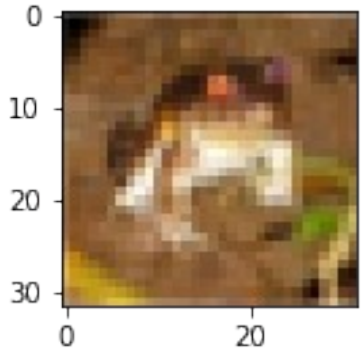
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import datetime, time

import warnings
warnings.filterwarnings('ignore')

pd.set_option("display.max_columns",None)
from sklearn.model_selection import train_test_split
from sklearn.metrics import r2_score
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import accuracy_score, precision_score,
recall_score, f1_score
from sklearn.metrics import classification_report
from sklearn.metrics import accuracy_score
from imblearn.over_sampling import SMOTE
import tensorflow as tf
from tensorflow.keras import datasets, layers, models

(xtrain,ytrain),(xtest,ytest) = datasets.cifar10.load_data()

xtrain.shape

(50000, 32, 32, 3)

ytrain.shape

(50000, 1)

xtest.shape

(10000, 32, 32, 3)

ytest.shape

(10000, 1)

ytrain

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

ytrain = ytrain.reshape(-1,)

plt.figure(figsize=(12,2))
plt.imshow(xtrain[0])
```

```
<matplotlib.image.AxesImage at 0x2288d0448b0>
```




```
# normalize images
xtrain = xtrain/255
xtrain
```

```
array([[[[0.23137255, 0.24313725, 0.24705882],
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```

```
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```

```
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```

```
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```

```
# cnn
cnn = models.Sequential([
    layers.Conv2D(filters=64,kernel_size=(3,3), activation='relu',
input_shape=(32,32,3)),
    layers.MaxPooling2D((2,2)),
    layers.Conv2D(filters=32,kernel_size=(3,3), activation='relu'),
    layers.MaxPooling2D((2,2)),
    layers.Dropout(0.3),
    layers.Flatten(),
    layers.Dense(64,activation='relu'),
    layers.Dense(32,activation='relu'),
    layers.Dense(10,activation='softmax'),
])

cnn.compile(optimizer='adam',loss='sparse_categorical_crossentropy',me
trics=['accuracy'])

cnn.fit(xtrain,ytrain,epochs=20)
```

```
Epoch 1/20
1563/1563 [==============================] - 52s 32ms/step - loss:
1.6247 - accuracy: 0.4043
Epoch 2/20
1563/1563 [==============================] - 50s 32ms/step - loss:
1.3249 - accuracy: 0.5276
Epoch 3/20
1563/1563 [==============================] - 50s 32ms/step - loss:
1.1949 - accuracy: 0.5753
Epoch 4/20
1563/1563 [==============================] - 50s 32ms/step - loss:
1.1129 - accuracy: 0.6065
Epoch 5/20
1563/1563 [==============================] - 50s 32ms/step - loss:
1.0586 - accuracy: 0.6293
Epoch 6/20
1563/1563 [==============================] - 50s 32ms/step - loss:
1.0211 - accuracy: 0.6418
Epoch 7/20
1563/1563 [==============================] - 48s 31ms/step - loss:
0.9753 - accuracy: 0.6548
Epoch 8/20
1563/1563 [==============================] - 49s 31ms/step - loss:
0.9402 - accuracy: 0.6689
Epoch 9/20
1563/1563 [==============================] - 48s 31ms/step - loss:
0.9106 - accuracy: 0.6803
Epoch 10/20
1563/1563 [==============================] - 50s 32ms/step - loss:
0.8838 - accuracy: 0.6895
Epoch 11/20
1563/1563 [==============================] - 48s 31ms/step - loss:
0.8637 - accuracy: 0.6954
Epoch 12/20
1563/1563 [==============================] - 49s 31ms/step - loss:
0.8500 - accuracy: 0.7004
Epoch 13/20
1563/1563 [==============================] - 51s 32ms/step - loss:
0.8297 - accuracy: 0.7066
Epoch 14/20
1563/1563 [==============================] - 51s 32ms/step - loss:
0.8141 - accuracy: 0.7141
Epoch 15/20
1563/1563 [==============================] - 51s 32ms/step - loss:
0.7985 - accuracy: 0.7164
Epoch 16/20
1563/1563 [==============================] - 49s 31ms/step - loss:
0.7871 - accuracy: 0.7221
Epoch 17/20
1563/1563 [==============================] - 49s 31ms/step - loss:
```

