

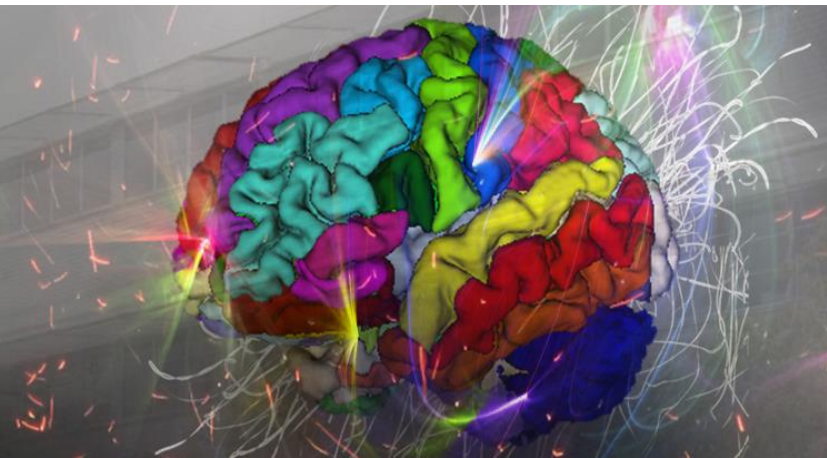


Object detection

Based on work from Ivan Laptev

Improving object detection with boosted histograms (IVC 2009)

Xavier Lladó, Robert Martí



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2. Object Detection Scheme
3. Detection Procedure
4. Evaluation and Conclusion

1. Definition of Object detection

1. Goal
2. Applications
3. Problems/Challenges
4. Qualities of a good detection

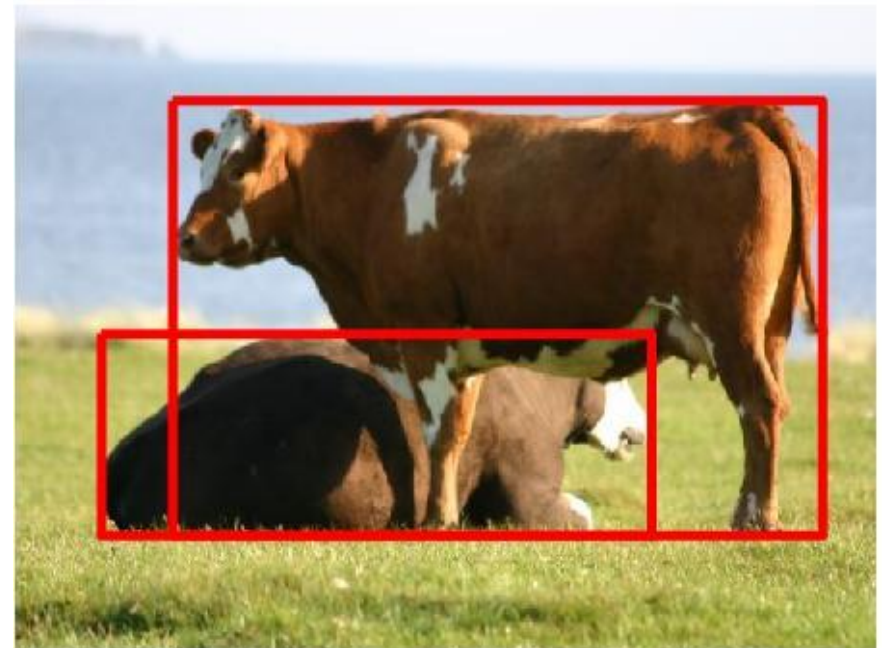
2. Object Detection Scheme

3. Detection Procedure

4. Evaluation and conclusion

1. Definition

1.1 Goal of Object Detection ?

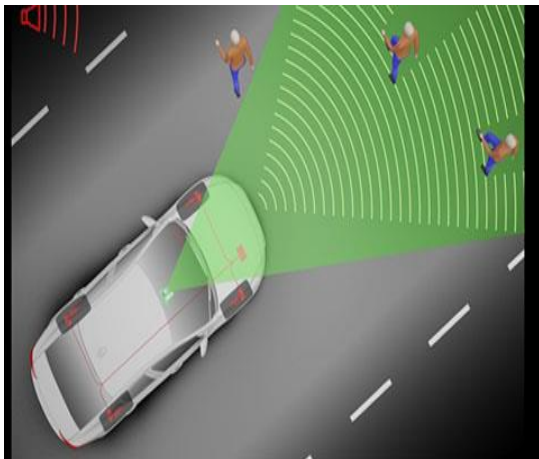


The goal of Object detection is to determine the existence of object in a scene.

1. Definition

1.2 Object Detection Applications

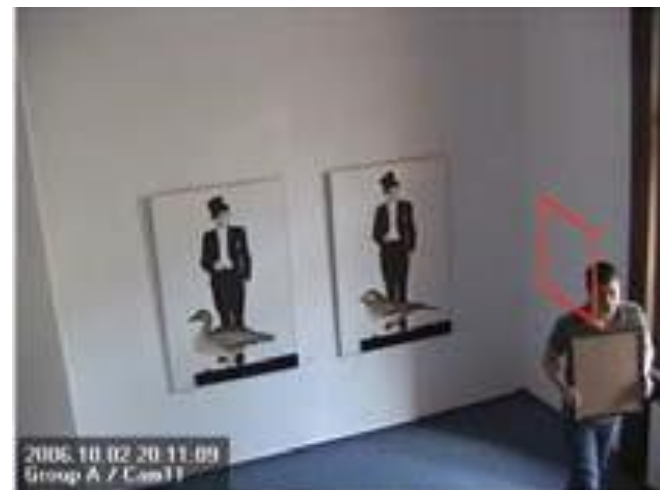
Security / Surveillance



Pedestrians Detection



Abandoned Object Det.

