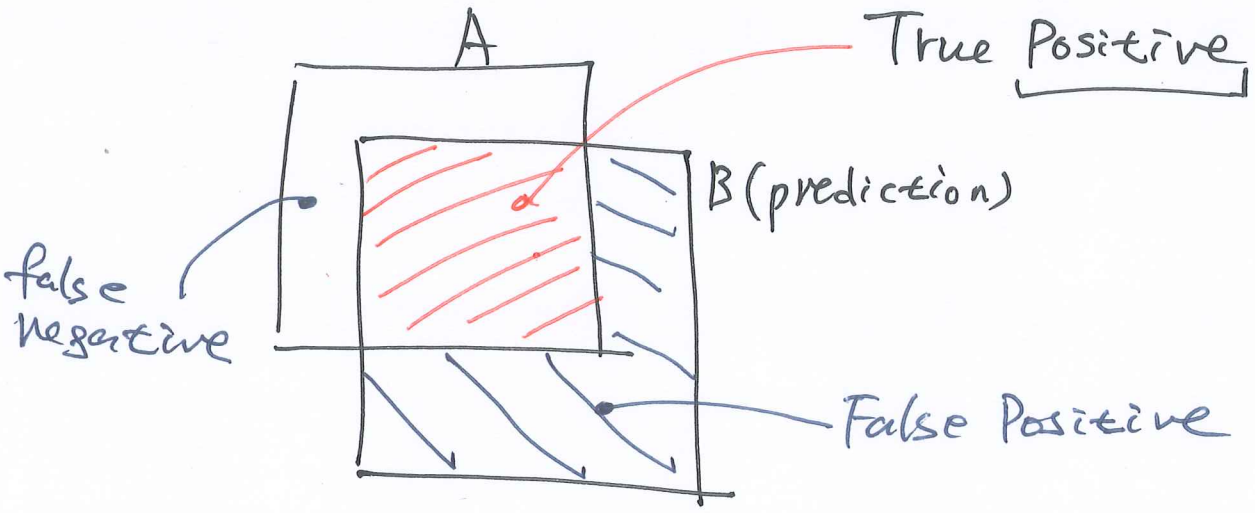
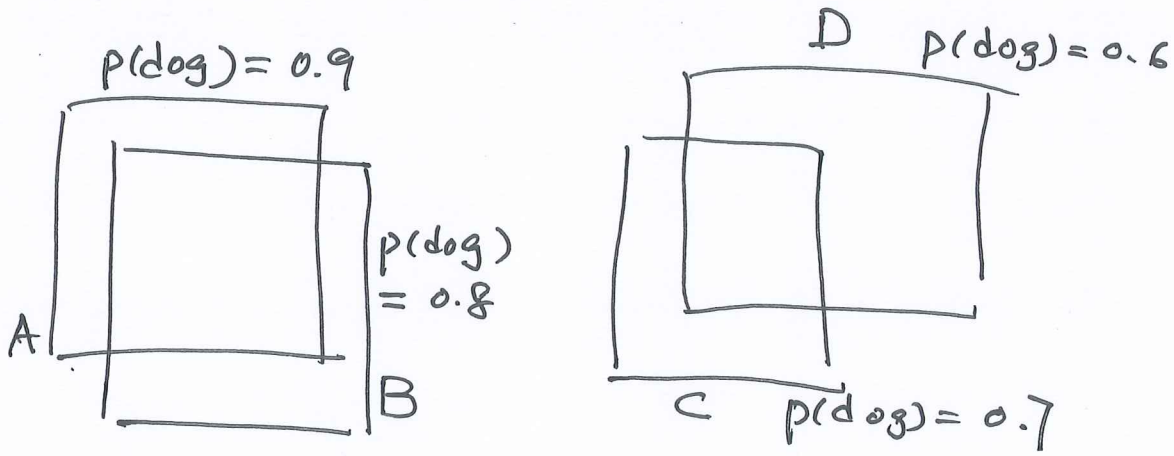

A
True Positive
B (prediction)
false negative
False Positive

choose a binding box for each dog.

