Task : 08

Object detection:

Object detection is a phenomenon in computer vision that involves the detection of various objects in digital videos or images.

There are basic questions for detect an object:

1. What is an object ? (to identify the object in a specific image.)
2. Where is it ? (to establish the exact location of the object within the image.)

Object detection consists of various approaches such as faster R-CNN, single shot multibox detector(SSD), YOLO, Retina-net etc.

YOLO- You only look once

Yolo is a state of the art, object detection system. Yolo is an algorithm which uses neural networks to provide real time object detection. This algorithm is very popular and in use because of its speed and accuracy.
It has been used in various applications to detect traffic signals, parking meters, and animals.

The Yolo algorithm has gained popularity because of its superior performance over the aforementioned object detection techniques.

The YOLO algorithm employs convolutional neural networks (CNN) to detect the real time object. As the name suggests the algorithm requires only a single forward propagation through a neural network to detect an object. It means the prediction in the entire image is done in a single algorithm run. The CNN is used to predict various class probabilities and bounding boxes simultaneously.

The yolo algorithm consists of various variants as v1, v2, v3, v4, v5 etc

Why is yolo important ?

1. Speed :

   This algorithm is mostly popular because of its speed of detection due to it can predict objects in real-time.

2. High Accuracy:

   Yolo is a productive technique that provides accurate results with minimal background errors.

3. Learning capabilities:

   The algorithm has excellent learning capabilities that enable it to learn the representations of objects and apply them in object detection.

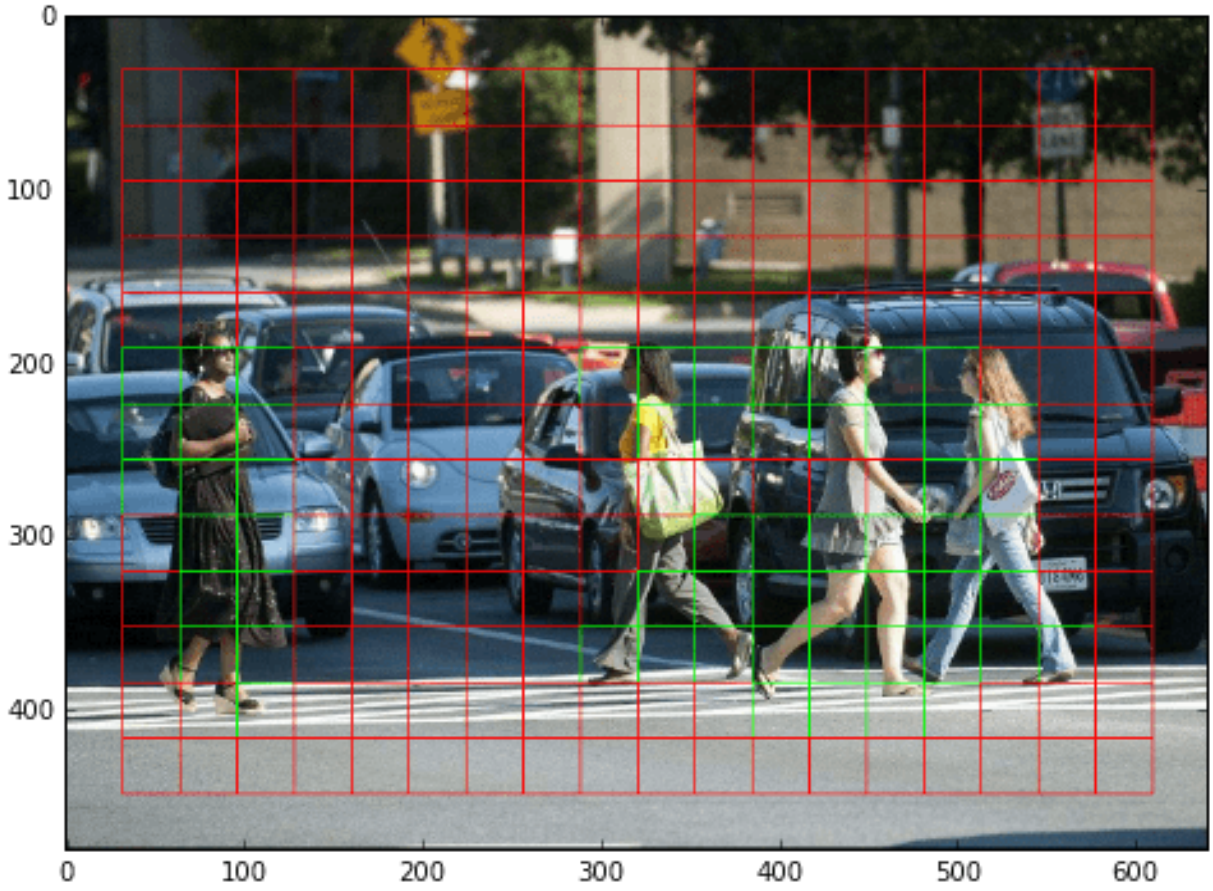
How does the yolo algorithm work ?

