Master in Computer Vision *Barcelona*

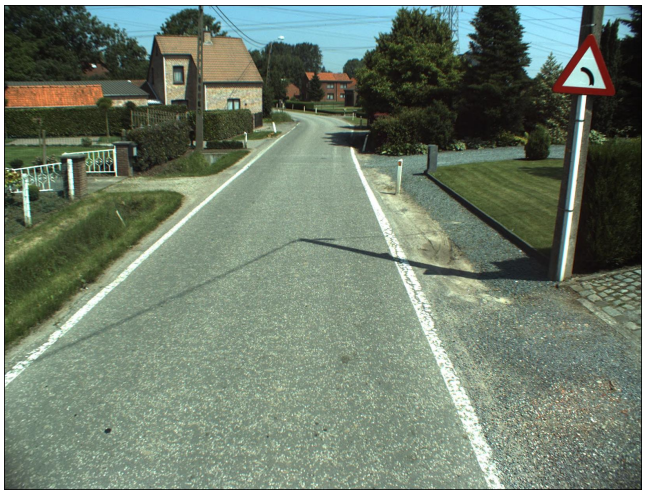
Module: M1

Project: Traffic Sign Detection/Recognition

Coordinator: Ramon Morros / Verónica Vilaplana
ramon.morros@upc.edu, veronica.vilaplana@upc.edu