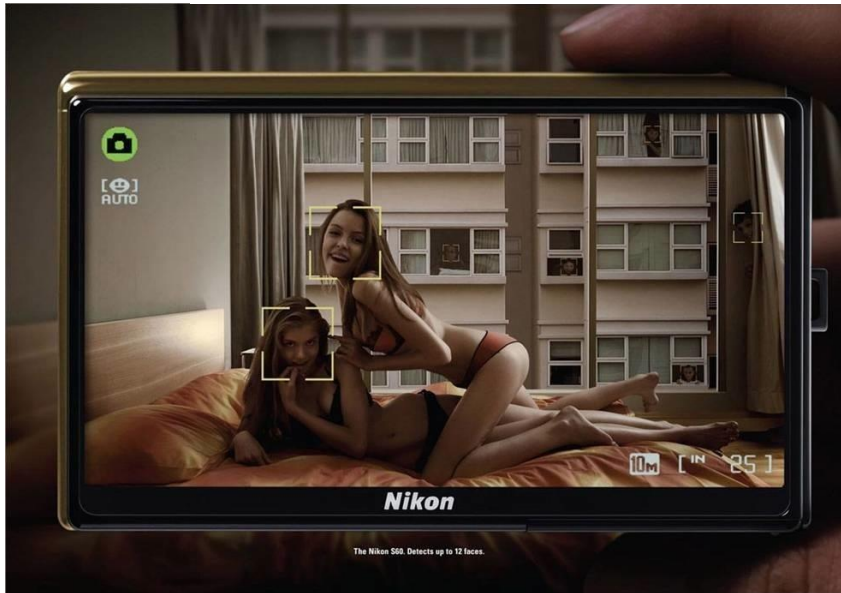


Stealing Object Det.

