In [1]:

```
!pip install tensorflow
```

```
Collecting tensorflow

ERROR: pip's dependency resolver does not currently take into account all the packag
es that are installed. This behaviour is the source of the following dependency conf
licts.
google-cloud-storage 1.31.0 requires google-auth<2.0dev,>=1.11.0, but you have googl
e-auth 2.17.3 which is incompatible.
google-cloud-core 1.7.1 requires google-auth<2.0dev,>=1.24.0, but you have google-au
th 2.17.3 which is incompatible.
google-api-core 1.25.1 requires google-auth<2.0dev,>=1.21.1, but you have google-aut
h 2.17.3 which is incompatible.

  Using cached tensorflow-2.12.0-cp39-cp39-win_amd64.whl (1.9 kB)
Collecting tensorflow-intel==2.12.0
  Using cached tensorflow_intel-2.12.0-cp39-cp39-win_amd64.whl (272.8 MB)
Collecting termcolor>=1.1.0
  Using cached termcolor-2.3.0-py3-none-any.whl (6.9 kB)
Requirement already satisfied: typing-extensions>=3.6.6 in c:₩users₩wogml₩anaconda3
₩lib₩site-packages (from tensorflow-intel==2.12.0->tensorflow) (4.1.1)
Requirement already satisfied: h5py>=2.9.0 in c:₩users₩wogml₩anaconda3₩lib₩site-pack
```

In [1]:

```
import numpy as np
import tensorflow as tf

from tensorflow.keras.utils import to_categorical

from tensorflow.keras.datasets import cifar10

from tensorflow.keras.models import Sequential

from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten, Dense

from tensorflow.keras.optimizers import Adam

import matplotlib.pyplot as plt
```

In [2]:

```
(x_train, t_train), (x_test, t_test) = cifar10.load_data()

print("x_train : ", np.shape(x_train))
print("t_train : ", np.shape(t_train))
print("x_test : ", np.shape(x_test))
print("t_test : ", np.shape(t_test))
```

```
x_train :  (50000, 32, 32, 3)
t_train :  (50000, 1)
x_test :  (10000, 32, 32, 3)
t_test :  (10000, 1)
```

In [3]:

```
print("x_train 1번째 이미지 shape : ", x_train[0].shape)
x_train[0]
```

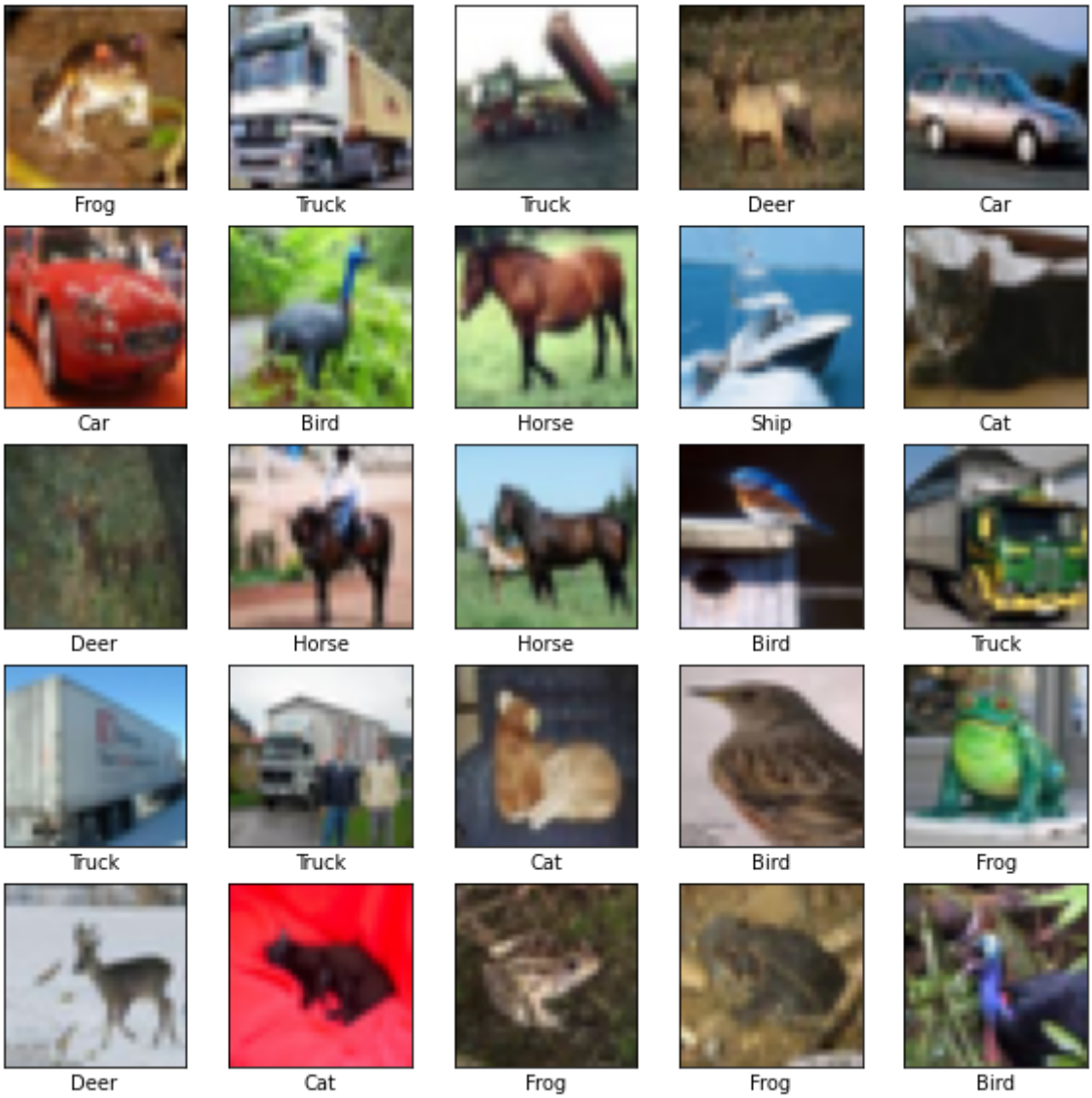
```
x_train 1번째 이미지 shape :  (32, 32, 3)
```