M1 – Project: Global approach

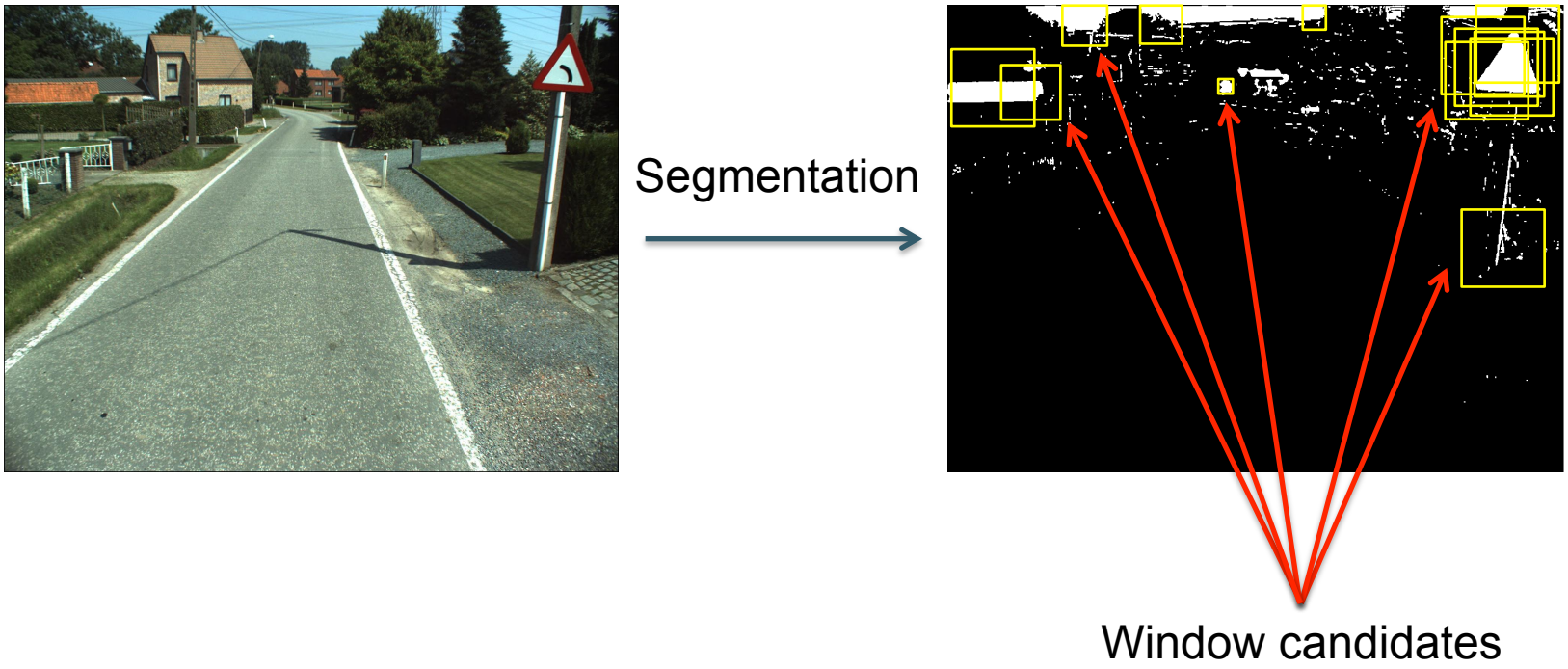
The approach we will follow



Segmentation

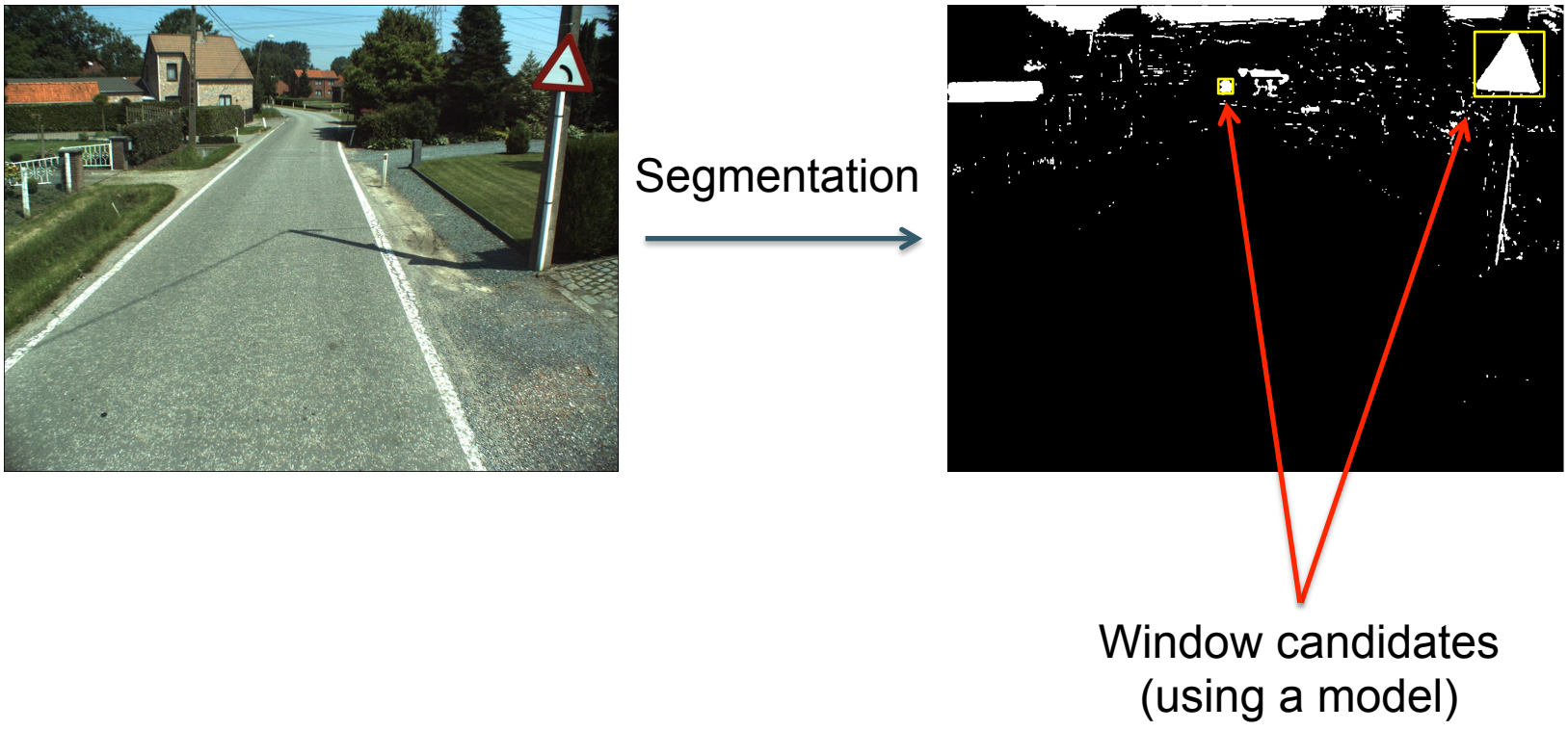
M1 – Project: Global approach

The approach we will follow



M1 – Project: Global approach

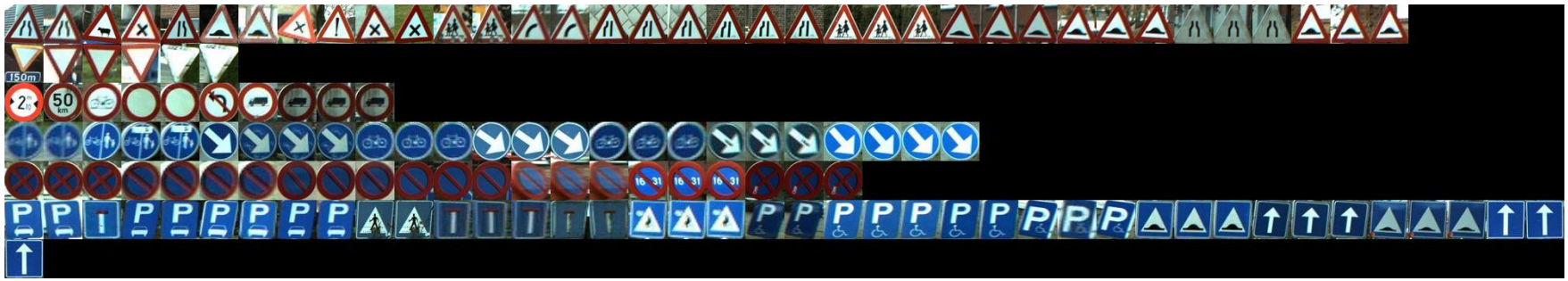
The approach we will follow



M1 – Project: Homework Block 1

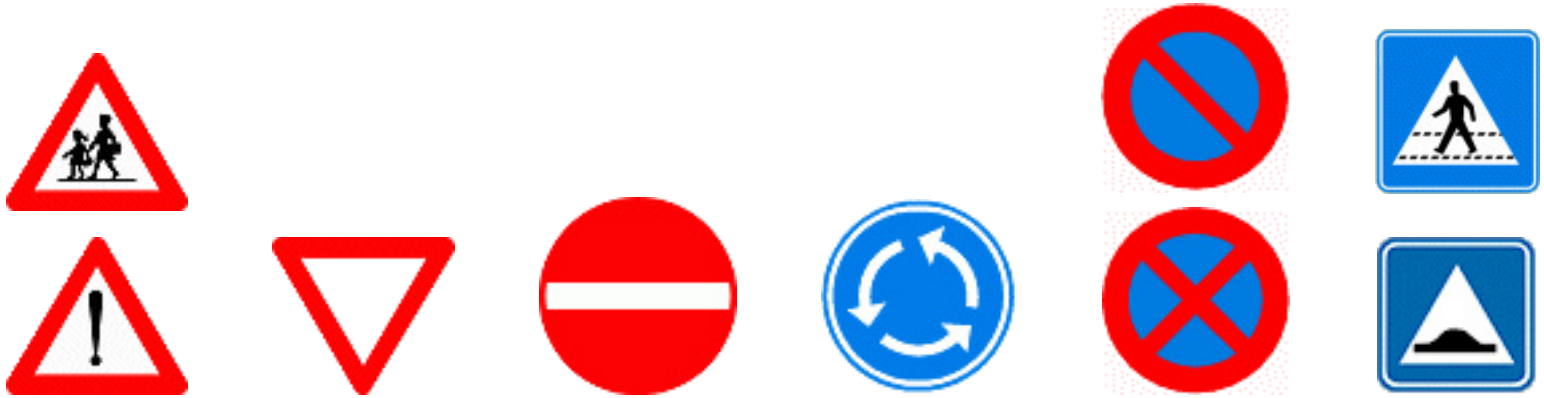
- Training dataset

- Test dataset



M1 – Project: Homework Block 1

Signal types



A B C D E F

Textual annotations

gt/gt.01.003635.txt

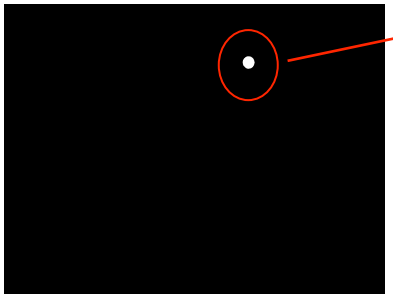
194.20 1232.53 255.27 1300.80 A

Signal type

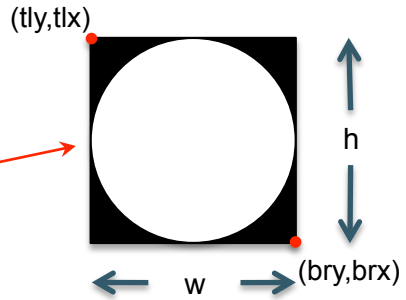
M1 – Project: Homework Block 1

- **Task 1**: Determine the characteristics of the signals in the training set: max and min size, form factor, filling ratio of each type of signal, frequency of appearance (using text annotations and ground-truth masks). Group the signals according to their shape and color.
  - Upload the code used to analyze the dataset

