In [38]:
```
pip install keras
```

```
Requirement already satisfied: keras in d:\anaconda\lib\site-packages (2.8.0)N
ote: you may need to restart the kernel to use updated packages.

WARNING: You are using pip version 22.0.3; however, version 22.0.4 is availabl
e.
You should consider upgrading via the 'D:\Anaconda\python.exe -m pip install
--upgrade pip' command.
```

In [39]:
```
pip install tensorflow
```

```
Requirement already satisfied: tensorflow in d:\anaconda\lib\site-packages (2.
8.0)
Requirement already satisfied: typing-extensions>=3.6.6 in d:\anaconda\lib\sit
e-packages (from tensorflow) (3.7.4.3)
Requirement already satisfied: tf-estimator-nightly==2.8.0.dev2021122109 in
d:\anaconda\lib\site-packages (from tensorflow) (2.8.0.dev2021122109)
Requirement already satisfied: gast>=0.2.1 in d:\anaconda\lib\site-packages (f
rom tensorflow) (0.5.3)
Requirement already satisfied: setuptools in d:\anaconda\lib\site-packages (fr
om tensorflow) (60.8.2)
Requirement already satisfied: google-pasta>=0.1.1 in d:\anaconda\lib\site-pac
kages (from tensorflow) (0.2.0)
Requirement already satisfied: flatbuffers>=1.12 in d:\anaconda\lib\site-packa
ges (from tensorflow) (2.0)
Requirement already satisfied: six>=1.12.0 in d:\anaconda\lib\site-packages (f
rom tensorflow) (1.15.0)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in d:\anaconda\lib\site-pac
kages (from tensorflow) (1.44.0)
Requirement already satisfied: h5py>=2.9.0 in d:\anaconda\lib\site-packages (f
rom tensorflow) (2.10.0)
Requirement already satisfied: protobuf>=3.9.2 in d:\anaconda\lib\site-package
s (from tensorflow) (3.11.2)
Requirement already satisfied: termcolor>=1.1.0 in d:\anaconda\lib\site-packag
es (from tensorflow) (1.1.0)
Requirement already satisfied: opt-einsum>=2.3.2 in d:\anaconda\lib\site-packa
ges (from tensorflow) (3.3.0)
Requirement already satisfied: absl-py>=0.4.0 in d:\anaconda\lib\site-packages
(from tensorflow) (1.0.0)
Requirement already satisfied: numpy>=1.20 in d:\anaconda\lib\site-packages (f
rom tensorflow) (1.21.5)
Requirement already satisfied: libclang>=9.0.1 in d:\anaconda\lib\site-package
s (from tensorflow) (13.0.0)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in d:\anac
onda\lib\site-packages (from tensorflow) (0.24.0)
Requirement already satisfied: keras-preprocessing>=1.1.1 in d:\anaconda\lib\s
ite-packages (from tensorflow) (1.1.2)
Requirement already satisfied: keras<2.9,>=2.8.0rc0 in d:\anaconda\lib\site-pa
ckages (from tensorflow) (2.8.0)
Requirement already satisfied: wrapt>=1.11.0 in d:\anaconda\lib\site-packages
(from tensorflow) (1.12.1)
Requirement already satisfied: tensorboard<2.9,>=2.8 in d:\anaconda\lib\site-p
ackages (from tensorflow) (2.8.0)
Requirement already satisfied: astunparse>=1.6.0 in d:\anaconda\lib\site-packa
ges (from tensorflow) (1.6.3)
Requirement already satisfied: wheel<1.0,>=0.23.0 in d:\anaconda\lib\site-pack
ages (from astunparse>=1.6.0->tensorflow) (0.37.1)
Requirement already satisfied: markdown>=2.6.8 in d:\anaconda\lib\site-package
s (from tensorboard<2.9,>=2.8->tensorflow) (3.3.6)
Requirement already satisfied: werkzeug>=0.11.15 in d:\anaconda\lib\site-packa
```

```
ges (from tensorboard<2.9,>=2.8->tensorflow) (1.0.1)
Requirement already satisfied: requests<3,>=2.21.0 in d:\anaconda\lib\site-pac
kages (from tensorboard<2.9,>=2.8->tensorflow) (2.25.1)
Requirement already satisfied: google-auth<3,>=1.6.3 in d:\anaconda\lib\site-p
ackages (from tensorboard<2.9,>=2.8->tensorflow) (2.6.2)
Requirement already satisfied: tensorboard-data-server<0.7.0,>=0.6.0 in d:\ana
conda\lib\site-packages (from tensorboard<2.9,>=2.8->tensorflow) (0.6.1)
Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in d:\anaconda\li
b\site-packages (from tensorboard<2.9,>=2.8->tensorflow) (1.8.1)
Requirement already satisfied: google-auth-oauthlib<0.5,>=0.4.1 in d:\anacond
a\lib\site-packages (from tensorboard<2.9,>=2.8->tensorflow) (0.4.6)
Requirement already satisfied: pyasn1-modules>=0.2.1 in d:\anaconda\lib\site-p
ackages (from google-auth<3,>=1.6.3->tensorboard<2.9,>=2.8->tensorflow) (0.2.
8)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in d:\anaconda\lib\site-
packages (from google-auth<3,>=1.6.3->tensorboard<2.9,>=2.8->tensorflow) (5.0.
0)
Requirement already satisfied: rsa<5,>=3.1.4 in d:\anaconda\lib\site-packages
(from google-auth<3,>=1.6.3->tensorboard<2.9,>=2.8->tensorflow) (4.8)
Requirement already satisfied: requests-oauthlib>=0.7.0 in d:\anaconda\lib\sit
e-packages (from google-auth-oauthlib<0.5,>=0.4.1->tensorboard<2.9,>=2.8->tens
orflow) (1.3.1)
Requirement already satisfied: importlib-metadata>=4.4 in d:\anaconda\lib\site
-packages (from markdown>=2.6.8->tensorboard<2.9,>=2.8->tensorflow) (4.11.3)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in d:\anaconda\lib\site-p
ackages (from requests<3,>=2.21.0->tensorboard<2.9,>=2.8->tensorflow) (1.26.4)
Requirement already satisfied: idna<3,>=2.5 in d:\anaconda\lib\site-packages
(from requests<3,>=2.21.0->tensorboard<2.9,>=2.8->tensorflow) (2.10)
Requirement already satisfied: certifi>=2017.4.17 in d:\anaconda\lib\site-pack
ages (from requests<3,>=2.21.0->tensorboard<2.9,>=2.8->tensorflow) (2020.12.5)
Requirement already satisfied: chardet<5,>=3.0.2 in d:\anaconda\lib\site-packa
ges (from requests<3,>=2.21.0->tensorboard<2.9,>=2.8->tensorflow) (4.0.0)
Requirement already satisfied: zipp>=0.5 in d:\anaconda\lib\site-packages (fro
m importlib-metadata>=4.4->markdown>=2.6.8->tensorboard<2.9,>=2.8->tensorflow)
(3.4.1)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in d:\anaconda\lib\site-pa
ckages (from pyasn1-modules>=0.2.1->google-auth<3,>=1.6.3->tensorboard<2.9,>=
2.8->tensorflow) (0.4.8)
Requirement already satisfied: oauthlib>=3.0.0 in d:\anaconda\lib\site-package
s (from requests-oauthlib>=0.7.0->google-auth-oauthlib<0.5,>=0.4.1->tensorboar
d<2.9,>=2.8->tensorflow) (3.2.0)
WARNING: You are using pip version 22.0.3; however, version 22.0.4 is availabl
e.
You should consider upgrading via the 'D:\Anaconda\python.exe -m pip install
--upgrade pip' command.
```

