CmpE258
Part II, Review & Yolo4

March 18

Example: 1° moments Definition

$$\iint_{\Omega} (x-\bar{x})^k B(x,y)\,dx\,dy \quad \cdots (1)$$

$$\sum_{y=0}^{N-1}\sum_{x=0}^{M-1}(x-\bar{x})^k B(x,y) \quad \cdots (1^*)$$

$$m_{pq} = \iint (x-\bar{x})^p (y-\bar{y})^q B(x,y)\,dx\,dy \quad \cdots (2)$$

moment(s) for $p = 0, 1, 2, \ldots$, $q = 0, 1, 2, \ldots$,

Let $q=0$, Eqn(2) becomes Eqn(1)

$p = k$

Let $p=0, q=2$, to get Eqn(4) from the ppt Example.

$$m_{pq} = \sum_{y=0}^{N-1}\sum_{x=0}^{M-1}(x-\bar{x})^p (y-\bar{y})^q B(x,y) \quad \cdots (2^*)$$

Note: Eqn (2^*) is implemented as one of the OpenCV function.

Use $I(x,y)$ (Binary Image $B(x,y)$) to Compute a (from Eqn (1^*)).

$k=2$

$$a = \sum_{y=1}^{4}\sum_{x=1}^{4}(x-\bar{x})^2 B(x,y)$$

Suppose we have Computed $\bar{x}$ already.

$$= \sum_{y=1}^{4}\sum_{x=1}^{4}(x-\bar{x})^2 B(x,y)$$

$$= \sum_{y=1}^{4}\Big[(1-\bar{x})^2 B(1,y) + (2-\bar{x})^2 B(2,y) + (3-\bar{x})^2 B(3,y) + (4-\bar{x})^2 B(4,y)\Big]$$

$$= (1-\bar{x})^2 B(1,4) + (2-\bar{x})^2 B(2,3) + (2-\bar{x})^2 B(2,4) + (3-\bar{x})^2 B(3,2) + (4-\bar{x})^2 B(4,1)$$

$$= (1-\bar{x})^2 + (2-\bar{x})^2 \cdot 2 + (3-\bar{x})^2 + (4-\bar{x})^2$$

Example = { External Contours, Tree Contours }

TreeList → Pattern

"Build Tree" for this

Review.

1) Midterm 1 1/2 hr.

2) Formula sheet is allowed, No Example, No Verbal Explanation, Close Book, close Notes

3) ~3 Questions
a Math. Formulation, Calculation.
b Design/Implementations

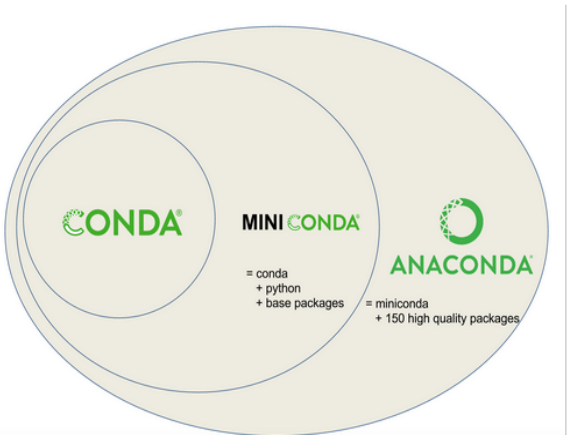
4) Subjects.

a F.NN, b Preprocessing Functions
Neurons, Weight $\sum_{i=1}^{N} w_i x_i$ B(x,y); $\bar{x}, \bar{y}$; Orientation; moments

c Convolutions CNN
Kernel, Computation.
Activation Function

April 8 (Thur) PART II Yolo
1. midterm key posted on github
2. Team final project Presentation (semester Long Project)
3. Yolo 4 4. Anaconda

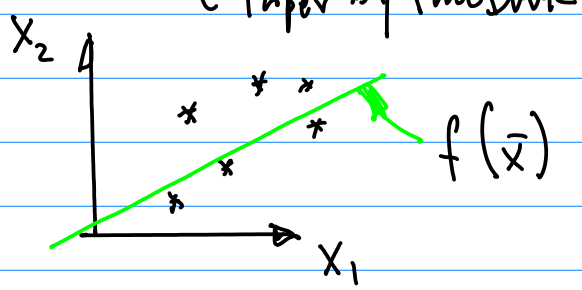
Introduction on Anaconda
https://kaust-vislab.github.io/python-novice-gapminder/00-getting-started-with-conda/index.html



Example: Yolo4 github Repo.
Ref: Readme.txt on github.
Step1. Anaconda is installed on your machine
Step2. Source Code Repo github.
Step3. Create GPU Environment By Anaconda
Step4 Activate the gpu environment
Step5. Download pre-trained Weights (yolo4)

Repo: Implementation
- a Anaconda
- b github → Customization

Theoretical Foundation
- PPT
- Paper by FaceBook AI.