1. Definition

1.2 Object Detection Applications

Entertainment



Face Detection

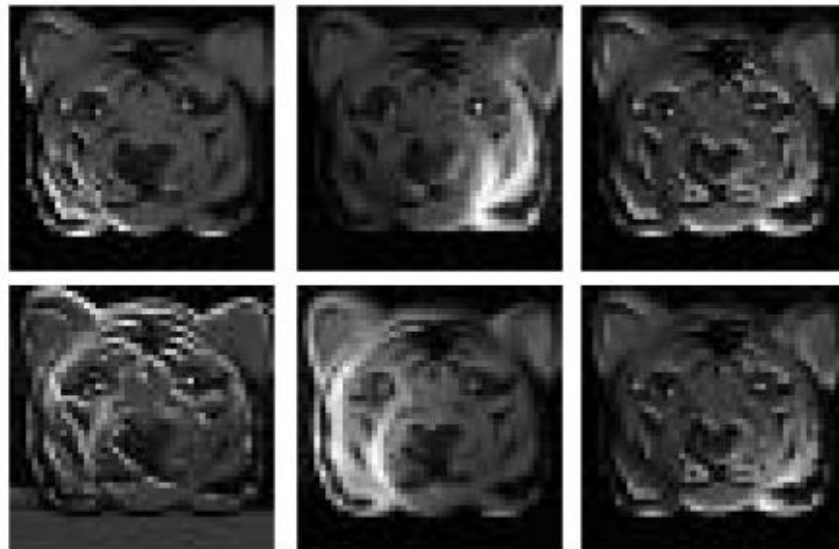


Game controller

1. Definition

1.3 Problems and Challenges of object Detection

Lightning Variation



1. Definition

1.3 Problems and Challenges of object Detection

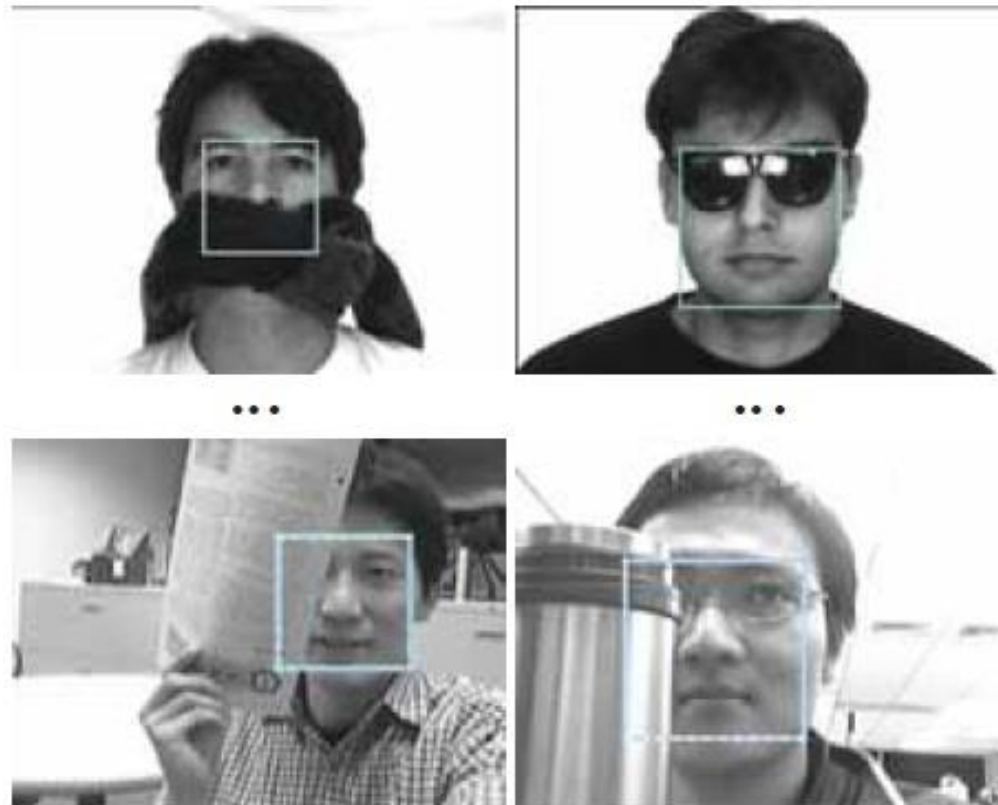
View point / Scale Variations



1. Definition

1.3 Problems and Challenges of object Detection

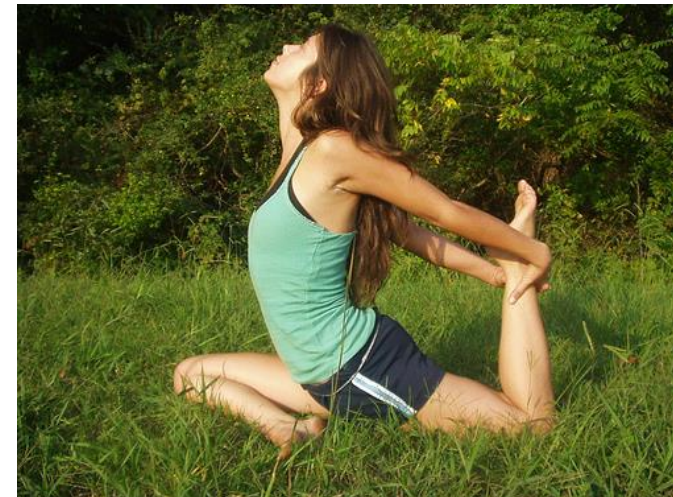
Occlusions



1. Definition

1.3 Problems and Challenges of object Detection

Deformation
Pose Variation



1. Definition

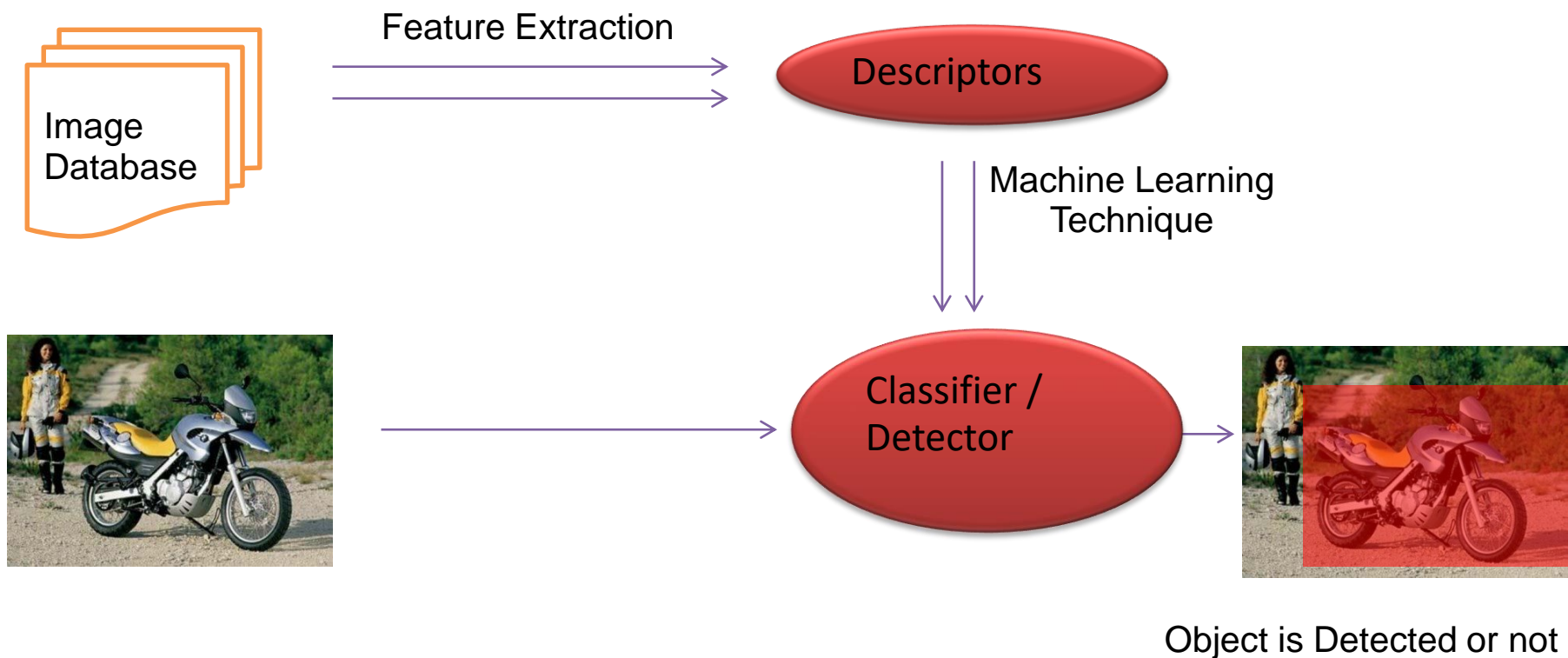
1.4 Qualities of a good detection

- Robust to above mentioned variations
 - Occlusion
 - Light
 - Viewpoint / Scale
 - Pose / Deformation

1. Definition of Object detection
- 2. Object Detection Scheme**
 1. General Case
 2. Boosted Histograms
 1. HOG
 2. Adaboost
3. Detection Procedure
4. Evaluation and conclusion

