Ex No: 8 **OBJECT DETECTION WITH YOLO3**

Aim:

To build an object detection model with YOLO3 using Keras/TensorFlow.

Procedure:

1. Download and load the dataset.
2. Perform analysis and preprocessing of the dataset.
3. Build a simple neural network model using Keras/TensorFlow.
4. Compile and fit the model.
5. Perform prediction with the test dataset.
6. Calculate performance metrics.

PROGRAM:

```
# load yolov3 model and perform object detection
# based on https://github.com/experiencor/keras-yolo3
import numpy as np
from numpy import expand_dims
from keras.models import load_model
from keras.preprocessing.image import load_img
from keras.preprocessing.image import img_to_array
from matplotlib import pyplot
from matplotlib.patches import Rectangle

class BoundBox:
	def __init__(self, xmin, ymin, xmax, ymax, objness = None, classes = None):
		self.xmin = xmin
		self.ymin = ymin
		self.xmax = xmax
		self.ymax = ymax
		self.objness = objness
		self.classes = classes
		self.label = -1
		self.score = -1
```

```
    def get_label(self):
        if self.label == -1:
            self.label = np.argmax(self.classes)

        return self.label

    def get_score(self):
        if self.score == -1:
            self.score = self.classes[self.get_label()]

        return self.score

def _sigmoid(x):
    return 1. / (1. + np.exp(-x))

def decode_netout(netout, anchors, obj_thresh, net_h, net_w):
    grid_h, grid_w = netout.shape[:2]
    nb_box = 3
    netout = netout.reshape((grid_h, grid_w, nb_box, -1))
    nb_class = netout.shape[-1] - 5
    boxes = []
    netout[..., :2]  = _sigmoid(netout[..., :2])
    netout[..., 4:]  = _sigmoid(netout[..., 4:])
    netout[..., 5:]  = netout[..., 4][..., np.newaxis] * netout[..., 5:]
    netout[..., 5:] *= netout[..., 5:] > obj_thresh

    for i in range(grid_h*grid_w):
        row = i / grid_w
        col = i % grid_w
        for b in range(nb_box):
            # 4th element is objectness score
            objectness = netout[int(row)][int(col)][b][4]
            if(objectness.all() <= obj_thresh): continue
            # first 4 elements are x, y, w, and h
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```
                x, y, w, h = netout[int(row)][int(col)][b][:4]
                x = (col + x) / grid_w # center position, unit: image width
                y = (row + y) / grid_h # center position, unit: image height
                w = anchors[2 * b + 0] * np.exp(w) / net_w # unit: image width
                h = anchors[2 * b + 1] * np.exp(h) / net_h # unit: image height
                # last elements are class probabilities
                classes = netout[int(row)][col][b][5:]
                box = BoundBox(x-w/2, y-h/2, x+w/2, y+h/2, objectness, classes)
                boxes.append(box)
    return boxes

def correct_yolo_boxes(boxes, image_h, image_w, net_h, net_w):
    new_w, new_h = net_w, net_h
    for i in range(len(boxes)):
        x_offset, x_scale = (net_w - new_w)/2./net_w, float(new_w)/net_w
        y_offset, y_scale = (net_h - new_h)/2./net_h, float(new_h)/net_h
        boxes[i].xmin = int((boxes[i].xmin - x_offset) / x_scale * image_w)
        boxes[i].xmax = int((boxes[i].xmax - x_offset) / x_scale * image_w)
        boxes[i].ymin = int((boxes[i].ymin - y_offset) / y_scale * image_h)
        boxes[i].ymax = int((boxes[i].ymax - y_offset) / y_scale * image_h)

def _interval_overlap(interval_a, interval_b):
    x1, x2 = interval_a
    x3, x4 = interval_b
    if x3 < x1:
        if x4 < x1:
            return 0
