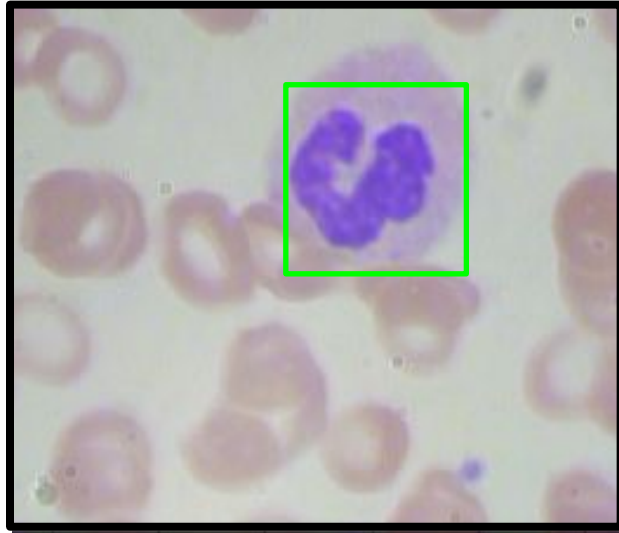


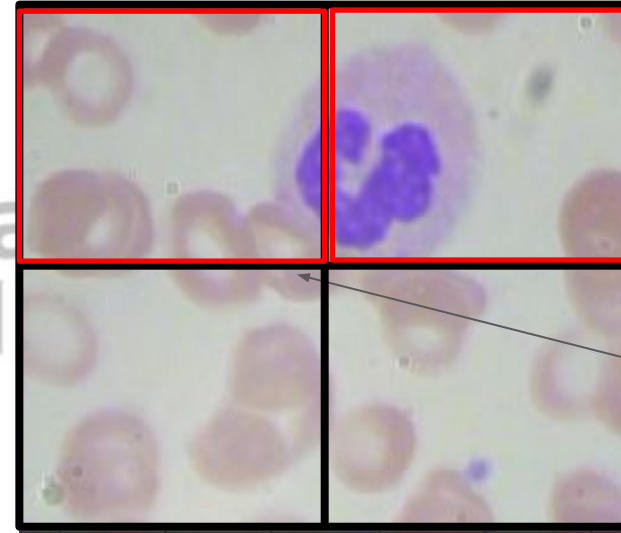
Understanding Intersection Over Union

Selecting Bounding Box



Original Bounding Box

Ana
Vid



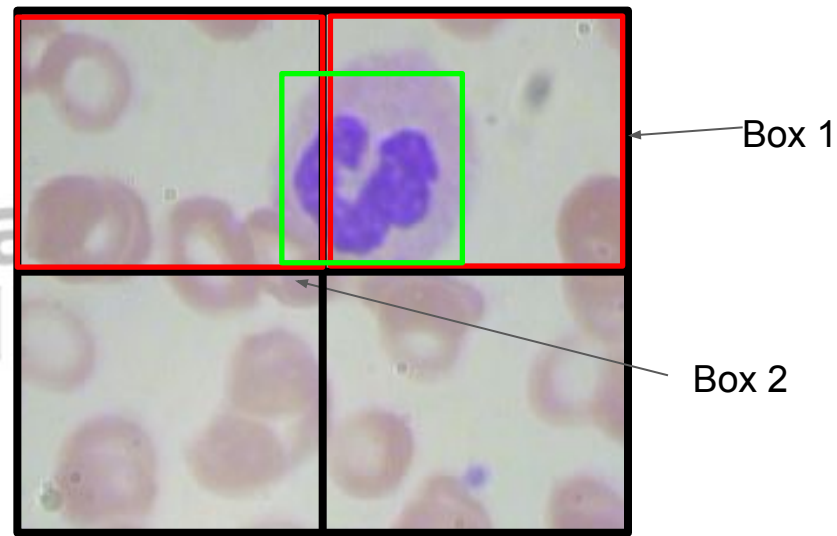
Box 1

Box 2

Predicted Bounding Boxes

Selecting Bounding Box

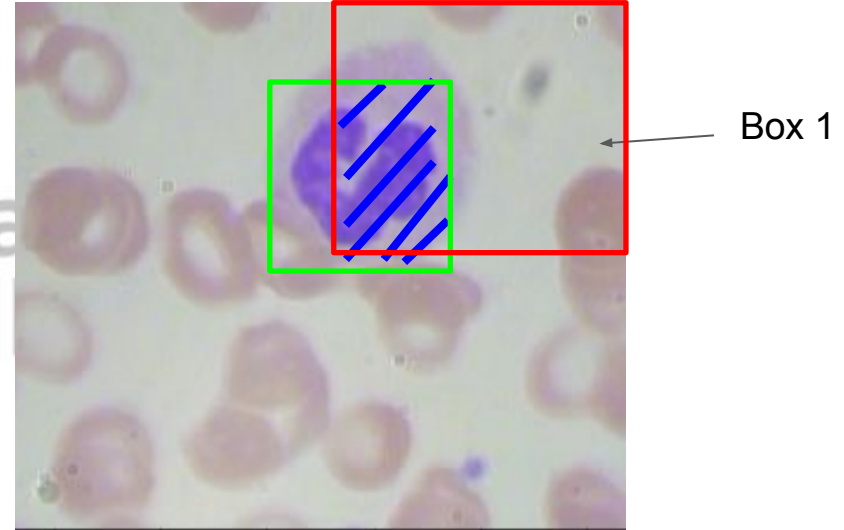
Which Bounding Box is more accurate?



Predicted Bounding Boxes

