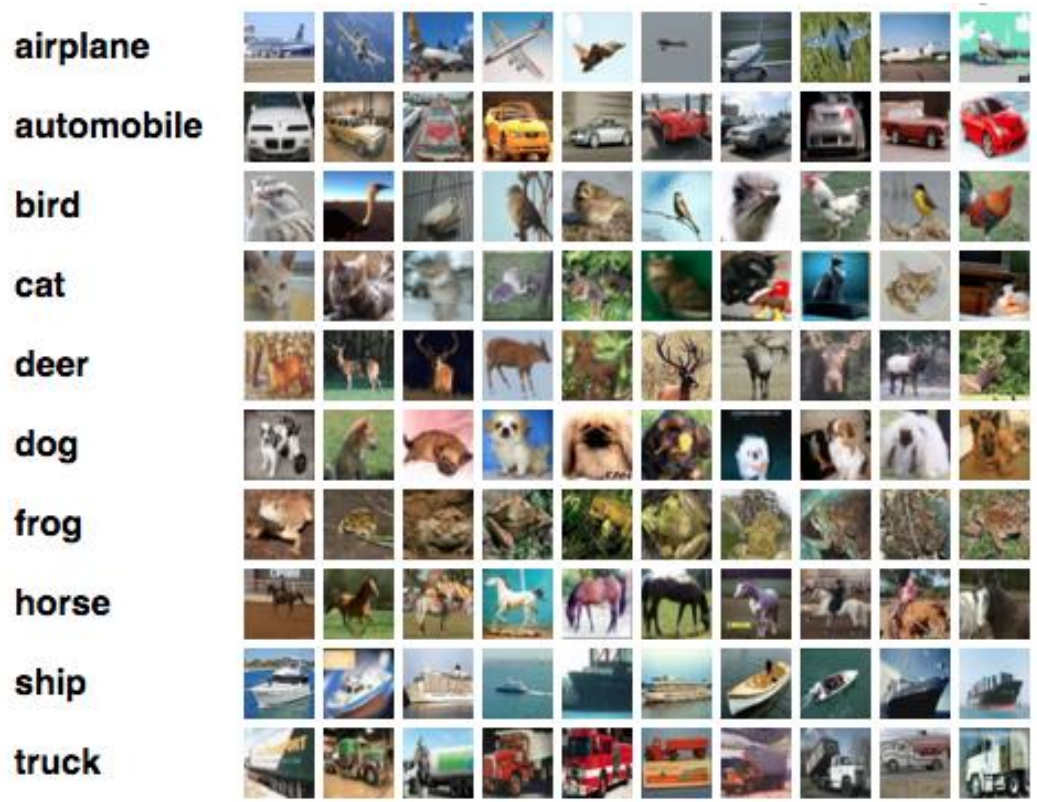
CIFAR-10 분류 구현

CIFAR-10 데이터셋

- 비행기, 자동차 등 사물의 10 개 분류
  - 손글씨와 구조하나 칼라
    - 50000개(학습용), 10000개(테스트용), 28 X 28 X 3 이미지 구조, 10개의 분류
      - 비행기, 자동차, 새, 고양이, 사슴, 개, 개구리, 말, 배(ship), 트럭



파일

- **cifar10_basic_dnn.ipynb**

CIFAR-10 데이터 저장

- **datasets.cifar10.load_data()**

```
import numpy as np
import matplotlib.pyplot as plt
import tensorflow as tf
from tensorflow import keras
from tensorflow.keras import datasets, layers, models

cifar10 = datasets.cifar10
(train_images, train_labels), (test_images, test_labels) = cifar10.load_data()

class_names = ['airplane', 'automobile', 'bird', 'cat', 'deer', 'dog', 'frog', 'horse'
, 'ship', 'truck']

print("Train samples:", train_images.shape, train_labels.shape)
print("Test samples:", test_images.shape, test_labels.shape)
```

```
Downloading data from https://www.cs.toronto.edu/~kriz/cifar-10-python.tar.gz
170500096/170498071 [==============================] - 3s 0us/step
Train samples: (50000, 32, 32, 3) (50000, 1)
Test samples: (10000, 32, 32, 3) (10000, 1)
```

