In [1]:
```
pip install tensorflow
```

```
Requirement already satisfied: tensorflow in c:\users\samir\anaconda3\lib\site-packages (2.14.0)
Requirement already satisfied: tensorflow-intel==2.14.0 in c:\users\samir\anaconda3\lib\site-packages (from ten
sorflow) (2.14.0)
Requirement already satisfied: absl-py>=1.0.0 in c:\users\samir\anaconda3\lib\site-packages (from tensorflow-in
tel==2.14.0->tensorflow) (2.0.0)
Requirement already satisfied: astunparse>=1.6.0 in c:\users\samir\anaconda3\lib\site-packages (from tensorflow
-intel==2.14.0->tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=23.5.26 in c:\users\samir\anaconda3\lib\site-packages (from tensorf
low-intel==2.14.0->tensorflow) (23.5.26)
Requirement already satisfied: gast!=0.5.0,!=0.5.1,!=0.5.2,>=0.2.1 in c:\users\samir\anaconda3\lib\site-package
s (from tensorflow-intel==2.14.0->tensorflow) (0.5.4)
Requirement already satisfied: google-pasta>=0.1.1 in c:\users\samir\anaconda3\lib\site-packages (from tensorfl
ow-intel==2.14.0->tensorflow) (0.2.0)
Requirement already satisfied: h5py>=2.9.0 in c:\users\samir\anaconda3\lib\site-packages (from tensorflow-intel
==2.14.0->tensorflow) (3.9.0)
Requirement already satisfied: libclang>=13.0.0 in c:\users\samir\anaconda3\lib\site-packages (from tensorflow-
intel==2.14.0->tensorflow) (16.0.6)
Requirement already satisfied: ml-dtypes==0.2.0 in c:\users\samir\anaconda3\lib\site-packages (from tensorflow-
intel==2.14.0->tensorflow) (0.2.0)
Requirement already satisfied: numpy>=1.23.5 in c:\users\samir\anaconda3\lib\site-packages (from tensorflow-int
el==2.14.0->tensorflow) (1.24.3)
Requirement already satisfied: opt-einsum>=2.3.2 in c:\users\samir\anaconda3\lib\site-packages (from tensorflow
-intel==2.14.0->tensorflow) (3.3.0)
Requirement already satisfied: packaging in c:\users\samir\anaconda3\lib\site-packages (from tensorflow-intel==
2.14.0->tensorflow) (23.1)
Requirement already satisfied: protobuf!=4.21.0,!=4.21.1,!=4.21.2,!=4.21.3,!=4.21.4,!=4.21.5,<5.0.0dev,>=3.20.3
 in c:\users\samir\anaconda3\lib\site-packages (from tensorflow-intel==2.14.0->tensorflow) (3.20.3)
Requirement already satisfied: setuptools in c:\users\samir\anaconda3\lib\site-packages (from tensorflow-intel=
=2.14.0->tensorflow) (68.0.0)
Requirement already satisfied: six>=1.12.0 in c:\users\samir\anaconda3\lib\site-packages (from tensorflow-intel
==2.14.0->tensorflow) (1.16.0)
Requirement already satisfied: termcolor>=1.1.0 in c:\users\samir\anaconda3\lib\site-packages (from tensorflow-
intel==2.14.0->tensorflow) (2.3.0)
Requirement already satisfied: typing-extensions>=3.6.6 in c:\users\samir\anaconda3\lib\site-packages (from ten
sorflow-intel==2.14.0->tensorflow) (4.7.1)
Requirement already satisfied: wrapt<1.15,>=1.11.0 in c:\users\samir\anaconda3\lib\site-packages (from tensorfl
ow-intel==2.14.0->tensorflow) (1.14.1)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in c:\users\samir\anaconda3\lib\site-packag
es (from tensorflow-intel==2.14.0->tensorflow) (0.31.0)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in c:\users\samir\anaconda3\lib\site-packages (from tensorfl
ow-intel==2.14.0->tensorflow) (1.59.0)
Requirement already satisfied: tensorboard<2.15,>=2.14 in c:\users\samir\anaconda3\lib\site-packages (from tens
orflow-intel==2.14.0->tensorflow) (2.14.1)
Requirement already satisfied: tensorflow-estimator<2.15,>=2.14.0 in c:\users\samir\anaconda3\lib\site-packages
 (from tensorflow-intel==2.14.0->tensorflow) (2.14.0)
Requirement already satisfied: keras<2.15,>=2.14.0 in c:\users\samir\anaconda3\lib\site-packages (from tensorfl
ow-intel==2.14.0->tensorflow) (2.14.0)
Requirement already satisfied: wheel<1.0,>=0.23.0 in c:\users\samir\anaconda3\lib\site-packages (from astunpars
e>=1.6.0->tensorflow-intel==2.14.0->tensorflow) (0.38.4)
Requirement already satisfied: google-auth<3,>=1.6.3 in c:\users\samir\anaconda3\lib\site-packages (from tensor
board<2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (2.23.3)
Requirement already satisfied: google-auth-oauthlib<1.1,>=0.5 in c:\users\samir\anaconda3\lib\site-packages (fr
om tensorboard<2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (1.0.0)
Requirement already satisfied: markdown>=2.6.8 in c:\users\samir\anaconda3\lib\site-packages (from tensorboard<
2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (3.4.1)
Requirement already satisfied: requests<3,>=2.21.0 in c:\users\samir\anaconda3\lib\site-packages (from tensorbo
ard<2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (2.31.0)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in c:\users\samir\anaconda3\lib\site-packa
ges (from tensorboard<2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (0.7.2)
Requirement already satisfied: werkzeug>=1.0.1 in c:\users\samir\anaconda3\lib\site-packages (from tensorboard<
2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (2.2.3)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in c:\users\samir\anaconda3\lib\site-packages (from googl
e-auth<3,>=1.6.3->tensorboard<2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (5.3.2)
Requirement already satisfied: pyasn1-modules>=0.2.1 in c:\users\samir\anaconda3\lib\site-packages (from google
-auth<3,>=1.6.3->tensorboard<2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (0.2.8)
Requirement already satisfied: rsa<5,>=3.1.4 in c:\users\samir\anaconda3\lib\site-packages (from google-auth<3,
>=1.6.3->tensorboard<2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (4.9)
Requirement already satisfied: requests-oauthlib>=0.7.0 in c:\users\samir\anaconda3\lib\site-packages (from goo
gle-auth-oauthlib<1.1,>=0.5->tensorboard<2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (1.3.1)
Requirement already satisfied: charset-normalizer<4,>=2 in c:\users\samir\anaconda3\lib\site-packages (from req
uests<3,>=2.21.0->tensorboard<2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in c:\users\samir\anaconda3\lib\site-packages (from requests<3,>=2.
21.0->tensorboard<2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (3.4)
Requirement already satisfied: urllib3<3,>=1.21.1 in c:\users\samir\anaconda3\lib\site-packages (from requests<
3,>=2.21.0->tensorboard<2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (1.26.16)
```

```
Requirement already satisfied: certifi>=2017.4.17 in c:\users\samir\anaconda3\lib\site-packages (from requests<
3,>=2.21.0->tensorboard<2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (2023.7.22)
Requirement already satisfied: MarkupSafe>=2.1.1 in c:\users\samir\anaconda3\lib\site-packages (from werkzeug>=
1.0.1->tensorboard<2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (2.1.1)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in c:\users\samir\anaconda3\lib\site-packages (from pyasn1-
modules>=0.2.1->google-auth<3,>=1.6.3->tensorboard<2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow) (0.4.8)
Requirement already satisfied: oauthlib>=3.0.0 in c:\users\samir\anaconda3\lib\site-packages (from requests-oau
thlib>=0.7.0->google-auth-oauthlib<1.1,>=0.5->tensorboard<2.15,>=2.14->tensorflow-intel==2.14.0->tensorflow)
(3.2.2)
Note: you may need to restart the kernel to use updated packages.
```