Out[3]:

```
array([[[ 59,  62,  63],
        [ 43,  46,  45],
        [ 50,  48,  43],
        ...,
        [158, 132, 108],
        [152, 125, 102],
        [148, 124, 103]],

       [[ 16,  20,  20],
        [  0,   0,   0],
        [ 18,   8,   0],
        ...,
        [123,  88,  55],
        [119,  83,  50],
        [122,  87,  57]],

       [[ 25,  24,  21],
        [ 16,   7,   0],
        [ 49,  27,   8],
        ...,
        [118,  84,  50],
        [120,  84,  50],
        [109,  73,  42]],

       ...,

       [[208, 170,  96],
        [201, 153,  34],
        [198, 161,  26],
        ...,
        [160, 133,  70],
        [ 56,  31,   7],
        [ 53,  34,  20]],

       [[180, 139,  96],
        [173, 123,  42],
        [186, 144,  30],
        ...,
        [184, 148,  94],
        [ 97,  62,  34],
        [ 83,  53,  34]],

       [[177, 144, 116],
        [168, 129,  94],
        [179, 142,  87],
        ...,
        [216, 184, 140],
        [151, 118,  84],
        [123,  92,  72]]], dtype=uint8)
```

In [4]:

```
label_names = ['Airplane', 'Car', 'Bird', 'Cat', 'Deer', 'Dog', 'Frog', 'Horse', 'Ship', 'Truck']
plt.figure(figsize = (10, 10))

for i in range(25):
    plt.subplot(5, 5, i + 1)
    plt.xticks([])
    plt.yticks([])
    plt.imshow(x_train[i])
    plt.xlabel(label_names[t_train[i][0]])

plt.show()
```

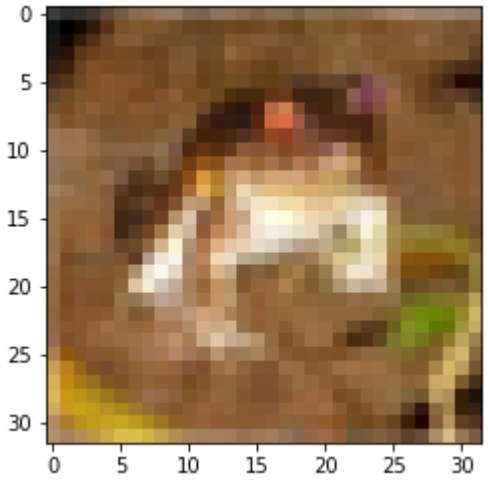


In [5]:

```
image_0 = x_train[0]

plt.xticks([])
plt.yticks([])
plt.imshow(image_0, cmap='gray')

plt.show()
```

In [6]:

```
plt.imshow(x_train[0])
plt.show()
```



In [7]:

```
plt.xticks([])
plt.yticks([])
plt.imshow(x_train[0])
plt.show()
```

In [8]:

```
t_train
```

Out[8]:

```
array([[6],
       [9],
       [9],
       ...,
       [9],
       [1],
       [1]], dtype=uint8)
```

In [9]:

```
for i in range(5):
    print(t_train[i])
```

```
[6]
[9]
[9]
[4]
[1]
```