이미지와 레이블

- **이미지**

```
print(train_images.shape)
train_images[0]
```

- **레이블**

```
print(train_labels.shape)
Train_labels
```

```
(50000, 1)
array([[6], [9], [9], ..., [9], [1], [1]], dtype=uint8)
```

```
(50000, 32, 32, 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)
```

이미지 보기

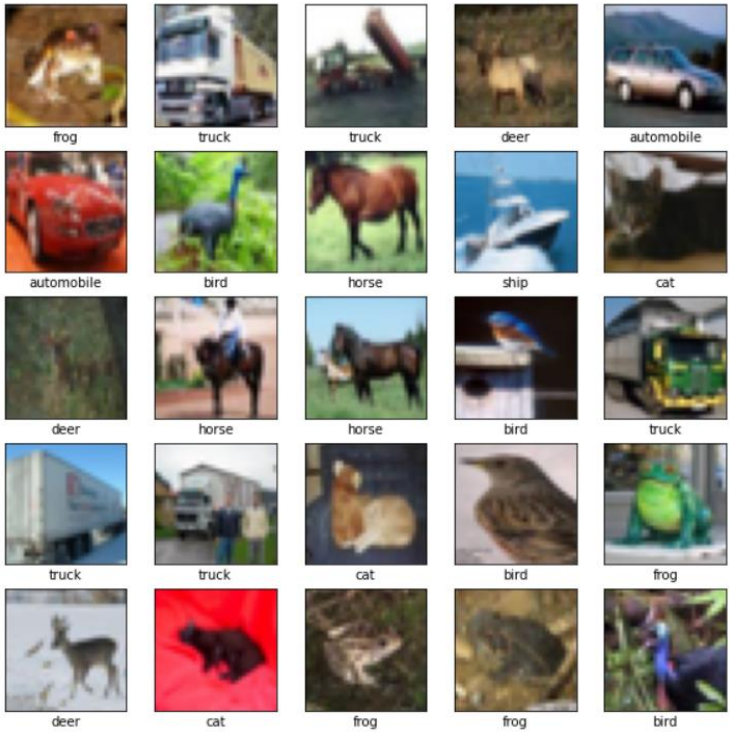
- 하나 보기
- 25개 보기

```
[9]  1 import matplotlib.pyplot as plt
     2
     3 print(train_images[0].shape)
     4 plt.figure(figsize=(2, 2))
     5 plt.xticks([])
     6 plt.yticks([])
     7 plt.grid(False)
     8 plt.imshow(train_images[0])
     9 plt.xlabel(class_names[train_labels[0][0]])
    10 plt.show()
```

```
(32, 32, 3)
```


```
plt.figure(figsize=(10, 10))
for i in range(25):
    plt.subplot(5, 5, i+1)
    plt.xticks([])
    plt.yticks([])
    plt.grid(False)
    plt.imshow(train_images[i])
    plt.xlabel(class_names[train_labels[i][0]])
plt.show()
```

```
train_images = train_images/255.0
test_images = test_images/255.0
```



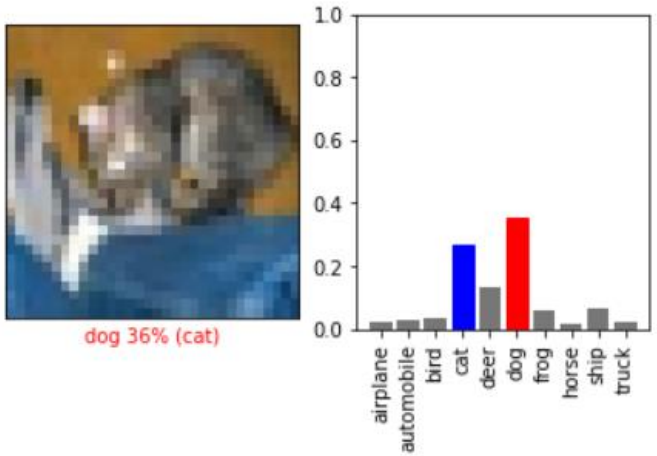
모델 Sequential

```
model = models.Sequential()
model.add(layers.Flatten())
model.add(layers.Dense(256, activation='relu'))
model.add(layers.Dense(128, activation='relu'))
model.add(layers.Dense(64, activation='relu'))
model.add(layers.Dense(10, activation='softmax'))

model.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metr
ics=['accuracy'])
model.fit(train_images, train_labels, epochs=10)
test_loss, test_acc = model.evaluate(test_images, test_labels)
print('Test accuracy:', test_acc)
```

```
Epoch 8/10
1563/1563 [==============================] - 12s 7ms/step - loss: 1.4363 - accuracy: 0.4877
Epoch 9/10
1563/1563 [==============================] - 12s 7ms/step - loss: 1.4196 - accuracy: 0.4935
Epoch 10/10
1563/1563 [==============================] - 12s 8ms/step - loss: 1.3981 - accuracy: 0.5001
313/313 [==============================] - 1s 3ms/step - loss: 1.5084 - accuracy: 0.4705
Test accuracy: 0.47049999237060547
```

이미지와 예측 확률 그리기

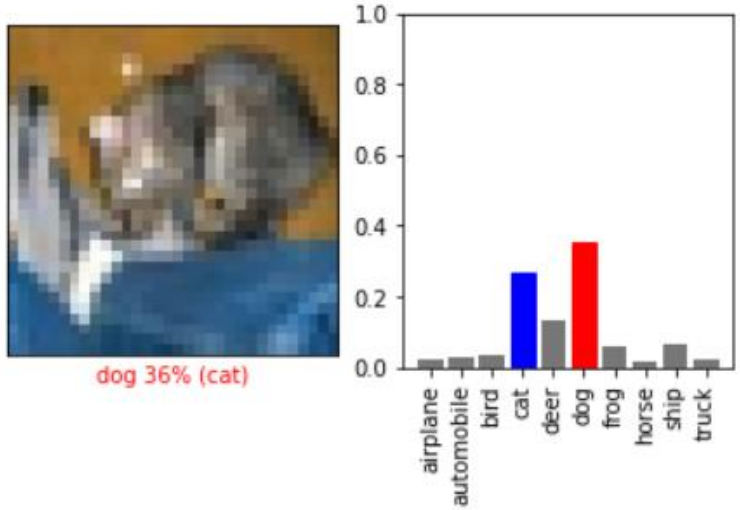
```
def plot_image(i, predictions_array, true_label, img):
    predictions_array, true_label, img = predictions_array[i], true_label[i], img[i]
    plt.grid(False)
    plt.xticks([])
    plt.yticks([])

    plt.imshow(img, cmap=plt.cm.binary)

    predicted_label = np.argmax(predictions_array)
    if predicted_label == true_label:
        color = 'blue'
    else:
        color = 'red'

    plt.xlabel("{} {:2.0f}% ({})".format(class_names[predicted_label]
                                100*np.max(predictions_array),
                                class_names[true_label[0]]),
                                color=color)
```




```
def plot_value_array(i, predictions_array, true_label):
    predictions_array, true_label = predictions_array[i], true_label[i]
    plt.grid(False)
    thisplot = plt.bar(range(10), predictions_array, color="#777777")
    plt.ylim([0, 1])
    predicted_label = np.argmax(predictions_array)

    thisplot[predicted_label].set_color('red')
    thisplot[true_label[0]].set_color('blue')

    # 각 종류 레이블을 직접 세로로 출력
    xlabel = [class_names[i] for i in range(10)]
    plt.xticks(np.arange(10), xlabel, rotation='vertical')
```

