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→ State of Computer Vision

→ (week3) Object Detection
1- identify object
2- localize

→ object localization
. inorder to design object recognition we must learn about object localization.
. if we want to localize the object in image we modify the neural network to have output units the boundey box $b_x, b_y, b_h, b_w$
($b_x, b_y$ → midpoint; $b_h$ → height; $b_w$ → width)
. localize focuses determing the positions of objects in image

→ land Mark detection
. in other cases NN have xy cordinates, which are important point in image these points called landmarks we want the model to recognize
. used in Snapchat filters & Posture detection

→ object detection
. we will take about using convnet for obj detection using something called sliding window.
. for exi: Car detection only. first: we need to create a label training set with closely croped x & y examples of cars


second train Convnets using this set to output 0 or 1 if there is car or not

Third use's slide window by picking certin window size and apply it to the image then input it to conv net that make prediction

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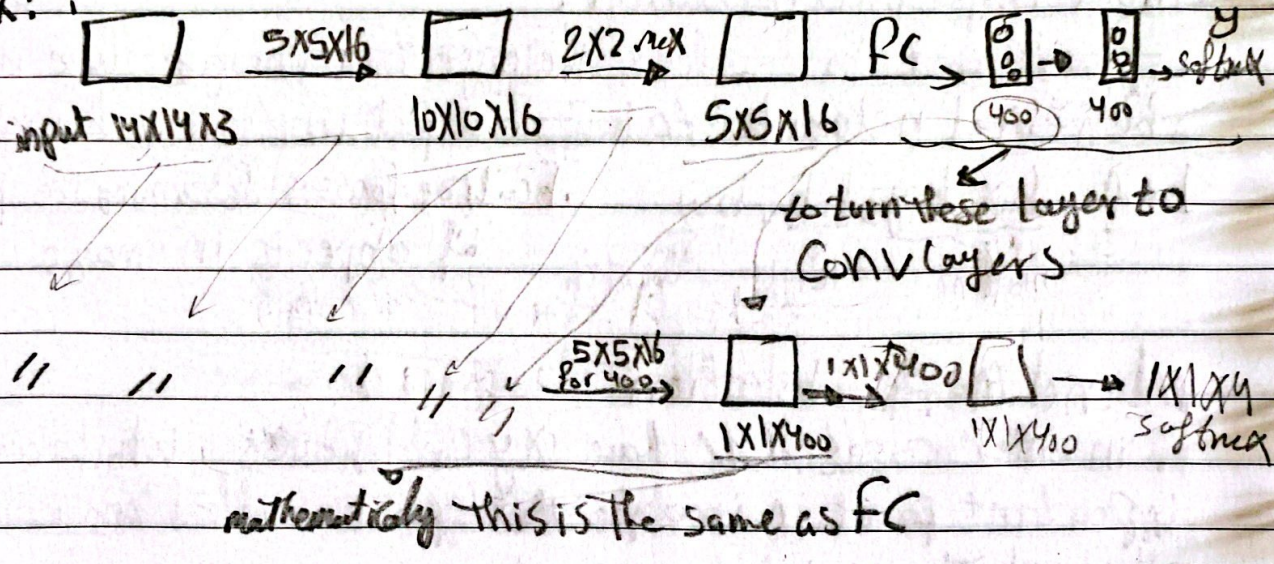
→ Convolutional implementation of sliding windows.
• we saw that sliding window was to slow & has a high computional cost, how can we implement it convolutionaly
• let see first how can we transform a fully connected layer of neural network into conv layer

ex:




mathematicaly this is the same as FC

→ intersection over union (IOU)
• we use it to evaluate obj. detection alg.

$$= \frac{\text{size of intersection}}{\text{size of union}} \quad \text{if iou} \geq 0.5 \text{ :)}$$

→ non-max suppression
• its a way to make sure that the alg. only detects obj once
• each output $\begin{bmatrix} P_c \\ b_x \\ b_y \\ b_h \\ b_w \end{bmatrix}$ → Discard $P_c < 0.6$
↳ picks the box with the highest $P_c$ & output that as prediction

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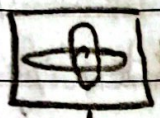
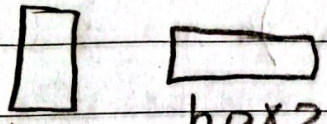
## anchor boxes

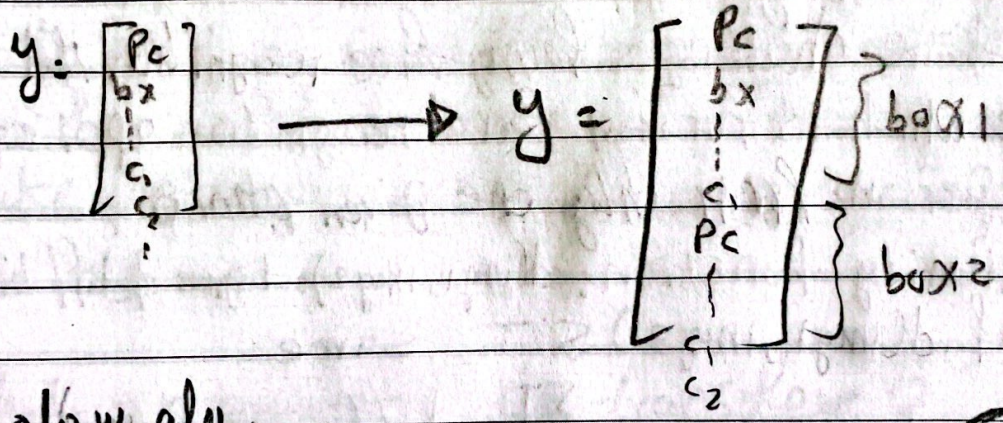
- if each of grid cells detect one object what if grid cell wants to detect multiple objects heres anchor boxes are used



overlapping objects

anchor boxes predfined two box shape




→ yolow obj.

if $y = 3 \times 3 \times 2 \times 8$

anchors, num of classes