Image
01.002959.jpg



Ground-truth mask
mask/mask.01.002959.png
0:background, 1: object



223.56 1020.81 276.53 1071.24 C

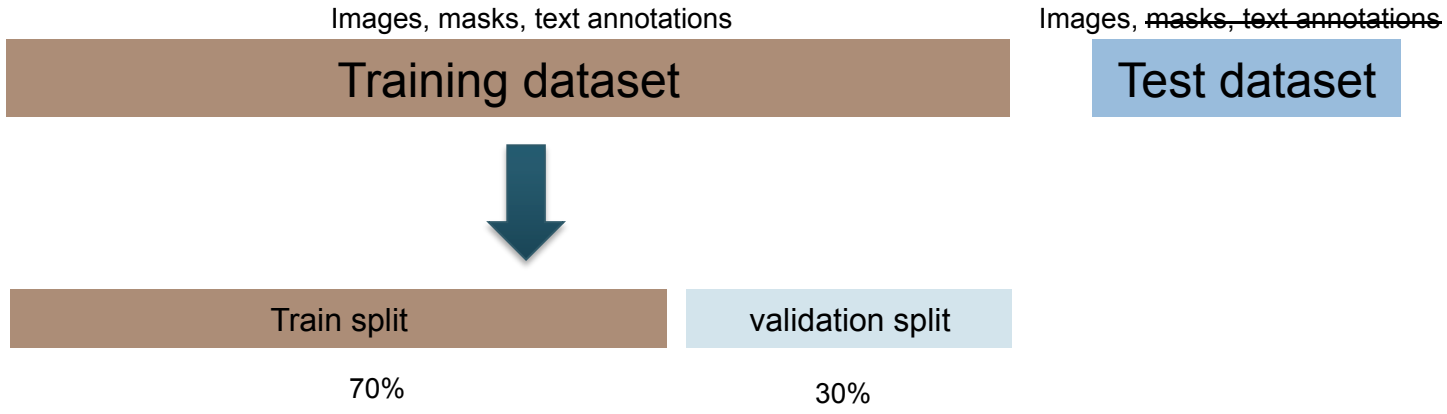
Text annotation
gt/gt.01.002959.txt

form_factor = width / height
filling_ratio = mask_area / bbox_area

tly: top, left Y coordinate
tlx: top, left X coordinate
bry: bottom, right Y coordinate
brx: bottom, right X coordinate

M1 – Project: Homework Block 1

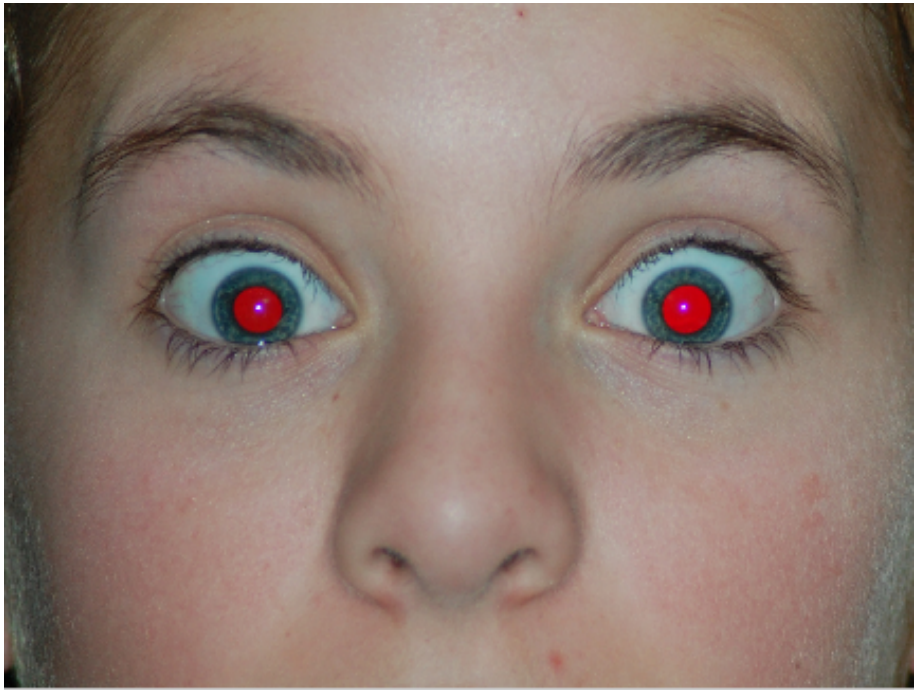
- **Task 2:** Create train/validation split using provided training images
  - Test dataset masks and text annotations are not provided to students.