첫 데스트 이미지와 확률값 그리기

```
predictions = model.predict(test_images)
i = 0
plt.figure(figsize=(6,3))
plt.subplot(1,2,1)
plot_image(i, predictions, test_labels, test_images)
plt.subplot(1,2,2)
plot_value_array(i, predictions,  test_labels)
plt.show()
```



CIFAR-10 분류 CNN 구현

이미지 로드와 보기

- **cifar10.load_data()**
- **채널이 마지막에 위치 한 구조라 reshape이 필요 없음**

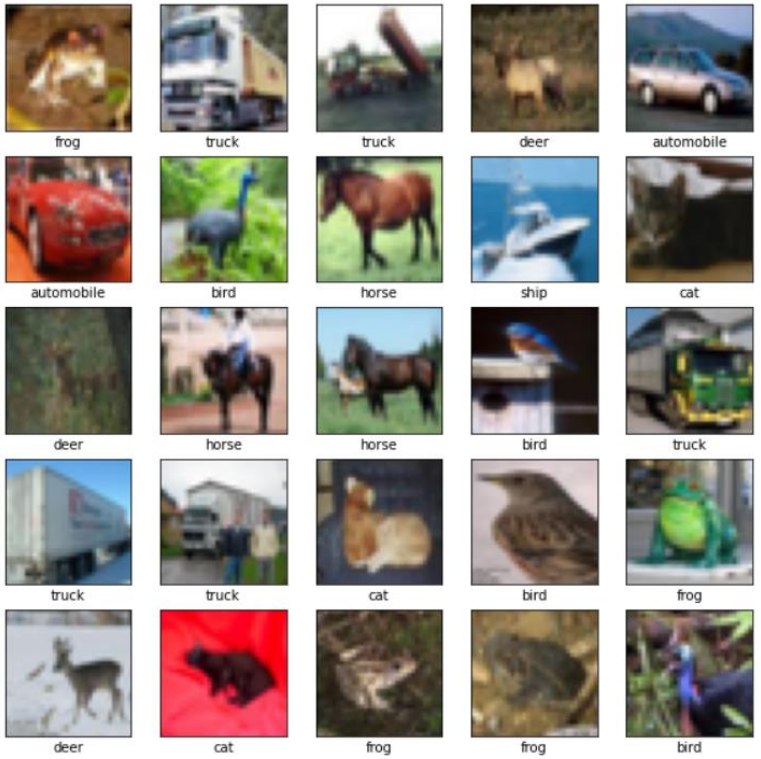
```
import numpy as np
import matplotlib.pyplot as plt
import tensorflow as tf
from tensorflow import keras
from tensorflow.keras import datasets, layers, models

cifar10 = datasets.cifar10
(train_images, train_labels), (test_images, test_labels) = cifar10.load_data()

class_names = ['airplane', 'automobile', 'bird', 'cat', 'deer', 'dog', 'frog', 'horse', 'ship', 'truck']

print("Train samples:", train_images.shape, train_labels.shape)
print("Test samples:", test_images.shape, test_labels.shape)

#train_images = train_images.reshape((50000, 32, 32, 3))
#test_images = test_images.reshape((10000, 32, 32, 3))
```

```
Train samples: (50000, 32, 32, 3) (50000, 1)
Test samples: (10000, 32, 32, 3) (10000, 1)
```

이미지 보기

- **5 x 5 이미지 그리기**

```
plt.figure(figsize=(10, 10))
for i in range(25):
    plt.subplot(5, 5, i+1)
    plt.xticks([])
    plt.yticks([])
    plt.grid(False)
    plt.imshow(train_images[i])
    plt.xlabel(class_names[train_labels[i][0]])
plt.show()
```