In [40]:

```
pip install StandardScaler
```

```
Requirement already satisfied: StandardScaler in d:\anaconda\lib\site-packages
(0.5)
Requirement already satisfied: dask in d:\anaconda\lib\site-packages (from Sta
ndardScaler) (2021.4.0)
Requirement already satisfied: scikit-learn in d:\anaconda\lib\site-packages
(from StandardScaler) (1.0.2)
Requirement already satisfied: numpy in d:\anaconda\lib\site-packages (from St
andardScaler) (1.21.5)
Requirement already satisfied: pandas in d:\anaconda\lib\site-packages (from S
tandardScaler) (1.2.4)
Requirement already satisfied: scikit-elm in d:\anaconda\lib\site-packages (fr
om StandardScaler) (0.21a0)
Requirement already satisfied: cloudpickle>=1.1.1 in d:\anaconda\lib\site-pack
ages (from dask->StandardScaler) (1.6.0)
Requirement already satisfied: partd>=0.3.10 in d:\anaconda\lib\site-packages
```

```
(from dask->StandardScaler) (1.2.0)
Requirement already satisfied: toolz>=0.8.2 in d:\anaconda\lib\site-packages
(from dask->StandardScaler) (0.11.1)
Requirement already satisfied: fsspec>=0.6.0 in d:\anaconda\lib\site-packages
(from dask->StandardScaler) (0.9.0)
Requirement already satisfied: pyyaml in d:\anaconda\lib\site-packages (from d
ask->StandardScaler) (5.4.1)
Requirement already satisfied: pytz>=2017.3 in d:\anaconda\lib\site-packages
(from pandas->StandardScaler) (2021.1)
Requirement already satisfied: python-dateutil>=2.7.3 in d:\anaconda\lib\site-
packages (from pandas->StandardScaler) (2.8.1)
Requirement already satisfied: scipy in d:\anaconda\lib\site-packages (from sc
ikit-elm->StandardScaler) (1.6.2)
Requirement already satisfied: joblib>=0.11 in d:\anaconda\lib\site-packages
(from scikit-learn->StandardScaler) (1.0.1)
Requirement already satisfied: threadpoolctl>=2.0.0 in d:\anaconda\lib\site-pa
ckages (from scikit-learn->StandardScaler) (2.1.0)
Requirement already satisfied: locket in d:\anaconda\lib\site-packages\locket-
0.2.1-py3.8.egg (from partd>=0.3.10->dask->StandardScaler) (0.2.1)
Requirement already satisfied: six>=1.5 in d:\anaconda\lib\site-packages (from
python-dateutil>=2.7.3->pandas->StandardScaler) (1.15.0)

WARNING: You are using pip version 22.0.3; however, version 22.0.4 is availabl
e.
You should consider upgrading via the 'D:\Anaconda\python.exe -m pip install
--upgrade pip' command.
```

