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 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
                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"]

v_boxes, v_labels, v_scores = get_boxes(boxes, labels, class_threshold)

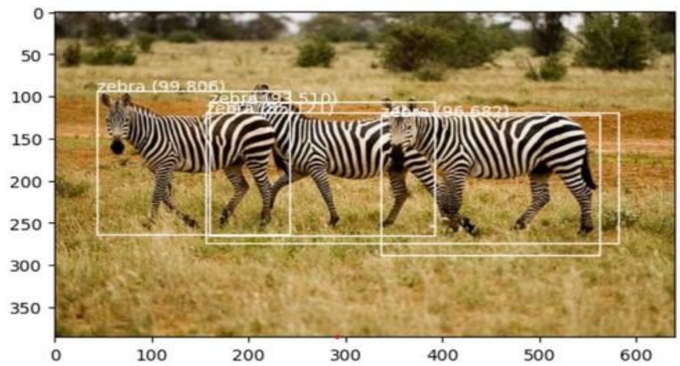
# summarize what we found
for i in range(len(v_boxes)):

print(v_labels[i], v_scores[i]) # draw

what we found

draw_boxes(photo_filename, v_boxes, v_labels, v_scores) Output:

```
WARNING:absl:No training configuration found in the save file, so the model was *not* compiled. Compile it manually.
1/1 ━━━━━━━━━━━━━━━━━━━━ 3s 3s/step
[(1, 13, 13, 255), (1, 26, 26, 255), (1, 52, 52, 255)]
zebra 99.80648159980774
zebra 93.50959062576294
zebra 85.12062430381775
zebra 96.68247699737549
```



Result: Object Detection using YOLO has been successfully implemented.