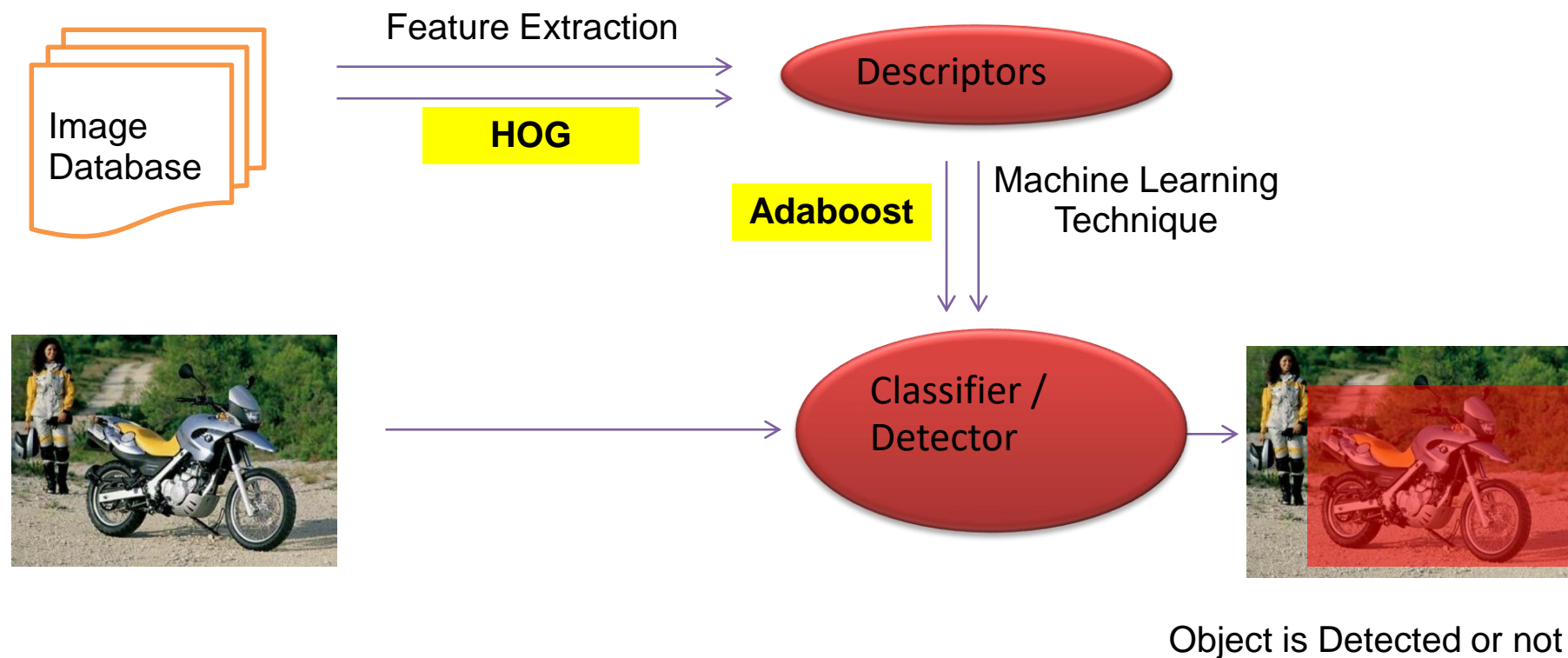
2. Object detection scheme

2.1 General Case



2. Object detection scheme

2.2 Object Detection with Boosted Histograms



2. Object detection scheme

2.2.1 Definition

- HOG is acronym for Histogram of Oriented Gradients



- Contrast stretching
 - Gamma transform
 - Log Transform
 - Histogram Equalization



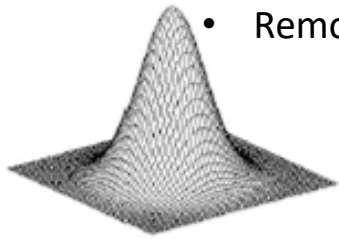
2.2.1 HOG features

2.2.1 Definition

– HOG is acronym for Histogram of Oriented Gradients



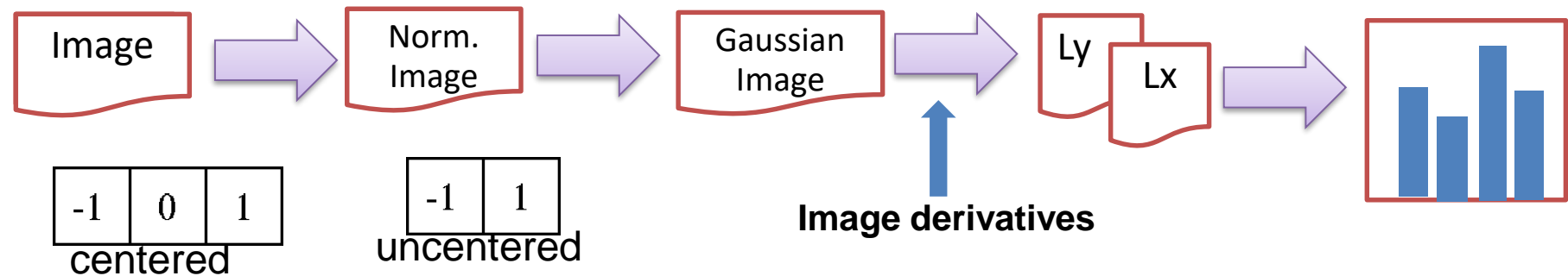
- Smoothing
- Eliminates noise edges
- Makes edges smother
- Removes fine detail



2.2.1 HOG features

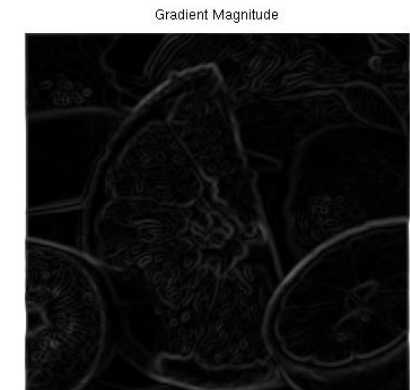
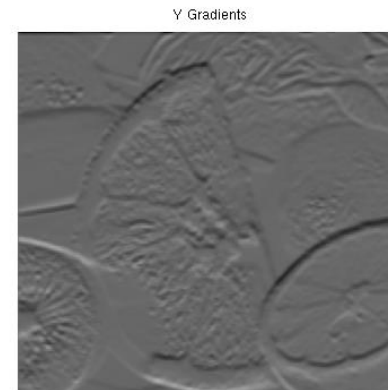
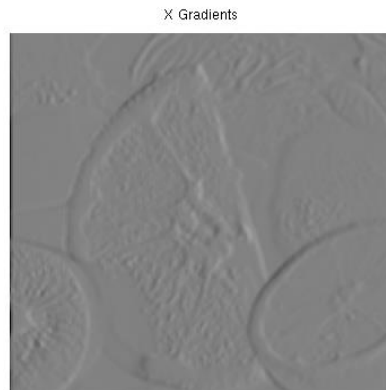
2.2.1 Definition