In [1]:

```
### import libraries
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.svm import SVC
```

In [2]:

```
### reading train dataset
mnist_train=pd.read_csv("C:\\Users\\Lenovo\\OneDrive\\Desktop\\train.csv")
mnist_train
```

Out[2]:

	label	pixel0	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	pixel8	...	pixel774	pixel
0	1	0	0	0	0	0	0	0	0	0	...	0	
1	0	0	0	0	0	0	0	0	0	0	...	0	
2	1	0	0	0	0	0	0	0	0	0	...	0	
3	4	0	0	0	0	0	0	0	0	0	...	0	
4	0	0	0	0	0	0	0	0	0	0	...	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	
41995	0	0	0	0	0	0	0	0	0	0	...	0	
41996	1	0	0	0	0	0	0	0	0	0	...	0	
41997	7	0	0	0	0	0	0	0	0	0	...	0	
41998	6	0	0	0	0	0	0	0	0	0	...	0	

	label	pixel0	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	pixel8	...	pixel774	pixel
41999	9	0	0	0	0	0	0	0	0	0	...	0	

In [3]:
```
### reading test dataset
mnist_test=pd.read_csv("C:\\Users\\Lenovo\\OneDrive\\Desktop\\test.csv")
mnist_test
```

Out[3]:

	pixel0	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	pixel8	pixel9	...	pixel774	pixe
0	0	0	0	0	0	0	0	0	0	0	...	0	
1	0	0	0	0	0	0	0	0	0	0	...	0	
2	0	0	0	0	0	0	0	0	0	0	...	0	
3	0	0	0	0	0	0	0	0	0	0	...	0	
4	0	0	0	0	0	0	0	0	0	0	...	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	
27995	0	0	0	0	0	0	0	0	0	0	...	0	
27996	0	0	0	0	0	0	0	0	0	0	...	0	
27997	0	0	0	0	0	0	0	0	0	0	...	0	
27998	0	0	0	0	0	0	0	0	0	0	...	0	
27999	0	0	0	0	0	0	0	0	0	0	...	0	