Bounding Box Intersection

Which Bounding Box is more accurate?

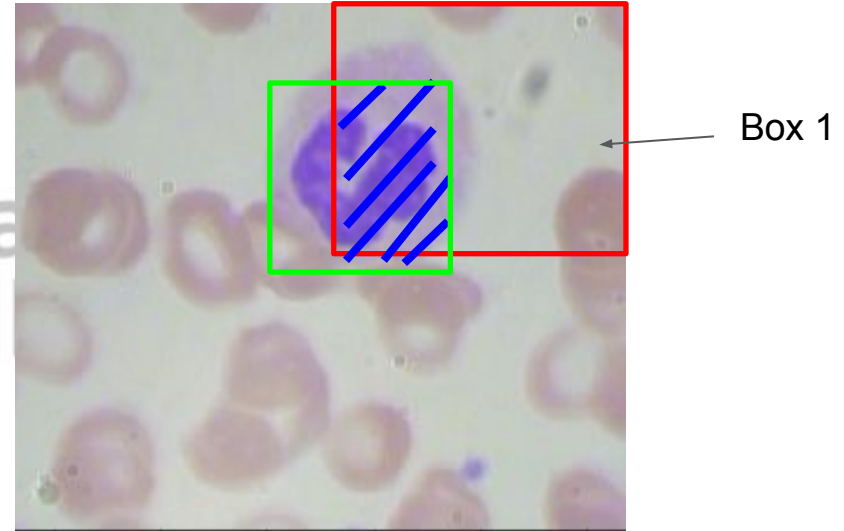


Predicted Bounding Boxes

Bounding Box Intersection

Which Bounding Box is more accurate?

Area of Intersection = 70%

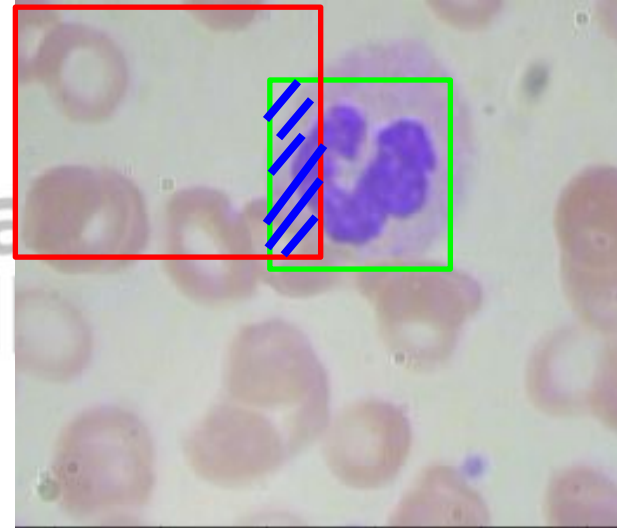


Predicted Bounding Boxes

Bounding Box Intersection

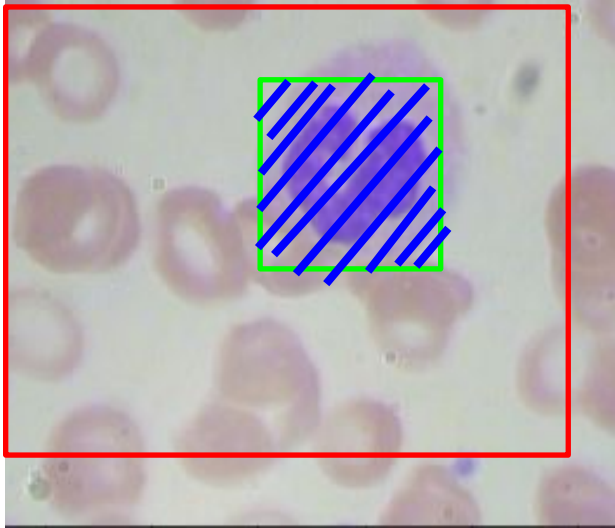
Which Bounding Box is more accurate?