– HOG is acronym for Histogram of Oriented Gradients



-1	0	1
-2	0	2
-1	0	1

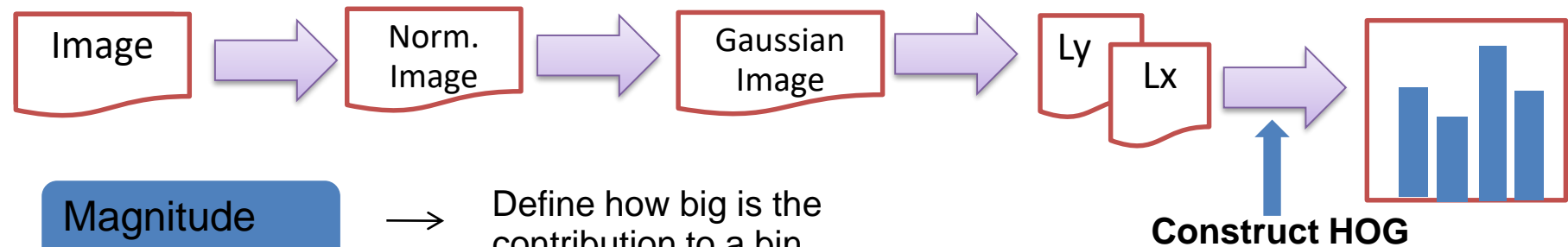
Sobel



2.2.1 HOG features

2.2.1 Definition

– HOG is acronym for Histogram of Oriented Gradients

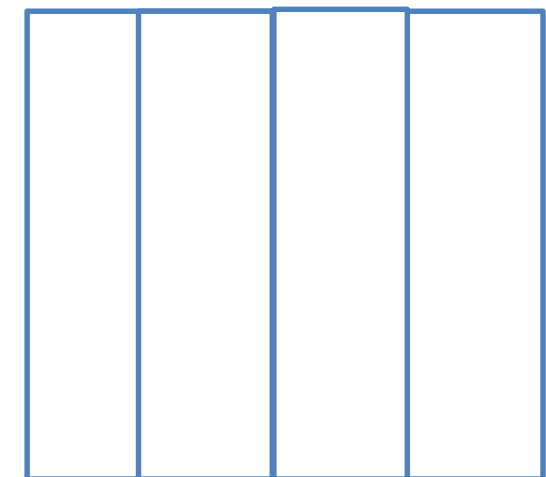


Magnitude

→ Define how big is the contribution to a bin

Orientation

→ Define to which bin the magnitude will be assigned

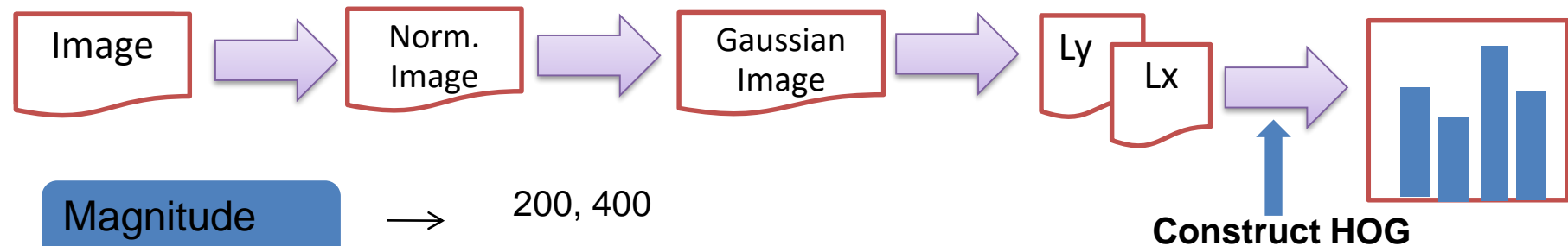


Bins : 1 2 3 4

2.2.1 HOG features

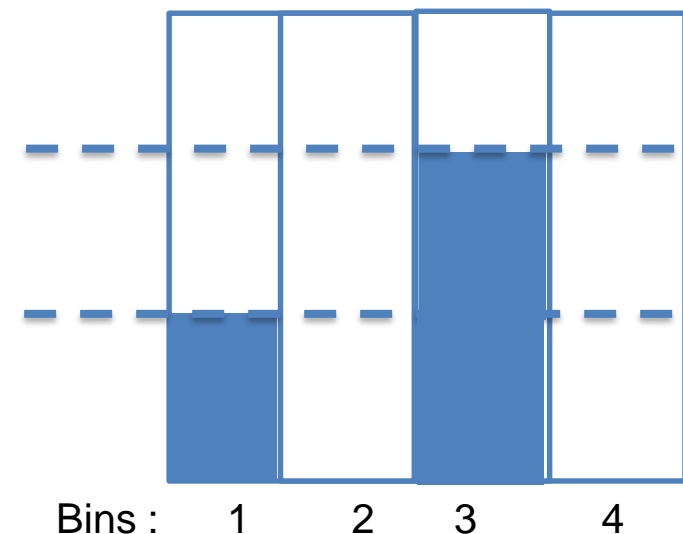
2.2.1 Definition

- HOG is acronym for Histogram of Oriented Gradients



Magnitude → 200, 400

