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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 CNN 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 CNN

```
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, Conv2D, MaxPooling2D, Dropout
```

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

```
xtr.shape
```

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

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

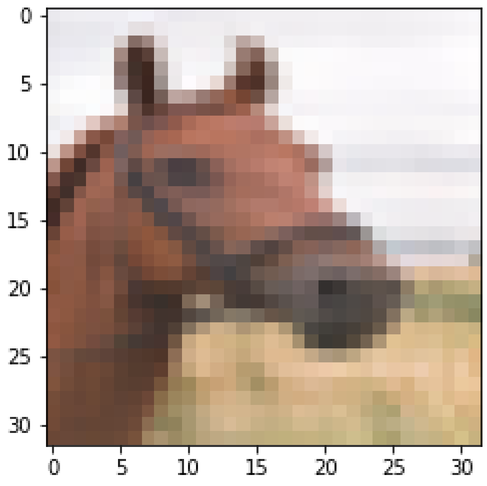
```
<matplotlib.image.AxesImage at 0x7fbfdcdf2940>
```

```
ytr[99]
```

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

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

```
<matplotlib.image.AxesImage at 0x7fbfdce7bcc0>
```



```
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()
model.add(Conv2D(64,(3,3),input_shape=(32,32,3),activation='relu'))
model.add(Conv2D(32,(3,3),activation='relu'))
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Dropout(0.3))

model.add(Conv2D(64,(3,3),activation='relu'))
model.add(Conv2D(32,(3,3),activation='relu'))
model.add(MaxPooling2D(pool_size=(2,2)))
model.add(Dropout(0.4))

model.add(Flatten())

model.add(Dense(512,activation='relu'))
model.add(Dropout(0.4))
model.add(Dense(256,activation='relu'))
model.add(Dropout(0.4))
model.add(Dense(10, activation='softmax'))
```

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

```
history = model.fit(xtr,ytr, validation_data=(xte,yte),epochs=15, batch_size=128)
```

```
Epoch 1/15
391/391 [==============================] - 4s 11ms/step - loss: 1.7685 - accuracy: 0.3379 - va
Epoch 2/15
391/391 [==============================] - 4s 10ms/step - loss: 1.3900 - accuracy: 0.4971 - va
Epoch 3/15
391/391 [==============================] - 4s 11ms/step - loss: 1.2394 - accuracy: 0.5556 - va
Epoch 4/15
391/391 [==============================] - 4s 11ms/step - loss: 1.1353 - accuracy: 0.5983 - va
Epoch 5/15
391/391 [==============================] - 4s 10ms/step - loss: 1.0434 - accuracy: 0.6315 - va
Epoch 6/15
391/391 [==============================] - 4s 11ms/step - loss: 0.9908 - accuracy: 0.6509 - va
Epoch 7/15
391/391 [==============================] - 4s 11ms/step - loss: 0.9382 - accuracy: 0.6694 - va
Epoch 8/15
391/391 [==============================] - 4s 11ms/step - loss: 0.8994 - accuracy: 0.6845 - va
Epoch 9/15
391/391 [==============================] - 4s 11ms/step - loss: 0.8690 - accuracy: 0.6948 - va
Epoch 10/15
391/391 [==============================] - 4s 11ms/step - loss: 0.8385 - accuracy: 0.7049 - va
Epoch 11/15
391/391 [==============================] - 4s 11ms/step - loss: 0.8191 - accuracy: 0.7114 - va
Epoch 12/15
391/391 [==============================] - 4s 11ms/step - loss: 0.7967 - accuracy: 0.7203 - va
Epoch 13/15
391/391 [==============================] - 4s 11ms/step - loss: 0.7780 - accuracy: 0.7272 - va
Epoch 14/15
391/391 [==============================] - 4s 11ms/step - loss: 0.7620 - accuracy: 0.7302 - va
Epoch 15/15
391/391 [==============================] - 4s 11ms/step - loss: 0.7524 - accuracy: 0.7370 - va
```

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

```
1563/1563 [==============================] - 4s 3ms/step - loss: 0.5249 - accuracy: 0.8202
[0.5248758792877197, 0.8201599717140198]
```

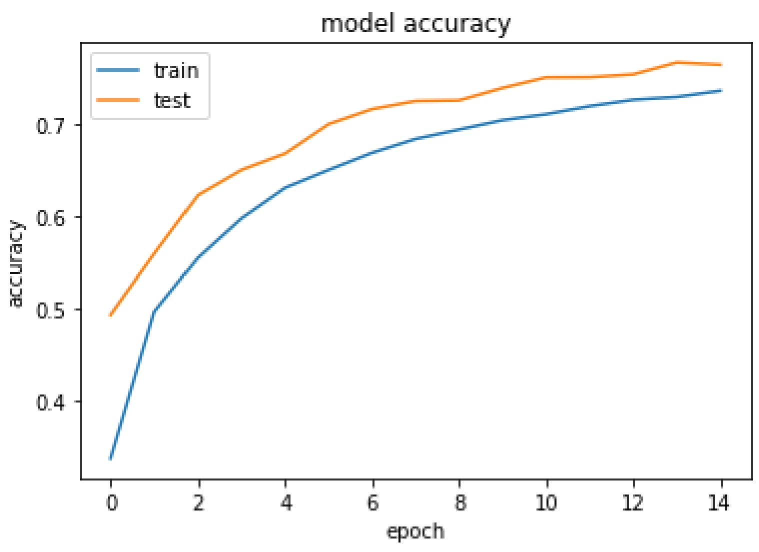
```
score = model.evaluate(xte,yte)
```

```
313/313 [==============================] - 1s 3ms/step - loss: 0.6804 - accuracy: 0.7653
```

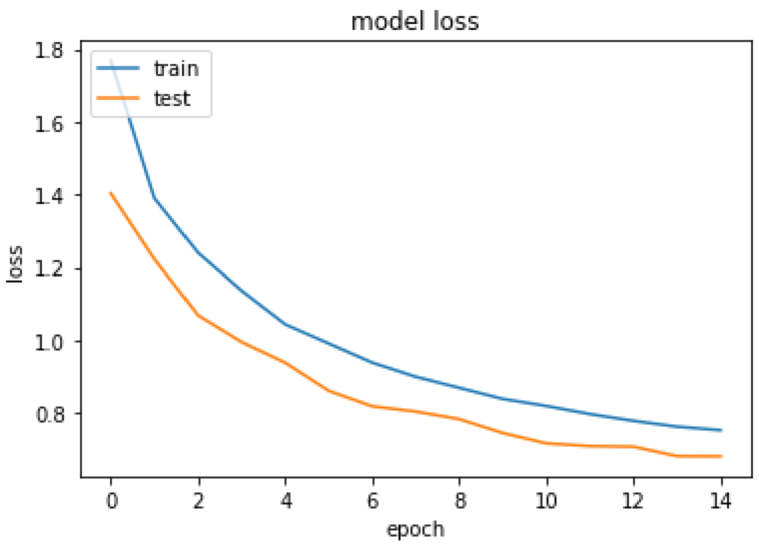
```
print('Test loss:', score[0])
print('Test accuracy:', score[1])
```

```
Test loss: 0.680413544178009
Test accuracy: 0.7652999758720398
```

```
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()
```



```
model.save("CNN_cifar_10.h5")
```

```
model.load_weights("CNN_cifar.h5")
```

```
loaded_model = tf.keras.models.load_model("CNN_cifar.h5")

loaded_model.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
conv2d_4 (Conv2D)            (None, 30, 30, 64)        1792      
_________________________________________________________________
conv2d_5 (Conv2D)            (None, 28, 28, 32)        18464     
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 14, 14, 32)        0         
_________________________________________________________________
dropout_4 (Dropout)          (None, 14, 14, 32)        0         
_________________________________________________________________
conv2d_6 (Conv2D)            (None, 12, 12, 64)        18496     
_________________________________________________________________
conv2d_7 (Conv2D)            (None, 10, 10, 32)        18464     
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (None, 5, 5, 32)          0         
_________________________________________________________________
dropout_5 (Dropout)          (None, 5, 5, 32)          0         
_________________________________________________________________
flatten_1 (Flatten)          (None, 800)               0         
_________________________________________________________________
dense_3 (Dense)              (None, 512)               410112    
_________________________________________________________________
dropout_6 (Dropout)          (None, 512)               0         
_________________________________________________________________
dense_4 (Dense)              (None, 256)               131328    
_________________________________________________________________
dropout_7 (Dropout)          (None, 256)               0         
_________________________________________________________________
dense_5 (Dense)              (None, 10)                2570      
```

```
np.save('my_history.npy',history.history)
```

```
Total params: 601,226
Trainable params: 601,226
Non-trainable params: 0
_________________________________________________________________
```