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EXPERIMENT #2

DATE: 01-09-2020

TITLE : ML II ASSIGNMENT 2

AIM

Perform Image classification using CIFAR-10 dataset.

OBJECTIVE

1. Implement FFNN for Image Classification using CIFAR-10 dataset.

DRIVE LINK - *https://drive.google.com/drive/u/0/folders/1VFRRP-IpjH_iq-Beojnorny4Rm53uT6E*

**Notebook, code, pdf, output snapshots have been stored on the above given drive link.*

CIFAR10

```
from tensorflow.keras.datasets import cifar10
from matplotlib import pyplot as plt
from tensorflow import keras
import tensorflow.compat.v2 as tf
from sklearn.model_selection import train_test_split
from tensorflow.keras.utils import to_categorical as tcg
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Flatten
```

```
(xtr,ytr),(xte,yte)=cifar10.load_data()
```

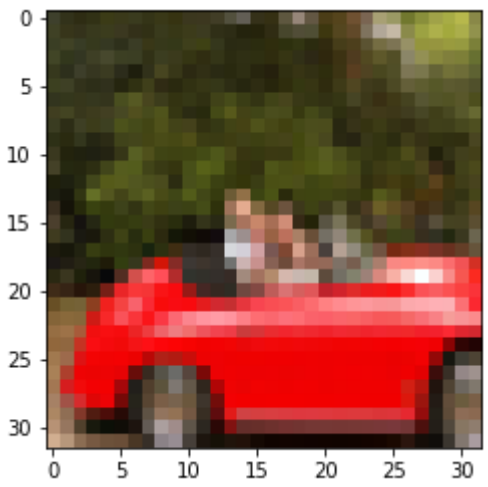
```
Downloading data from https://www.cs.toronto.edu/~kriz/cifar-10-python.tar.gz
170500096/170498071 [==============================] - 4s 0us/step
```

```
xtr.shape
```

```
(50000, 32, 32, 3)
```

```
plt.imshow(xtr[99], cmap='gray')
```

```
<matplotlib.image.AxesImage at 0x7fad71155a58>
```




```
ytr[99]
```

```
array([1], dtype=uint8)
```

```
plt.imshow(xte[99], cmap='gray')
```

```
<matplotlib.image.AxesImage at 0x7fad70c2bf98>
```


```
yte[99]
```

```
array([7], dtype=uint8)
```

```
ytr=tcg(ytr)
yte=tcg(yte)
```

```
xte=xte.reshape(xte.shape[0],xte.shape[1],xte.shape[2],3).astype('float32')/255
xtr=xtr.reshape(xtr.shape[0],xtr.shape[1],xtr.shape[2],3).astype('float32')/255
```

```
model = Sequential([
  Flatten(input_shape=(32, 32, 3)),
  Dense(256, activation='relu'),
  Dense(128, activation='relu', kernel_initializer='he_uniform'),
  Dense(64, activation='relu'),
  Dense(10, activation='softmax'),

])
```

```
from keras.optimizers import Adam
model.compile(loss='categorical_crossentropy',optimizer=Adam(lr = 0.0001), metrics=['accuracy'])
```

```
history = model.fit(xtr,ytr, validation_data=(xte,yte),epochs=13, batch_size=64)
```

```
Epoch 1/13
782/782 [==============================] - 3s 3ms/step - loss: 1.8873 - accuracy: 0.3270 - val_loss: 1.7314 - val_accuracy: 0.3858
Epoch 2/13
782/782 [==============================] - 2s 3ms/step - loss: 1.7034 - accuracy: 0.3978 - val_loss: 1.6928 - val_accuracy: 0.3876
Epoch 3/13
782/782 [==============================] - 2s 3ms/step - loss: 1.6259 - accuracy: 0.4250 - val_loss: 1.6071 - val_accuracy: 0.4357
Epoch 4/13
782/782 [==============================] - 2s 3ms/step - loss: 1.5671 - accuracy: 0.4484 - val_loss: 1.5501 - val_accuracy: 0.4555
Epoch 5/13
782/782 [==============================] - 2s 3ms/step - loss: 1.5304 - accuracy: 0.4586 - val_loss: 1.5393 - val_accuracy: 0.4487
Epoch 6/13
782/782 [==============================] - 2s 3ms/step - loss: 1.4948 - accuracy: 0.4706 - val_loss: 1.5043 - val_accuracy: 0.4658
Epoch 7/13
782/782 [==============================] - 2s 3ms/step - loss: 1.4652 - accuracy: 0.4824 - val_loss: 1.5158 - val_accuracy: 0.4651
Epoch 8/13
782/782 [==============================] - 2s 3ms/step - loss: 1.4382 - accuracy: 0.4931 - val_loss: 1.5349 - val_accuracy: 0.4496
Epoch 9/13
782/782 [==============================] - 2s 3ms/step - loss: 1.4122 - accuracy: 0.5006 - val_loss: 1.4530 - val_accuracy: 0.4811
Epoch 10/13
782/782 [==============================] - 2s 3ms/step - loss: 1.3894 - accuracy: 0.5088 - val_loss: 1.4243 - val_accuracy: 0.4969
Epoch 11/13
782/782 [==============================] - 2s 3ms/step - loss: 1.3687 - accuracy: 0.5163 - val_loss: 1.4299 - val_accuracy: 0.4897
Epoch 12/13
782/782 [==============================] - 2s 3ms/step - loss: 1.3490 - accuracy: 0.5236 - val_loss: 1.4342 - val_accuracy: 0.4885
Epoch 13/13
782/782 [==============================] - 2s 3ms/step - loss: 1.3312 - accuracy: 0.5286 - val_loss: 1.3998 - val_accuracy: 0.4979
```

```
model.evaluate(xtr,ytr)
```

```
1563/1563 [==============================] - 3s 2ms/step - loss: 1.3076 - accuracy: 0.5397
[1.3075944185256958, 0.5396999716758728]
```

```
score = model.evaluate(xte,yte)
```

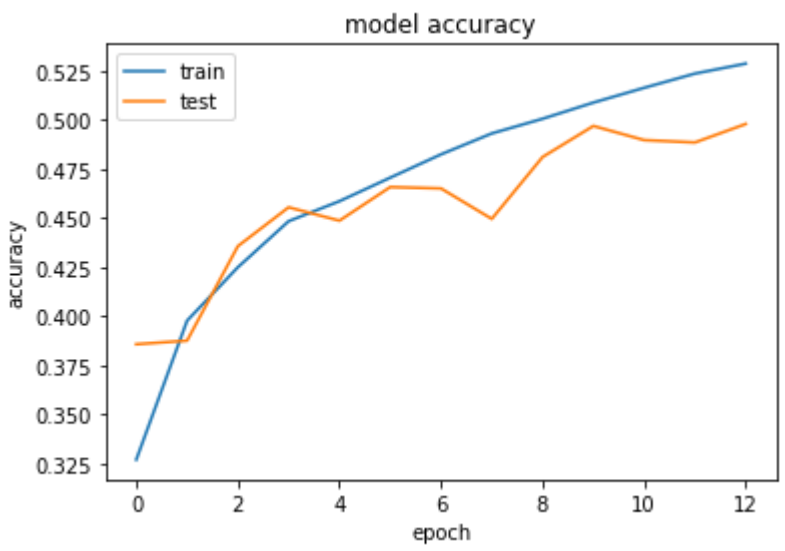
```
313/313 [==============================] - 1s 2ms/step - loss: 1.3998 - accuracy: 0.4979
```

```
print('Test loss:', score[0])
print('Test accuracy:', score[1])
```

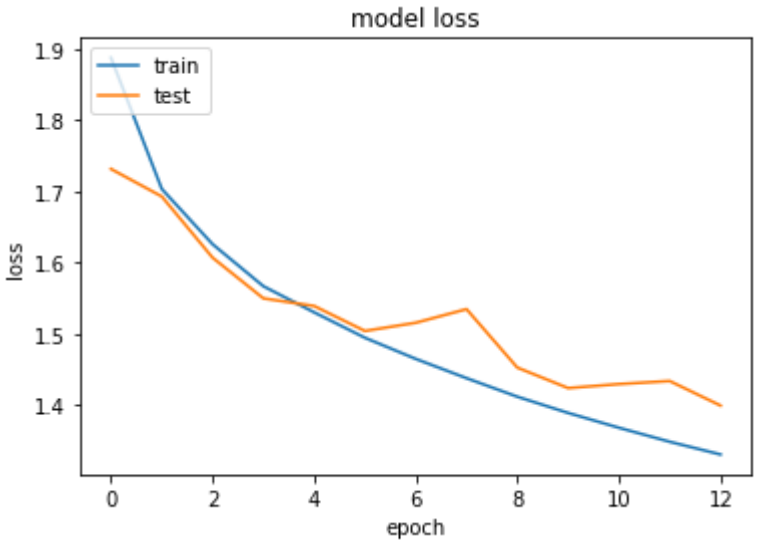
```
Test loss: 1.3997923135757446
Test accuracy: 0.49790000915527344
```

```
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.title('model accuracy')
plt.ylabel('accuracy')
```

```
plt.xlabel('epoch')
plt.legend(['train', 'test'], loc='upper left')
plt.show()
```




```
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('model loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'test'], loc='upper left')
plt.show()
```




```
import numpy as np
np.save('my_history.npy',history.history)
```

```
model.save('FFNN_CIFAR10.h5')
```