



# Inria's participation at ImageCLEF 2013 Plant Identification Task

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# The ImageCLEF2013 Plant Task



Scan or “Scan-like” of Leaf  
“SheetAsBackground”  
*uniform (white) background*

Leaf - Flower - Fruit - Bark - Entire  
“NaturalBackground”  
*with more or less cluttered background*

“Species retrieval” task:

- 20985 train images covering 250 species
- 5092 test images without ground truth
- for each test image give a list of species

Specific metric attempting to reduce some bias due to repetitive test images from a same individual plant (same “event”)

$$S = \frac{1}{U} \sum_{u=1}^U \frac{1}{P_u} \sum_{p=1}^{P_u} \frac{1}{N_{u,p}} \sum_{n=1}^{N_{u,p}} s_{u,p,n}$$



# Inria PlantNet participation



Scan or “Scan-like” of Leaf  
“SheetAsBackground”  
*uniform (white) background*

1. Shape approaches  
+ information fusion  
-> multiples features  
-> multiples image tests

Leaf - Flower - Fruit - Bark - Entire  
“NaturalBackground”  
*with more or less cluttered background*

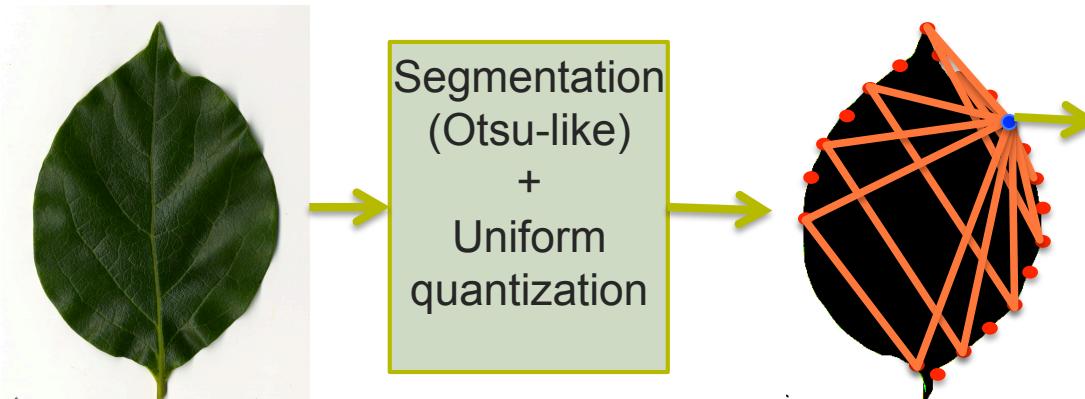
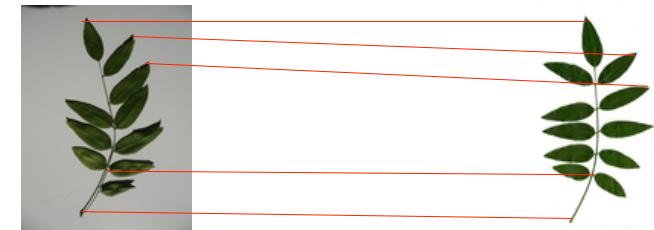
- 2.a. Large scale matching approach  
+ information fusion  
->multiple features  
->multiple image tests  
->flowering time
- 2.b. Fisher vector +SVM approach

# SheetAsBackground category

## Multiscale triangular shape descriptors

[Mouine2013]

- local matching of shapes
- robust & fast to compute
- validated on various leaf databases