28000 rows × 784 columns

In [4]:
```
### print the dimension or shape of test data
mnist_test.shape
```

Out[4]: (28000, 784)

In [5]:
```
### print the dimension or shape of train data
mnist_train.shape
```

Out[5]: (42000, 785)

In [6]:
```
mnist_train.head()
```

Out[6]:

	label	pixel0	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	pixel8	...	pixel774	pixel775
0	1	0	0	0	0	0	0	0	0	0	...	0	0
1	0	0	0	0	0	0	0	0	0	0	...	0	0
2	1	0	0	0	0	0	0	0	0	0	...	0	0
3	4	0	0	0	0	0	0	0	0	0	...	0	0

	label	pixel0	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	pixel8	...	pixel774	pixel775
4	0	0	0	0	0	0	0	0	0	0	...	0	0

In [7]:
```
mnist_test.head()
```

Out[7]:

	pixel0	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	pixel8	pixel9	...	pixel774	pixel775
0	0	0	0	0	0	0	0	0	0	0	...	0	0
1	0	0	0	0	0	0	0	0	0	0	...	0	0
2	0	0	0	0	0	0	0	0	0	0	...	0	0
3	0	0	0	0	0	0	0	0	0	0	...	0	0
4	0	0	0	0	0	0	0	0	0	0	...	0	0

5 rows × 784 columns

In [8]:
```
### there are no missing values in the dataset
mnist_train.isnull().sum()
```

Out[8]:
```
label       0
pixel0      0
pixel1      0
pixel2      0
pixel3      0
           ..
pixel779    0
pixel780    0
pixel781    0
pixel782    0
pixel783    0
Length: 785, dtype: int64
```

In [9]:
```
mnist_test.isnull().sum()
```

Out[9]:
```
pixel0      0
pixel1      0
pixel2      0
pixel3      0
pixel4      0
           ..
pixel779    0
pixel780    0
pixel781    0
pixel782    0
pixel783    0
Length: 784, dtype: int64
```

In [10]:
```
mnist_train.describe()
```

Out[10]:

	label	pixel0	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	pixel8
count	42000.000000	42000.0	42000.0	42000.0	42000.0	42000.0	42000.0	42000.0	42000.0	42000.0

	label	pixel0	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	pixel8
mean	4.456643	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
std	2.887730	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
min	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25%	2.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50%	4.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75%	7.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
max	9.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

In [11]:
```
mnist_test.describe()
```

Out[11]:

	pixel0	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	pixel8	pixel9	...	
count	28000.0	28000.0	28000.0	28000.0	28000.0	28000.0	28000.0	28000.0	28000.0	28000.0	...	28
mean	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	
std	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	
min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	
25%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	
50%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	
75%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	
max	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	

8 rows × 784 columns

In [12]:
```
### dimensions, shape
print("Dimensions: ",mnist_train.shape,"\n")
print(mnist_train.info())
```

```
Dimensions:  (42000, 785)

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 42000 entries, 0 to 41999
Columns: 785 entries, label to pixel783
dtypes: int64(785)
memory usage: 251.5 MB
None
```

In [13]:
```
print("Dimensions: ",mnist_test.shape,"\n")
print(mnist_test.info())
```

```
Dimensions:  (28000, 784)

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 28000 entries, 0 to 27999
Columns: 784 entries, pixel0 to pixel783
dtypes: int64(784)
```

```
memory usage: 167.5 MB
None
```