```
0.7782 - accuracy: 0.7277
Epoch 18/20
1563/1563 [==============================] - 51s 32ms/step - loss:
0.7706 - accuracy: 0.7292
Epoch 19/20
1563/1563 [==============================] - 51s 32ms/step - loss:
0.7607 - accuracy: 0.7318
Epoch 20/20
1563/1563 [==============================] - 51s 32ms/step - loss:
0.7515 - accuracy: 0.7356

<keras.callbacks.History at 0x22881135970>

ytest = ytest.reshape(-1,)
ytest

array([3, 8, 8, ..., 5, 1, 7], dtype=uint8)

cnn.evaluate(xtest,ytest)

313/313 [==============================] - 3s 8ms/step - loss:
180.9363 - accuracy: 0.3905

[180.93634033203125, 0.390500009059906]

cnn=models.Sequential([

layers.Conv2D(filters=64,kernel_size=(3,3),activation='relu',input_sha
pe=(32,32,3)),
    layers.MaxPooling2D((2,2)),
    layers.Conv2D(filters=32,kernel_size=(3,3),activation='relu'),
    layers.MaxPooling2D((2,2)),
    layers.Dropout(0.3),layers.Flatten(),
    layers.Dense(64,activation='relu'),
    layers.Dense(32,activation='relu'),
    layers.Dense(10,activation='softmax')
])

cnn.compile(optimizer='adam',loss='sparse_categorical_crossentropy',me
trics=['accuracy'])

cnn.fit(xtrain,ytrain,epochs=20)

Epoch 1/20
1563/1563 [==============================] - 51s 32ms/step - loss:
1.5698 - accuracy: 0.4263
Epoch 2/20
1563/1563 [==============================] - 50s 32ms/step - loss:
1.2486 - accuracy: 0.5553
Epoch 3/20
1563/1563 [==============================] - 50s 32ms/step - loss:
1.1373 - accuracy: 0.5985
```

```
Epoch 4/20
1563/1563 [==============================] - 50s 32ms/step - loss:
1.0701 - accuracy: 0.6238
Epoch 5/20
1563/1563 [==============================] - 50s 32ms/step - loss:
1.0090 - accuracy: 0.6437
Epoch 6/20
1563/1563 [==============================] - 50s 32ms/step - loss:
0.9671 - accuracy: 0.6597
Epoch 7/20
1563/1563 [==============================] - 50s 32ms/step - loss:
0.9267 - accuracy: 0.6734
Epoch 8/20
1563/1563 [==============================] - 50s 32ms/step - loss:
0.8965 - accuracy: 0.6844
Epoch 9/20
1563/1563 [==============================] - 50s 32ms/step - loss:
0.8685 - accuracy: 0.6936
Epoch 10/20
1563/1563 [==============================] - 50s 32ms/step - loss:
0.8462 - accuracy: 0.7009
Epoch 11/20
1563/1563 [==============================] - 49s 32ms/step - loss:
0.8288 - accuracy: 0.7074
Epoch 12/20
1563/1563 [==============================] - 50s 32ms/step - loss:
0.8099 - accuracy: 0.7139
Epoch 13/20
1563/1563 [==============================] - 50s 32ms/step - loss:
0.7955 - accuracy: 0.7191
Epoch 14/20
1563/1563 [==============================] - 50s 32ms/step - loss:
0.7792 - accuracy: 0.7241
Epoch 15/20
1563/1563 [==============================] - 48s 31ms/step - loss:
0.7666 - accuracy: 0.7286
Epoch 16/20
1563/1563 [==============================] - 51s 32ms/step - loss:
0.7519 - accuracy: 0.7350
Epoch 17/20
1563/1563 [==============================] - 50s 32ms/step - loss:
0.7424 - accuracy: 0.7355
Epoch 18/20
1563/1563 [==============================] - 51s 32ms/step - loss:
0.7332 - accuracy: 0.7416
Epoch 19/20
1563/1563 [==============================] - 51s 33ms/step - loss:
0.7269 - accuracy: 0.7431
Epoch 20/20
```

```
1563/1563 [==============================] - 51s 33ms/step - loss:
0.7127 - accuracy: 0.7462

<keras.callbacks.History at 0x228826ee9d0>

cnn.evaluate(xtest/255,ytest.reshape(-1,))

313/313 [==============================] - 3s 8ms/step - loss: 0.8513
- accuracy: 0.7051

[0.8513100743293762, 0.7050999999046326]
```