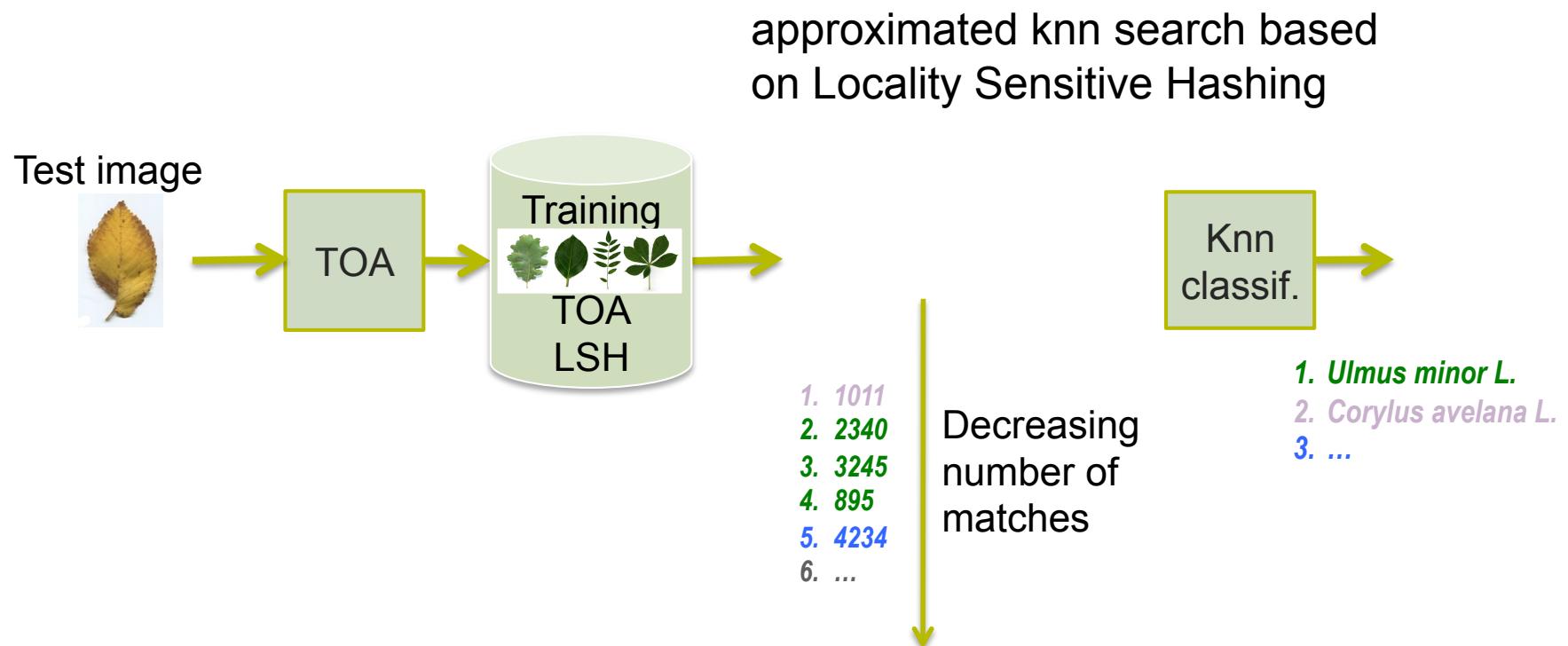
400 local features described with 20 triangles

2 versions:

