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? Write these answers in a word file.
    - 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
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)
```

The number of boxes (1783) is a result of the filtering operation applied to randomly generated boxes. This filtering process is based on factors like box confidence, bounding box coordinates, and class probabilities.

Box Generation:

The boxes are generated using TensorFlow's random_normal function, which takes specified mean and standard deviation values. The initial shape of these generated boxes is (19, 19, 5, 4), representing a 19x19 grid of cells, with each cell predicting 5 bounding boxes, and each box having 4 coordinates.

Box Filtering:

The yolo_filter_boxes function filters these boxes according to their confidence scores and other criteria. Only the boxes with confidence scores higher than the threshold (0.5 in the example) are kept.

1783 Boxes:

The number 1783 refers to the boxes that remained after the filtering process, influenced by the randomness in box generation and the threshold. The count can vary depending on these factors.\

Maximum and Minimum Number of Boxes:

Maximum Number: 1805 (which is 19x19x5), if no boxes are filtered out.

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

Effect of Changing Mean, Stddev, and Threshold:

Mean and Stddev: Changing these values alters the distribution of the generated boxes and their confidence scores, impacting the number of boxes that meet the threshold.

Threshold: Increasing the threshold reduces the number of boxes that pass, while lowering it allows more boxes to pass through

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? Give the answers to these questions in the word file.

Advantage of Using Anchor Boxes:

Pre-defined Shapes: The anchor boxes enable the model to predict bounding boxes with higher proficiency by providing predefined shapes, which correspond to a common aspect ratio of objects in the dataset. This improves object detection accuracy and speed because it does not have to learn the shapes.

Scale and Aspect Ratio: The usage of multiple anchor boxes with diversified scales and aspect ratios in the object detection model will help the model capture objects of different sizes and shapes. This will also help the model generalize across a lot of object dimensions in the dataset.