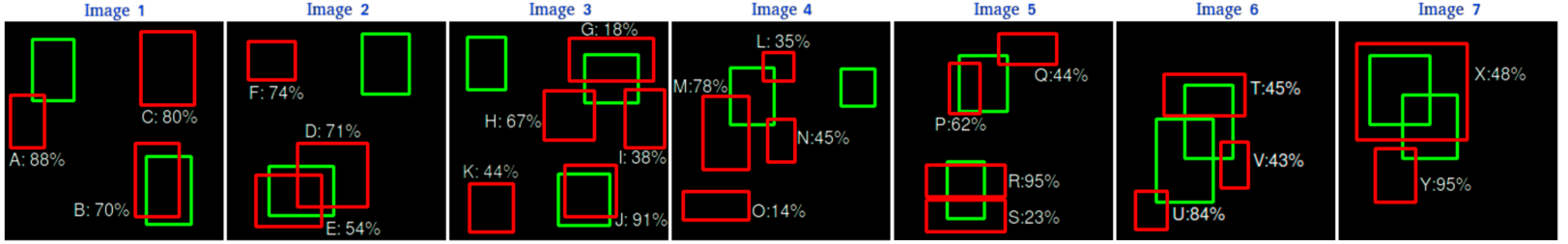
A Survey on Performance Metrics for Object-Detection Algorithms

Boulder

YouTube Playlist

"In the object detection context, a true negative (TN) result does not apply, as there are infinite number of bounding boxes that should not be detected within any given image."



- True positive (TP): A correct detection of a ground-truth bounding box;
- False positive (FP): An incorrect detection of a nonexistent object or a misplaced detection of an existing object;
- False negative (FN): An undetected ground-truth bounding box;

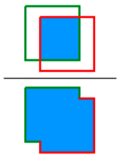
ground-truth bounding box

predicted bounding box

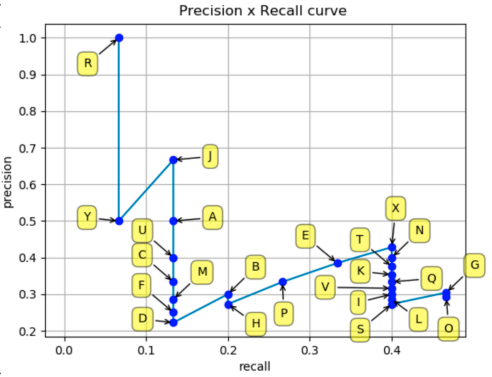
$$J(B_p, B_{gt}) = \text{IOU} = \frac{\text{area}(B_p \cap B_{gt})}{\text{area}(B_p \cup B_{gt})}$$

Intersection over Union

Jaccard Index



detection	confidence	TP	FP	acc TP	acc FP	precision	recall
R	95%	1	0	1	0	1	0.0666
Y	95%	0	1	1	1	0.5	0.0666
J	91%	1	0	2	1	0.6666	0.1333
A	88%	0	1	2	2	0.5	0.1333
U	84%	0	1	2	3	0.4	0.1333
C	80%	0	1	2	4	0.3333	0.1333
M	78%	0	1	2	5	0.2857	0.1333
F	74%	0	1	2	6	0.25	0.1333
D	71%	0	1	2	7	0.2222	0.1333
B	70%	1	0	3	7	0.3	0.2
H	67%	0	1	3	8	0.2727	0.2
P	62%	1	0	4	8	0.3333	0.2666
E	54%	1	0	5	8	0.3846	0.3333
X	48%	1	0	6	8	0.4285	0.4
N	45%	0	1	6	9	0.4	0.4
T	45%	0	1	6	10	0.375	0.4
K	44%	0	1	6	11	0.3529	0.4
Q	44%	0	1	6	12	0.3333	0.4
V	43%	0	1	6	13	0.3157	0.4
I	38%	0	1	6	14	0.3	0.4
L	35%	0	1	6	15	0.2857	0.4
S	23%	0	1	6	16	0.2727	0.4
G	18%	1	0	7	16	0.3043	0.4666
O	14%	0	1	7	17	0.2916	0.4666



$t \rightarrow$ threshold

$\text{IOU} > t \rightarrow$ correct

$\text{IOU} < t \rightarrow$ incorrect

$$P = \frac{\text{TP}}{\text{TP} + \text{FP}} = \frac{\text{TP}}{\text{all detections}},$$

$$R = \frac{\text{TP}}{\text{TP} + \text{FN}} = \frac{\text{TP}}{\text{all ground truths}}$$

$$\text{AP}_{11} = \frac{1}{11} \sum_{R \in \{0, 0.1, \ldots, 0.9, 1\}} P_{\text{interp}}(R)$$

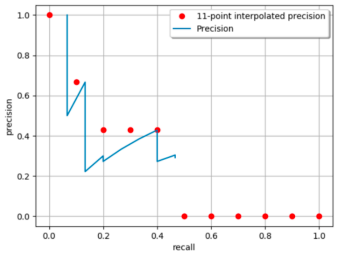
$$P_{\text{interp}}(R) = \max_{\tilde{R}:\tilde{R} \geq R} P(\tilde{R})$$

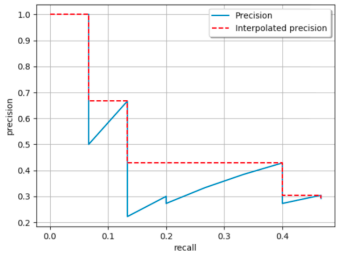
$$\text{AP}_{\text{all}} = \sum_{n} (R_{n+1} - R_n) P_{\text{interp}}(R_{n+1})$$

$$P_{\text{interp}}(R_{n+1}) = \max_{\tilde{R}:\tilde{R} \geq R_{n+1}} P(\tilde{R})$$

$$\text{mAP} = \frac{1}{N} \sum_{i=1}^{N} \text{AP}_i$$

$\text{AP}_i \rightarrow i$-th class





Padilla, Rafael, Sergio L. Netto, and Eduardo AB da Silva. "A Survey on Performance Metrics for Object-Detection Algorithms." *2020 International Conference on Systems, Signals and Image Processing (IWSSIP)*. IEEE, 2020.