CNN 모델 생성, 학습, 평가

- 컨볼루션 신경망(convolutional neural network) 기반 이미지 분류기

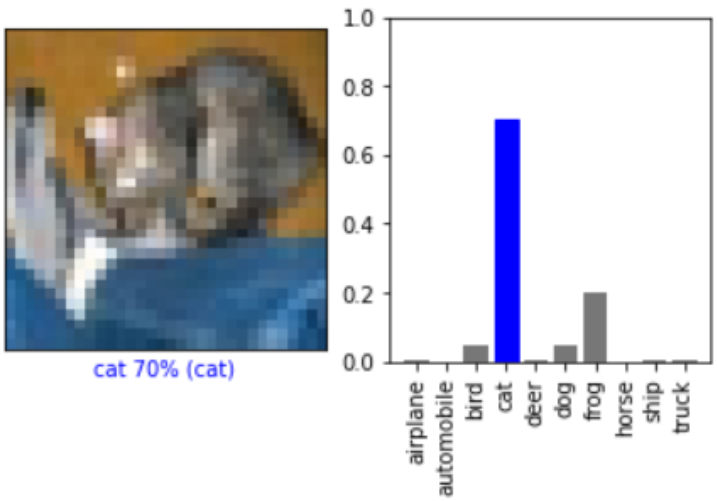
```
train_images = train_images/255.0
test_images = test_images/255.0

model = models.Sequential()
model.add(layers.Conv2D(32, (3, 3), activation='relu', input_shape=(32, 32, 3)))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
model.add(layers.Flatten())
model.add(layers.Dense(64, activation='relu'))
model.add(layers.Dense(10, activation='softmax'))

model.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metrics=['accuracy'])
model.fit(train_images, train_labels, epochs=10)

test_loss, test_acc = model.evaluate(test_images, test_labels)

print('Test accuracy:', test_acc)
```

filters, kernel_size, ...

```
Epoch 10/10
1563/1563 [==============================] - 9s 6ms/step - loss: 0.5993 - accuracy: 0.7891
313/313 [==============================] - 1s 3ms/step - loss: 0.8726 - accuracy: 0.7083
Test accuracy: 0.708299994468689
```

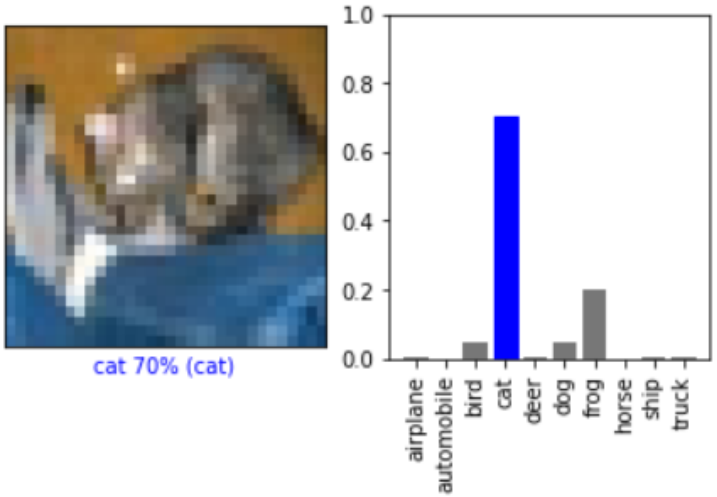
이미지 그리기 함수

```
def plot_image(i, predictions_array, true_label, img):
    predictions_array, true_label, img = predictions_array[i], true_label[i], img[i]
    plt.grid(False)
    plt.xticks([])
    plt.yticks([])

    plt.imshow(img, cmap=plt.cm.binary)

    predicted_label = np.argmax(predictions_array)
    if predicted_label == true_label:
        color = 'blue'
    else:
        color = 'red'

    plt.xlabel("{} {:2.0f}% ({})".format(class_names[predicted_label],
                                100*np.max(predictions_array),
                                class_names[true_label[0]]),
                                color=color)
```