In [2]:
```python
from tensorflow import keras
```

In [6]:
```python
import tensorflow as tf
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import random
%matplotlib inline
```

In [7]:
```python
mnist=tf.keras.datasets.mnist
(x_train,y_train),(x_test,y_test)=mnist.load_data()
```

In [8]:
```python
plt.matshow(x_train[0])
```

Out[8]:
```
<matplotlib.image.AxesImage at 0x1c86021f410>
```
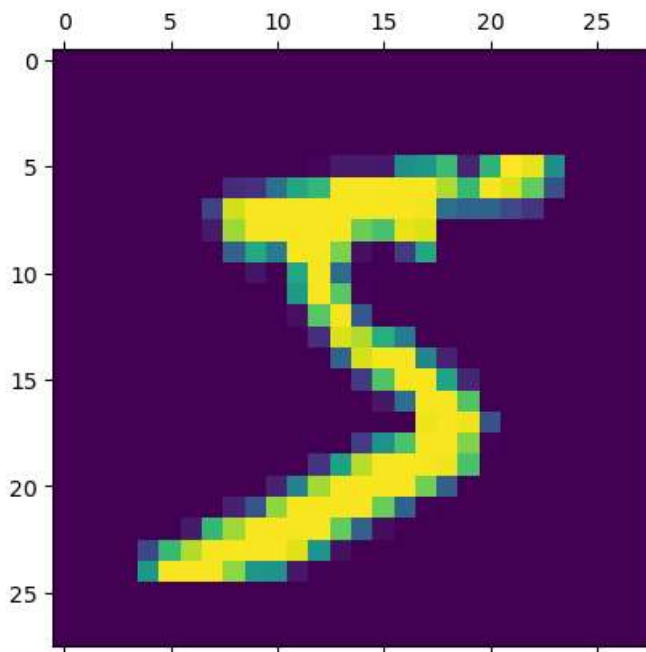