Three techniques used in yolo algorithm:

1. Residual blocks
2. Bounding box regression
3. Intersection Over Union (IOU)

1. Residual blocks:

First the image is divided into various grids. Each grid has a dimension of s*s.



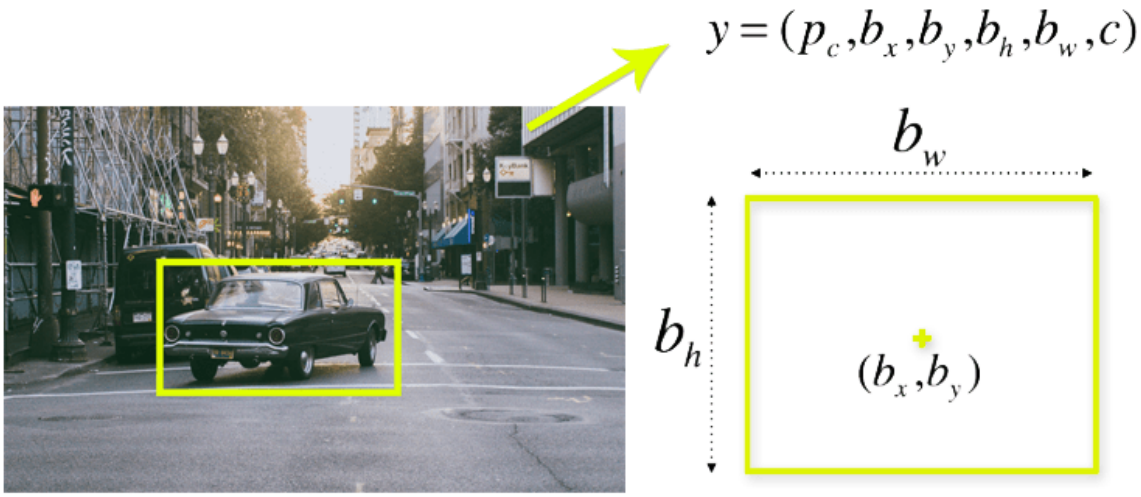
In this image there are many grids in equal dimensions. Every grid cell will detect objects that appear within them. For example the green colored grid cell has an object the lady this cell is responsible for detection itself.

2. Bounding box regression:

Bounding box is an outline that highlights objects in an image.

Every Bounding box in images consists of following attributes:

a. Width
b. Height
c. Class (person, light, traffic, car)
d. Counting vox centre (bx,by)



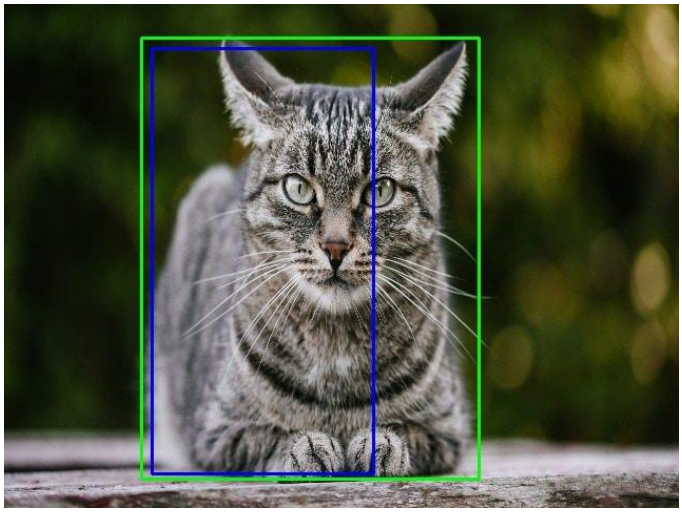
In this image the car is an object and the yellow outline is a bounding box. Yolo used single bounding box regression to predict the height, width, center and class of the object.