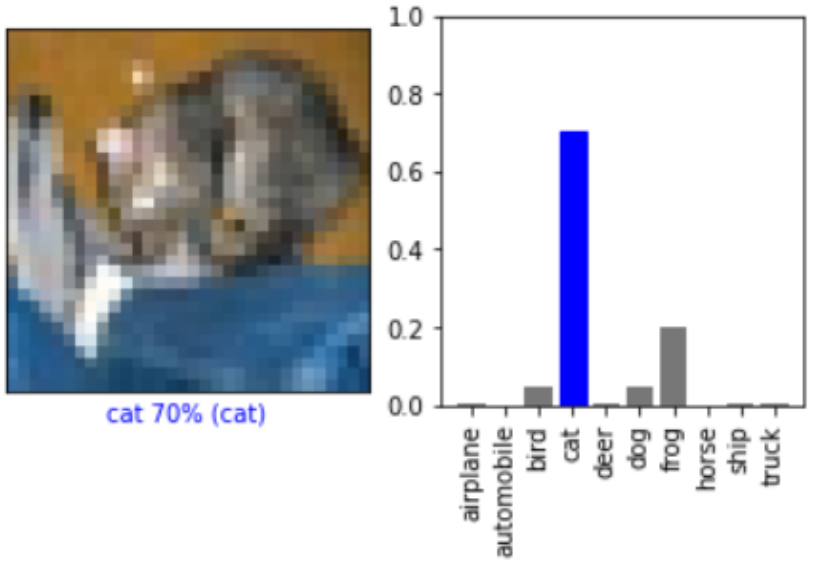
확률 값 그리기

```
def plot_value_array(i, predictions_array, true_label):
    predictions_array, true_label = predictions_array[i], true_label[i]
    plt.grid(False)
    #plt.xticks([])
    #plt.yticks([])
    thisplot = plt.bar(range(10), predictions_array, color="#777777")
    plt.ylim([0, 1])
    predicted_label = np.argmax(predictions_array)

    thisplot[predicted_label].set_color('red')
    thisplot[true_label[0]].set_color('blue')

    # 각 종류 레이블을 직접 세로로 출력
    xlabel = [class_names[i] for i in range(10)]
    plt.xticks(np.arange(10), xlabel, rotation='vertical')
```



첫 데스트 이미지와 확률값 그리기

```
predictions = model.predict(test_images)
i = 0
plt.figure(figsize=(6,3))
plt.subplot(1,2,1)
plot_image(i, predictions, test_labels, test_images)
plt.subplot(1,2,2)
plot_value_array(i, predictions,  test_labels)
plt.show()
```



가중치와 편향 수

```
model = models.Sequential()
model.add(layers.Conv2D(32, (3, 3), activation='relu', input_shape=(32, 32, 3)))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
model.add(layers.Flatten())
model.add(layers.Dense(64, activation='relu'))
model.add(layers.Dense(10, activation='softmax'))

model.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 30, 30, 32)        896
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 15, 15, 32)        0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 13, 13, 64)        18496
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 6, 6, 64)          0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 4, 4, 64)          36928
_________________________________________________________________
flatten_1 (Flatten)          (None, 1024)              0
_________________________________________________________________
dense_4 (Dense)              (None, 64)                65600
_________________________________________________________________
dense_5 (Dense)              (None, 10)                650
=================================================================
Total params: 122,570
Trainable params: 122,570
Non-trainable params: 0
```

(None, 32, 32, 3)

커널 수(K) * 커널 사이즈(F)^2 * (채널:색상 수(D)) + 커널 수(K)
32 * 3*3 * 3 + 32 = 896

커널 수(K) * 커널 사이즈(F)^2 * (채널:색상 수(D)) + 커널 수(K)
64 * 3*3 * 32 + 64 = 18,496

커널 수(K) * 커널 사이즈(F)^2 * (채널:색상 수(D)) + 커널 수(K)
64 * 3*3 * 64 + 64 = 36,928

(이전 출력 노드 수 + 1) * 노드 수
(1024 + 1) * 64

(64 + 1) * 10