- TOA: successive Oriented Angles
- TSLA: Length and Angles

# SheetAsBackground category

## Matching

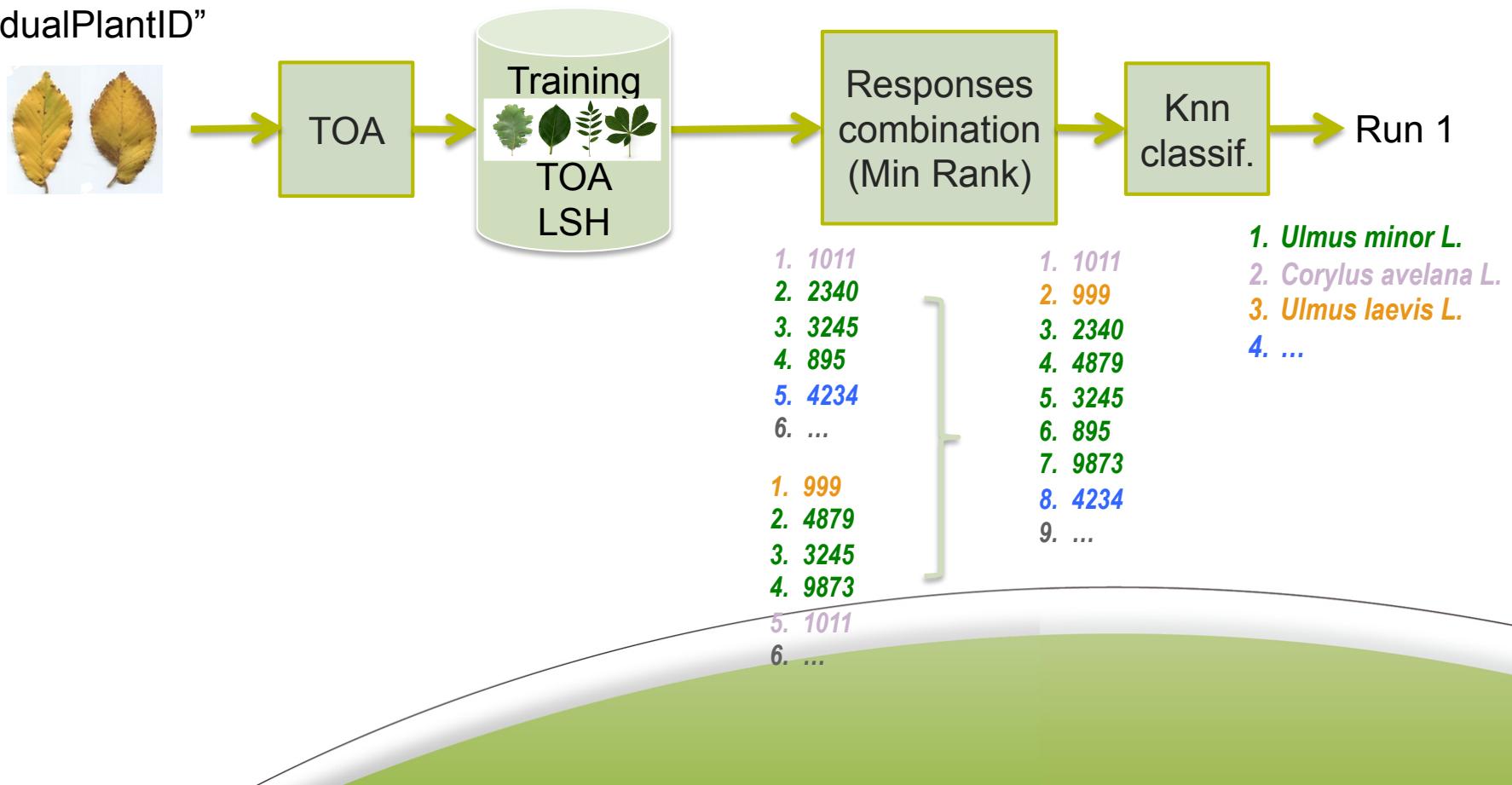


# SheetAsBackground category

Combining test images from a same plant observation

→ Inria PlantNet Run 1

Test images with a  
same  
“IndividualPlantID”