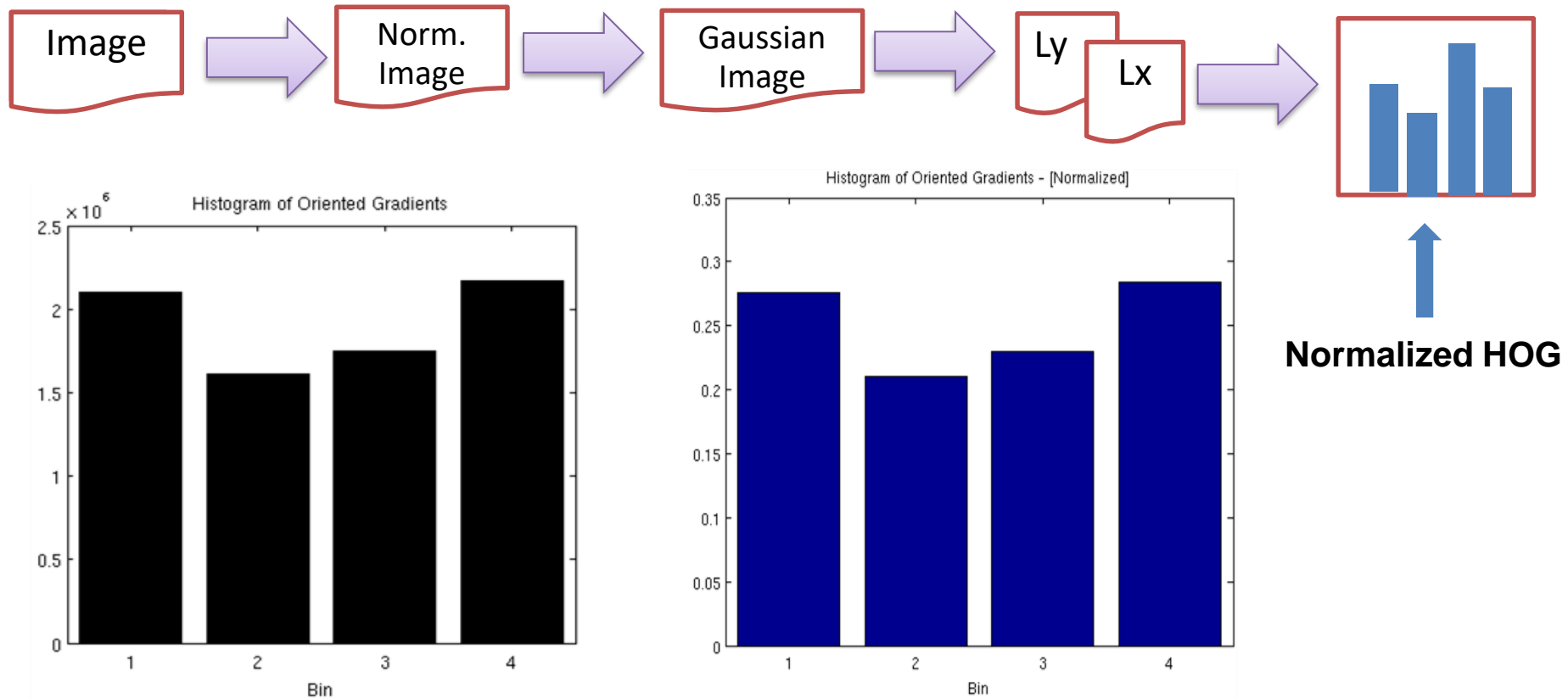
Orientation → 75°, 215°



2.2.1 HOG features

2.2.1 Definition

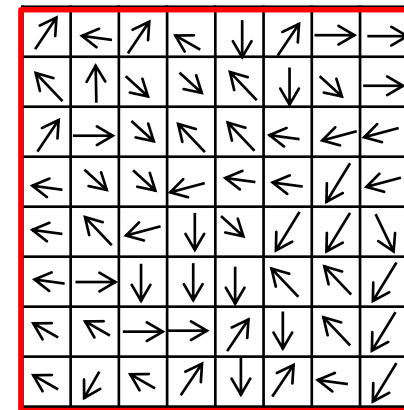
- HOG is acronym for Histogram of Oriented Gradients



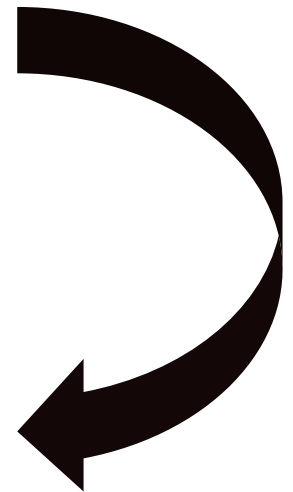
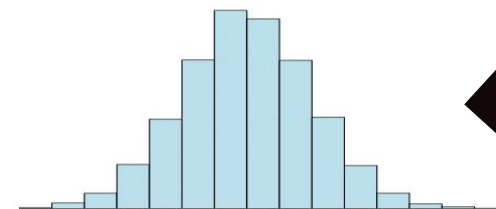
2.2.1 HOG features

Features:

Histogram of Oriented Gradients(HOG) [6]



Feature Vector :



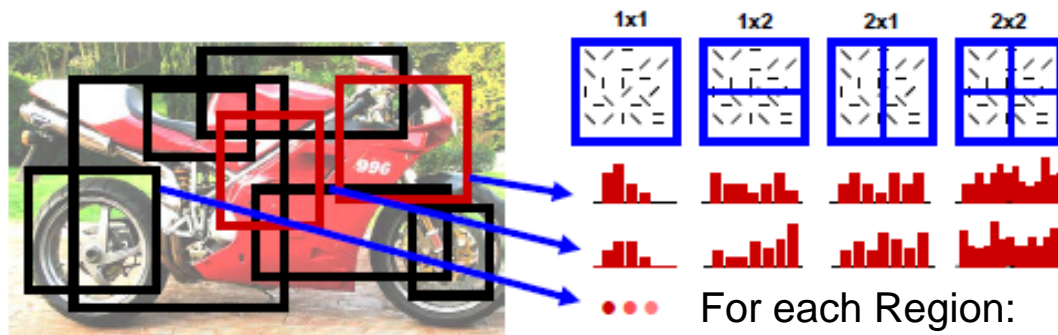
[6] N. Dalal and B. Triggs, "Histograms of Oriented Gradients for Human Detection" CVPR 2005

2.2.1 HOG features

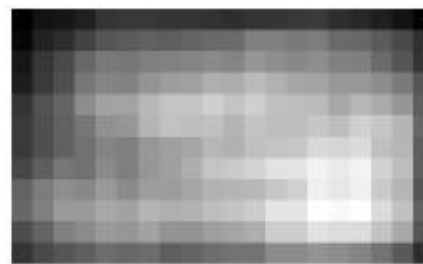
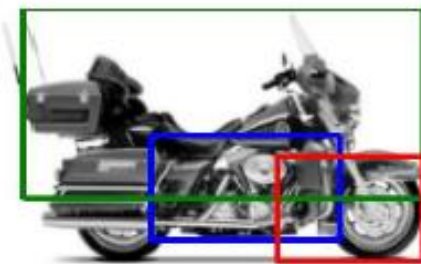
2.2.2 How to use HOG