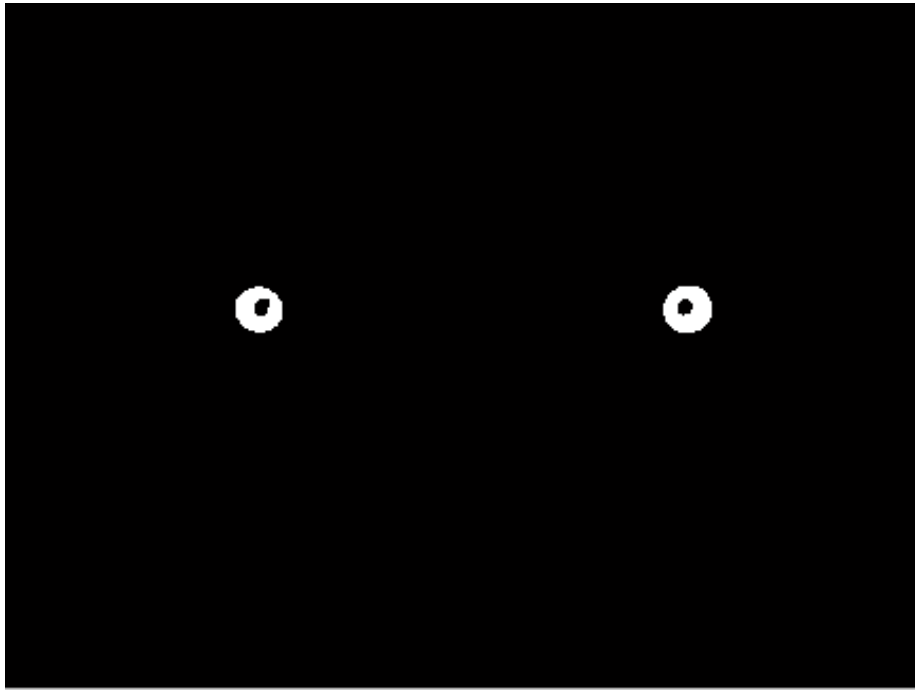


  - Create a split that is well balanced in terms of numbers of elements of each class in train/ validation splits.
  - Use the information of class frequencies computed in Task 1
  - Upload the code used to create the splits

M1 – Project: Homework Block 1

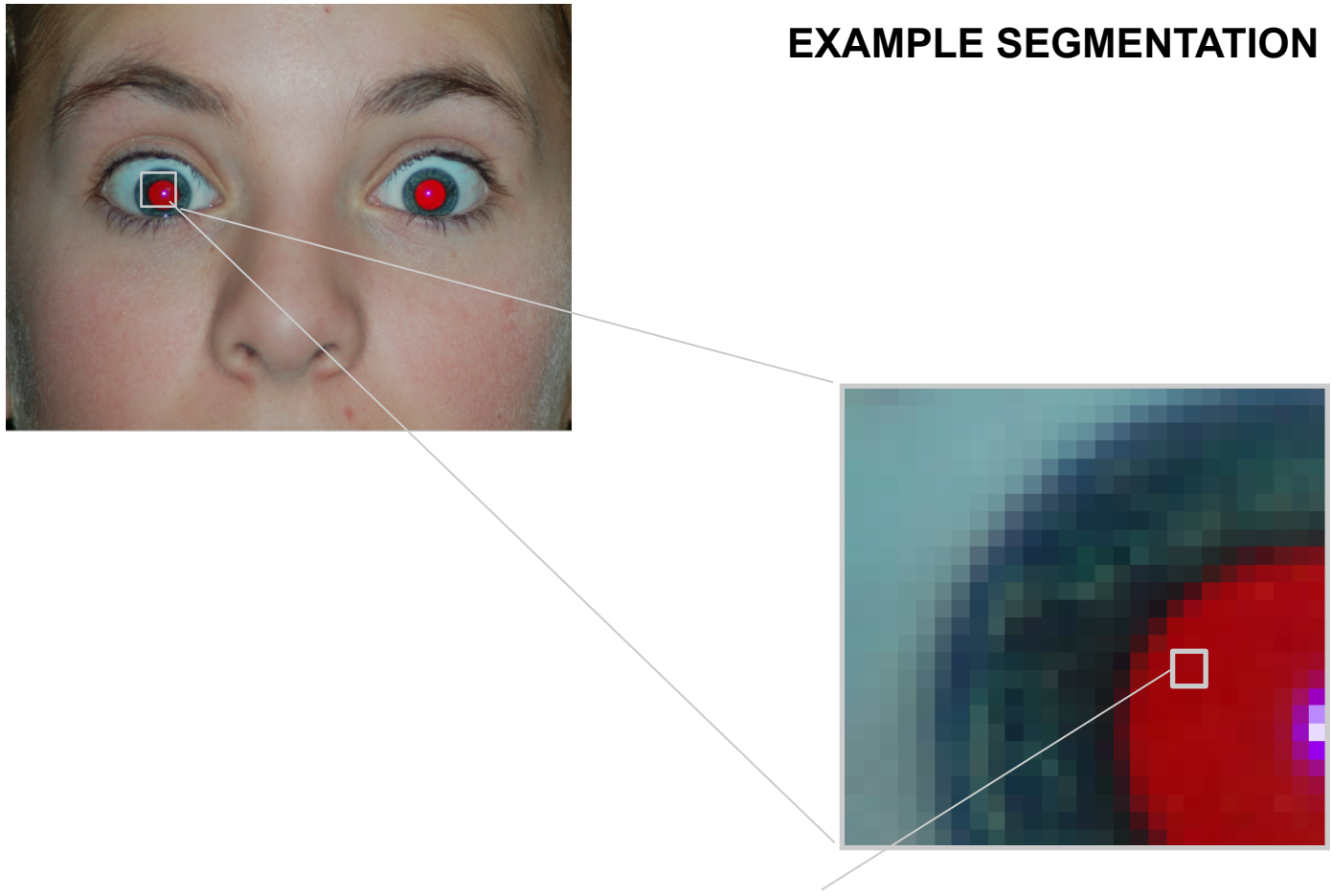
- **Task 3:** Color segmentation to generate a mask