In [14]:

```
print(mnist_train.columns)
print(mnist_test.columns)
```

```
Index(['label', 'pixel0', 'pixel1', 'pixel2', 'pixel3', 'pixel4', 'pixel5',
       'pixel6', 'pixel7', 'pixel8',
       ...
       'pixel774', 'pixel775', 'pixel776', 'pixel777', 'pixel778', 'pixel779',
       'pixel780', 'pixel781', 'pixel782', 'pixel783'],
      dtype='object', length=785)
Index(['pixel0', 'pixel1', 'pixel2', 'pixel3', 'pixel4', 'pixel5', 'pixel6',
       'pixel7', 'pixel8', 'pixel9',
       ...
       'pixel774', 'pixel775', 'pixel776', 'pixel777', 'pixel778', 'pixel779',
       'pixel780', 'pixel781', 'pixel782', 'pixel783'],
      dtype='object', length=784)
```

In [15]:

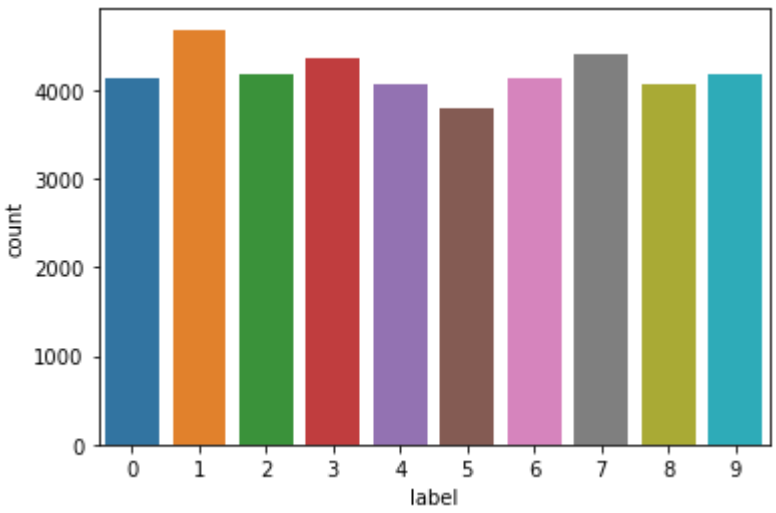
```
order=list(np.sort(mnist_train['label'].unique()))
print(order)
```

```
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```

In [16]:

```
### Visualizing the number of class and counts in the datasets
sns.countplot(mnist_train['label'])
plt.show()
```

```
D:\Anaconda\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass t
he following variable as a keyword arg: x. From version 0.12, the only valid p
ositional argument will be `data`, and passing other arguments without an expl
icit keyword will result in an error or misinterpretation.
  warnings.warn(
```



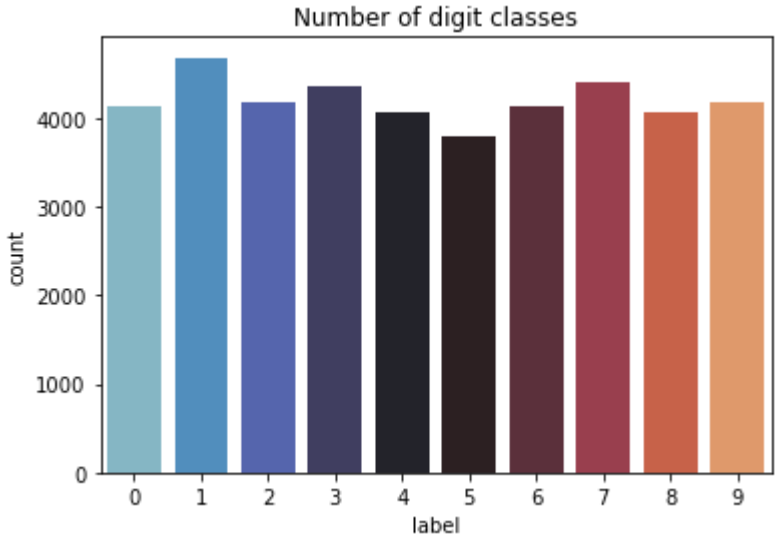
In [17]:

```
### Visualizing the number of class and counts in the datasets
plt.plot(figure=(15,9))
g=sns.countplot(mnist_train["label"],palette='icefire')
plt.title("Number of digit classes")
mnist_train.label.astype("category").value_counts()
```

```
D:\Anaconda\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass t
he following variable as a keyword arg: x. From version 0.12, the only valid p
```

