Master in Computer Vision *Barcelona*

Module: M1

Project: Traffic Sign Detection/Recognition

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M1 – Project: Homework Block 2

Comments:

- The name of the presentation should contain the team number
- Explain in the slides the correspondence between methods and acronyms used in the submission
- For each task with submission, provide only the best method.
- Explain better the proposed approaches in the slides. For example, teams 1&8 did a good job on that
- Always add a last slide with conclusions

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	Precision	Recall	F1	Comments
Team1 (method2)	0.51	0.71	0.60	Area open + dil diamond + HF. P-R cross to select size
Team1 (m3ethod)	0.50	0.71	0.59	Histogram 'simple' backprojection
Team2 (backp)	0.42	0.13	0.20	Different BP methods, not clear which implementation
Team2 (week1+mo)	0.04	0.73	0.08	Imclose+imfill+imopen
Team3 (HSV mo)	**0.66**	**0.72**	**0.69**	Approach??. Relationship with results in slides table not clear
Team4 (method1?)	0.23	0.78	0.36	Dil + imfill + open. Relationship with results in slides table not clear
Team4 (method4?)	0.03	0.51	0.06	Relationship with results in slides table not clear
Team5 (HSV&RGB)	0.22	0.77	0.34	HF + open diamond + open horz/vert lines
Team5 (HistBP)	0.08	0.68	0.15	Paper full back projection method
Team6 (HBP + mo)	0.04	**0.89**	0.08	Morphological processing not detailed
Team7 (method1)	0.13	0.35	0.18	Approach??. Relationship with results in slides table not clear
Team7 (method3)	0.01	0.78	0.01	Approach??. Relationship with results in slides table not clear
Team8 (fill_open)	0.10	0.50	0.16	Imfill + open (disk) +dil?
Team8 (backp)	0.03	0.41	0.06	Normalization?

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Comments Task 1&2:

- Results between teams can not be compared.
  - Different images
  - Different # of iterations!

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Comments Task 3:

- Team 2: Precision/Recall in the test set not consistent with validation set
- Team 3: Approach not explained. Which operators? SE? Order?
- Team 3: Results table not clear (Best? v2?)
- Team 4: Names ←→ method not clear
- Team 5: Size of structuring elements not given
- Team 6: Morphological processing not detailed. Which operators? SE? Order?
- Team 7: Approach not explained. Which operators? SE? Order?
- Team 8: Good analysis of problems and proposal of solutions ✔
- Team 8: Use of signals statistics + PR curves to derive the size of SE ✔

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Comments Task 4:

- **Team 1**: Explain how histograms are combined in method 4
- **Team 1**: P-R curves used to define thresholds ✔
- Team 2: P-R curves given.✔ How are the # bins & thresholds obtained? Explain
- Team 2: Inconsistencies between validation results and test results. Table does not make sense
- Team 2: Need better summarization: less methods and more conclusions
- **Team 3**: Show histograms for 3 groups.✔
- **Team 3**: Names ←→ method on the results table not clear.
- Team 4: Normalization as in paper? Selection of thresholds not explained
- Team 4: No conclusions!
- **Team 5**: Paper full method. Selection of thresholds not explained
- Team 6: Not clear which particular implementation. Normalization?
- Team 6: P-R curves given. Used to define thresholds? ✔
- **Team 7**: Not clear which particular implementation. Normalization?
- **Team 7**: No conclusions
- Team 8: ROC curves used to define thresholds ✔

M1 – Project: Homework Block 3

Goal: Simple region-based detection

Task 1 : Implement a function for CCL that labels all connected components in a binary image and returns a list of the bounding boxes. To discard false positives, simple geometric constraints can be used (aspect ratio / filling ratio / ...)

Task 2 : Implement a multi-scale sliding window approach. Use at least one geometric feature to remove windows that are not likely to contain traffic signs without affecting too much the recall. Write a method to merge the overlapping windows in order to get the best detection for the given region.

Task 3 : Improve the efficiency of the sliding window approach using integral images. Compare the computational efficiency of the two methods.

Task 4 : Perform region based evaluation in addition to the pixel based evaluation. Matlab functions are provided for region based evaluation.

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Task 5 (optional) : Improve the efficiency of the basic sliding window approach using convolutions. Compare the computational efficiency of this method and the previous ones.

