

1. In the below given cell, shape of the boxes.eval() is (1783,4). Why are there 1783 boxes? Explain the reason for it. What is the maximum number and minimum number you can get for that?
  - Change the values like mean and stddev in lines 2 and 4 as well as threshold value in line 5 and observe the different values you get for the boxes.eval().shape.

```
1 with tf.compat.v1.Session() as test_a:
2     box_confidence = tf.compat.v1.random_normal([19, 19, 5, 1], mean=1, stddev=4, seed = 1)
3     boxes = tf.compat.v1.random_normal([19, 19, 5, 4], mean=1, stddev=4, seed = 1)
4     box_class_probs = tf.compat.v1.random_normal([19, 19, 5, 80], mean=1, stddev=4, seed = 1)
5     scores, boxes, classes = yolo_filter_boxes(box_confidence, boxes, box_class_probs, threshold = 0.5)
6     print("scores[2] = " + str(scores[2].eval()))
7     print("boxes[2] = " + str(boxes[2].eval()))
8     print("classes[2] = " + str(classes[2].eval()))
9     print("scores.shape = " + str(scores.shape))
10    print("boxes.shape = " + str(boxes.shape))
11    print("classes.shape = " + str(classes.shape))
12    print(boxes.eval().shape)
```

Tensor("boolean\_mask/GatherV2:0", shape=(None,), dtype=float32) Tensor("random\_normal\_1:0", shape=(19, 19, 5, 4), dtype=float32)

scores[2] = 10.750582  
boxes[2] = [ 8.426533 3.2713668 -0.5313436 -4.9413733]  
classes[2] = 7  
scores.shape = (None,)  
boxes.shape = (None, 4)  
classes.shape = (None,)  
(1783, 4)

Answer –

The number of boxes (1783) observed is due to the filtering operation applied to randomly generated boxes. The filtering depends on box confidence, bounding box coordinates, and class probabilities.

- **Box Generation** - The boxes are generated using TensorFlow's `random\_normal` function with a given mean and standard deviation. The initial shape of these boxes is (19, 19, 5, 4). This indicates 19x19 grid cells, each predicting 5 bounding boxes, with each box having 4 coordinates.
- **Box Filtering** - The `yolo\_filter\_boxes` function filters boxes based on the confidence score and other criteria. Only boxes with confidence scores above the threshold (0.5 in the example) are retained.
- **1783 Boxes** - The count of 1783 boxes are the result of the filtering process, which depends on the randomly generated values and the threshold. This count can vary due to randomness.

### Maximum and Minimum Number of Boxes

Maximum Number - 1805 (19x19x5), if no boxes are filtered out.

Minimum Number - 0, if all boxes have confidence scores below the threshold.

### Effect of Changing Mean, Stddev, and Threshold

**Mean and Stddev** - Changing these values alters the distribution of generated boxes and

confidence scores, affecting the number of boxes that pass the threshold.

**Threshold** - Increasing the threshold reduces the number of boxes, while decreasing it allows more boxes.

2. yolo\_anchors.txt contains 10 values. They can be considered as height and width of 5 anchor boxes. What is the advantage of using such anchor boxes? What was the method used to determine the sizes of these anchor boxes?

Answer -

### 1. Advantage of Using Anchor Boxes

- **Predefined Shapes:** Anchor boxes allow the model to predict bounding boxes more effectively by providing predefined shapes that match the common aspect ratios of objects in the dataset. This helps in improving the accuracy and speed of object detection.
- **Scale and Aspect Ratio:** By having multiple anchor boxes with different scales and aspect ratios, the model can better detect objects of varying sizes and shapes.