```
ositional argument will be `data`, and passing other arguments without an expl
icit keyword will result in an error or misinterpretation.
  warnings.warn(
```

Out[17]:
```
1    4684
7    4401
3    4351
9    4188
2    4177
6    4137
0    4132
4    4072
8    4063
5    3795
Name: label, dtype: int64
```



In [18]:
```
# average feature values
round(mnist_train.drop('label', axis=1).mean(), 2)
```

Out[18]:
```
pixel0      0.0
pixel1      0.0
pixel2      0.0
pixel3      0.0
pixel4      0.0
           ...
pixel779    0.0
pixel780    0.0
pixel781    0.0
pixel782    0.0
pixel783    0.0
Length: 784, dtype: float64
```

In [19]:
```
### seperating x and y variables

y=mnist_train['label']
y
```

Out[19]:
```
0        1
1        0
2        1
3        4
4        0
       ..
```

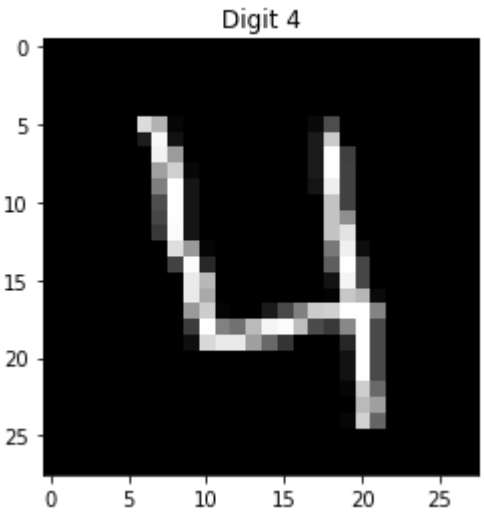
```
41995    0
41996    1
41997    7
41998    6
41999    9
```

In [36]:

```
### Plotting some samples as well as converting into matrix

four=mnist_train.iloc[3,1:]
four.shape
four=four.values.reshape(28,28)
plt.imshow(four,cmap="gray")
plt.title("Digit 4")
```

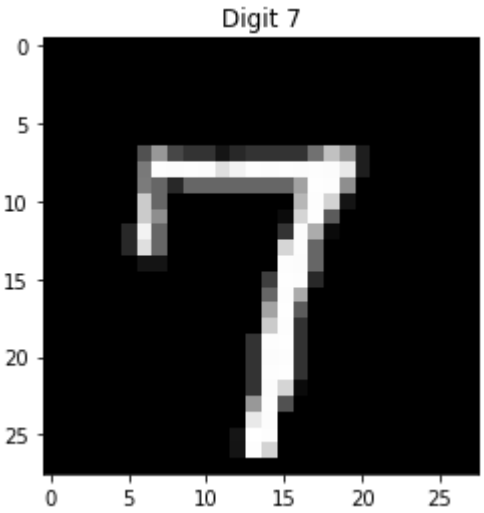
Out[36]: Text(0.5, 1.0, 'Digit 4')



In [37]:

```
seven=mnist_train.iloc[6,1:]
seven.shape
seven=seven.values.reshape(28,28)
plt.imshow(seven,cmap="gray")
plt.title("Digit 7")
```

Out[37]: Text(0.5, 1.0, 'Digit 7')



In [20]:
```
### dropping the variable 'label' from x variable

x=mnist_train.drop(columns='label')
x
```

Out[20]:

	pixel0	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	pixel8	pixel9	...	pixel774	pix
0	0	0	0	0	0	0	0	0	0	0	...	0	
1	0	0	0	0	0	0	0	0	0	0	...	0	
2	0	0	0	0	0	0	0	0	0	0	...	0	
3	0	0	0	0	0	0	0	0	0	0	...	0	
4	0	0	0	0	0	0	0	0	0	0	...	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	
41995	0	0	0	0	0	0	0	0	0	0	...	0	
41996	0	0	0	0	0	0	0	0	0	0	...	0	
41997	0	0	0	0	0	0	0	0	0	0	...	0	
41998	0	0	0	0	0	0	0	0	0	0	...	0	
41999	0	0	0	0	0	0	0	0	0	0	...	0	

42000 rows × 784 columns

In [21]:
```
print(mnist_train.shape)
```