In [10]:

```
for i in range(5):
    print(t_train[i][0])
```

```
6
9
9
4
1
```

In [11]:

```
x_train = x_train.astype('float32') / 255.0
x_test = x_test.astype('float32') / 255.0

t_train = to_categorical(t_train)
t_test = to_categorical(t_test)

print("One-hoe Vector 적용 후 t_train shape : ", t_train.shape)
print("One-hoe Vector 적용 후 t_test shape : ", t_test.shape)
```

```
One-hoe Vector 적용 후 t_train shape :  (50000, 10)
One-hoe Vector 적용 후 t_test shape :  (10000, 10)
```

In [12]:

```
width = 32
height = 32
channel = 3

model = Sequential(name = 'CIRAR10_CNN')

model.add(Conv2D(filters = 32, kernel_size = (3, 3), padding='same', activation='relu', input_shape

model.add(MaxPooling2D(pool_size=(2, 2)))


model.add(Conv2D(filters = 64, kernel_size = (3, 3), padding='same', activation='relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))

model.add(Conv2D(filters = 128, kernel_size = (3, 3), padding='same', activation='relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))

model.add(Flatten())

model.add(Dense(10, activation='softmax'))
model.compile(loss = 'categorical_crossentropy', optimizer = Adam(learning_rate = 0.001), metrics =
model.summary()
```

```
Model: "CIRAR10_CNN"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 32, 32, 32)        896

 max_pooling2d (MaxPooling2D  (None, 16, 16, 32)       0
 )

 conv2d_1 (Conv2D)           (None, 16, 16, 64)        18496

 max_pooling2d_1 (MaxPooling  (None, 8, 8, 64)         0
 2D)

 conv2d_2 (Conv2D)           (None, 8, 8, 128)         73856

 max_pooling2d_2 (MaxPooling  (None, 4, 4, 128)        0
 2D)

 flatten (Flatten)           (None, 2048)              0

 dense (Dense)               (None, 10)                20490

=================================================================
Total params: 113,738
Trainable params: 113,738
Non-trainable params: 0
_________________________________________________________________
```

In [13]:

```
model.fit(x_train, t_train, epochs = 10, batch_size = 16)
```

```
Epoch 1/10
3125/3125 [==============================] - 79s 25ms/step - loss: 1.3164 - accurac
y: 0.5296
Epoch 2/10
3125/3125 [==============================] - 83s 27ms/step - loss: 0.9167 - accurac
y: 0.6825
Epoch 3/10
3125/3125 [==============================] - 87s 28ms/step - loss: 0.7755 - accurac
y: 0.7301
Epoch 4/10
3125/3125 [==============================] - 88s 28ms/step - loss: 0.6796 - accurac
y: 0.7649
Epoch 5/10
3125/3125 [==============================] - 88s 28ms/step - loss: 0.6057 - accurac
y: 0.7902
Epoch 6/10
3125/3125 [==============================] - 99s 32ms/step - loss: 0.5399 - accurac
y: 0.8116
Epoch 7/10
3125/3125 [==============================] - 94s 30ms/step - loss: 0.4868 - accurac
y: 0.8304
Epoch 8/10
3125/3125 [==============================] - 87s 28ms/step - loss: 0.4357 - accurac
y: 0.8466
Epoch 9/10
3125/3125 [==============================] - 88s 28ms/step - loss: 0.3923 - accurac
y: 0.8597
Epoch 10/10
3125/3125 [==============================] - 89s 29ms/step - loss: 0.3557 - accurac
y: 0.8737
```

Out[13]:

```
<keras.callbacks.History at 0x29648a69eb0>
```

In [14]:

```
width = 32
height = 32
channel = 3

label_names = ['Airplane', 'Car', 'Bird', 'Cat', 'Deer', 'Dog', 'Frog', 'Horse', 'Ship', 'Truck']

for i in range(10):
    plt.figure(figsize = (2, 2))

    output = model.predict(x_test[i].reshape(1, width, height, channel))

    plt.xticks([])
    plt.yticks([])
    plt.imshow(x_test[i].reshape(width, height, channel))

    print("예측 : " + label_names[np.argmax(output)] + '/ 정답 : ' + label_names[np.argmax(t_test[i]
    plt.show()
```

```
1/1 [==============================] - 0s 107ms/step
예측 : Cat/ 정답 : Cat
```

```
1/1 [==============================] - 0s 20ms/step
예측 : Ship/ 정답 : Ship
```

In [15]:

```
loss, accuracy = model.evaluate(x_test, t_test, verbose = 1)

print("test loss : ", round(loss, 6))
print("test accuracy : ", round(accuracy * 100, 3), "%")
```

```
313/313 [==============================] - 5s 16ms/step - loss: 0.9519 - accuracy:
0.7335
test loss :  0.951904
test accuracy :  73.35 %
```

In [ ]:

```

```