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Task 1:

1st approach: Connected Component Labeling (CCL)

- *Detect connected components*
- *Obtain BBox for each CC*
- *Use simple tests to discard regions that are not signals*
  Features:
  - *Filling ratio*
  - *Aspect ratio*
  - *…*
- Result: List of BBoxes containing a detection

BBOX for CC: try bwconncomp(), regionprops() matlab functions

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Task 2:

2nd approach: Sliding window

Signal? →Yes/No

Signal? →Yes/No

- "Slide" a window over the image
- Each resulting crop is separately classified
  - Filling ratio
  - …
- Several window sizes / aspect ratios should be tested
- Result: List of BBoxes containing a detection

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Task 2:

2nd approach: Sliding window. Multiple detections

- Problem: multiple overlapped detection

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Task 2:

2nd approach: Sliding window. Multiple detections

- Problem: multiple overlapped detection
- Solution: arbitration
  - Union, intersection, mean, …

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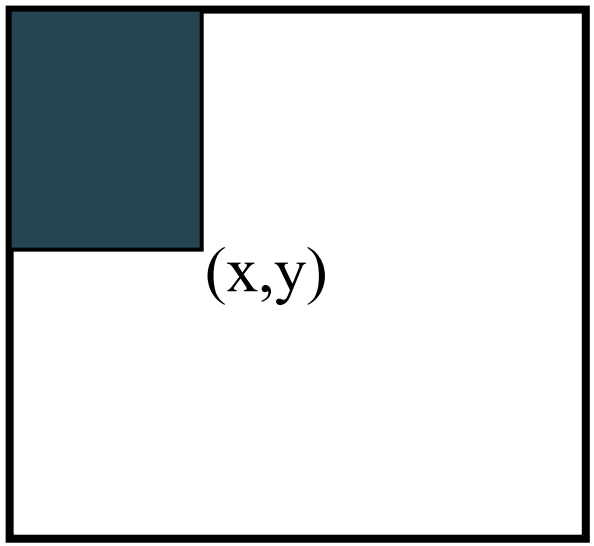
Task 3:

Improve efficiency of feature computation using the integral image

- The **integral image** computes a value at each pixel (x,y) that is the sum of the pixel values above and to the left of (x,y), inclusive.
- This can quickly be computed in one pass through the image
- Idea introduced to computer graphics by Crow, 1984



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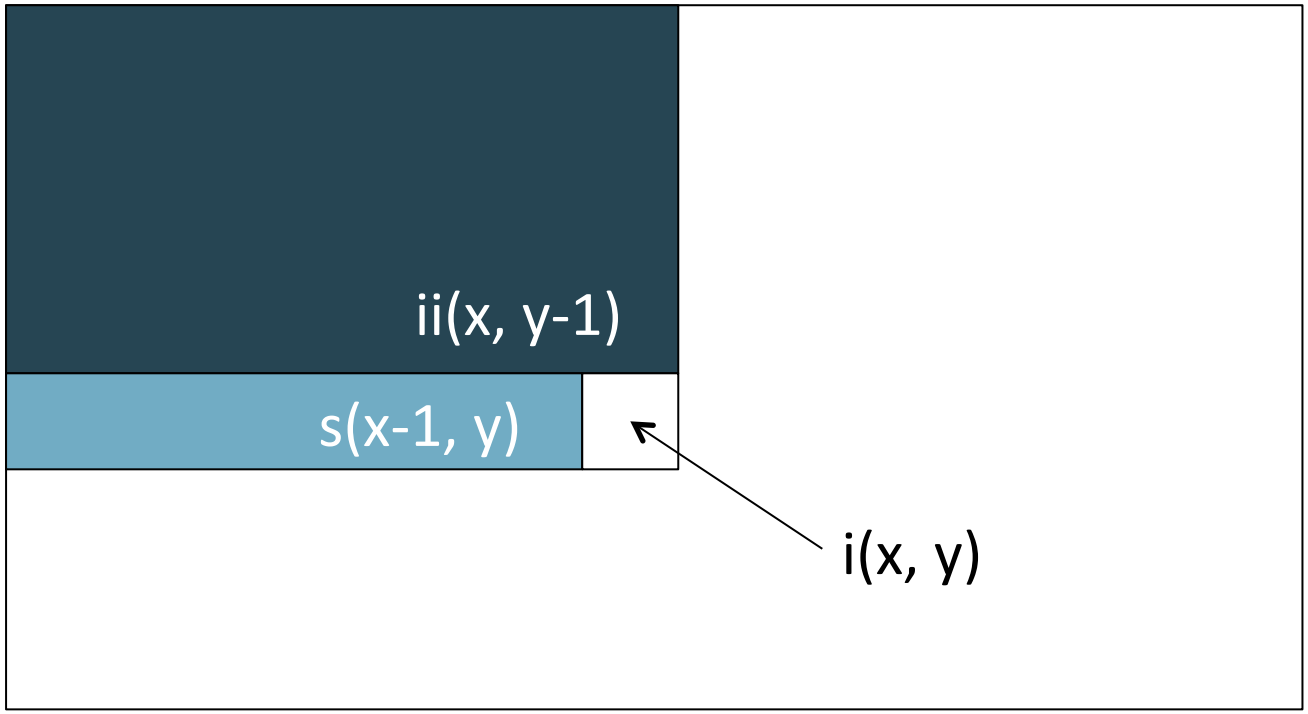
Task 3: *Computing the integral image*



