VIT-Vellore, SCOPE

CSE6037 - Deep Learning and its Applications

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Assessment 4

GitHub Link: https://github.com/manansuthar55/CSE6037_20MAI0016/tree/main/Assessment_4

Problem 2: Implement VGG16 on Multiclass image dataset.

In [16]:

```
import keras,os
from keras.models import Sequential
from keras.layers import Dense, Conv2D, MaxPool2D , Flatten, BatchNormalization, Dropout
from keras.layers import Input, Lambda, Dense, Flatten
from keras.models import Model
from keras.preprocessing import image
from keras.preprocessing.image import ImageDataGenerator
from keras.optimizers import SGD
import numpy as np
```

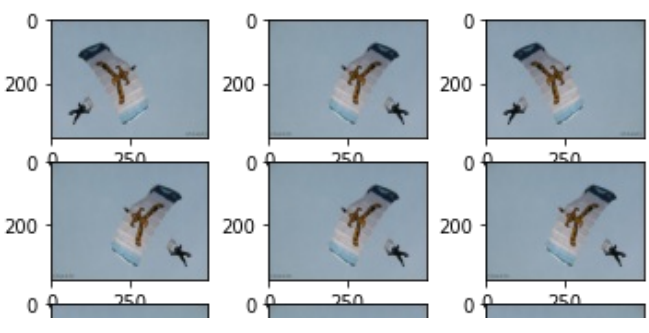
In [17]:

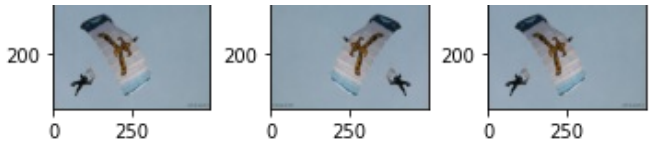
```
from keras.preprocessing.image import ImageDataGenerator
imagegen = ImageDataGenerator()
train = imagegen.flow_from_directory("imagenette2/train/", class_mode="categorical", shuf
fle=False, batch_size=128, target_size=(224, 224))
val = imagegen.flow_from_directory("imagenette2/val/", class_mode="categorical", shuffle=
False, batch_size=128, target_size=(224, 224))
```

```
Found 9469 images belonging to 10 classes.
Found 3925 images belonging to 10 classes.
```

In [28]:

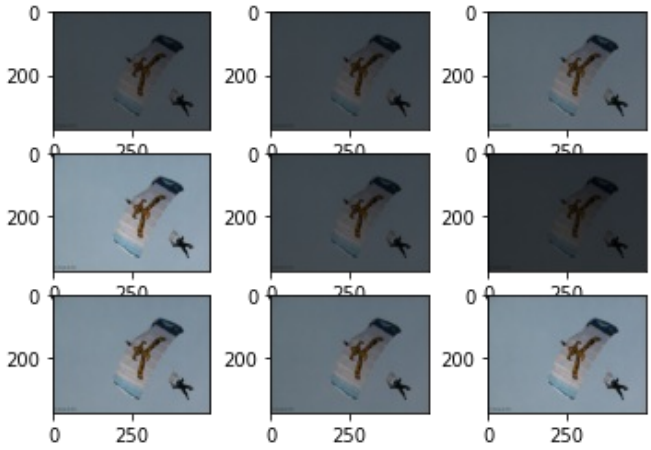
```
from numpy import expand_dims
from keras.preprocessing.image import load_img
from keras.preprocessing.image import img_to_array
from matplotlib import pyplot
img = load_img('/content/imagenette2/train/n03888257/ILSVRC2012_val_00002665.JPEG')
data = img_to_array(img)
samples = expand_dims(data, 0)
datagen = ImageDataGenerator(horizontal_flip=True)
it = datagen.flow(samples, batch_size=1)
for i in range(9):
 pyplot.subplot(330 + 1 + i)
 batch = it.next()
 image = batch[0].astype('uint8')
 pyplot.imshow(image)
pyplot.show()
```





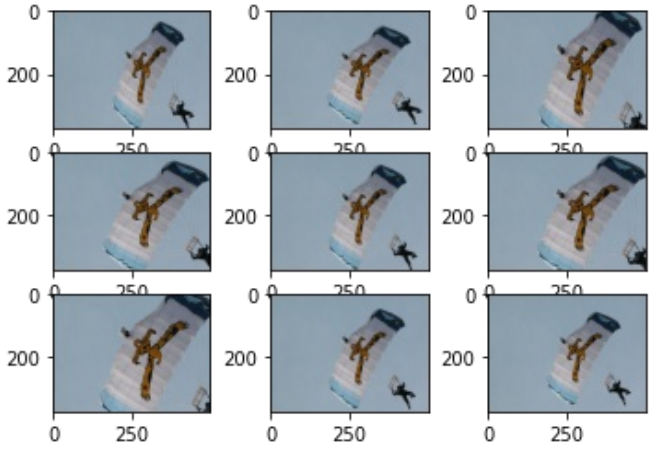
In [29]:

```
data = img_to_array(img)
samples = expand_dims(data, 0)
datagen = ImageDataGenerator(brightness_range=[0.2,1.0])
it = datagen.flow(samples, batch_size=1)
for i in range(9):
 pyplot.subplot(330 + 1 + i)
 batch = it.next()
 image = batch[0].astype('uint8')
 pyplot.imshow(image)
pyplot.show()
```



In [30]:

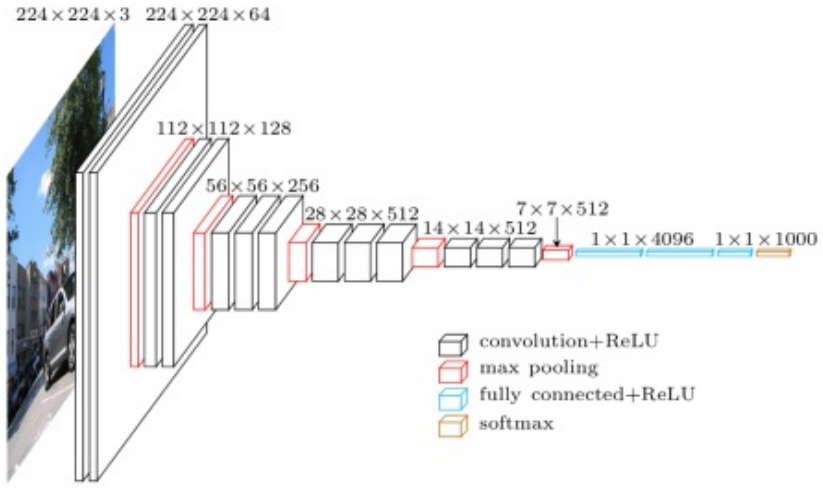
```
data = img_to_array(img)
samples = expand_dims(data, 0)
datagen = ImageDataGenerator(zoom_range=[0.5,1.0])
it = datagen.flow(samples, batch_size=1)
for i in range(9):
 pyplot.subplot(330 + 1 + i)
 batch = it.next()
 image = batch[0].astype('uint8')
 pyplot.imshow(image)
pyplot.show()
```



In [18]:

```
train_target = keras.utils.to_categorical(train.labels)
val_target = keras.utils.to_categorical(val.labels)
```

VGG 16 Architecture



In [19]:

```
model = Sequential()
model.add(Conv2D(input_shape=(224,224,3),filters=64,kernel_size=(3,3),padding="same", activation="relu"))
model.add(Conv2D(filters=64,kernel_size=(3,3),padding="same", activation="relu"))
model.add(BatchNormalization())
model.add(MaxPool2D(pool_size=(2,2),strides=(2,2)))
model.add(Conv2D(filters=128, kernel_size=(3,3), padding="same", activation="relu"))
model.add(Conv2D(filters=128, kernel_size=(3,3), padding="same", activation="relu"))
model.add(MaxPool2D(pool_size=(2,2),strides=(2,2)))
model.add(Conv2D(filters=256, kernel_size=(3,3), padding="same", activation="relu"))
model.add(Conv2D(filters=256, kernel_size=(3,3), padding="same", activation="relu"))
model.add(Conv2D(filters=256, kernel_size=(3,3), padding="same", activation="relu"))
model.add(MaxPool2D(pool_size=(2,2),strides=(2,2)))
model.add(Conv2D(filters=512, kernel_size=(3,3), padding="same", activation="relu"))
model.add(Conv2D(filters=512, kernel_size=(3,3), padding="same", activation="relu"))
model.add(Conv2D(filters=512, kernel_size=(3,3), padding="same", activation="relu"))
model.add(MaxPool2D(pool_size=(2,2),strides=(2,2)))
model.add(Conv2D(filters=512, kernel_size=(3,3), padding="same", activation="relu"))
model.add(Conv2D(filters=512, kernel_size=(3,3), padding="same", activation="relu"))
model.add(Conv2D(filters=512, kernel_size=(3,3), padding="same", activation="relu"))
model.add(MaxPool2D(pool_size=(2,2),strides=(2,2)))
model.add(Flatten())
model.add(Dense(units=4096,activation="relu"))
model.add(Dense(units=4096,activation="relu"))
model.add(Dense(units=1, activation="sigmoid"))
model.summary()
```

```
Model: "sequential_3"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_13 (Conv2D)           (None, 224, 224, 64)      1792
_________________________________________________________________
conv2d_14 (Conv2D)           (None, 224, 224, 64)      36928
_________________________________________________________________
batch_normalization_2 (Batch (None, 224, 224, 64)      256
_________________________________________________________________
max_pooling2d_5 (MaxPooling2 (None, 112, 112, 64)      0
_________________________________________________________________
conv2d_15 (Conv2D)           (None, 112, 112, 128)     73856
_________________________________________________________________
conv2d_16 (Conv2D)           (None, 112, 112, 128)     147584
_________________________________________________________________
max_pooling2d_6 (MaxPooling2 (None, 56, 56, 128)       0
_________________________________________________________________
conv2d_17 (Conv2D)           (None, 56, 56, 256)       295168
_________________________________________________________________
conv2d_18 (Conv2D)           (None, 56, 56, 256)       590080
_________________________________________________________________
conv2d_19 (Conv2D)           (None, 56, 56, 256)       590080
_________________________________________________________________
max_pooling2d_7 (MaxPooling2 (None, 28, 28, 256)       0
```

```
_________________________________________________________________
conv2d_20 (Conv2D)           (None, 28, 28, 512)       1180160
_________________________________________________________________
conv2d_21 (Conv2D)           (None, 28, 28, 512)       2359808
_________________________________________________________________
conv2d_22 (Conv2D)           (None, 28, 28, 512)       2359808
_________________________________________________________________
max_pooling2d_8 (MaxPooling2 (None, 14, 14, 512)       0
_________________________________________________________________
conv2d_23 (Conv2D)           (None, 14, 14, 512)       2359808
_________________________________________________________________
conv2d_24 (Conv2D)           (None, 14, 14, 512)       2359808
_________________________________________________________________
conv2d_25 (Conv2D)           (None, 14, 14, 512)       2359808
_________________________________________________________________
max_pooling2d_9 (MaxPooling2 (None, 7, 7, 512)         0
_________________________________________________________________
flatten_3 (Flatten)          (None, 25088)             0
_________________________________________________________________
dense_6 (Dense)              (None, 4096)              102764544
_________________________________________________________________
dense_7 (Dense)              (None, 4096)              16781312
_________________________________________________________________
dense_8 (Dense)              (None, 1)                 4097
=================================================================
Total params: 134,264,897
Trainable params: 134,264,769
Non-trainable params: 128
_________________________________________________________________
```

In [21]:

```
sgd = SGD(lr=0.1, decay=1e-6, momentum=0.9, nesterov=True)
model.compile(optimizer=sgd, loss='categorical_crossentropy', metrics=['accuracy'])
```

In [25]:

```
model.fit(train, train_target, epochs=10, batch_size=128, validation_data=(val, val_targ
et))
```

```
Epoch 1/10
74/74 [==============================] - 2s 16ms/step - loss: 0.6691 - accuracy: 0.8102 -
val_loss: 0.2105 - val_accuracy: 0.9353
Epoch 2/10
74/74 [==============================] - 1s 14ms/step - loss: 0.1787 - accuracy: 0.9508 -
val_loss: 0.1842 - val_accuracy: 0.9396
Epoch 3/10
74/74 [==============================] - 1s 14ms/step - loss: 0.0932 - accuracy: 0.9769 -
val_loss: 0.1806 - val_accuracy: 0.9401
Epoch 4/10
74/74 [==============================] - 1s 14ms/step - loss: 0.0706 - accuracy: 0.9815 -
val_loss: 0.1863 - val_accuracy: 0.9419
Epoch 5/10
74/74 [==============================] - 1s 14ms/step - loss: 0.0522 - accuracy: 0.9866 -
val_loss: 0.1771 - val_accuracy: 0.9434
Epoch 6/10
74/74 [==============================] - 1s 14ms/step - loss: 0.0381 - accuracy: 0.9902 -
val_loss: 0.1724 - val_accuracy: 0.9465
Epoch 7/10
74/74 [==============================] - 1s 14ms/step - loss: 0.0286 - accuracy: 0.9934 -
val_loss: 0.1771 - val_accuracy: 0.9475
Epoch 8/10
74/74 [==============================] - 1s 14ms/step - loss: 0.0212 - accuracy: 0.9946 -
val_loss: 0.1852 - val_accuracy: 0.9457
Epoch 9/10
74/74 [==============================] - 1s 14ms/step - loss: 0.0194 - accuracy: 0.9944 -
val_loss: 0.1959 - val_accuracy: 0.9447
Epoch 10/10
74/74 [==============================] - 1s 14ms/step - loss: 0.0148 - accuracy: 0.9964 -
val_loss: 0.1961 - val_accuracy: 0.9465
```

Out[25]:

```
<tensorflow.python.keras.callbacks.History at 0x7f1bd0198290>
```