Area of Intersection = 20%

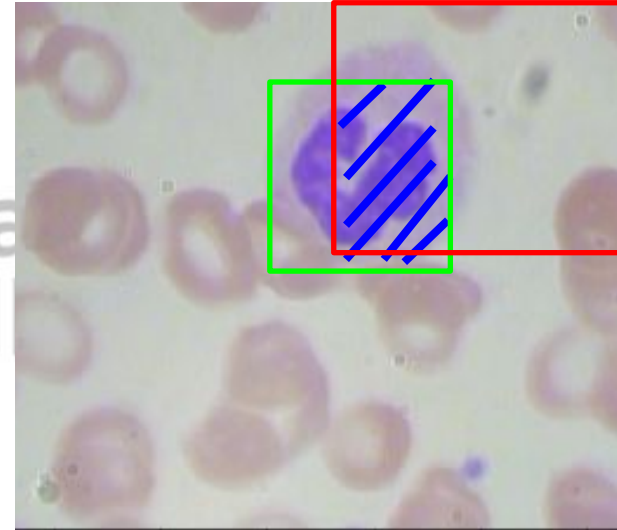


Predicted Bounding Boxes

Problem with Bounding Box Intersection



Area of Intersection = 100%

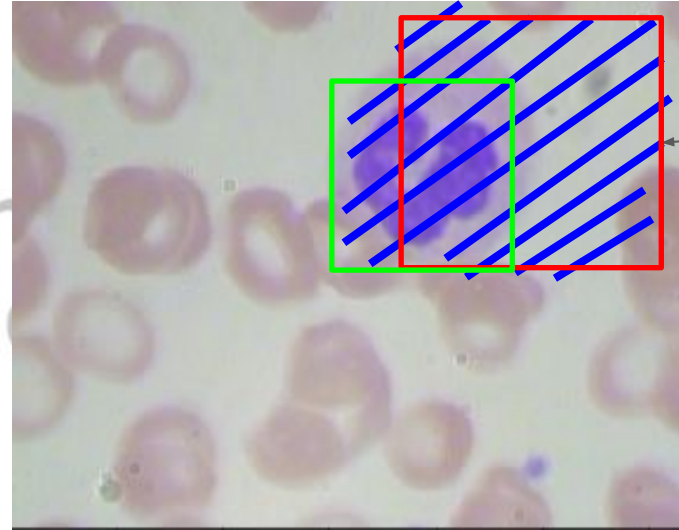


Area of Intersection = 70%

Intersection over Union (IoU)

Which Bounding Box is more accurate?

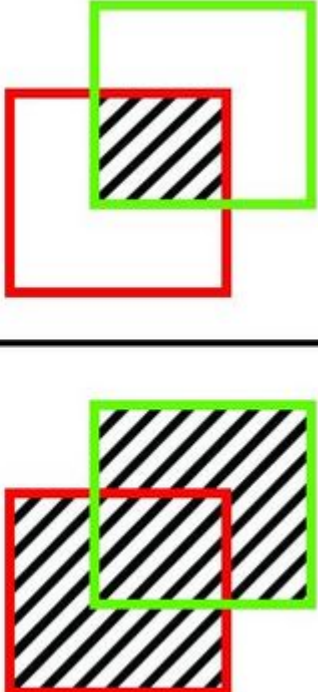
$$\text{IoU} = \frac{\text{Area of Intersection}}{\text{Area of Union}}$$



Box 1

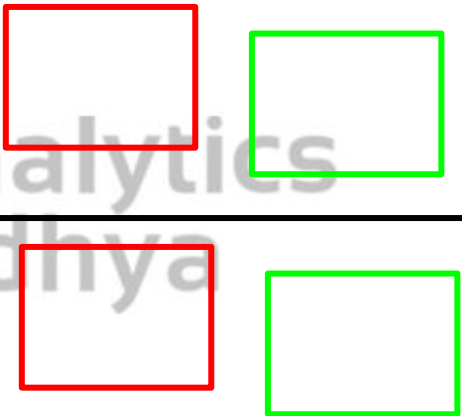
Predicted Bounding Boxes

Intersection over Union (IoU)

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



The diagram illustrates the Intersection over Union (IoU) metric. It consists of two parts. The top part shows two overlapping squares, one red and one green. The intersection of the two squares is shaded with black diagonal lines. The bottom part shows the same two squares, but the entire area covered by both (the union) is shaded with black diagonal lines. A horizontal line separates the two parts, with the text 'Area of Intersection' above it and 'Area of Union' below it. The formula $\text{IoU} = \frac{\text{Area of Intersection}}{\text{Area of Union}}$ is written to the left of the line.