- Cumulative row sum: s(x, y) = s(x–1, y) + i(x, y)
- Integral image: ii(x, y) = ii(x, y−1) + s(x, y)

MATLAB: **ii = cumsum(cumsum(double(i)), 2);**

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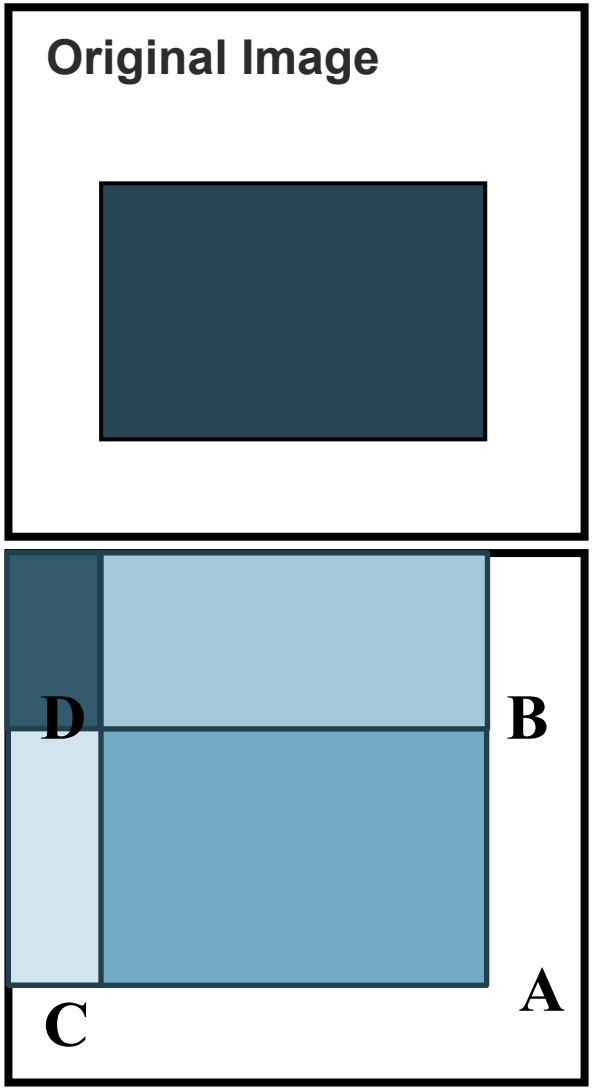
Task 3: *Computing sum within a rectangle*

- Let A, B, C, D be the values of the integral image at the corners of a rectangle
- Then the sum of original image values within the rectangle can be computed as **Sum = A - B - C+ D**
- Only 3 additions are required for any size of rectangle!



