Evaluation Metrics for Object Detection

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- Intersection over Union (IoU)

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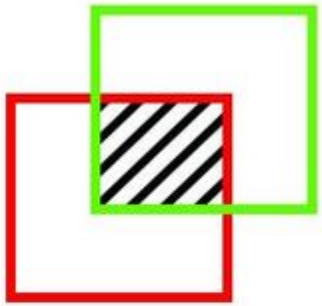
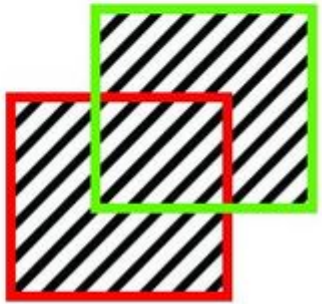
- Intersection over Union (IoU)
- mean Average Precision (mAP)

Analytics Vidhya

Intersection over Union (IoU)

$$IoU = \frac{\text{Area of Intersection}}{\text{Area of Union}}$$

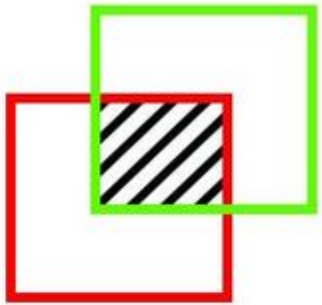


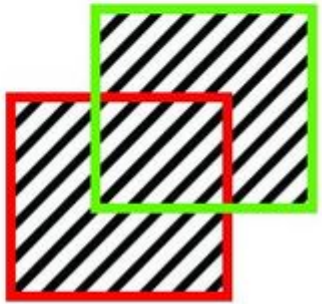


Analytics Vidhya

Intersection over Union (IoU)

$$IoU = \frac{\text{Area of Intersection}}{\text{Area of Union}} > \text{threshold}$$





True Positive

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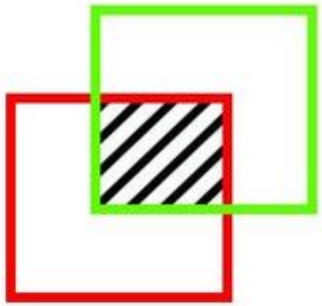
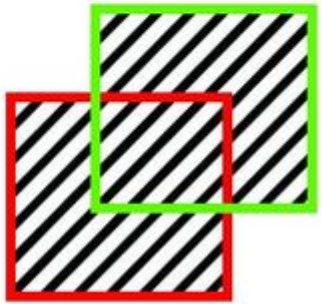
Intersection over Union (IoU)

$$IoU = \frac{\text{Area of Intersection}}{\text{Area of Union}}$$





< threshold

False Positive

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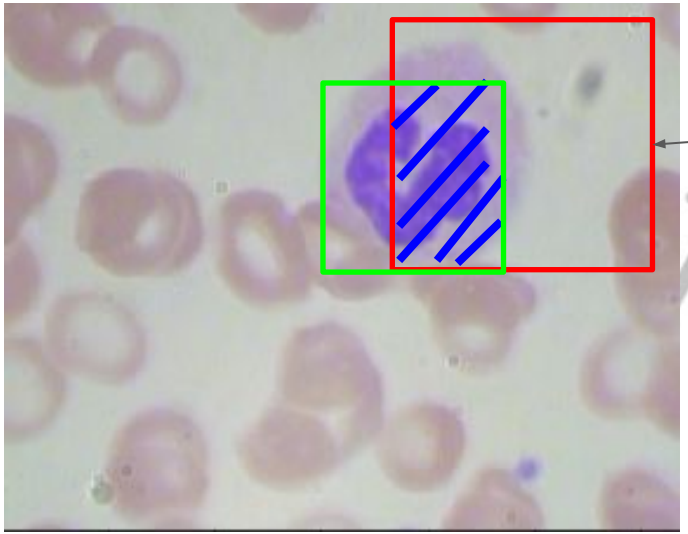
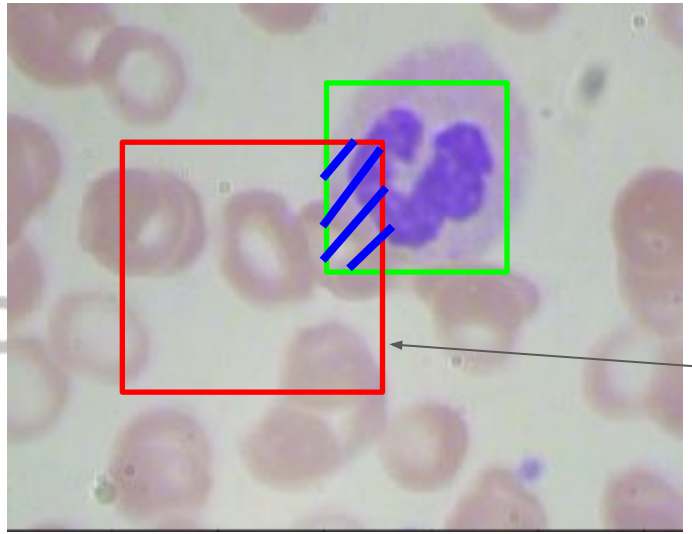
Intersection over Union (IoU)