(Public Domain, Font: Wikipedia)

M1 – Project: Homework Block 1



Pixel value can be between 0 and 255 (in a typical 8 bits/channel image)
This pixel is (R,G,B)=(169,5,9)

M1 – Project: Homework Block 1

EXAMPLE SEGMENTATION

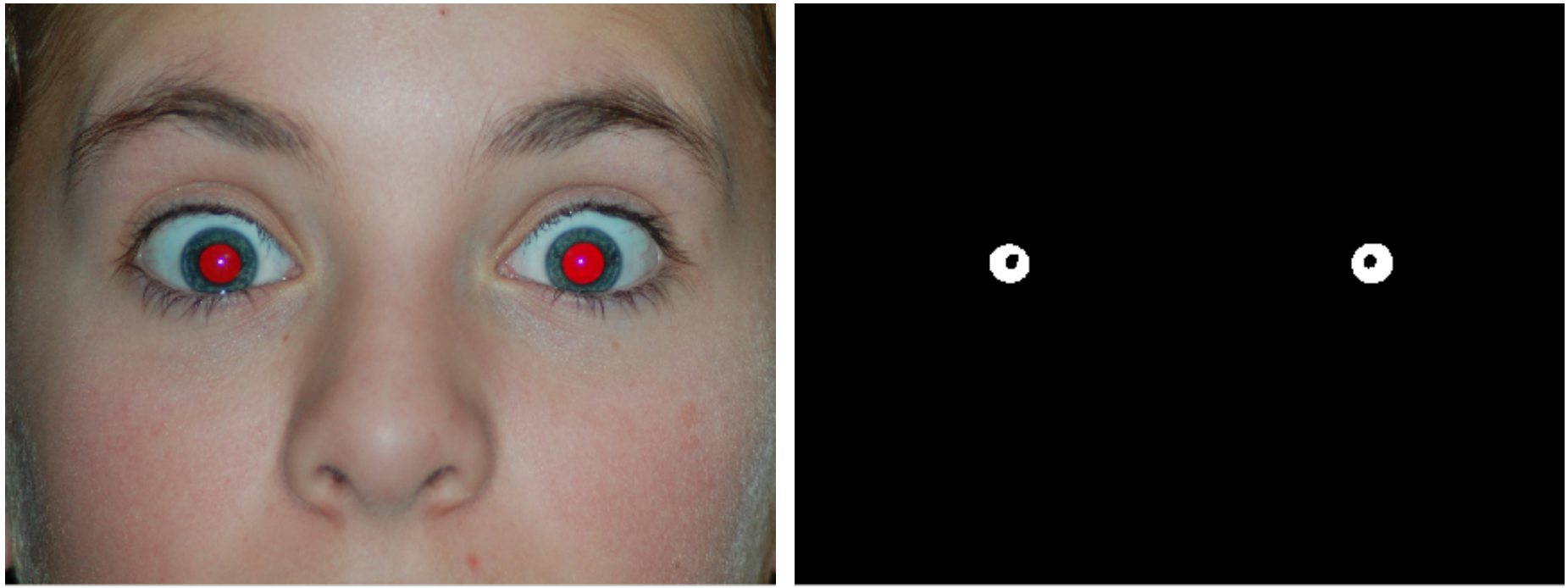
```
im=imread('BoldRedEye.jpg');

mask = im(:,:,1)>100 & im(:,:,2)<50 & im(:,:,3)<50;
```

Red channel | Green channel | Blue channel

M1 – Project: Homework Block 1

EXAMPLE SEGMENTATION



M1 – Project: Homework Block 1

- **Task 3:** Color segmentation to generate a mask
  - Thresholds can be hand-picked by looking to some images in the *train split*
  - An appropriate color space should be selected
  - More powerful methods: Ground truth masks of the *train split* can be used to create a color model:
    - Histograms to study color distributions: per channel histograms, joint histograms, etc.
    - Modeling of color distribution using a suitable model (e.g. gaussian)
    - …

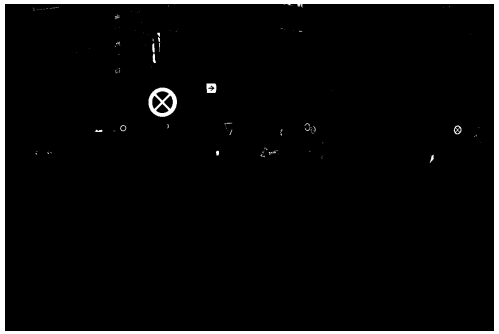
Lecture 3

M1 – Project: Homework Block 1

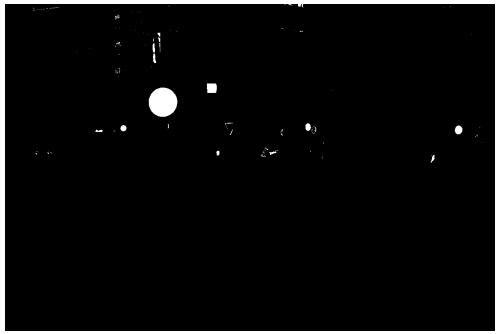
- **Task 4:** Evaluate the segmentation using ground truth

How do we know which technique works better?

test image



output segmentation (technique 1)

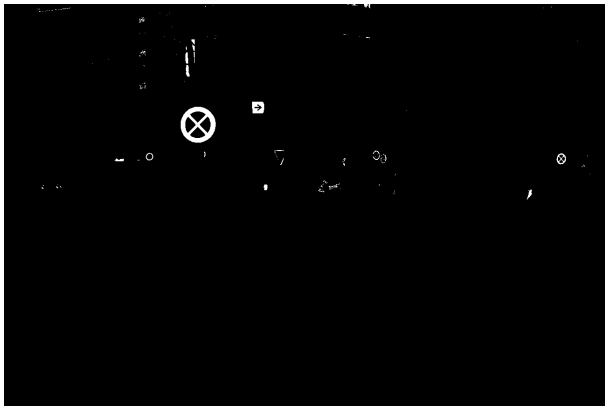


output segmentation (technique 2)

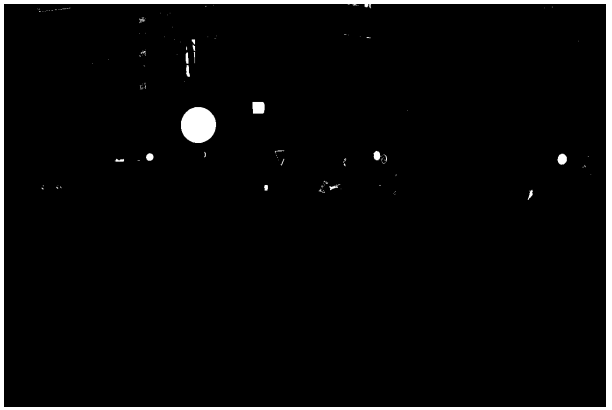
M1 – Project: Homework Block 1

How do we know which technique works better?

test image



output segmentation (technique 1)

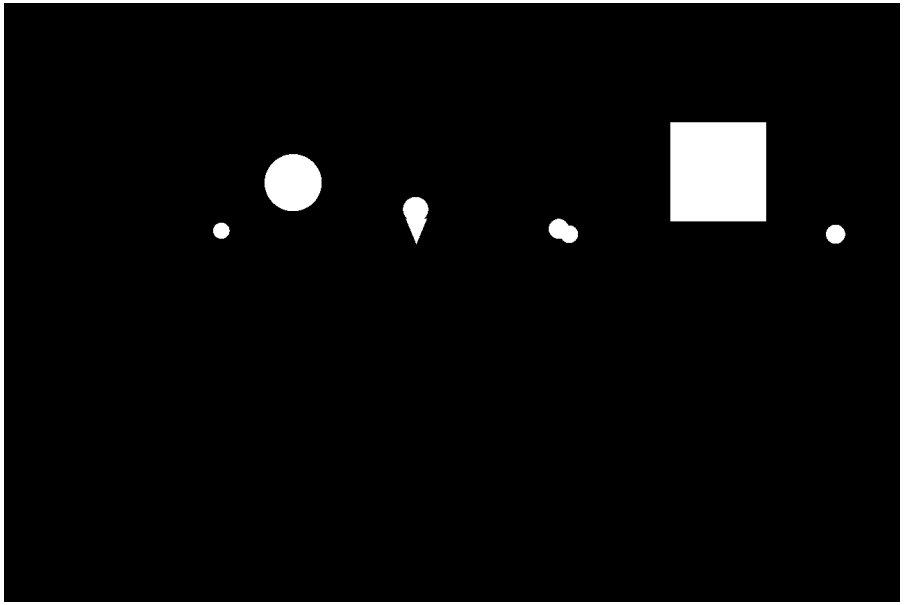


output segmentation (technique 2)

M1 – Project: Homework Block 1

How do we know which technique works better?

test image



annotation (a.k.a. groundtruth)
(it is what we expect)

M1 – Project: Homework Block 1

Annotations

Test image

01.003635.png

Mask images

mask/mask.01.003635.png

Textual annotations

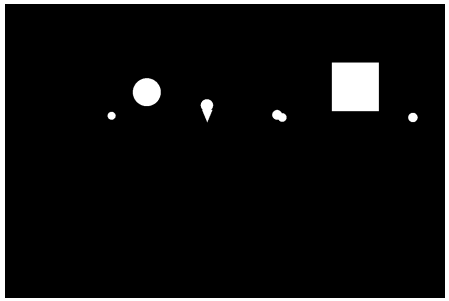
gt/gt.01.003635.txt

194.20 1232.53 255.27 1300.80 A

Signal type

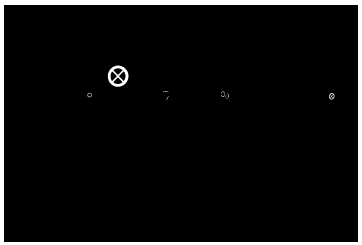
M1 – Project: Homework Block 1

How do we know which technique works better?

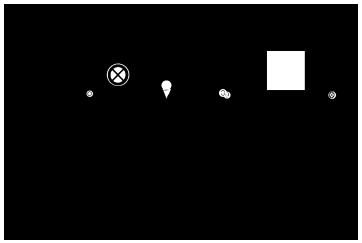


annotation (A)

technique 1 (O)

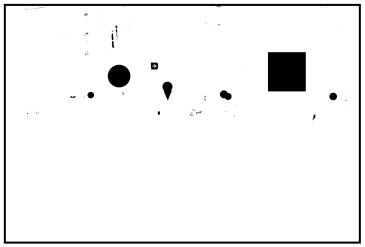


True Positive (TP)
= A & O



False Negative
(FN) = A & ¬O

False Positive (FP)
= ¬A & O



True Negative (FP)
= ¬A & ¬O

M1 – Project: Homework Block 1

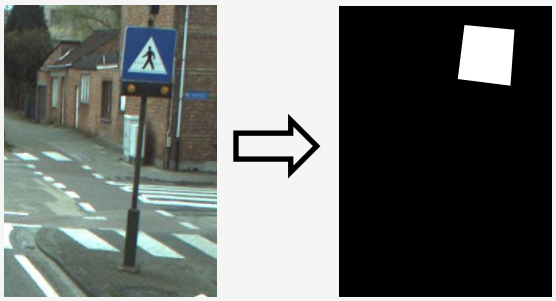
How do we know which technique works better?

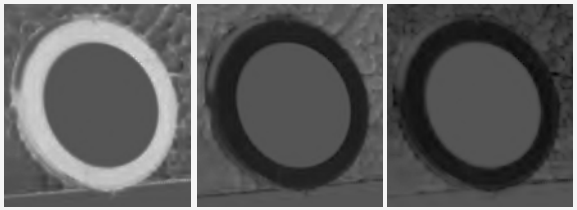
	Precision	Accuracy	Recall	F1-mesure	TP	FP	FN	Time per frame
Method 1								
Method 2								
Method 3								

Provide results for the validation split

M1 – Project: Homework Block 1

- Segmentation
  - Color spaces: NormRGB, HSV, Opp colorspace CODE, normrgb, etc.





R G B

- Pixel-based evaluation (precision, accuracy, specificity, recall)
  PerformanceEvaluationPixel CODE

		Groundtruth	
		T	**N**
Label	**T**	TP	FP
	N	FN	TN

Submit progress slides + code + mask images (png, 0:background, 1: object)
Deadline: October 16th, 2016 20:00

M1 – Project: Homework Block 1

- **Task 5:** Study the influence of luminance normalization **(Optional)**
  - Analyze how differences in illumination affect the performance of your approach
  - Determine if a illumination compensation technique con be useful to improve the detection results
    - Histogram equalization, etc.

M1 – Project: Homework Block 1

- **Task 1**: Determine the characteristics of the signals in the training set: max and min size, form factor, filling ratio of each type of signal, frequency of appearance. Group the signals according to their shape and color.
- **Task 2:** Create train/validation splits using provided training images
- **Task 4:** Color segmentation to generate a mask
- **Task 4:** Evaluate the segmentation using ground truth
- **Task 5:** Study the influence of luminance normalization **(Optional)**

Submit progress slides + code + mask images (png)
Deadline: 16/10/2016 20:00

M1 – Project

Tips for Slides:

- Be concise!
- Analyze errors and problems
- Discuss results
- Explain how parameters are obtained
- Provide results in the training and test sets separately
- Provided tasks are a starting point. Other methods welcome!