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Task 4:

Region-based evaluation

- Green: Ground Truth Bbox
- Yellow: Candidate detection BBox

Correct detection:

$$\frac{BBox_{Det} \cap BBox_{GT}}{BBox_{Det} \cup BBox_{GT}} > T \quad (T = 0.5)$$

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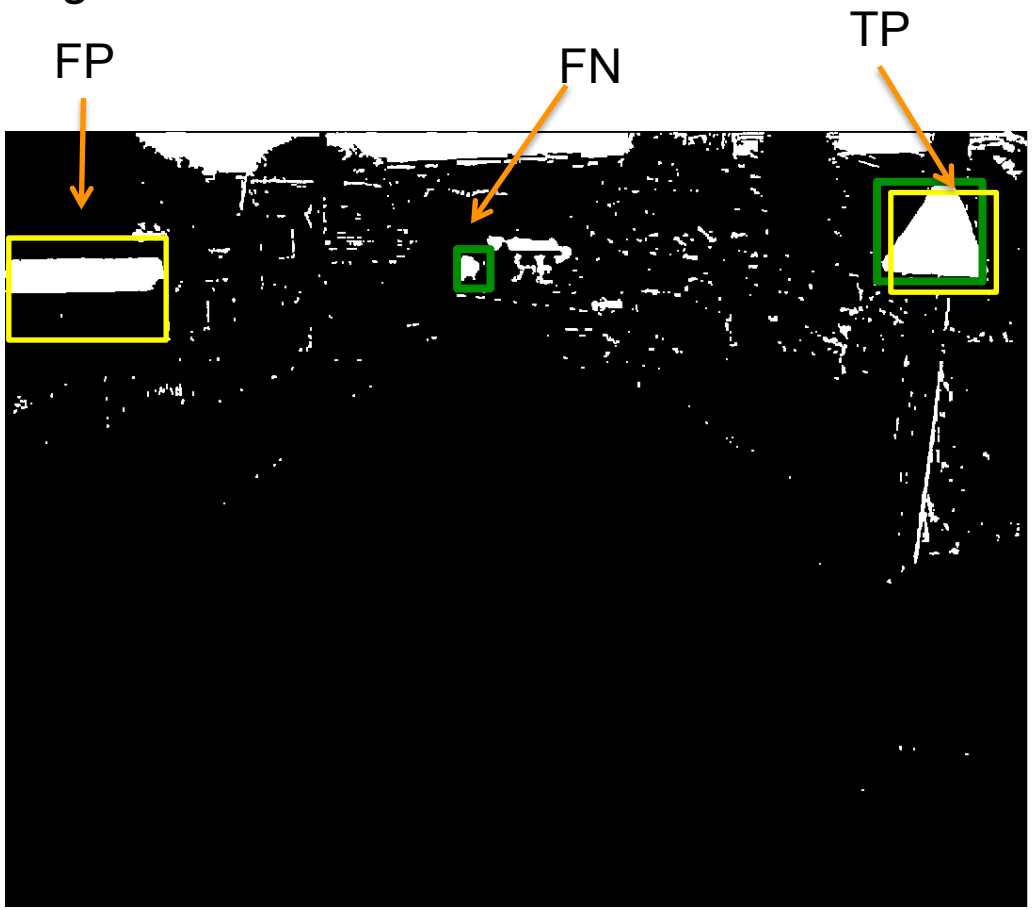
Task 4:

Region-based evaluation



- Region-based evaluation
  (precision, recall)

PerformanceAccumulationWindow CODE

PerformanceEvaluationWindow CODE

Bbox annotation:

gt/gt.??.??????.txt

248.85 275.26 289.72 315.17 D

tlx tly brx bry type

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Task 5 (optional):

Improve efficiency of feature computation using convolutions
Compare with integral image approach

- Problems:
  - which filter?
  - how many filters?

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Submissions:

- masks for pixel-based evaluation
- .mat file containing the variable “windowCandidates” (see template) for region-based evaluation
  - CCL
  - Sliding window (3 methods, that should give same results)

- We will upload a fake test script so you can test if your submission is valid

windowCandidates = [struct(x,y,w,h) ; struct(x,y,w,h) ; ...]

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Evaluation: Region-based (+ pixel based to compare with previous week)

Pixel Based	Precision	Accuracy	Recall	F1-mesure	TP	FP	FN	Time per frame
Method 1								
Method 2								
Method 3								

Object Based	Precision	Accuracy	Recall	F1-mesure	TP	FP	FN
Method 1							
Method 2							
Method 3							

Note: Deliver masks and mat files to:
/home/ihcv0X/m1-results/week1/test/**method1**/*.{png,mat}
/home/ihcv0X/m1-results/week1/test/**method2**/*.{png,mat}

Submit progress slides
Deadline:30/10/2016 20:00