dog



$P = \{A, B, C, D\}$

Step 1: A is selected ∵ $p(dog) = 0.9$ is the largest in P

$P = \{B, C, D\}$

Step 2: $IoU(A, B) > T$, $IoU(A, C) < T$, $IoU(A, D) < T$ → $P = \{\cancel{B}, C, D\}$, $K = \{A\}$

Step 1: C is selected ∵ $p(dog) = 0.7$ is the largest in P

Step 2: $IoU(C, D) > T$ → $P = \{\cancel{C}\cancel{D}\}$

$K = \{A, C\}$

Final list of predictions

12 dog boxes (ground truth)

missing 5

prediction	1st	2nd	3rd	4th	5th	6th	7th
confidence level	0.63	0.77	0.92	0.86	0.88	0.58	0.91
	TP	TP	TP	FP	TP	TP	FP

IoU = 0.5

ranking

	3rd	7th	5th	4th	2nd	1st	6th
Confidence level	0.92	0.91	0.88	0.86	0.77	0.63	0.58
	TP	FP	TP	FP	TP	TP	TP
cumulative TP	1	1	2	2	3	4	5
cumulative FP	0	1	1	2	2	2	2
precision $\frac{TP}{TP+FP}$	$\frac{1}{1+0}=1$	$\frac{1}{1+1}=0.5$	$\frac{2}{2+1}=0.67$	$\frac{2}{2+2}=0.5$	$\frac{3}{3+2}=0.6$	$\frac{4}{4+2}=0.67$	$\frac{5}{5+2}=0.71$
Recall $\frac{TP}{12}$	$\frac{1}{12}=0.08$	$\frac{1}{12}=0.08$	$\frac{2}{12}=0.17$	$\frac{2}{12}=0.17$	$\frac{3}{12}=0.25$	$\frac{4}{12}=0.33$	$\frac{5}{12}=0.42$

(1, 0.08) (0.67, 0.17) (0.6, 0.25) (0.71, 0.42)

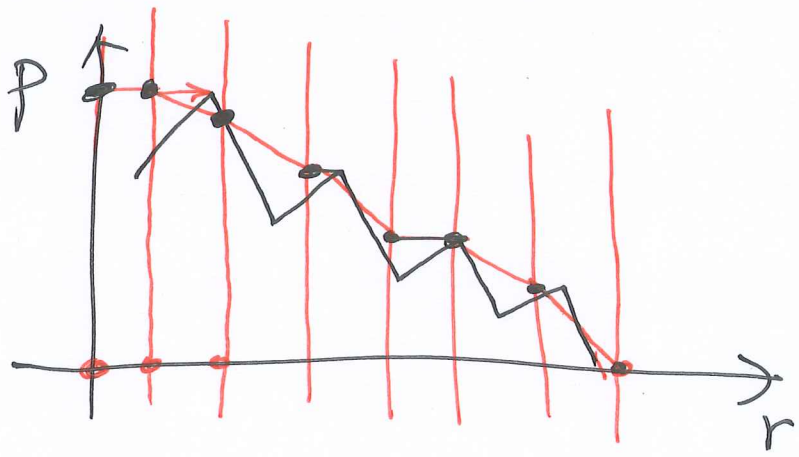
(0.5, 0.08) (0.5, 0.17) (0.67, 0.33)

Interpolated value	1	0.71	0.71	0.71	0.71	0	

0 0.1 0.2 ... 1 Recall

11 precision values

1st 11th



$$AP = \frac{1 + 0.71 + 0.71 + 0.71 + 0.71}{11}$$

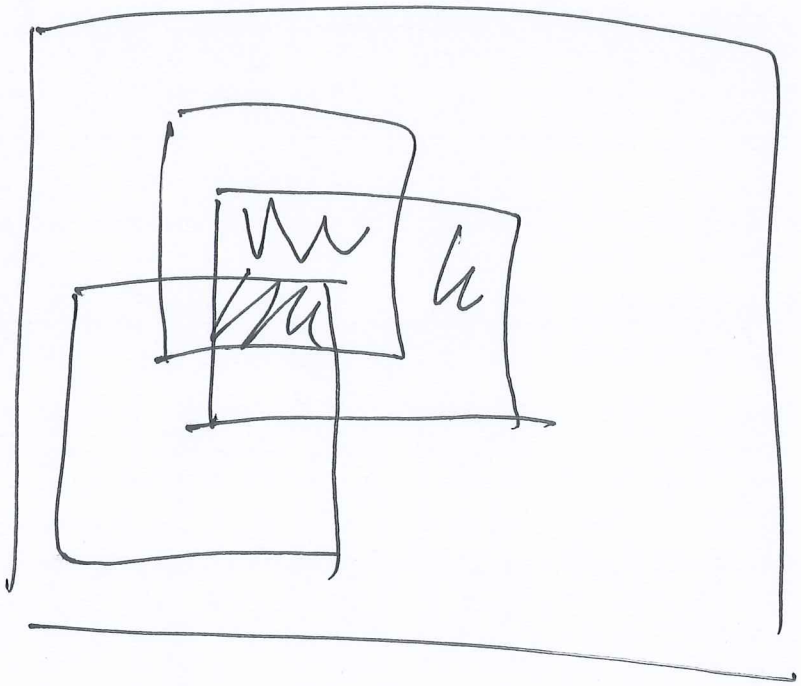
$$= 0.349 \ (34.9\%)$$

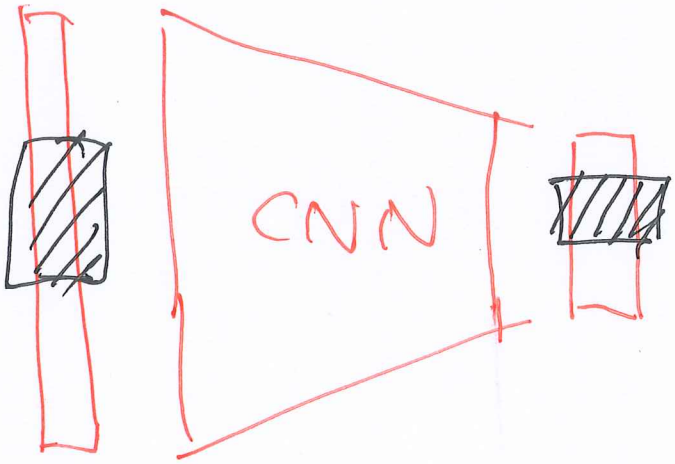
	dog	person	sheep	truck	teddy
AP_i	34.9%	54.5%	0%	100%	50%

$$mAP = \frac{1}{N} \text{Sum}(AP_i)$$

$$= 47.88\%$$

mAP @ 0.5 = 47.88%




CNN

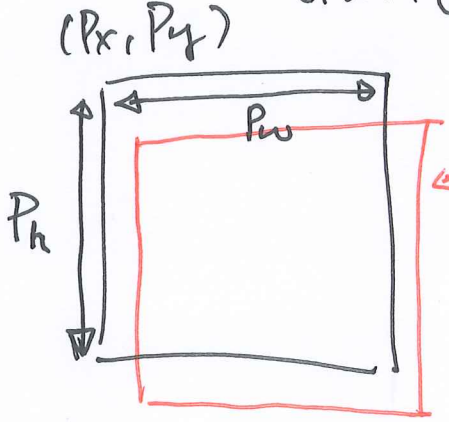
region proposal

(P_x, P_y, P_w, P_h)

change

(b_x, b_y, b_w, b_h)

ground truth : good fit



loss

$$b_x = P_x + P_w t_x \quad \rightarrow \quad t_x = \frac{b_x - P_x}{P_w}$$

$$b_y = P_y + P_h t_y \quad \rightarrow \quad t_y = \frac{b_y - P_y}{P_h}$$

$$b_w = P_w e^{t_w} \quad \rightarrow \quad t_w = \log\left(\frac{b_w}{P_w}\right)$$

$$b_h = P_h e^{t_h} \quad \rightarrow \quad t_h = \log\left(\frac{b_h}{P_h}\right)$$

↑ modification parameters