Range of Intersection over Union (IoU)

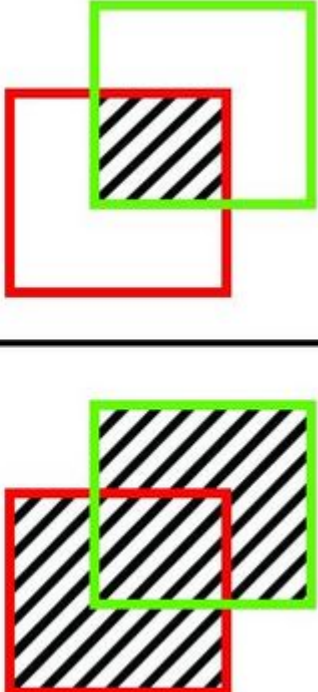
$$\text{IoU} = \frac{\text{Area of Intersection}}{\text{Area of Union}} = 0$$


The diagram illustrates the calculation of the Intersection over Union (IoU) metric. It features a horizontal line representing the denominator, 'Area of Union'. Above the line is the label 'Area of Intersection'. Below the line is the label 'Area of Union'. To the right of the line, there are two rectangles: a red one and a green one. The red rectangle is positioned above the line, and the green rectangle is positioned below the line. This visualizes the case where the intersection of two bounding boxes is zero, resulting in an IoU of 0.

Range of Intersection over Union (IoU)

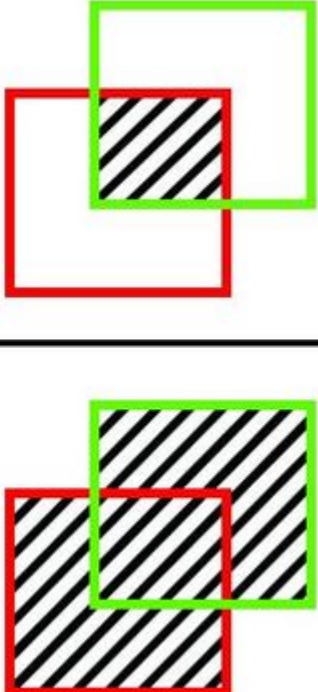
$$\text{IoU} = \frac{\text{Area of Intersection}}{\text{Area of Union}} = 1$$
The diagram illustrates the IoU calculation with two overlapping rectangles. The top rectangle, outlined in red and green, is labeled 'Area of Intersection'. The bottom rectangle, also outlined in red and green, is labeled 'Area of Union'. A horizontal line separates the two labels, and the equation 'IoU = ... = 1' is shown to the left and right of the line.

Intersection over Union (IoU)

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


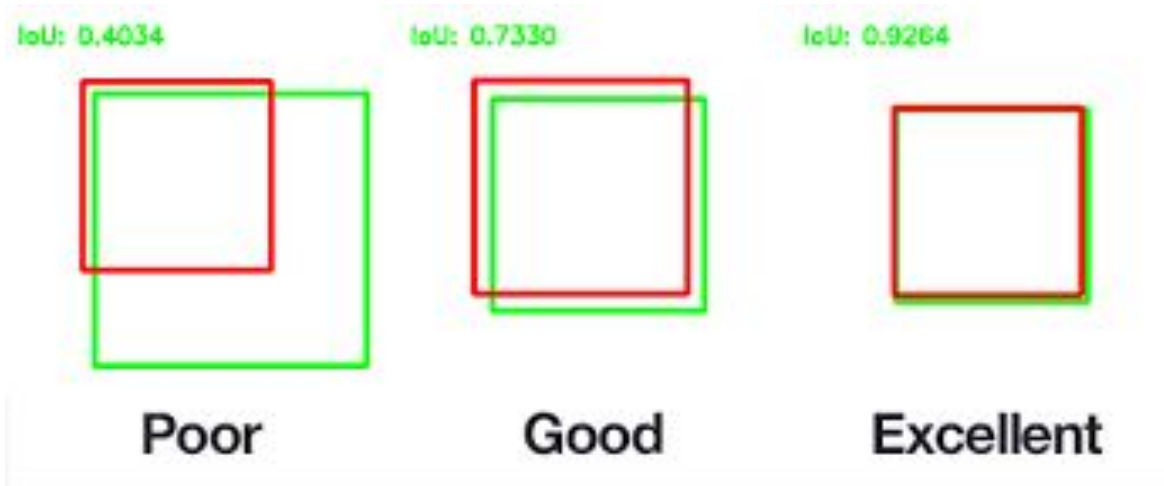
The diagram illustrates the Intersection over Union (IoU) metric. It consists of two parts. The top part shows two overlapping rectangles, one red and one green, with their intersection area shaded with black diagonal lines. The bottom part shows the same two rectangles, but the entire area covered by both (the union) is shaded with black diagonal lines.

