

Deep Learning with Tensorflow and Keras

August 5, 2019

```
[1]: import tensorflow as tf
```

```
tf.__version__
```

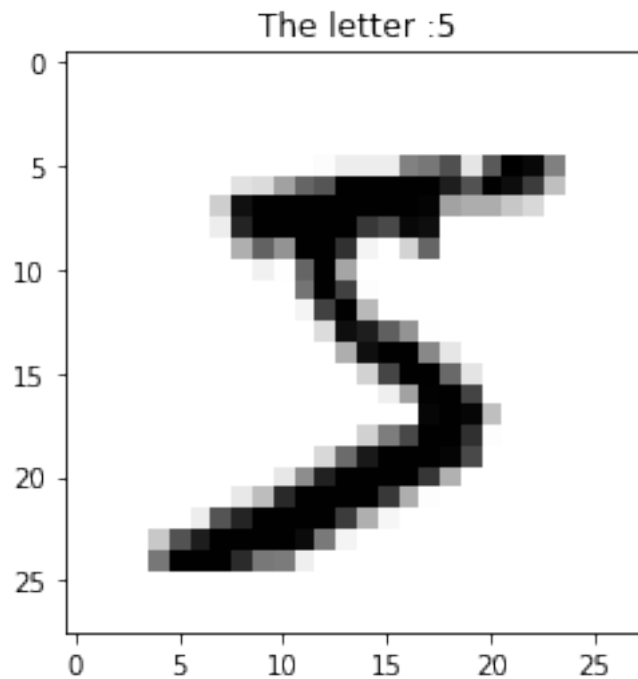
```
[1]: '1.10.0'
```

```
[31]: mnist = tf.keras.datasets.mnist
```

```
(x_train, y_train), (x_test, y_test) = mnist.load_data()
```

```
[16]: import matplotlib.pyplot as plt
```

```
plt.imshow(x_train[0], cmap=plt.cm.binary)  
plt.title('The letter : ' + str(y_train[0]))  
plt.show()
```



```
[37]: import numpy as np
print(type(x_test))
print(np.shape(x_train))
print(np.shape(y_train))
print(np.shape(x_test))
print(np.shape(y_test))
x_train[0, 20:24, ]
```

```
<class 'numpy.ndarray'>
(60000, 28, 28)
(60000,)
(10000, 28, 28)
(10000,)
```

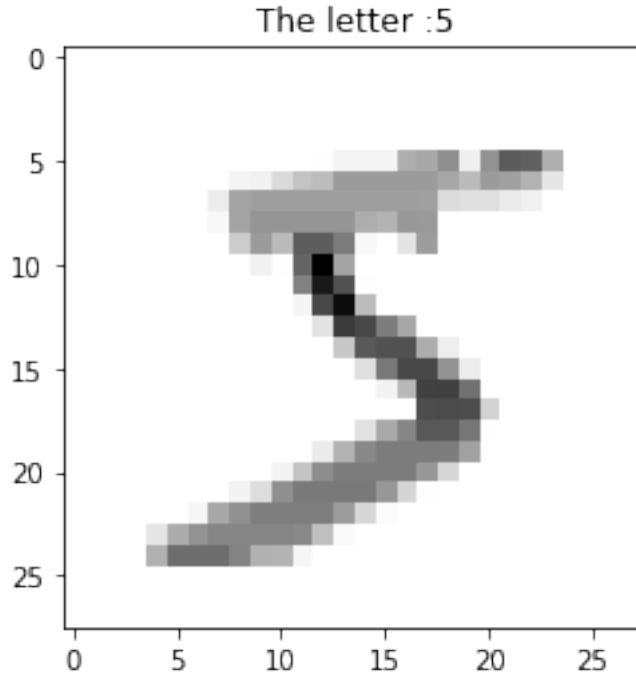
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[37]: array([[0.          , 0.          , 0.          , 0.          , 0.          ,
0.          , 0.          , 0.          , 0.          , 0.          ,
0.04117838, 0.16813739, 0.28960162, 0.32790981, 0.36833534,
0.3689874 , 0.34978968, 0.25961929, 0.12760592, 0.          ,
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0.36545809, 0.37314701, 0.33153488, 0.32790981, 0.36833534,
0.28877275, 0.111988 , 0.00258328, 0.          , 0.          ,
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```
[34]: x_train = tf.keras.utils.normalize(x_train, axis=1)
x_test = tf.keras.utils.normalize(x_test, axis=1)

x_train[0, 20:24, ]
y_train
```

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

```
[24]: plt.imshow(x_train[0], cmap=plt.cm.binary)
plt.title('The letter : ' + str(y_train[0]))
plt.show()
```



