Importing Necessary Libraries

In [2]:

```
import numpy as np
import cv2
import os
import matplotlib.pyplot as plt
import pickle
import xlrd
import tensorflow as tf
import keras
from keras.models import Sequential
from keras.layers import Dense, Conv2D, MaxPooling2D, Dropout, Activation, Flatten
from keras.layers.normalization import BatchNormalization
import keras.backend as K
from keras.models import load_model

%matplotlib inline
```

```
 :\Users\npl\Anaconda3\lib\site-packages\h5py\__init__.py:36: FutureWarning:
 onversion of the second argument of issubdtype from `float` to `np.floating
` is deprecated. In future, it will be treated as `np.float64 == np.dtype(fl
 at).type`.
  from ._conv import register_converters as _register_converters
 sing TensorFlow backend.
```

Data Preparation

Defining some funcitons

In [94]:

```
def process(image):

    image_og = image
    image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
    some = cv2.resize(image, (100, 100))/255
    some = some.reshape(1, 100, 100, 1)

    return some

# Simplifying the 'pickling' process as we'll need this quite often
def pickleIn(name):
    # 'name' - name of the file we wish to load (should be a string, eg. 'train_batch.pickl
    pickle_in = open(name,'rb')
    return pickle.load(pickle_in)

def pickleOut(name, to_be_stored):
    # 'name' - name of the file we wish to store (should be a string, eg. 'train_batch.pick
    # 'to_be_stored' - the variable of which we'll be making the "pickle"
    pickle_out = open(name,'wb')
    pickle.dump(to_be_stored, pickle_out)
    pickle_out.close
```

Below have we provided 4 variables - *'x_train', 'y_train', 'x_valid', 'y_valid'*

'x_train' and 'x_valid' are 4D Tensors 'y_train' and 'y_valid' are 2D Tensors

All of them are initialized with '0'

Now to train the model we have to feed it with actual 12000 images in the form of x_train (pre-processed) and 2000 images in x_valid and their respective labels in y_train and y_labels

Kindly refer Approach_text.pdf to know how to make the image labels

In [ ]:

```
x_train = np.zeros((12000,100,100,1))
y_train = np.zeros((12000,4))
x_valid = np.zeros((2000,100,100,1))
y_valid = np.zeros((2000,4))
```

Google drive link to *d2c_data.tar* - https://drive.google.com/open?id=1RVoKzP6IeulTmuLRg6cgsoVEr3RcJAe- (https://drive.google.com/open?id=1RVoKzP6IeulTmuLRg6cgsoVEr3RcJAe-)

It containes - *x_train.pickle y_train.pickle x_valid.pickle y_valid.pickle*

In [5]:

```
# Write your code here or use this code of mine #

# the Training Files
x_train = pickleIn('x_train.pickle')
y_train = pickleIn('y_train.pickle')
x_valid = pickleIn('x_valid.pickle')
y_valid = pickleIn('y_valid.pickle')
```

Training Phase

EITHER we can DIRECTLY LOAD the MODEL OR skip to 'Building our Model'

We have stored the weights in the file named *model_0038_83_1.h5*

and here is the google drive link to the model - https://drive.google.com/open?id=1Ed81aWjZ_tH_CdjbC7j2RddalnuWYpmh (https://drive.google.com/open?id=1Ed81aWjZ_tH_CdjbC7j2RddalnuWYpmh)

In [4]:

```
model = load_model('model_0038_83_1.h5')
```

Building our Model

In [ ]:

```
model = Sequential()

model.add(ZeroPadding2D(padding=(1, 1), data_format=None))

model.add(Conv2D(5, kernel_size=(2, 2),
                 activation='relu',
                 input_shape=(100,100,1)))
model.add(Conv2D(5, (2, 2), activation='relu'))
model.add(BatchNormalization())

model.add(Conv2D(10, (2, 2), activation='relu'))
model.add(Conv2D(10, (2, 2), activation='relu'))
model.add(ZeroPadding2D(padding=(1, 1), data_format=None))
model.add(BatchNormalization())

model.add(Conv2D(10, (2, 2), activation='relu'))
model.add(Conv2D(10, (2, 2), activation='relu'))
model.add(BatchNormalization())

model.add(Conv2D(10, (2, 2), activation='relu'))
model.add(Conv2D(10, (2, 2), activation='relu'))
model.add(BatchNormalization())

model.add(Conv2D(20, (3, 3), activation='relu'))
model.add(Conv2D(20, (3, 3), activation='relu'))
model.add(AveragePooling2D(pool_size=(2, 2)))

model.add(Conv2D(15, (3, 3), activation='relu'))
model.add(AveragePooling2D(pool_size=(2, 2)))

model.add(Conv2D(30, (3, 3), activation='relu'))
model.add(Conv2D(30, (3, 3), activation='relu'))
model.add(AveragePooling2D(pool_size=(2, 2)))
model.add(Dropout(0.2))

model.add(Flatten())
model.add(Dense(1600, activation='relu'))
model.add(Dropout(0.5))

model.add(Dense(4))
```

Compliling Our Model

In [ ]:

```
model.compile(loss=keras.losses.mean_squared_error,
              optimizer=keras.optimizers.Adam(),
              metrics=['accuracy'])
```

Training the Model

In [ ]:

```
batch_size = 120
epochs = 125

model.fit(x_train, y_train,
          batch_size=batch_size,
          epochs=epochs,
          verbose=1,
          validation_data=(x_valid, y_valid))

score = model.evaluate(x_valid, y_valid, verbose=0)
print('Test loss:', score[0])
print('Test accuracy:', score[1])
```

Prediction Phase

Test Data Preparation

x_test is also a 4D Tensor of size *(Number, 100, 100, 1)* where *Number* is the number of test samples one plans to give to the model to predict

In [ ]:

```
Number = #Enter a number here#

x_test = np.zeros((Number, 100, 100, 1))
```

In [ ]:

```
for i in range(Number):

    im_loc = 'C:/location/example'

    x [i,:,:,:] = process(cv2.imread(im_loc))
```

x_submit.pickle has the test images mentioned in the *test.csv*

Google Drive Link - https://drive.google.com/open?id=1igc5FSytG8iZ6otXhkEyubuc9M8S4LQ5 (https://drive.google.com/open?id=1igc5FSytG8iZ6otXhkEyubuc9M8S4LQ5)

In [ ]:

```
# Or use this code of mine #

x_test = pickleIn('x_submit.pickle')
```

In [30]:

```
pred = model.predict(x_test[0:2,:,:,:])
```

In [31]:

```
print(pred)
```

```
[[0.5267871  0.5094267  0.35535783 0.66509175]
 [0.50417024 0.52293444 0.7433772  0.43731084]]
```

Defining Some Functions

iou would be used to calculate the Intersection over Union for bounding boxes

In [ ]:

```
def iou(y_true, y_pred):

    x_t = y_true[0]
    y_t = y_true[1]
    w_t = y_true[2]
    h_t = y_true[3]

    # Calculating the Co-ordinates from Center and Length Values (Actual Square)
    x1_t = ((2*x_t) - w_t)/2
    y1_t = ((2*y_t) - h_t)/2
    x2_t = ((2*x_t) + w_t)/2
    y2_t = ((2*y_t) + h_t)/2

    x_p = y_pred[0]
    y_p = y_pred[1]
    w_p = y_pred[2]
    h_p = y_pred[3]

    # Calculating the Co-ordinates from center and length values (Prediction Square)
    x1_p = ((2*x_p) - w_p)/2
    y1_p = ((2*y_p) - h_p)/2
    x2_p = ((2*x_p) + w_p)/2
    y2_p = ((2*y_p) + h_p)/2

    # Calculating the co-ordinates of intersecting square
    x1 = max(x1_t,x1_p)
    y1 = max(y1_t,y1_p)
    x2 = min(x2_t,x2_p)
    y2 = min(y2_t,y2_p)

    # Area of Intersection
    I_area = (x2-x1)*(y2-y1)

    true_area = (x2_t-x1_t)*(y2_t-y1_t)
    pred_area = (x2_p-x1_p)*(y2_p-y1_p)

    # Union of both regions
    U_area = true_area + pred_area - I_area

    # Intersection over Union
    IOU = I_area/U_area

    return IOU
```

If given the location of a particular image then we can use the following definition over the image

In [98]:

```
def predict_1x100x100x1(image):

    some = image[i,:,:,:]

    plt.imshow(some.reshape(100,100))
    plt.plot(100*pred[i,0],100*pred[i,1],'ro')

    x1_ = 100*((2*pred[i,0]) - pred[i,2])/2
    y1_ = 100*((2*pred[i,1]) - pred[i,3])/2
    x2_ = 100*((2*pred[i,0]) + pred[i,2])/2
    y2_ = 100*((2*pred[i,1]) + pred[i,3])/2

    plt.plot(x1_,y1_,'ro')
    plt.plot(x2_,y2_,'ro')
    plt.plot(x1_,y2_,'ro')
    plt.plot(x2_,y1_,'ro')

def predict_640x480x3(image, model):

    # image - is the original image without any preprocessing step
    # model - is the model we used to train

    pred = model.predict(process(image))

    plt.imshow(image)
    plt.plot(640*pred[0,0], 480*pred[0,1],'ro')

    x1_ = 640*((2*pred[0,0]) - pred[0,2])/2
    y1_ = 480*((2*pred[0,1]) - pred[0,3])/2
    x2_ = 640*((2*pred[0,0]) + pred[0,2])/2
    y2_ = 480*((2*pred[0,1]) + pred[0,3])/2

    plt.plot(x1_,y1_,'ro')
    plt.plot(x2_,y2_,'ro')
    plt.plot(x1_,y2_,'ro')
    plt.plot(x2_,y1_,'ro')
```

In [26]:

```
model.summary()
```

```
_________________________________________________________________
ayer (type)                 Output Shape              Param #   
=================================================================
ero_padding2d_11 (ZeroPaddi (None, 102, 102, 1)       0         
_________________________________________________________________
onv2d_784 (Conv2D)          (None, 101, 101, 5)       25        
_________________________________________________________________
onv2d_785 (Conv2D)          (None, 100, 100, 5)       105       
_________________________________________________________________
atch_normalization_99 (Batc (None, 100, 100, 5)       20        
_________________________________________________________________
onv2d_786 (Conv2D)          (None, 99, 99, 10)        210       
_________________________________________________________________
onv2d_787 (Conv2D)          (None, 98, 98, 10)        410       
_________________________________________________________________
ero_padding2d_12 (ZeroPaddi (None, 100, 100, 10)      0         
_________________________________________________________________
atch_normalization_100 (Bat (None, 100, 100, 10)      40        
_________________________________________________________________
onv2d_788 (Conv2D)          (None, 99, 99, 10)        410       
_________________________________________________________________
onv2d_789 (Conv2D)          (None, 98, 98, 10)        410       
_________________________________________________________________
atch_normalization_101 (Bat (None, 98, 98, 10)        40        
_________________________________________________________________
onv2d_790 (Conv2D)          (None, 97, 97, 10)        410       
_________________________________________________________________
onv2d_791 (Conv2D)          (None, 96, 96, 10)        410       
_________________________________________________________________
atch_normalization_102 (Bat (None, 96, 96, 10)        40        
_________________________________________________________________
onv2d_792 (Conv2D)          (None, 94, 94, 20)        1820      
_________________________________________________________________
onv2d_793 (Conv2D)          (None, 92, 92, 20)        3620      
_________________________________________________________________
verage_pooling2d_1 (Average (None, 46, 46, 20)        0         
_________________________________________________________________
onv2d_794 (Conv2D)          (None, 44, 44, 15)        2715      
_________________________________________________________________
verage_pooling2d_2 (Average (None, 22, 22, 15)        0         
_________________________________________________________________
onv2d_795 (Conv2D)          (None, 20, 20, 30)        4080      
_________________________________________________________________
onv2d_796 (Conv2D)          (None, 18, 18, 30)        8130      
_________________________________________________________________
verage_pooling2d_3 (Average (None, 9, 9, 30)          0         
_________________________________________________________________
ropout_19 (Dropout)         (None, 9, 9, 30)          0         
_________________________________________________________________
latten_9 (Flatten)          (None, 2430)              0         
_________________________________________________________________
ense_16 (Dense)             (None, 1600)              3889600   
_________________________________________________________________
ropout_20 (Dropout)         (None, 1600)              0         
_________________________________________________________________
ense_17 (Dense)             (None, 4)                 6404      
=================================================================
otal params: 3,918,899
rainable params: 3,918,829
on-trainable params: 70
```

Writing into *test.csv*

In [ ]:

```
pred_submit = model_1.predict(x_submit)
```

We first wrote the prediction values in *submit.xls* then copied the cells in *test.csv* and uploaded it on the portal

In [ ]:

```
import xlwt

wb = xlwt.Workbook()

ws = wb.add_sheet("Sheet1")

ws.write(0,0,"x1")
ws.write(0,1,"x2")
ws.write(0,2,"y1")
ws.write(0,3,"y2")

for i in range(12815):

    x1_ = 640*((2*pred_submit[i,0]) - pred_submit[i,2])/2
    y1_ = 480*((2*pred_submit[i,1]) - pred_submit[i,3])/2
    x2_ = 640*((2*pred_submit[i,0]) + pred_submit[i,2])/2
    y2_ = 480*((2*pred_submit[i,1]) + pred_submit[i,3])/2

    ws.write(i+1,0,x1_)
    ws.write(i+1,1,x2_)
    ws.write(i+1,2,y1_)
    ws.write(i+1,3,y2_)

wb.save("submit.xls")
```

In [67]:

```
import cv2
```

Working of *predict_640x480x3(image, model)*

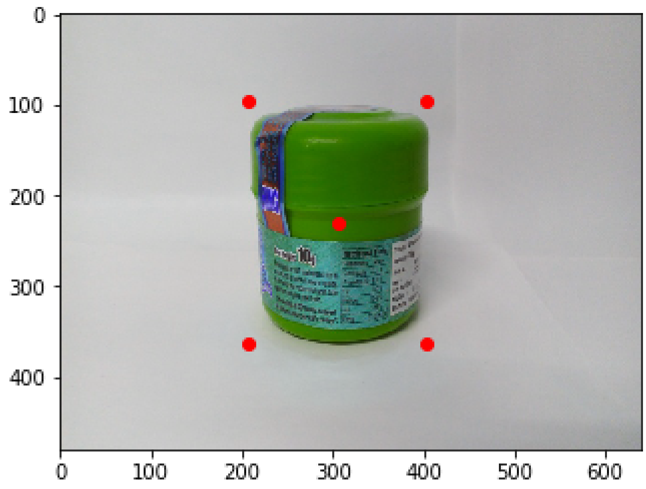
- read an *image* from computer and then feed it, along with the *model*
- it will output an image with bounding box co-ordinates marked over it

In [100]:

```
image = cv2.imread("C:\\Users\\npl\\Desktop\\Divyanshu\\Competition\\Dare2Complete\\Round_2

# Evaluator can give any image location the above is just an example...
# but the model has to either be trained or loaded from Google drive link

predict_640x480x3(image, model)
```



In [ ]: