**07. 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?**

* There we can get 1805 (19\*19\*5) boxes as initial boxes count before executing the yolo\_filter\_boxes function.
* **Initial Boxes=** 19x19x5 = 1805 boxes.
* **After the Filtering**: The yolo\_filter\_boxes function applies a threshold to the class scores. Boxes with a maximum class probability below this threshold are discarded. The number of remaining boxes depends on how many boxes have scores above the threshold we set.
* In our case, 1783 boxes remain, meaning that 22 boxes were filtered out because their highest-class probability was below 0.5(threshold).
* **maximum number** =1805
* **minimum number**=0

**8. 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?**

Anchor boxes are pre-defined boxes of various sizes and aspect ratios used in object detection algorithms like YOLO. Here's the advantage of using anchor boxes and how their sizes are determined:

* **Advantages of Anchor Boxes**
  + **Improved Accuracy:** Anchor boxes help the model converge faster and more accurately during training, especially for detecting objects of varying shapes and sizes. The model learns to predict offsets from these anchor boxes rather than predicting bounding boxes directly, which is a simpler task.
  + **Handling Different Scales:** Using multiple anchor boxes at different scales allows the model to detect both small and large objects within the same image.
  + **Faster Convergence:** By providing good initializations for bounding boxes, anchor boxes can significantly reduce the time taken for the model to learn optimal bounding box predictions.
* **Determining Anchor Box Sizes**
  + **K-Means Clustering:** A common method is to use k-means clustering on the ground truth bounding boxes in the training dataset. The centroids of the clusters become the anchor box dimensions. The value of 'k' determines the number of anchor boxes.
  + **Manual Selection:** In some cases, anchor boxes might be manually selected based on prior knowledge of the objects and their sizes in the dataset.

10. Download the output images zip file from the google drive and observe the bounding boxes in the autonomous driving dataset (i.e., 21 images from 0100.jpg to 0120.jpg). Select 2 images from these 21 images and,

* + Write what you observe regarding correctly detected objects, incorrectly detected objects, undetected objects and incorrect bounding boxes in the word file.
  + Include these output 2 images as well as the original 2 images in the word file.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| image | correctly detected objects | incorrectly detected objects | undetected objects | incorrect bounding boxes |
| 0111.jpg | 2 | 0 | 1 | 0 |
| 0120.jpg | 0 | 0 | 1 | 0 |

A road with trees and grass

Description automatically generated



A crosswalk with a bicycle painted on it

Description automatically generated

A crosswalk with traffic lights

Description automatically generated