Feature Extraction

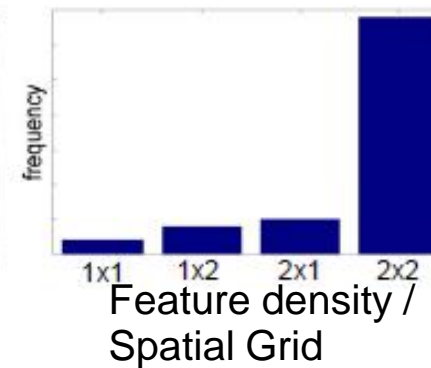
Using
exhaustive set
o regions



Most
Discriminative
Regions



Feature
density



2.2.1 HOG features

- HOG [6] - dense representation
 - overlapping local contrast normalization for improved accuracy
- SIFT[3] - sparse representation due to keypoint localization
 - 4x4 with 8 bins = 128 element feature vector

[3] D. Lowe, "Distinctive Image Features from Scale-Invariant Keypoints", IJCV 2004

[6] N. Dalal and B. Triggs, "Histograms of Oriented Gradients for Human Detection" CVPR 2005

2.2.2 Adaboost

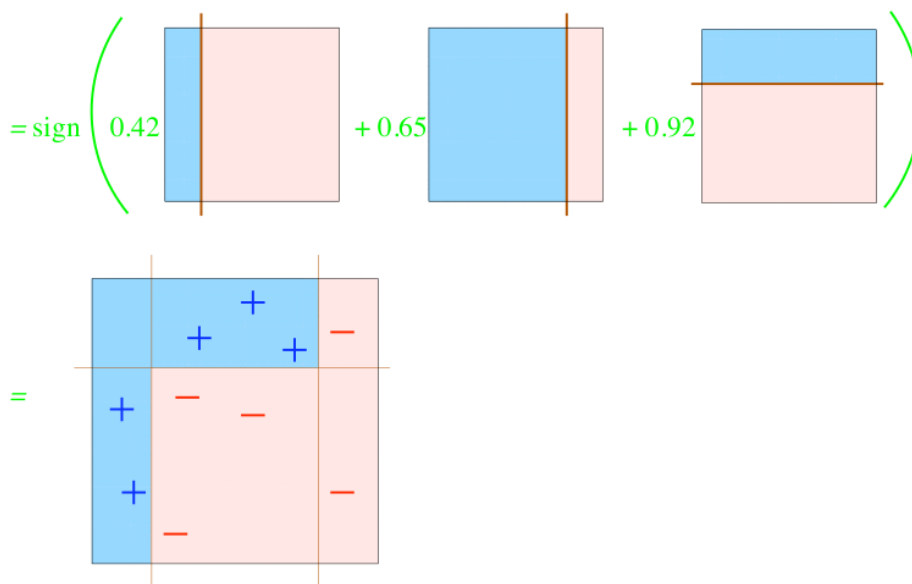
2.2.2.1 Definition

- Weak Classifier
- Combination to Boost

Toy Example: Final Classifier

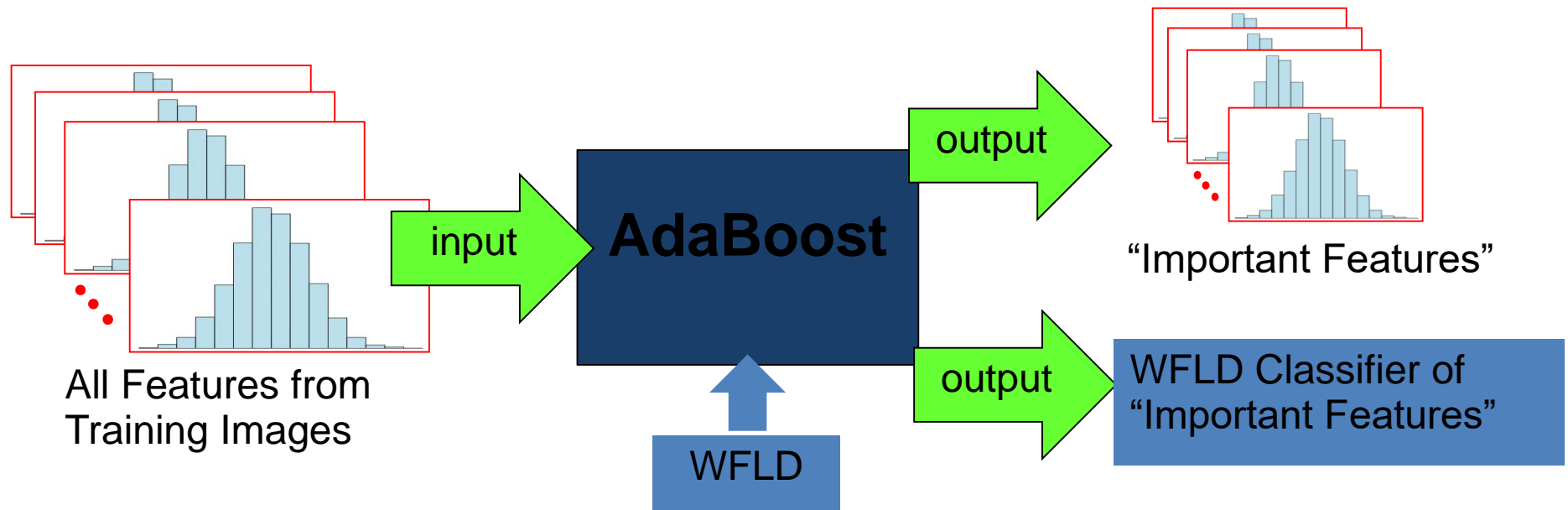
$$H(z) = \text{sgn}\left(\sum_{t=1}^T \alpha_t h_t(z)\right)$$

final = sign (0.42 + 0.65 + 0.92)



The diagram illustrates the final Adaboost classifier's output. It shows three weak classifiers being combined. The first classifier has a weight of 0.42 and classifies the left half as blue (+) and the right half as red (-). The second classifier has a weight of 0.65 and classifies the left half as blue (+) and the right half as red (-). The third classifier has a weight of 0.92 and classifies the top half as blue (+) and the bottom half as red (-). The final classifier's output is the intersection of these three classifiers' outputs, resulting in a 2x2 grid. The top-left quadrant is blue (+), the top-right quadrant is red (-), the bottom-left quadrant is blue (+), and the bottom-right quadrant is red (-).