```
(42000, 785)
```

In [22]:
```
### Normalization

x=x/2255.0
mnist_test=mnist_test/255.0

print("x",x.shape)
print("mnist_test: ",mnist_test.shape)
```

```
x (42000, 784)
mnist_test:  (28000, 784)
```

In [23]:
```
### scaling the features

from sklearn.preprocessing import scale
x_scaled=scale(x)
x_scaled
```

Out[23]:
```
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.],
```

In [24]:
```
### train test split

x_train,x_test,y_train,y_test=train_test_split(x_scaled,y,test_size=0.3,train_
```

In [25]:
```
x_train
```

Out[25]:
```
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.]])
```

In [26]:
```
x_test
```

Out[26]:
```
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.]])
```

In [27]:
```
y_train
```

Out[27]:
```
2281     7
15412    9
24728    1
5353     4
21766    3
        ..
38531    7
13378    3
23855    0
38206    3
25157    1
Name: label, Length: 8400, dtype: int64
```

In [28]:
```
y_test
```

Out[28]:
```
27084    7
18640    3
41477    9
39744    8
28354    6
        ..
36651    7
23060    9
10399    1
10740    0
25674    1
Name: label, Length: 12600, dtype: int64
```

In [29]:
```
pip install SVM
```

```
Requirement already satisfied: SVM in d:\anaconda\lib\site-packages (0.1.0)
Requirement already satisfied: xmltodict in d:\anaconda\lib\site-packages (fro
m SVM) (0.12.0)
Requirement already satisfied: colorama in d:\anaconda\lib\site-packages (from
SVM) (0.4.4)
Requirement already satisfied: requests in d:\anaconda\lib\site-packages (from
SVM) (2.25.1)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in d:\anaconda\lib\site-p
ackages (from requests->SVM) (1.26.4)
Requirement already satisfied: idna<3,>=2.5 in d:\anaconda\lib\site-packages
(from requests->SVM) (2.10)
Requirement already satisfied: chardet<5,>=3.0.2 in d:\anaconda\lib\site-packa
ges (from requests->SVM) (4.0.0)
Note: you may need to restart the kernel to use updated packages.
WARNING: You are using pip version 22.0.3; however, version 22.0.4 is availabl
e.
You should consider upgrading via the 'D:\Anaconda\python.exe -m pip install
--upgrade pip' command.
Requirement already satisfied: certifi>=2017.4.17 in d:\anaconda\lib\site-pack
ages (from requests->SVM) (2020.12.5)
```

In [30]:
```
model_linear=SVC(kernel='linear')
model_linear.fit(x_train,y_train)
#y_pred=model_linear.predict(x_test)
```

Out[30]:
```
SVC(kernel='linear')
```

In [31]:
```
y_pred=model_linear.predict(x_test)
y_pred
```

Out[31]:
```
array([7, 3, 9, ..., 1, 0, 1], dtype=int64)
```

In [32]:
```
# confusion matrix and accuracy

from sklearn import metrics
from sklearn.metrics import confusion_matrix
# accuracy
print("accuracy:", metrics.accuracy_score(y_true=y_test, y_pred=y_pred), "\n")

# cm
print(metrics.confusion_matrix(y_true=y_test, y_pred=y_pred))
```

```
accuracy: 0.9133333333333333

[[1160    0    0    1    6    6   12    1    1    1]
 [   0 1389    3    4    3    0    0    2   12    0]
 [   9   11 1146   38   11    4   10   12   17    2]
 [   5    4   35 1204    0   51    2    3   21    6]
 [   3    3   20    3 1132    1   10    4    2   40]
 [   9   17   10   67    7  997   14    2   19    7]
 [  15    2   15    0    9   15 1160    1    2    0]
 [   5   12   18    9   26    2    1 1212    3   42]
 [   8   31   24   45    8   61    9   14 1002   15]
 [   9    6    7   28   56    3    0   53    7 1106]]
```