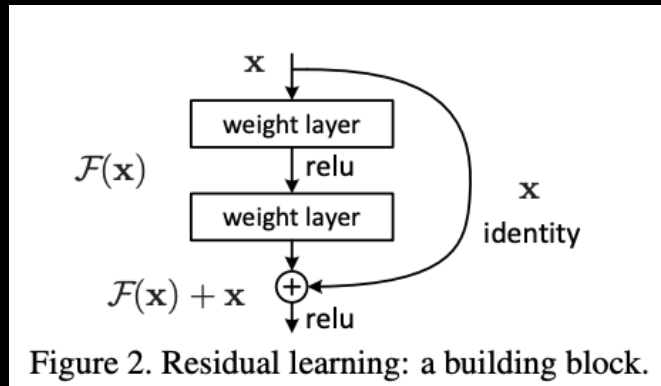


Today's Agenda

RESNET → Residual Learning



Vanish Grad
Accuracy Degrad

$x \rightarrow$ Input

$F(x) \rightarrow$ Info loss

Skip Connection

$F(x) + x$

Identity Mapping Operation

GoogLeNet → Auxiliary Classifiers
Softmax 0, 1

* { DenseNet } *
* { MobileNet } *

Object Detection

What?

Where?

location of the object

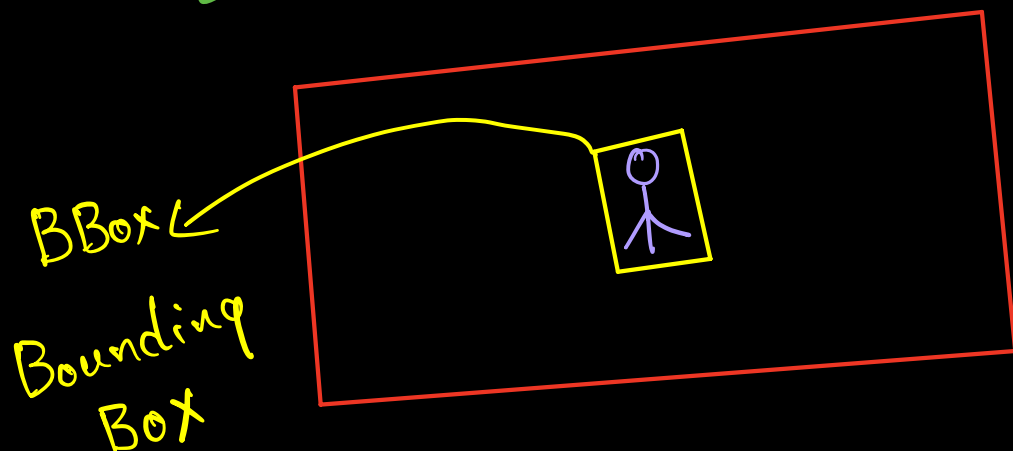
What + When

{ Classification + Regression }

Identification & Location

Classify each object

Localization of the object



Working of Obj Detect

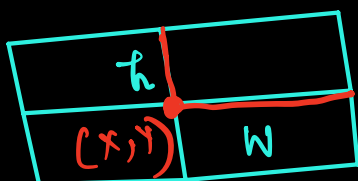
- 1) Input Image
- 2) CNN Backbone \rightarrow VNet, Resnet, Inception
- 3) Classification + Regression

Output :-

- 1) Class Label
- 2) BBox Coordinates
- 3) Confidence Scores
- * (4) Total no of objects *

BBOX Co-ordinates

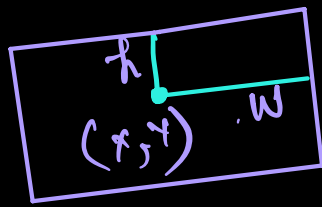
(x, y, w, h)



$(x, y) \rightarrow$ mid/center

$(w) \rightarrow$ width

$(h) \rightarrow$ height



$$\begin{pmatrix} x \\ y \end{pmatrix}$$

$$\begin{pmatrix} x + w \\ y + h \end{pmatrix}$$

Loss Functions

C.L = Classification Loss (Cross Entropy)
 R.L = Regression Loss (Smooth L1 / L2)

$$\text{Combined Loss} = \text{C.L} + \text{R.L}$$

Regression
loss

$$\lambda_{\text{coord}} \sum_{i=0}^{S^2} \sum_{j=0}^B \mathbb{1}_{ij}^{\text{obj}} \left[(x_i - \hat{x}_i)^2 + (y_i - \hat{y}_i)^2 \right]$$

$$+ \lambda_{\text{coord}} \sum_{i=0}^{S^2} \sum_{j=0}^B \mathbb{1}_{ij}^{\text{obj}} \left[\left(\sqrt{w_i} - \sqrt{\hat{w}_i} \right)^2 + \left(\sqrt{h_i} - \sqrt{\hat{h}_i} \right)^2 \right]$$

Confidence
loss

$$+ \sum_{i=0}^{S^2} \sum_{j=0}^B \mathbb{1}_{ij}^{\text{obj}} (c_i - \hat{c}_i)^2$$

$$+ \lambda_{\text{noobj}} \sum_{i=0}^{S^2} \sum_{j=0}^B \mathbb{1}_{ij}^{\text{noobj}} (c_i - \hat{c}_i)^2$$

Classification
loss

$$+ \sum_{i=0}^{S^2} \mathbb{1}_i^{\text{obj}} \sum_{c \in \text{classes}} (p_i(c) - \hat{p}_i(c))^2$$

Common Challenges

- 1) Small Object
- 2) Class Imbalance
- 3) Overlapping Objects

Evaluation Metrics

IOU \rightarrow Intersection Over Union

MAP \rightarrow Mean Average Precision

Object Detection Family

Single Stage

2016

YOLO
SSD

Two Stage

2014

RCNN

Family

RCNN

FAST RCNN

FASTER RCNN

MASK RCNN

Very Fast
Low Accuracy
30 ~ 60 FPS

High Acc
Slow
5-15 FPS