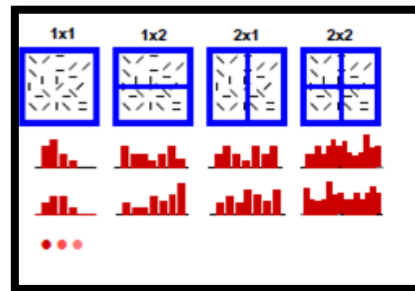
2.2.2 Adaboost



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- 3. Detection Procedure**
4. Evaluation and conclusion

3. Detection procedure

Extract Hog from Scanning Windows



Apply the classifier

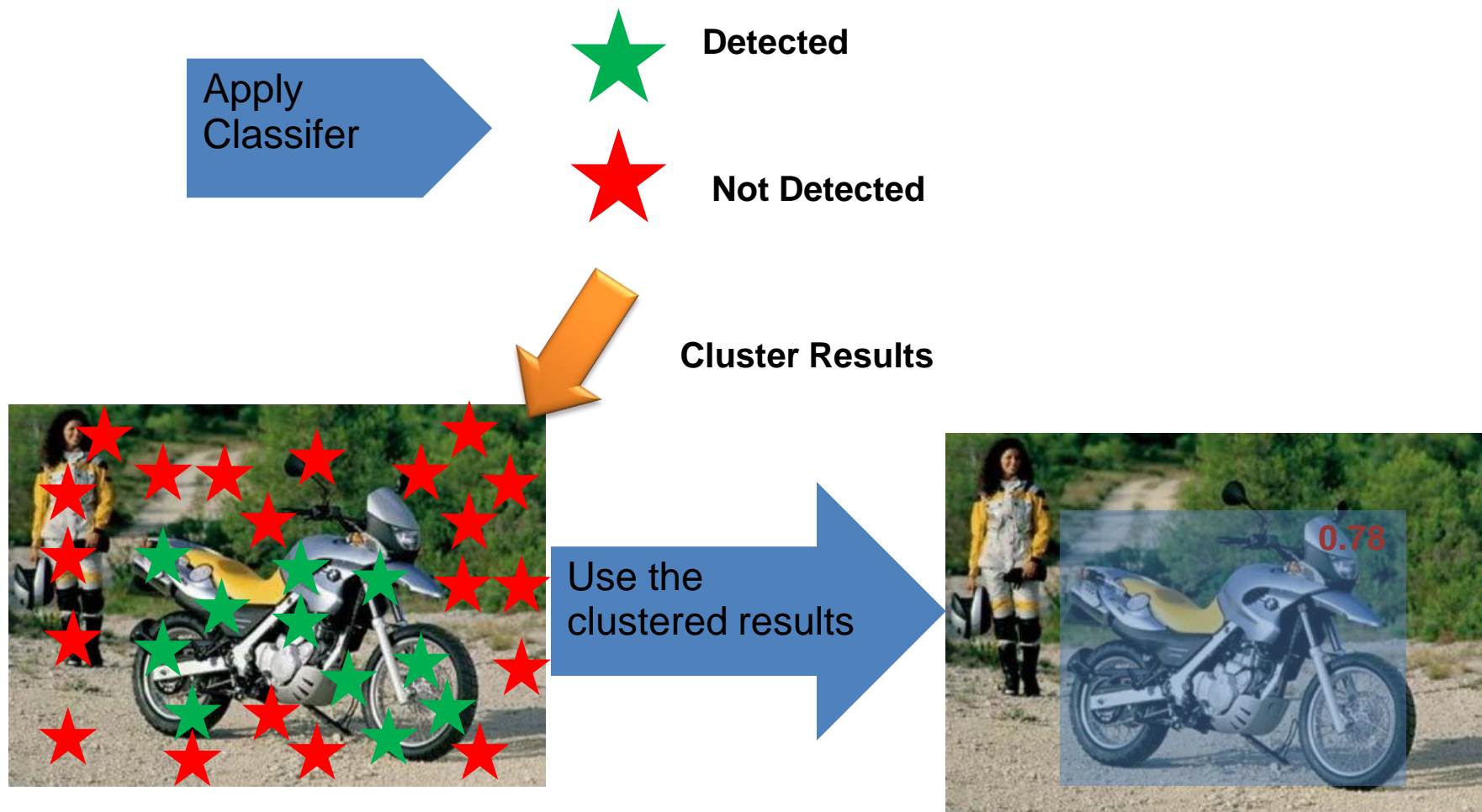


Detected



Not Detected

3. Detection procedure



3. Detection procedure

Window Scanning (Sliding Window)



3. Detection procedure

Window Scanning (Sliding Window)



Spatial clustering of multiple detections

1. Definition of Object detection
2. Object Detection Scheme
3. Detection Procedure
- 4. Evaluation and conclusion**
 1. Combined HOG
 2. Comparison

4. Evaluation and conclusion

- HOG \Leftrightarrow SIFT
- Robustness to
 - Lighting variation
 - Rotation variation
 - Object position variation
- VOC2006
 - Two 1st place and three 2nd place

4. Evaluation and conclusion

OBJECT DETECTION

- Basic approaches to object detection
- Improving object detection with boosted histograms
 - HOG features
 - WFLD
 - AdaBoost
 - Sliding window detection



Object detection

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