Intersection over Union (IoU)

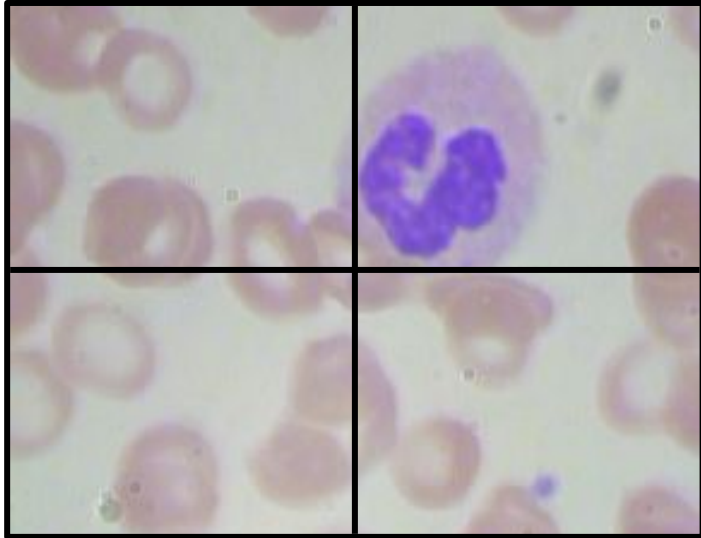
$$\text{IoU} = \frac{\text{Area of Intersection}}{\text{Area of Union}} < \text{threshold}$$


The diagram illustrates the Intersection over Union (IoU) metric. It consists of two parts. The top part shows two overlapping rectangles, one red and one green. The intersection of the two rectangles is shaded with black diagonal lines. The bottom part shows the same two rectangles, but the entire area covered by both (the union) is shaded with black diagonal lines. The formula for IoU is given as the ratio of the Area of Intersection to the Area of Union, which is less than a threshold.

Intersection over Union (IoU)



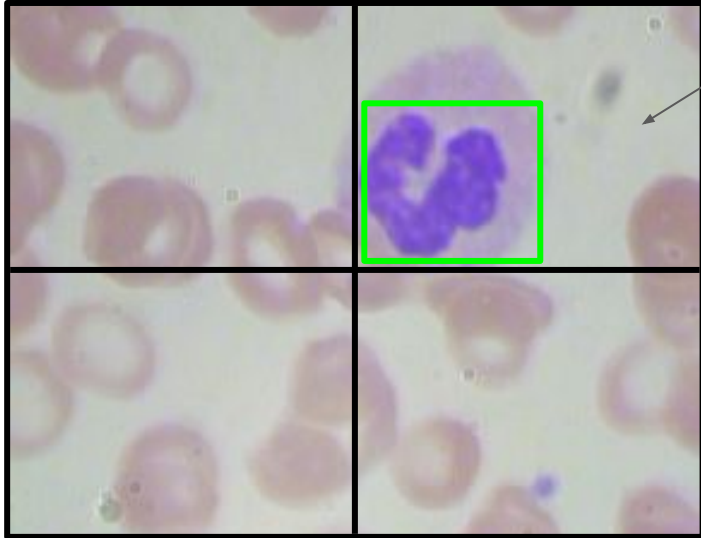
Prepare Train Data for Naive Approach



filename	patch	xmin	xmax	ymin	ymax	WBC (1/0)
1.jpg	1	0	320	0	240	0
1.jpg	2	320	640	0	240	1
1.jpg	3	0	320	240	480	0
1.jpg	4	320	640	240	480	0

Calculating IoU

IOU > 0.5



filename	patch	xmin	xmax	ymin	ymax	WBC (1/0)
1.jpg	1	0	320	0	240	0
1.jpg	2	320	640	0	240	1
1.jpg	3	0	320	240	480	0
1.jpg	4	320	640	240	480	0

Intersection Over Union (IoU)

- IoU can be used Can be used -
 - For selecting the best bounding box
 - As an Evaluation Metric