```
[39]: model = tf.keras.models.Sequential()
model.add(tf.keras.layers.Flatten())
model.add(tf.keras.layers.Dense(128, activation=tf.nn.relu))
model.add(tf.keras.layers.Dense(128, activation=tf.nn.relu))
model.add(tf.keras.layers.Dense(10, activation=tf.nn.softmax))
model.compile(optimizer='adam', loss='sparse_categorical_crossentropy',
↳metrics=['accuracy'])
model.fit(x_train, y_train, epochs=3)
```

```
Epoch 1/3
60000/60000 [=====] - 10s 174us/step - loss: 0.2640 -
acc: 0.9223
Epoch 2/3
60000/60000 [=====] - 7s 113us/step - loss: 0.1070 -
acc: 0.9672
Epoch 3/3
60000/60000 [=====] - 7s 110us/step - loss: 0.0738 -
acc: 0.9766
```

```
[39]: <tensorflow.python.keras.callbacks.History at 0x1f9086f6ba8>
```

```
[40]: val_loss, val_acc = model.evaluate(x_test, y_test)
      print(val_loss, val_acc)
```

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10000/10000 [=====] - 0s 46us/step
0.09595072400867939 0.9694
```

```
[42]: model.save('basic_1')

      new_model = tf.keras.models.load_model('basic_1')
```

```
[43]: val_loss, val_acc = new_model.evaluate(x_test, y_test)
      print(val_loss, val_acc)
```

```
10000/10000 [=====] - 0s 40us/step
0.09595072400867939 0.9694
```

```
[45]: predictions = new_model.predict([x_test])

      fig = plt.figure(figsize=(6, 6))

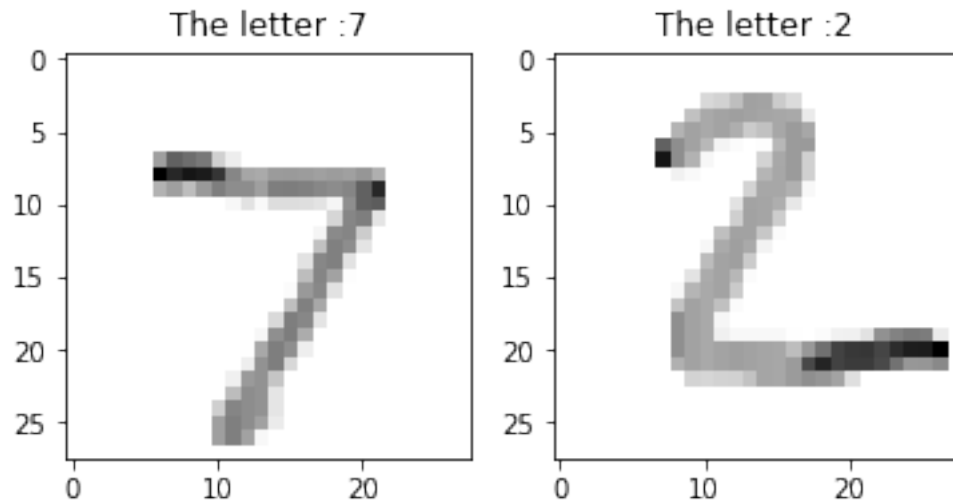
      plt.subplot(1, 2, 1)
      plt.imshow(x_test[0], cmap=plt.cm.binary)
      plt.title('The letter : ' + str(np.argmax(predictions[0])))

      plt.subplot(1, 2, 2)
      plt.imshow(x_test[1], cmap=plt.cm.binary)
      plt.title('The letter : ' + str(np.argmax(predictions[1])))

      # plt.subplot(2, 2, 3)
      # plt.plot(x, y)

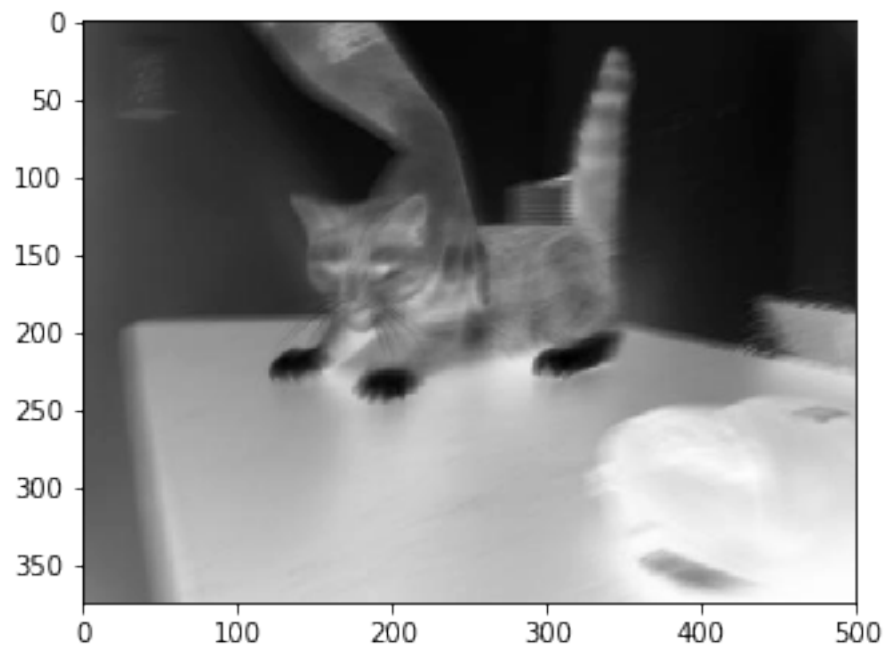
      # plt.subplot(2, 2, 4)
      # plt.plot(x, y)

      plt.show()
```