True Positive

Actual class and predicted class

False Positive

Object not present in the bounding box

Precision

$$precision = \frac{TP}{TP + FP}$$

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Precision

Predicted	IoU
Bounding Box 1	0.7
Bounding Box 2	0.2
Bounding Box 3	0.9
Bounding Box 4	0.8
Bounding Box 5	0.4

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Precision

Predicted	IoU	TP/ FP
Bounding Box 1	0.7	TP
Bounding Box 2	0.2	FP
Bounding Box 3	0.9	TP
Bounding Box 4	0.8	TP
Bounding Box 5	0.4	FP

Analytics Vidhya

Precision

Predicted	IoU	TP/ FP
Bounding Box 1	0.7	TP
Bounding Box 2	0.2	FP
Bounding Box 3	0.9	TP
Bounding Box 4	0.8	TP
Bounding Box 5	0.4	FP

$$precision = \frac{TP}{TP + FP}$$

$= \frac{3}{5}$

$= 0.6$

Average Precision

$$precision = \frac{TP}{TP + FP}$$

$$AP = \frac{1}{N} \Sigma\ precision_i$$

Average Precision

Predicted	IoU	TP/ FP
Bounding Box 1	0.7	TP
Bounding Box 2	0.2	FP
Bounding Box 3	0.9	TP
Bounding Box 4	0.8	TP
Bounding Box 5	0.4	FP

Average Precision

Predicted	IoU	TP/ FP	$Precision_i$
Bounding Box 1	0.7	TP	1
Bounding Box 2	0.2	FP	
Bounding Box 3	0.9	TP	
Bounding Box 4	0.8	TP	
Bounding Box 5	0.4	FP	

Average Precision

Predicted	IoU	TP/ FP	$Precision_i$
Bounding Box 1	0.7	TP	1
Bounding Box 2	0.2	FP	1
Bounding Box 3	0.9	TP	
Bounding Box 4	0.8	TP	
Bounding Box 5	0.4	FP	

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Average Precision

Predicted	IoU	TP/ FP	$Precision_i$
Bounding Box 1	0.7	TP	1
Bounding Box 2	0.2	FP	1
Bounding Box 3	0.9	TP	⅔ =0.66
Bounding Box 4	0.8	TP	0.75
Bounding Box 5	0.4	FP	0.75

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Average Precision

Predicted	IoU	TP/ FP	$Precision_i$
Bounding Box 1	0.7	TP	1
Bounding Box 2	0.2	FP	1
Bounding Box 3	0.9	TP	0.66
Bounding Box 4	0.8	TP	0.75
Bounding Box 5	0.4	FP	0.75

$$AP = \frac{1}{N} \Sigma\ precision_i$$

$$= \frac{1}{5} (4.16)$$

$$= 0.832$$

Average Precision

$$precision = \frac{TP}{TP + FP}$$

$$AP = \frac{1}{N} \Sigma\, precision_r$$

$$mAP = \frac{\sum_{i=1}^{K} AP_i}{K}$$

Average across all class

Thank You

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Average Precision

$$precision = \frac{TP}{TP + FP}$$

At a defined threshold

$$AP = \frac{1}{N} \Sigma\, precision_r$$

Average at different threshold

$$mAP = \frac{\sum_{i=1}^{K} AP_i}{K}$$

Average across all class

Precision

Predicted	IoU
Bounding Box 1	0.7
Bounding Box 2	0.2
Bounding Box 3	0.9
Bounding Box 4	0.8
Bounding Box 5	0.4

Analytics Vidhya

Precision

Predicted	IoU	TP/ FP
Bounding Box 1	0.7	TP
Bounding Box 2	0.2	FP
Bounding Box 3	0.9	TP
Bounding Box 4	0.8	TP
Bounding Box 5	0.4	FP

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Precision

Predicted	IoU	TP/ FP
Bounding Box 1	0.7	TP
Bounding Box 2	0.2	FP
Bounding Box 3	0.9	TP
Bounding Box 4	0.8	TP
Bounding Box 5	0.4	FP

$$precision = \frac{TP}{TP + FP}$$

$= \frac{3}{5}$

$= 0.6$