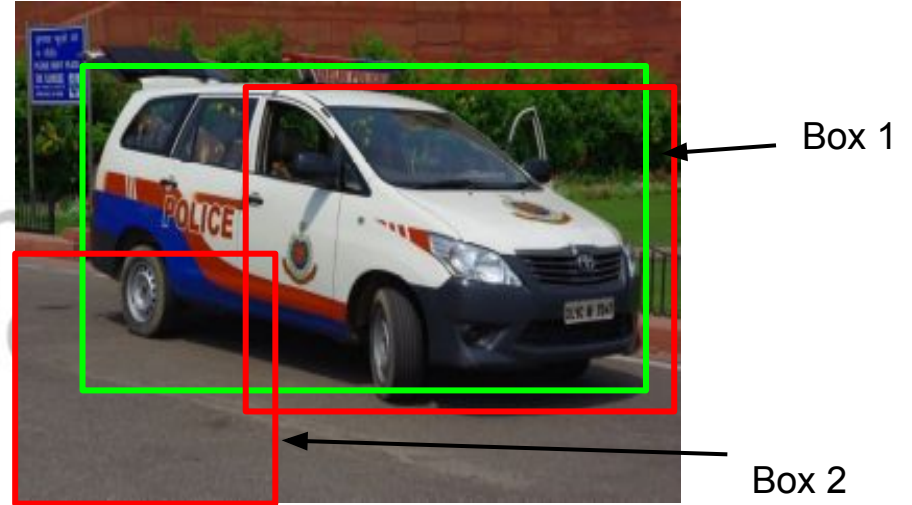


Thank You

Intersection over Union (IoU)



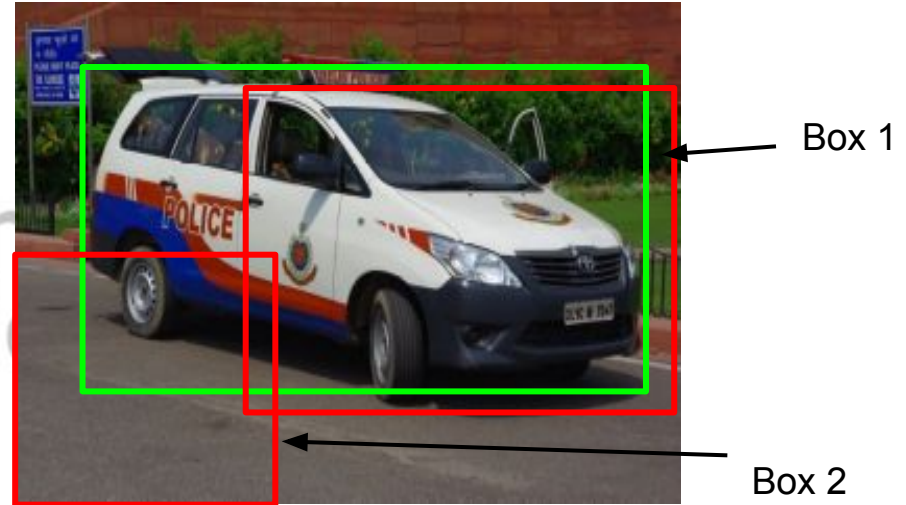
Original Bounding Box



Predicted Bounding Boxes

Intersection over Union (IoU)

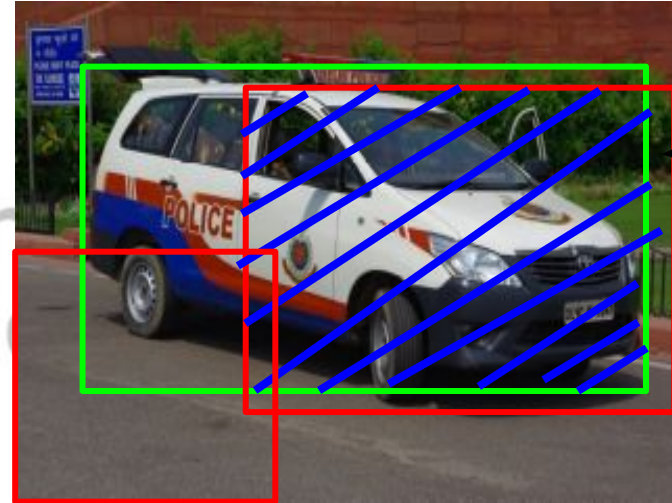
Which Bounding Box is more accurate?



Predicted Bounding Boxes

Intersection over Union (IoU)

Which Bounding Box is more accurate?