        else:
            return min(x2,x4) - x1
    else:
        if x2 < x3:
            return 0
        else:
            return min(x2,x4) - x3
```

```
def bbox_iou(box1, box2):
    intersect_w = _interval_overlap([box1.xmin, box1.xmax], [box2.xmin, box2.xmax])
    intersect_h = _interval_overlap([box1.ymin, box1.ymax], [box2.ymin, box2.ymax])
    intersect = intersect_w * intersect_h
    w1, h1 = box1.xmax-box1.xmin, box1.ymax-box1.ymin
    w2, h2 = box2.xmax-box2.xmin, box2.ymax-box2.ymin
    union = w1*h1 + w2*h2 - intersect
    return float(intersect) / union

def do_nms(boxes, nms_thresh):
    if len(boxes) > 0:
        nb_class = len(boxes[0].classes)
    else:
        return
    for c in range(nb_class):
        sorted_indices = np.argsort([-box.classes[c] for box in boxes])
        for i in range(len(sorted_indices)):
            index_i = sorted_indices[i]
            if boxes[index_i].classes[c] == 0: continue
            for j in range(i+1, len(sorted_indices)):
                index_j = sorted_indices[j]
                if bbox_iou(boxes[index_i], boxes[index_j]) >= nms_thresh:
                    boxes[index_j].classes[c] = 0

# load and prepare an image
def load_image_pixels(filename, shape):
    # load the image to get its shape
    image = load_img(filename)
    width, height = image.size
    # load the image with the required size
    image = load_img(filename, target_size=shape)
    # convert to numpy array
    image = img_to_array(image)
```

```
        # scale pixel values to [0, 1]
        image = image.astype('float32')
        image /= 255.0
        # add a dimension so that we have one sample
        image = expand_dims(image, 0)
        return image, width, height

# get all of the results above a threshold
def get_boxes(boxes, labels, thresh):
        v_boxes, v_labels, v_scores = list(), list(), list()
        # enumerate all boxes
        for box in boxes:
                # enumerate all possible labels
                for i in range(len(labels)):
                        # check if the threshold for this label is high enough
                        if box.classes[i] > thresh:
                                v_boxes.append(box)
                                v_labels.append(labels[i])
                                v_scores.append(box.classes[i]*100)
                                # don't break, many labels may trigger for one box
        return v_boxes, v_labels, v_scores

# draw all results
def draw_boxes(filename, v_boxes, v_labels, v_scores):
        # load the image
        data = pyplot.imread(filename)
        # plot the image
        pyplot.imshow(data)
        # get the context for drawing boxes
        ax = pyplot.gca()
        # plot each box
        for i in range(len(v_boxes)):
                box = v_boxes[i]
                # get coordinates
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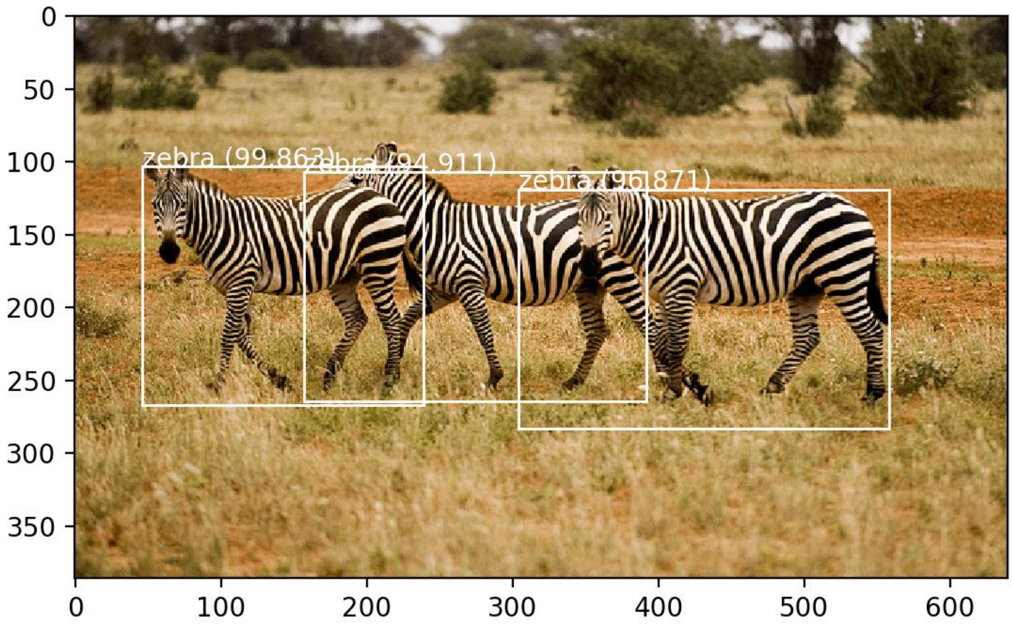
```
                y1, x1, y2, x2 = box.ymin, box.xmin, box.ymax, box.xmax
                # calculate width and height of the box
                width, height = x2 - x1, y2 - y1
                # create the shape
                rect = Rectangle((x1, y1), width, height, fill=False, color='white')
                # draw the box
                ax.add_patch(rect)
                # draw text and score in top left corner
                label = "%s (%.3f)" % (v_labels[i], v_scores[i])
                pyplot.text(x1, y1, label, color='white')
        # show the plot
        pyplot.show()