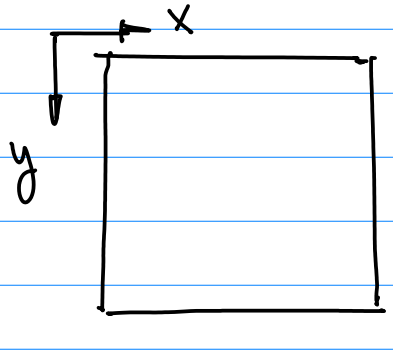
Step6. Convert the weights in DARKNET to T.F. format.

Step7. Run the code for either Video or Image(s).

Notations & Mathematical Formulation

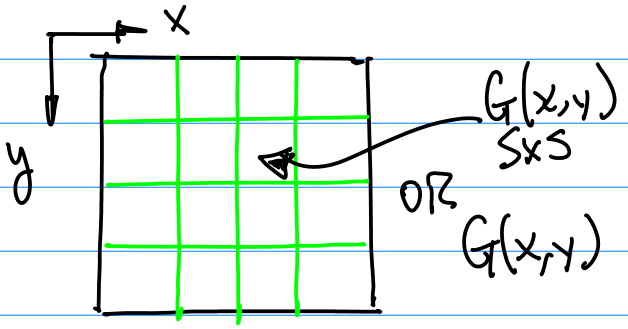
1. Image $I(x,y)$, $I_{m \times n}(x,y)$

Subscript → m x N Resolution



2. Divide $I(x,y)$ into SxS pixels

Each SxS pitch/Title/Subimage is defined as grid $G(x,y)$



3. Bounding Box, e.g. R.O.I. (Region of Interests) → Localized ROI on a given object $B(x,y)$

Note: The size of $B(x,y)$ is different from the size of $G(x,y)$, And it is usually bigger than $G(x,y)$.

Note: Each Bounding Box is required for Each Object, the objects may belong to Same class or different classes.

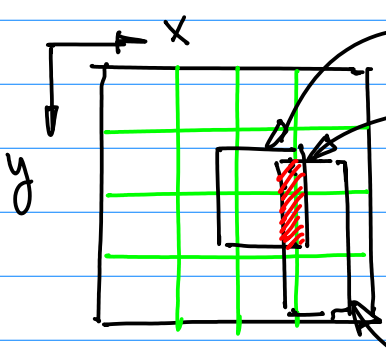
$B_j(x,y)$, for $j=1,2,\ldots,m$;

4. Object(s)

$O_i(x,y)$ for $i=1,2,\ldots,K$

i = center of the Object; K = total Objects

5. IOU (Intersection of Union)



IOU Truth

$$IDU = \begin{cases} 1 & B_p(x,y) = B_q(x,y) \\ [0,1) & \text{o/w} \end{cases} \quad \dots (1)$$

6. Five parameters defined for $B_{ij}(x,y)$. $\{\underbrace{x, y}_{\text{Centroid}}, W, H, \underbrace{f(B_j(x,y))}_{\text{Confidence}}\}$

$B_1(x,y)$ $f(B_1(x,y)) = f(B_1)$

$B_2(x,y)$ .. $f(B_2)$

$\vdots$

$B_M(x,y)$ $f(B_m)$

If Confidence $f(B_j(x,y))$ Representing Probability value

$$\sum_{j=1}^{m} f(B_j(x,y)) = 1 \quad \dots (2)$$

7. Define probability for Each object as follows

$$Prob(O_i(x,y)) = Prob(O_i) \quad \dots (3)$$

8. Denote classes as

C_i, for $i = 1, 2, \dots, N$;

Hence, the probability for C_i is

$$Prob(C_i)$$

$$\sum_{i=1}^{N} Prob(C_i) = 1 \quad \dots (4)$$

9, Define Condition Probability.

$$Prob(C_i | O_j) \quad \dots (5)$$

Given an object O_j, find the Probability of C_i, e.g. ~ that this object belongs to class i

$$\sum_{i=1}^{N} Prob(C_i | O_j) = 1 \quad \dots (5b)$$