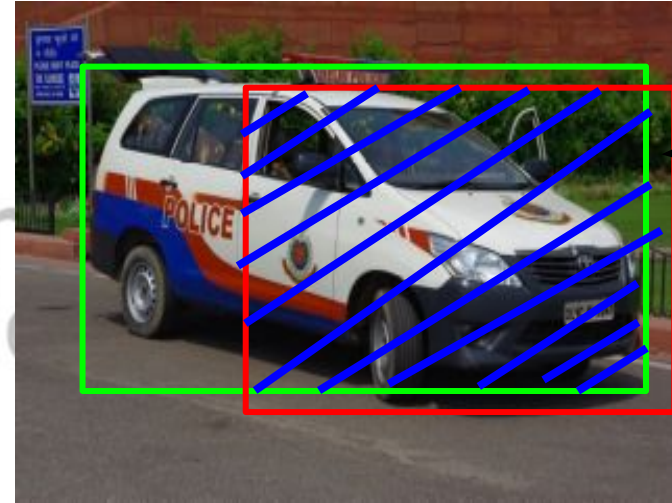
Box 1

Predicted Bounding Boxes

Intersection over Union (IoU)

Which Bounding Box is more accurate?

Area of Intersection = 70%



Box 1

Predicted Bounding Box 1

Intersection over Union (IoU)

Which Bounding Box is more accurate?

Area of Intersection = 20%



Box 1

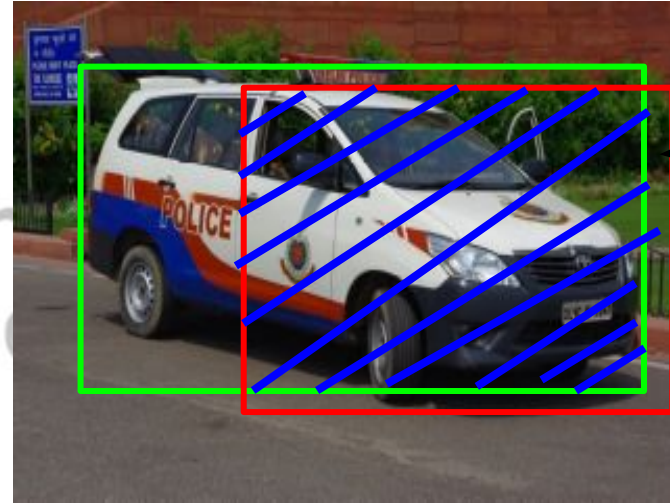
Predicted Bounding Box 2

Intersection over Union (IoU)



Box 3

Predicted Bounding Box 3



Box 1

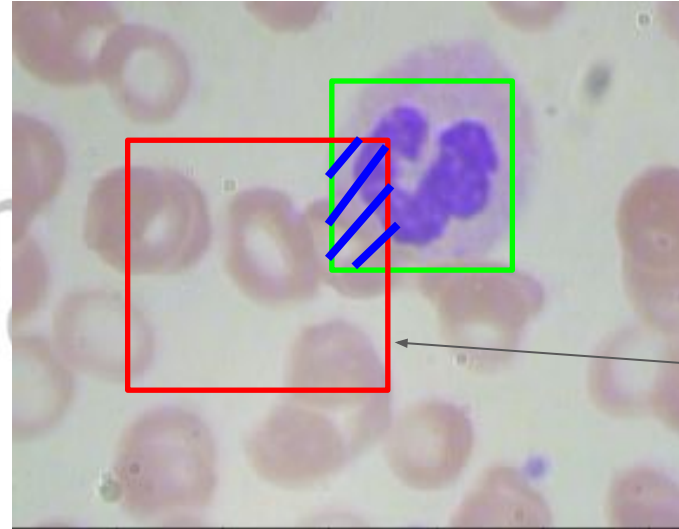
Predicted Bounding Box 1

Intersection over Union (IoU)

Which Bounding Box is more accurate?

$\text{IoU} =$

Area of Intersection



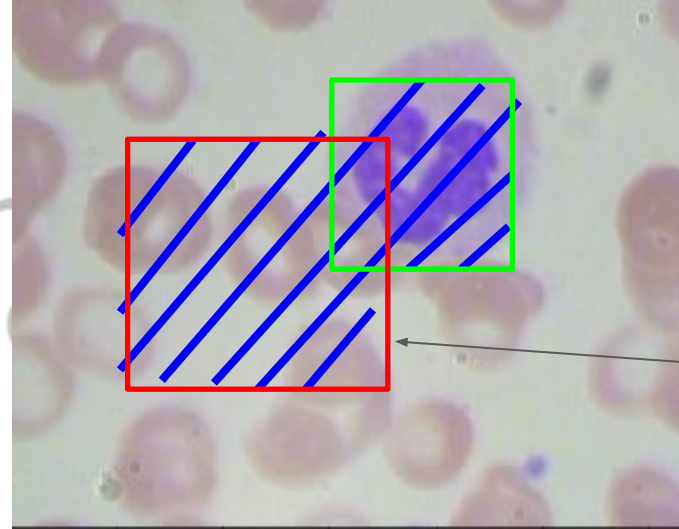
Box 2

Predicted Bounding Boxes

Intersection over Union (IoU)

Which Bounding Box is more accurate?