# load yolov3 model
model = load_model('model.h5')
# define the expected input shape for the model
input_w, input_h = 416, 416
# define our new photo
photo_filename = 'zebra.jpg'
# load and prepare image
image, image_w, image_h = load_image_pixels(photo_filename, (input_w, input_h))
# make prediction
yhat = model.predict(image)
# summarize the shape of the list of arrays
print([a.shape for a in yhat])
# define the anchors
anchors = [[116,90, 156,198, 373,326], [30,61, 62,45, 59,119], [10,13, 16,30, 33,23]]
# define the probability threshold for detected objects
class_threshold = 0.6
boxes = list()
for i in range(len(yhat)):
        # decode the output of the network
        boxes += decode_netout(yhat[i][0], anchors[i], class_threshold, input_h, input_w)
# correct the sizes of the bounding boxes for the shape of the image
```

```
correct_yolo_boxes(boxes, image_h, image_w, input_h, input_w)
# suppress non-maximal boxes
do_nms(boxes, 0.5)
# define the labels
labels = ["person", "bicycle", "car", "motorbike", "aeroplane", "bus", "train", "truck",
        "boat", "traffic light", "fire hydrant", "stop sign", "parking meter", "bench",
        "bird", "cat", "dog", "horse", "sheep", "cow", "elephant", "bear", "zebra", "giraffe",
        "backpack", "umbrella", "handbag", "tie", "suitcase", "frisbee", "skis", "snowboard",
        "sports ball", "kite", "baseball bat", "baseball glove", "skateboard", "surfboard",
        "tennis racket", "bottle", "wine glass", "cup", "fork", "knife", "spoon", "bowl", "banana",
        "apple", "sandwich", "orange", "broccoli", "carrot", "hot dog", "pizza", "donut", "cake",
        "chair", "sofa", "pottedplant", "bed", "diningtable", "toilet", "tvmonitor", "laptop", "mouse",
        "remote", "keyboard", "cell phone", "microwave", "oven", "toaster", "sink", "refrigerator",
        "book", "clock", "vase", "scissors", "teddy bear", "hair drier", "toothbrush"]
# get the details of the detected objects
v_boxes, v_labels, v_scores = get_boxes(boxes, labels, class_threshold)
# summarize what we found
for i in range(len(v_boxes)):
        print(v_labels[i], v_scores[i])
# draw what we found
draw_boxes(photo_filename, v_boxes, v_labels, v_scores)
```

OUTPUT:



RESULT:

An object detection model with YOLO3 using Keras/TensorFlow is successfully build.