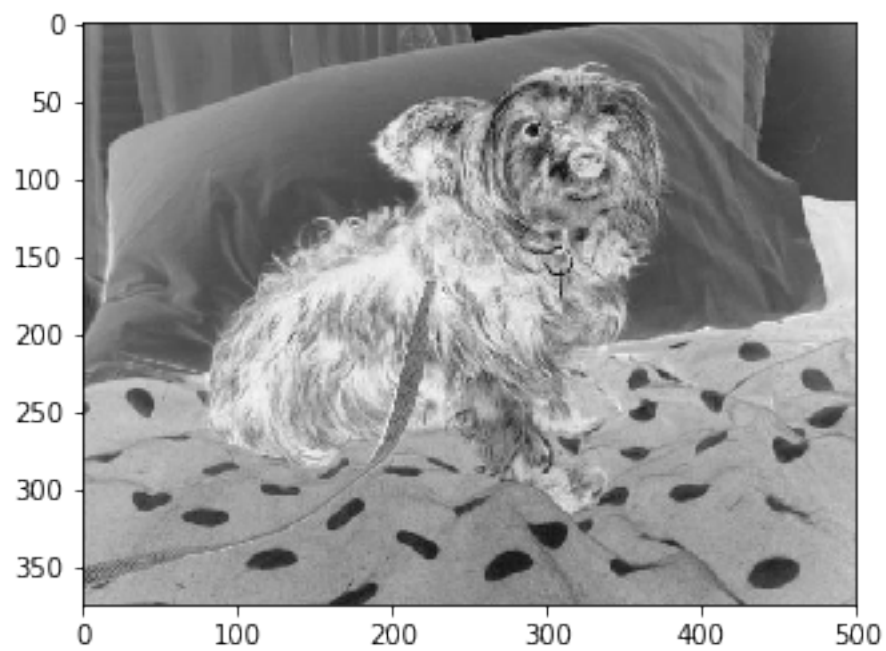


```
[46]: import numpy as np
import os
import matplotlib.pyplot as plt
import cv2

[54]: Dataset_Dir = './Datasets/CatsAndDogs/PetImages'
Categories = ['Cat', 'Dog']
for category in Categories:
    path = os.path.join(Dataset_Dir, category)
    for img_path in os.listdir(path):
        img_location = os.path.join(path, img_path)
        img = cv2.imread(img_location, cv2.IMREAD_GRAYSCALE)
        plt.imshow(img, cmap=plt.cm.binary)
        plt.show()
        print(img_location)
        break
```



./Datasets/CatsAndDogs/PetImages\Cat\0.jpg



./Datasets/CatsAndDogs/PetImages\Dog\0.jpg

```

[59]: dataset_catsanddogs = []

IMG_SIZE = 60

Dataset_Dir = './Datasets/CatsAndDogs/PetImages'
Categories = ['Cat', 'Dog']
for category in Categories:
    path = os.path.join(Dataset_Dir, category)
    for img_path in os.listdir(path):
        img_location = os.path.join(path, img_path)
        try:
            img = cv2.imread(img_location, cv2.IMREAD_GRAYSCALE)
            img = cv2.resize(img, (IMG_SIZE, IMG_SIZE))
            dataset_catsanddogs.append([img, Categories.index(category)])
            print('successfully added')
        except Exception as ex:
            print('Couldnot load')
            print(str(ex))

print(len(dataset_catsanddogs))
print([dataset_catsanddogs[i] for i in range(0, 10)])

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[183, 177, 158, ..., 177, 166, 135],
[163, 145, 145, ..., 180, 173, 161]], dtype=uint8), 0]]

```

```

[63]: import random
random.shuffle(dataset_catsanddogs)

X_LIST = []
Y_LIST = []
for feature, label in dataset_catsanddogs:
    X_LIST.append(feature)
    Y_LIST.append(label)

X_LIST = np.array(X_LIST).reshape(-1, IMG_SIZE, IMG_SIZE, 1)
# print([dataset_catsanddogs[i][1] for i in range(0, 10)])

```

```

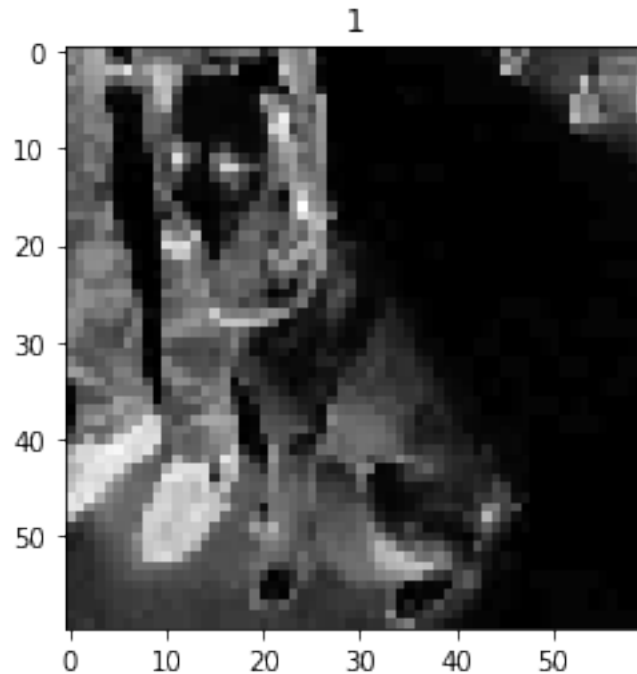
[64]: import shelve
catsdogs_db = shelve.open('catsdogs.db')
catsdogs_db['INITIAL_X'] = X_LIST
catsdogs_db['INITIAL_Y'] = Y_LIST

```

```

[70]: plt.imshow(catsdogs_db['INITIAL_X'][5].reshape(IMG_SIZE, IMG_SIZE), cmap=plt.cm.
        ↪binary)
plt.title(catsdogs_db['INITIAL_Y'][5])
plt.show()

```



```
[74]: from tensorflow.keras.models import Sequential
      from tensorflow.keras.layers import Dense, Dropout, Activation, Flatten,
      →Conv2D, MaxPooling2D

      X = X_LIST / 255
      Y = Y_LIST

      model = Sequential()

      model.add(Conv2D(64, (3, 3), input_shape=X.shape[1:]))
      model.add(Activation("relu"))
      model.add(MaxPooling2D(pool_size=(2, 2)))

      model.add(Conv2D(64, (3, 3)))
      model.add(Activation("relu"))
      model.add(MaxPooling2D(pool_size=(2, 2)))

      model.add(Flatten())
      model.add(Dense(64))

      model.add(Dense(1))
      model.add(Activation("sigmoid"))

      model.compile(loss='binary_crossentropy', optimizer='adam',
      →metrics=['accuracy'])
```

```
model.fit(X, Y, batch_size=32, validation_split=0.1, epochs=10)
```

Train on 22451 samples, validate on 2495 samples

Epoch 1/10

22451/22451 [=====] - 343s 15ms/step - loss: 0.6422 -
acc: 0.6293 - val_loss: 0.6011 - val_acc: 0.6645

Epoch 2/10

22451/22451 [=====] - 317s 14ms/step - loss: 0.4809 -
acc: 0.7710 - val_loss: 0.4912 - val_acc: 0.7627

Epoch 4/10

22451/22451 [=====] - 330s 15ms/step - loss: 0.4480 -
acc: 0.7931 - val_loss: 0.4867 - val_acc: 0.7627

Epoch 5/10

22451/22451 [=====] - 345s 15ms/step - loss: 0.4174 -
acc: 0.8109 - val_loss: 0.4551 - val_acc: 0.7880

Epoch 6/10

22451/22451 [=====] - 330s 15ms/step - loss: 0.3924 -
acc: 0.8251 - val_loss: 0.4200 - val_acc: 0.8100

Epoch 7/10

22451/22451 [=====] - 331s 15ms/step - loss: 0.3674 -
acc: 0.8358 - val_loss: 0.4384 - val_acc: 0.8036

Epoch 8/10

22451/22451 [=====] - 279s 12ms/step - loss: 0.3483 -
acc: 0.8464 - val_loss: 0.4285 - val_acc: 0.8024

Epoch 9/10

22451/22451 [=====] - 277s 12ms/step - loss: 0.3225 -
acc: 0.8580 - val_loss: 0.4551 - val_acc: 0.7956

Epoch 10/10

22451/22451 [=====] - 291s 13ms/step - loss: 0.3003 -
acc: 0.8707 - val_loss: 0.4536 - val_acc: 0.8060

[74]: <tensorflow.python.keras.callbacks.History at 0x1fa0503b7b8>

[75]: `model.save('catsanddogs_model_basic')`