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



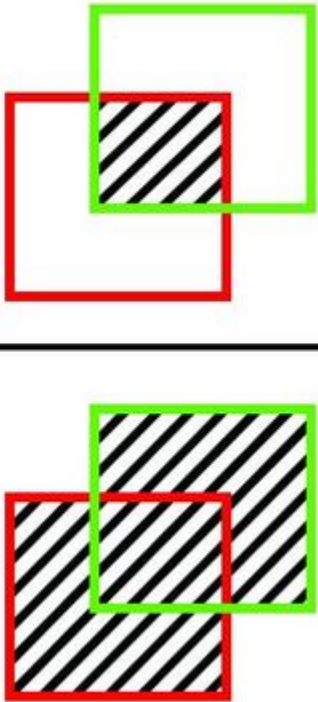
Box 2

Predicted Bounding Boxes

Intersection over Union (IoU)

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

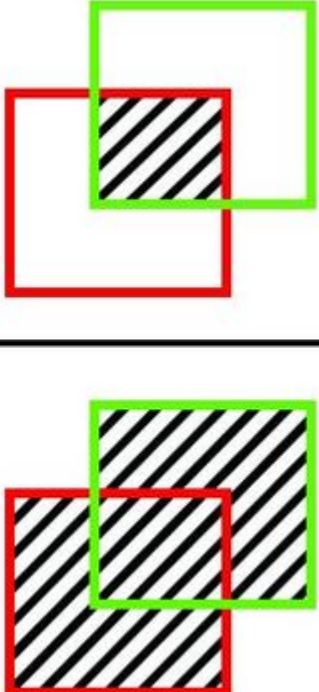
True Positive



Intersection over Union (IoU)

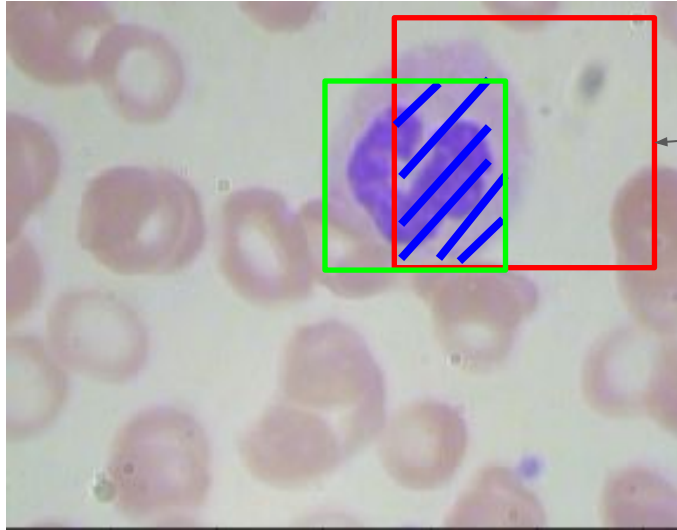
$$\text{IoU} = \frac{\text{Area of Intersection}}{\text{Area of Union}} < \text{threshold}$$

False Positive



The diagram illustrates the calculation of Intersection over Union (IoU) for two overlapping rectangles. The top part shows the intersection area shaded with diagonal lines. The bottom part shows the union area shaded with diagonal lines. The text 'False Positive' is written in red below the union area.

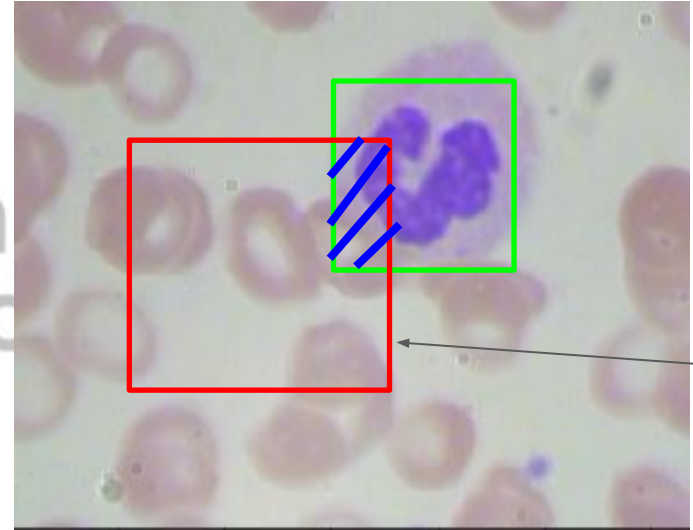
Intersection over Union (IoU)



Box 1

True Positive

Actual class and predicted class



Box 2

False Positive

Object not present in the bounding box