119us/step - loss: 0.1198 - acc: 0.8095 - val_
Epoch 494/500
60000/60000 [=====] - 7s 116us/step - loss: 0.1199 - acc: 0.8095 - val_
Epoch 495/500
60000/60000 [=====] - 7s 112us/step - loss: 0.1197 - acc: 0.8095 - val_
Epoch 496/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1199 - acc: 0.8094 - val_

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```
Epoch 497/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1198 - acc: 0.8095 - val_
Epoch 498/500
60000/60000 [=====] - 9s 147us/step - loss: 0.1200 - acc: 0.8094 - val_
Epoch 499/500
60000/60000 [=====] - 7s 117us/step - loss: 0.1197 - acc: 0.8095 - val_
Epoch 500/500
60000/60000 [=====] - 7s 114us/step - loss: 0.1198 - acc: 0.8095 - val_
```

0.0.4 Autoencoder on Noise = 50 vs Noise = 0

At step 85'ish, the autoencoder's accuracy (noise = 50) caught up, the acc., loss, val_acc., val_loss became indiscriminable from that point.

```
In [140]: encoded_imgs = encoder.predict(xtest_control)
          decoded_imgs = decoder.predict(encoded_imgs)
          import matplotlib.pyplot as plt

          n = 20 # how many digits we will display
          plt.figure(figsize=(40, 4))
          for i in range(n):
              # display original
              ax = plt.subplot(2, n, i + 1)
              plt.imshow(xtest_control[i].reshape(28, 28))
              plt.gray()
              ax.get_xaxis().set_visible(False)
              ax.get_yaxis().set_visible(False)

              # display reconstruction
              ax = plt.subplot(2, n, i + 1 + n)
              plt.imshow(decoded_imgs[i].reshape(28, 28))
              plt.gray()
              ax.get_xaxis().set_visible(False)
              ax.get_yaxis().set_visible(False)
          plt.show()
```



0.0.5 These images have got to be one of the most interesting stuff I've seen this month - and, I watch stuff on YouTube!

My guess is that the numbers look bold because there are higher variability along the y-axis? (I'm just throwing stuff on the wall here).