3. Intersection over union (IOU) :

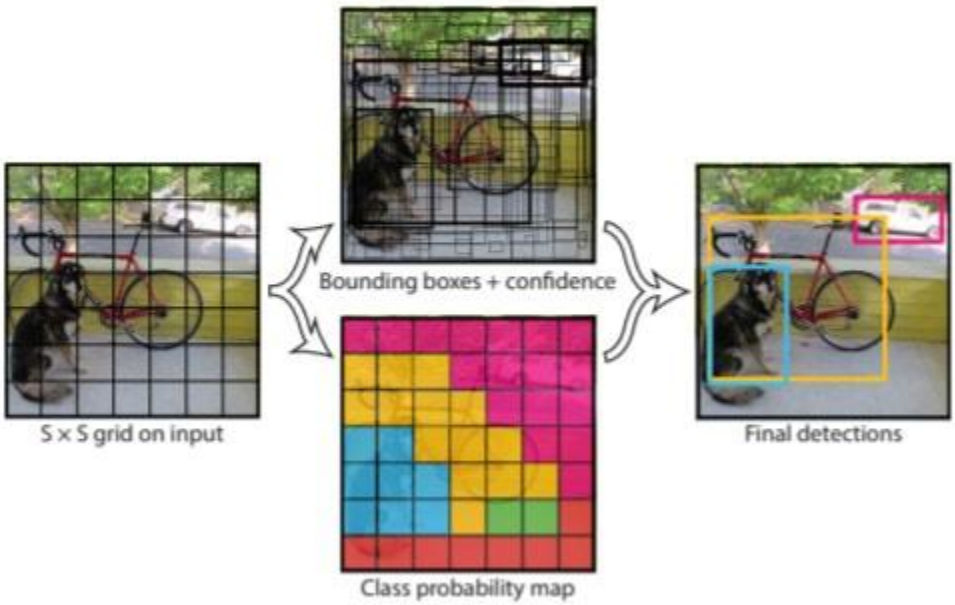
Intersection over union (IOU) is a phenomenon in object detection that describes how boxes overlap. Yolo uses IOU to provide an output box that sounds the objects perfectly.

Each grid cell is responsible for prediction of the bounding boxes and their confidence scores. The IOU is equal to 1 if the predicted bounding box is the same as the real box. This mechanism eliminates bounding boxes that are not equal to the real box.

In the following images there are two bounding boxes, one in green and the other one in blue. The blue box is the predicted box while the green box is the real box. YOLO ensures that the two bounding boxes are equal.



Combination of the three techniques:



1. The image is divided into a grid.
2. Each grid cell forecasts B bounding boxes and provides their confidence scores.
3. The cells predict the class probabilities of the class of each object.

For example, we can notice at least three classes of objects: car, cat, dog and a bicycle. All the predictions are made simultaneously using a single convolutional neural network.

Intersections over union ensure that the predicted bounding boxes are equal to the real boxes of the objects. This phenomenon eliminates unnecessary bounding

boxes that do not meet the characteristics of the objects. The final detection will consist of unique bounding boxes that fit the objects perfectly.
For example the car is surrounded by the pink bounding box while the bicycle is surrounded by the yellow bounding box. The dog has been highlighted using the blue bounding box.

Applications of yolo:

1. Autonomous driving:

   The Yolo algorithm can be used in autonomous cars to detect objects around cars such as vehicles, people and parking signals. Object detection in autonomous cars is done to avoid collision since no human driver is controlling the car.

2. Wildlife:

   This algorithm is used to detect various types of animals in forests. This type of detection is used by wildlife rangers and journalists to identify animals in videos and images.

3. Security:

   Yolo can be used in security systems to enforce security in an area. Let's assume that people have been restricted from passing through a certain area for security reasons. If someone passes through the restricted area, the yolo algorithm will detect him/her, which will require the security personnel to take further action.