In [9]:
```python
x_train=x_train/255
x_test=x_test/255
```

In [10]:
```python
x_train[0]
```

```
Out[10]:  array([[0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        ],
         [0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        ],
         [0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        ],
         [0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        ],
         [0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        ],
         [0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.01176471, 0.07058824, 0.07058824,
          0.07058824, 0.49411765, 0.53333333, 0.68627451, 0.10196078,
          0.65098039, 1.        , 0.96862745, 0.49803922, 0.        ,
          0.        , 0.        , 0.        ],
         [0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.11764706, 0.14117647,
          0.36862745, 0.60392157, 0.66666667, 0.99215686, 0.99215686,
          0.99215686, 0.99215686, 0.99215686, 0.88235294, 0.6745098 ,
          0.99215686, 0.94901961, 0.76470588, 0.25098039, 0.        ,
          0.        , 0.        , 0.        ],
         [0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.19215686, 0.93333333, 0.99215686,
          0.99215686, 0.99215686, 0.99215686, 0.99215686, 0.99215686,
          0.99215686, 0.99215686, 0.98431373, 0.36470588, 0.32156863,
          0.32156863, 0.21960784, 0.15294118, 0.        , 0.        ,
          0.        , 0.        , 0.        ],
         [0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.07058824, 0.85882353, 0.99215686,
          0.99215686, 0.99215686, 0.99215686, 0.99215686, 0.77647059,
          0.71372549, 0.96862745, 0.94509804, 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        ],
         [0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.31372549, 0.61176471,
          0.41960784, 0.99215686, 0.99215686, 0.80392157, 0.04313725,
          0.        , 0.16862745, 0.60392157, 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        ],
         [0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.05490196,
          0.00392157, 0.60392157, 0.99215686, 0.35294118, 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        ],
         [0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.54509804, 0.99215686, 0.74509804, 0.00784314,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        ],
         [0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.        , 0.        , 0.        , 0.        ,
          0.        , 0.04313725, 0.74509804, 0.99215686, 0.2745098 ,
```

```
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        ],
        [0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.1372549 , 0.94509804, 0.88235294,
         0.62745098, 0.42352941, 0.00392157, 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        ],
        [0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.31764706, 0.94117647,
         0.99215686, 0.99215686, 0.46666667, 0.09803922, 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        ],
        [0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.17647059,
         0.72941176, 0.99215686, 0.99215686, 0.58823529, 0.10588235,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        ],
        [0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.0627451 , 0.36470588, 0.98823529, 0.99215686, 0.73333333,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        ],
        [0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.97647059, 0.99215686, 0.97647059,
         0.25098039, 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        ],
        [0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.18039216,
         0.50980392, 0.71764706, 0.99215686, 0.99215686, 0.81176471,
         0.00784314, 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        ],
        [0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.15294118, 0.58039216, 0.89803922,
         0.99215686, 0.99215686, 0.99215686, 0.98039216, 0.71372549,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        ],
        [0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.09411765, 0.44705882, 0.86666667, 0.99215686, 0.99215686,
         0.99215686, 0.99215686, 0.78823529, 0.30588235, 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        ],
        [0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.09019608, 0.25882353,
         0.83529412, 0.99215686, 0.99215686, 0.99215686, 0.99215686,
         0.77647059, 0.31764706, 0.00784314, 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        ],
        [0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.07058824, 0.67058824, 0.85882353, 0.99215686,
         0.99215686, 0.99215686, 0.99215686, 0.76470588, 0.31372549,
         0.03529412, 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        ],
        [0.        , 0.        , 0.        , 0.        , 0.21568627,
         0.6745098 , 0.88627451, 0.99215686, 0.99215686, 0.99215686,
         0.99215686, 0.95686275, 0.52156863, 0.04313725, 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        ],
        [0.        , 0.        , 0.        , 0.        , 0.53333333,
         0.99215686, 0.99215686, 0.99215686, 0.83137255, 0.52941176,
         0.51764706, 0.0627451 , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        , 0.        , 0.        ,
         0.        , 0.        , 0.        ],
```

```
          [0.        , 0.        , 0.        , 0.        , 0.        ,
           0.        , 0.        , 0.        , 0.        , 0.        ,
           0.        , 0.        , 0.        , 0.        , 0.        ,
           0.        , 0.        , 0.        , 0.        , 0.        ,
           0.        , 0.        , 0.        , 0.        , 0.        ,
           0.        , 0.        , 0.        ],
          [0.        , 0.        , 0.        , 0.        , 0.        ,
           0.        , 0.        , 0.        , 0.        , 0.        ,
           0.        , 0.        , 0.        , 0.        , 0.        ,
           0.        , 0.        , 0.        , 0.        , 0.        ,
           0.        , 0.        , 0.        ],
          [0.        , 0.        , 0.        , 0.        , 0.        ,
           0.        , 0.        , 0.        , 0.        , 0.        ,
           0.        , 0.        , 0.        , 0.        , 0.        ,
           0.        , 0.        , 0.        , 0.        , 0.        ,
           0.        , 0.        , 0.        , 0.        , 0.        ,
           0.        , 0.        , 0.        ]])
```

In [11]:
```python
model=keras.Sequential([
    keras.layers.Flatten(input_shape=(28,28)),
    keras.layers.Dense(128,activation='relu'),
    keras.layers.Dense(10,activation='softmax')
])
```

In [12]:
```python
model.summary()
```

```
Model: "sequential"

_____
 Layer (type)                Output Shape              Param #
=================================================================
 flatten (Flatten)           (None, 784)               0

 dense (Dense)               (None, 128)               100480

 dense_1 (Dense)             (None, 10)                1290

=================================================================
Total params: 101770 (397.54 KB)
Trainable params: 101770 (397.54 KB)
Non-trainable params: 0 (0.00 Byte)
_____
```

In [13]:
```python
model.compile(optimizer='sgd',
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])
```

In [14]:
```python
n=random.randint(0,9999)
plt.imshow(x_test[n])
plt.show
```

Out[14]: <function matplotlib.pyplot.show(close=None, block=None)>
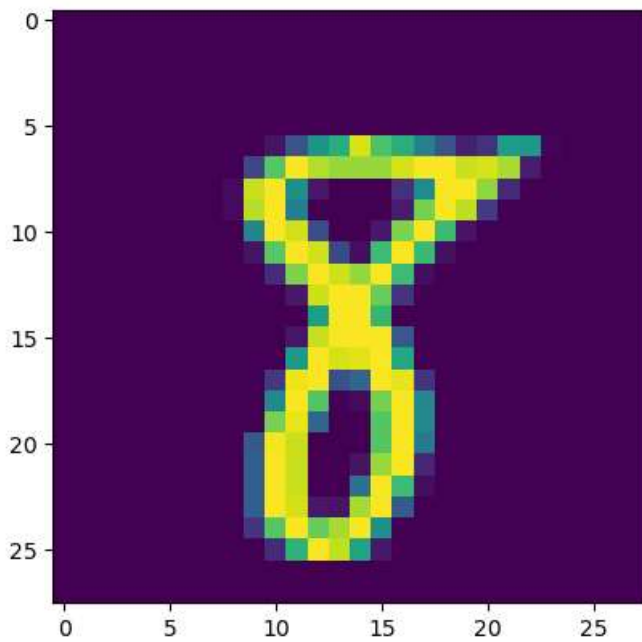
In [15]:
```
test_predict=model.predict(x_test)
test_predict_labels=np.argmax(test_predict,axis=1)
confusion_matrix=tf.math.confusion_matrix(labels=y_test,predictions=test_predict_labels)
print('confusion matrix of the test set :\n', confusion_matrix)
```

```
313/313 [==============================] - 2s 4ms/step
confusion matrix of the test set :
 tf.Tensor(
[[  0   0   1 144 480   2  82   6 172  93]
 [  0   5   3  11 344   0   2  49 506 215]
 [  0   5   2  60 384  21  37  64 245 214]
 [  0   0   2  14 423   3   4 135 366  63]
 [  0   0   0  67 629  11  14   6 130 125]
 [  0   1   0   8 435   0  47  53 282  66]
 [  0   0   0  13 633  14   7   9  76 206]
 [  0   0  19  43 605  10  49   7 238  57]
 [  0   1   0  32 356   0   1  46 471  67]
 [  0   0   7  52 803   3   7  16  53  68]], shape=(10, 10), dtype=int32)
```

In [ ]: