```
!wget --header="Host: storage.googleapis.com" --header="User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, li
```

```
--2019-10-03 07:18:16--  https://storage.googleapis.com/kaggle-datasets/188282/420762/malaria-bounding-boxes.zip?GoogleAccessId=
Resolving storage.googleapis.com (storage.googleapis.com)... 64.233.184.128, 2a00:1450:400c:c08::80
Connecting to storage.googleapis.com (storage.googleapis.com)|64.233.184.128|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 2259224287 (2.1G) [application/zip]
Saving to: ‘CurlWget597’

CurlWget597         100%[===================>]   2.10G  46.2MB/s    in 49s

2019-10-03 07:19:06 (43.8 MB/s) - ‘CurlWget597’ saved [2259224287/2259224287]
```

```
!unzip CurlWget597
```

```
import json
training_json = '/content/malaria/training.json'

with open(training_json) as file:
      file.seek(0)
      train_data = json.load(file)
```

```
train_data
```

```
class_dict = {'red blood cell': 0, 'trophozoite': 1, 'schizont': 2, 'difficult': 3, 'ring': 4, 'leukocyte': 5, 'gametocyte': 6}
```

```
train_data_=[]
for i in train_data:
  path = 'malaria'+i['image']['pathname']
  for j in i['objects']:
    category = j['category']
    bounding_box = j['bounding_box']
    line = bounding_box['maximum']['c'],bounding_box['maximum']['r'],bounding_box['minimum']['c'],bounding_box['minimum']['r'],class_dict[c
    train_data_.append(line)
```

```
train_data_
```

```
import csv
headers = [ 'minimum_c', 'minimum_r', 'maximum_c','maximum_r', 'category','path']
with open('train.csv', 'w') as f:
        wr = csv.writer(f, quoting=csv.QUOTE_ALL)
        wr.writerow(headers)
        wr.writerows(train_data_)
```

```
import pandas as pd
train_df=pd.read_csv('train.csv')
train_df.head(2)
```

	minimum_c	minimum_r	maximum_c	maximum_r	category	path
0	1540	1158	1440	1057	0	malaria/images/8d02117d-6c71-4e47-b50a-6cc8d5e...
1	1403	971	1303	868	0	malaria/images/8d02117d-6c71-4e47-b50a-6cc8d5e...

```
train_df.columns
```

```
Index(['minimum_c', 'minimum_r', 'maximum_c', 'maximum_r', 'category', 'path'], dtype='object')
```

```
train_df['category'].value_counts()
```

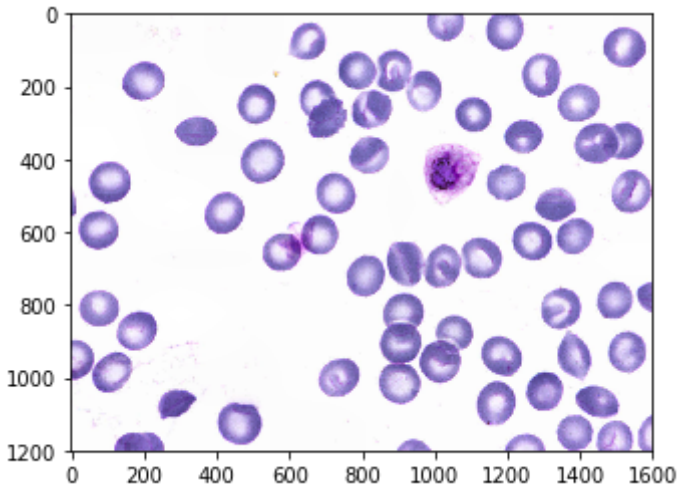
```
0    77420
1     1473
3      441
4      353
2      179
6      144
5      103
Name: category, dtype: int64
```

```
train_df['path'].value_counts()
```

```
train_df.shape
```

```
(80113, 6)
```

```
import matplotlib.pyplot as plt
from matplotlib import patches
image = plt.imread('/content/malaria/images/002f20ad-2ace-499c-9335-c9080bc3e6b5.png')
plt.imshow(image)
plt.show()
```




```
image.shape
```

```
(1200, 1600, 3)
```

```
train_df[train_df.path=="malaria/images/003a89b0-a095-417a-8dd6-f408339bbc68.png"]
```

```
for _,row in train_df[train_df.path=="malaria/images/003a89b0-a095-417a-8dd6-f408339bbc68.png"].iterrows():
    if row.category!='red blood cell':
      print(row)
```

Classification task : You are given an image with single object and you have to classify among different class , of which class it is from .

CNN is used as a classifier to classify between the images. So comes a point:

If a image contains several objects .

We have to detect the object which is far complex than classifying.

Can we detect objects in a given figure using naive CNN ?

The **ANSWER** is YES .

How?

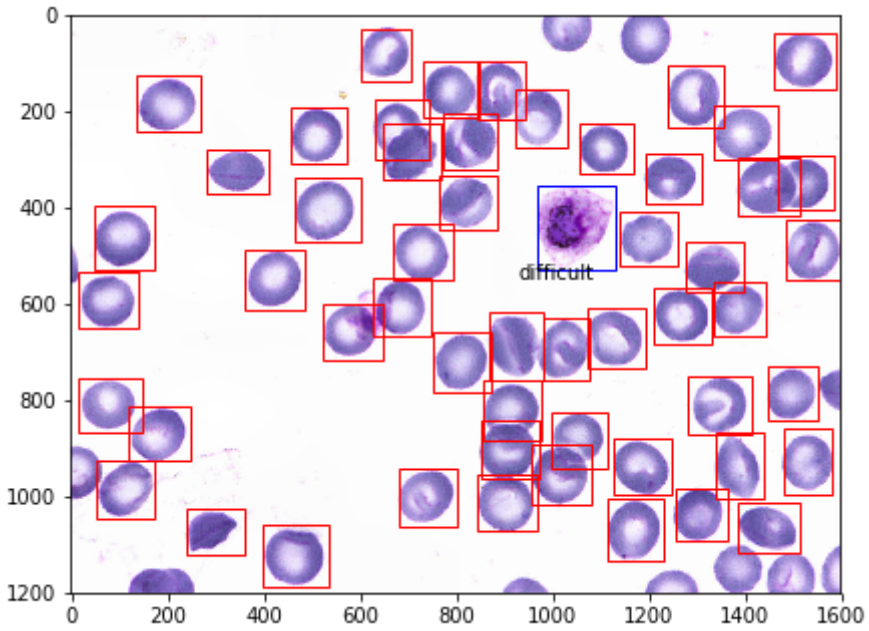
Take a image divide it into grids . Take any pre-trained model AlexNet,VGG take each grid and pass each grid into the model which can classified.

1. This is Brute Force method there is another method which is very efficient It is Fast - RCNN (Regions with CNN)

2. And Second is YOLO - You Only Look Once

```
fig = plt.figure()

ax = fig.add_axes([0,0,1,1])

image = plt.imread('malaria/images/002f20ad-2ace-499c-9335-c9080bc3e6b5.png')
plt.imshow(image)


for _,row in train_df[train_df.path=="malaria/images/002f20ad-2ace-499c-9335-c9080bc3e6b5.png"].iterrows():
    xmin = row.minimum_c
    xmax = row.maximum_c
    ymin = row.minimum_r
    ymax = row.maximum_r

    l = xmax-xmin
    b = ymax-ymin

    if row.category==0:
      color='r'
      #ax.annotate('red blood cell',xy=(xmax-40,ymin+20))
    elif row.category==1:
      color='g'
      ax.annotate('trophozoite',xy=(xmax-40,ymin+20))
    elif row.category==3:
      color='b'
      ax.annotate('difficult',xy=(xmax-40,ymin+20))
    elif row.category==4:
      color='r'
      ax.annotate('ring',xy=(xmax-40,ymin+20))
    elif row.category==2:
      color='r'
```

```
      ax.annotate('schizont',xy=(xmax-40,ymin+20))
    elif row.category==6:
      color='o'
      ax.annotate('gametocyte',xy=(xmax-40,ymin+20))
    elif row.category==5:
      color='b'
      ax.annotate('leukocyte',xy=(xmax-40,ymin+20))


    rect = patches.Rectangle((xmin,ymin), l, b, edgecolor = color, facecolor = 'none')
    ax.add_patch(rect)

```




```
#!git clone https://github.com/dek8v5/Malaria_detection_with_Faster-RCNN_and_YOLOv3.git
```

```

```

```
train_df.columns
```

```
Index(['minimum_c', 'minimum_r', 'maximum_c', 'maximum_r', 'category', 'path'], dtype='object')
```

```
train_df.isnull().any()
```

```
minimum_c    False
minimum_r    False
maximum_c    False
maximum_r    False
category     False
path         False
dtype: bool
```

```
data = pd.DataFrame()
data['format'] = train_df['path']


for i in range(data.shape[0]):
    data['format'][i] = data['format'][i] + ',' + str(train_df['minimum_c'][i]) + ',' + str(train_df['minimum_r'][i]) + ',' + str(train_df[

data.to_csv('annotate.txt', header=None, index=None, sep=' ')
```

```
!pip install -r /content/keras-frcnn/requirements.txt
```

```
!python /content/keras-frcnn/train_frcnn.py -o simple --num_epochs 2 -p annotate.txt
```

```

```

```
!python test_frcnn.py -p "/images/41be1bd3-0d31-4881-bf1f-3ccdfa21ff12.jpg"
```

Tried to create a bounding box on newly seen images FRCNN model is learning too slow this system

Classification

There are **4** Infected cell 'gametocyte', 'ring', 'difficult', 'schizont', 'trophozoite' and **2** uninfected cell 'red blood cell' and 'leukocyte'
We divide it into Infected and Uninfected classfication problem

Crop each cells from the actual image data (`80,000 cells`) . Each cell is labeled either **0** or **1** .

Metrics

As class is heavily imbalanced We will use F1- Score as a metric . First we will check with Random forest classifer and use a neural network to determine the score .

```
Train_df.shape
```

```
(80113, 6)
```

```
train_df.head(2)
```

	minimum_c	minimum_r	maximum_c	maximum_r	category	path
0	1540	1158	1440	1057	0	malaria/images/8d02117d-6c71-4e47-b50a-6cc8d5e...
1	1403	971	1303	868	0	malaria/images/8d02117d-6c71-4e47-b50a-6cc8d5e...

```
train_df['category'].value_counts()
```

```
0    77420
1     1473
3      441
4      353
2      179
6      144
5      103
Name: category, dtype: int64
```

```
train_df.category[train_df.category == 5] = 0
train_df.category[train_df.category == 1] = 1
train_df.category[train_df.category == 2] = 1
train_df.category[train_df.category == 3] = 1
train_df.category[train_df.category == 4] = 1
train_df.category[train_df.category == 6] = 1
```

```
train_df['category'].value_counts()
```

```
0    77523
1     2590
Name: category, dtype: int64
```

```
train_df
```

```

%matplotlib inline
import cv2
import numpy as np
images=[]
for i,row in train_df.iterrows():
  #print(row['path'])
  image=plt.imread(row['path'])
  #print(image.shape)
  #print(image)
  #plt.imshow(image)
  r_min = row['maximum_r']
  c_min = row['maximum_c']
  r_max = row['minimum_r']
  c_max = row['minimum_c']
  obj_image = image[r_min:r_max, c_min:c_max]
  #print(obj_image.shape)

  obj_image = cv2.resize(obj_image, (32, 32), 0, 0, cv2.INTER_LINEAR)
  obj_image = obj_image.astype(np.float32)

  plt.show()
  #obj_image = np.multiply(obj_image, 1.0 / 255.0)
  #plt.imshow(obj_image)

  obj_image = obj_image.flatten()
  images.append(obj_image)
```

```
import pickle
with open('Fruits', 'wb') as fp:
  pickle.dump(images, fp)
```

```
import pickle
with open('/content/drive/My Drive/Fruits', 'rb') as fp:
  images = pickle.load(fp)
```

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Go to this URL in a browser: https://accounts.google.com/o/oauth2/auth?client_id=947318989803-6bn6qk8qdgf4n4g3pfee6491hc0brc4i.a

Enter your authorization code:
··········
Mounted at /content/drive
```

```
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(images, train_df['category'], test_size=0.2, random_state=41)
```

```
from sklearn.ensemble import RandomForestClassifier

rf = RandomForestClassifier(n_estimators=120)

rf.fit(X_train, y_train)

y_pred_test = rf.predict(X_test)
```

We woul take metrics as F1 score as class is heavily imbalanced

```
from sklearn.metrics import f1_score
print(f1_score(y_test, y_pred_test, average='macro'))
```

```
0.7157014301804683
```

```
pickle.dump(rf, open('BBmodel', 'wb'))
```

```
len(images[0])
```

```
3072
```

Deep Learning model

```
import keras
from keras.models import Sequential
from keras.layers import Convolution2D
from keras.layers import MaxPooling2D
from keras.layers import Flatten
from keras.layers import Dense

```

```
Using TensorFlow backend.
```

```

#https://datascience.stackexchange.com/questions/45165/how-to-get-accuracy-f1-precision-and-recall-for-a-keras-model
from keras import backend as K
def recall_m(y_true, y_pred):
        true_positives = K.sum(K.round(K.clip(y_true * y_pred, 0, 1)))
        possible_positives = K.sum(K.round(K.clip(y_true, 0, 1)))
        recall = true_positives / (possible_positives + K.epsilon())
        return recall

def precision_m(y_true, y_pred):
        true_positives = K.sum(K.round(K.clip(y_true * y_pred, 0, 1)))
        predicted_positives = K.sum(K.round(K.clip(y_pred, 0, 1)))
        precision = true_positives / (predicted_positives + K.epsilon())
        return precision

def f1_m(y_true, y_pred):
    precision = precision_m(y_true, y_pred)
    recall = recall_m(y_true, y_pred)
    return 2*((precision*recall)/(precision+recall+K.epsilon()))
```

```
model = Sequential()
model.add(Convolution2D(32,3,3,input_shape=(32,32,3),activation = 'relu'))
model.add(MaxPooling2D(pool_size=(2,2), strides = 2))
model.add(Flatten())
model.add(Dense(units = 128, activation = 'relu'))
model.add(Dense(units = 64, activation = 'relu'))
model.add(Dense(units = 32, activation = 'relu'))

model.add(Dense(units = 1, activation = 'sigmoid'))

model.compile(optimizer = 'adam', loss = 'binary_crossentropy', metrics=['accuracy',f1_m])
```

```
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:2: UserWarning: Update your `Conv2D` call to the Keras 2 API: `Conv
```

```
1 len(images[0]),len(images)
```

```
(3072, 80113)
```

```
1 img = np.asarray(images).reshape(80113,32,32,3)
```

```
1 img.shape
```

```
(80113, 32, 32, 3)
```

```
1
```

```
1 model.fit(x=img,y=train_df['category'],batch_size=32,epochs=10,validation_split=0.3)
```

```
Train on 56079 samples, validate on 24034 samples
Epoch 1/10
56079/56079 [==============================] - 18s 315us/step - loss: 0.0324 - acc: 0.9912 - f1_m: 0.4824 - val_loss: 0.0337 - v
Epoch 2/10
56079/56079 [==============================] - 18s 315us/step - loss: 0.0262 - acc: 0.9927 - f1_m: 0.5104 - val_loss: 0.0285 - v
Epoch 3/10
56079/56079 [==============================] - 18s 314us/step - loss: 0.0202 - acc: 0.9943 - f1_m: 0.5333 - val_loss: 0.0510 - v
Epoch 4/10
56079/56079 [==============================] - 18s 315us/step - loss: 0.0178 - acc: 0.9947 - f1_m: 0.5326 - val_loss: 0.0334 - v
Epoch 5/10
56079/56079 [==============================] - 18s 313us/step - loss: 0.0153 - acc: 0.9954 - f1_m: 0.5466 - val_loss: 0.0322 - v
Epoch 6/10
56079/56079 [==============================] - 18s 316us/step - loss: 0.0125 - acc: 0.9961 - f1_m: 0.5547 - val_loss: 0.0310 - v
Epoch 7/10
56079/56079 [==============================] - 18s 318us/step - loss: 0.0105 - acc: 0.9967 - f1_m: 0.5784 - val_loss: 0.0334 - v
Epoch 8/10
56079/56079 [==============================] - 18s 315us/step - loss: 0.0083 - acc: 0.9974 - f1_m: 0.5877 - val_loss: 0.0507 - v
Epoch 9/10
56079/56079 [==============================] - 18s 314us/step - loss: 0.0083 - acc: 0.9974 - f1_m: 0.5899 - val_loss: 0.0372 - v
Epoch 10/10
56079/56079 [==============================] - 18s 314us/step - loss: 0.0077 - acc: 0.9978 - f1_m: 0.5947 - val_loss: 0.0339 - v
<keras.callbacks.History at 0x7f8054e08f98>
```

```
1
```