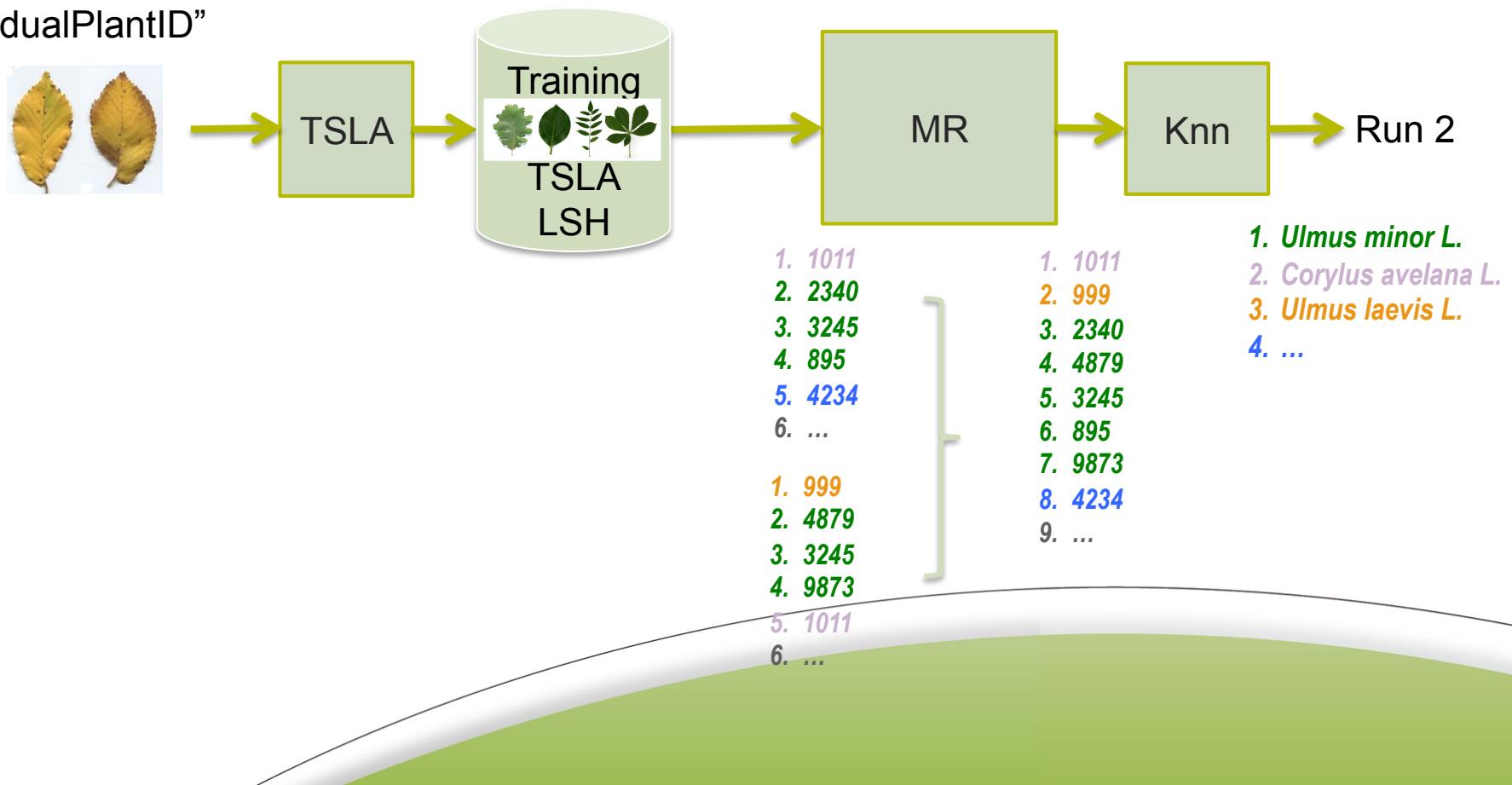


# SheetAsBackground category

Combining test images from a same plant observation

→ Inria PlantNet Run 2

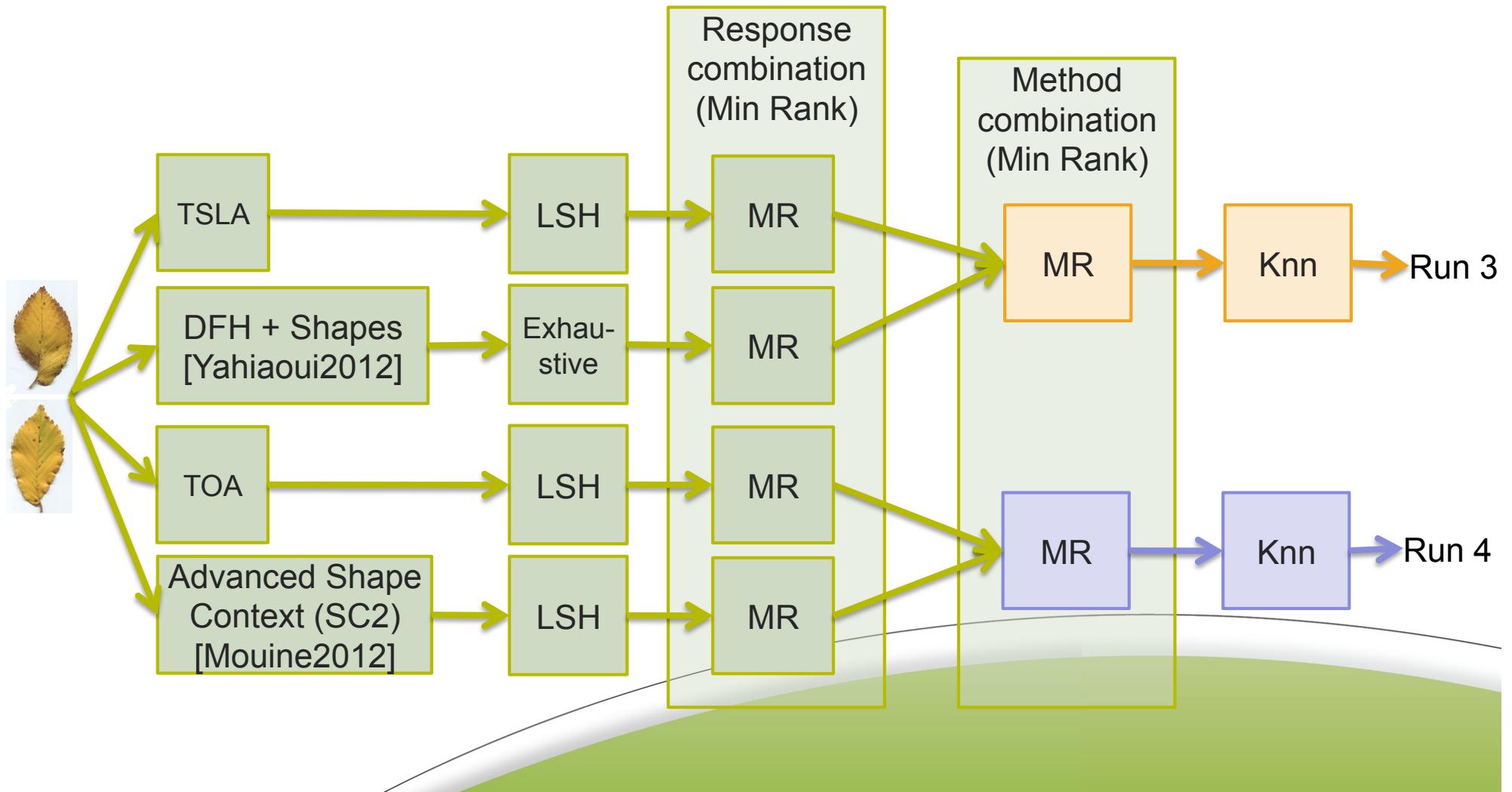
Test images with a  
same  
“IndividualPlantID”



# SheetAsBackground category

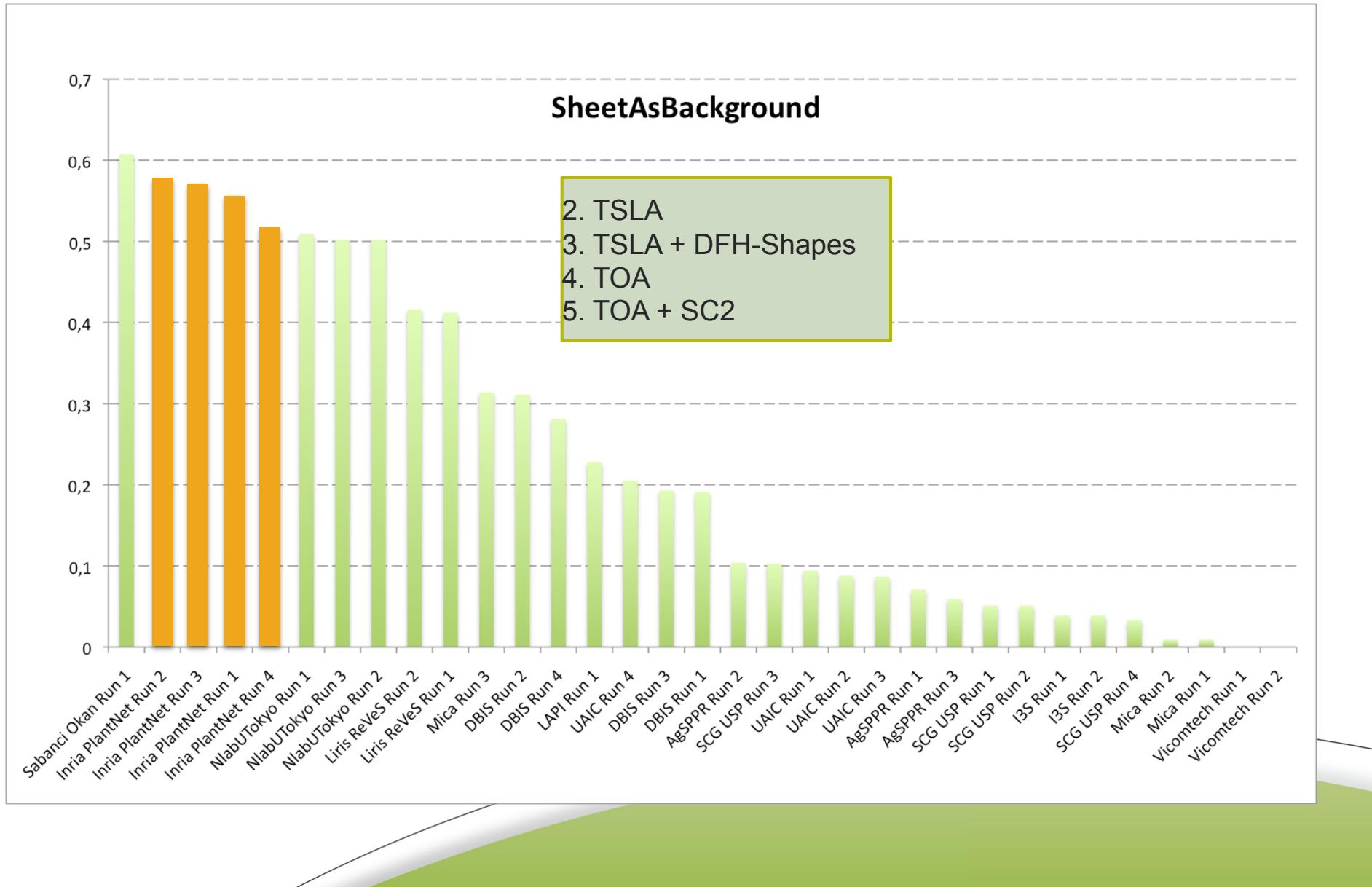
Combining with two previous successful shape based approaches

→ *Inria PlantNet Run 3&4*



# SheetAsBackground category

## Results



# Inria PlantNet participation



Scan of Leaf  
“SheetAsBackground”  
Most of the time white uniform background

1. Shape approaches  
+ information fusion  
-> multiples features  
-> multiples image tests

Leaf - Flower - Fruit - Bark - Entire  
“NaturalBackground”  
*with more or less cluttered background*

- 2.a. Large scale matching approach  
+ information fusion  
->multiple features  
->multiple image tests  
->flowering time

- 2.b. Fisher vector approach + SVM

# NaturalBackground category

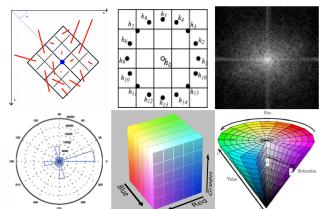
Main steps (Inria PlantNet Run 1, 2 & 3)

For each view (flower, fruit, leaf, stem, entire)

Interest point detection



Local features



Matching with RMMH



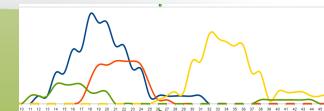
Response list  
to probabilities



Late fusion  
-features  
-images

$$P(C^k) = \sum_{f \in F} w(f) * P(C_f^k)$$

Flowering time



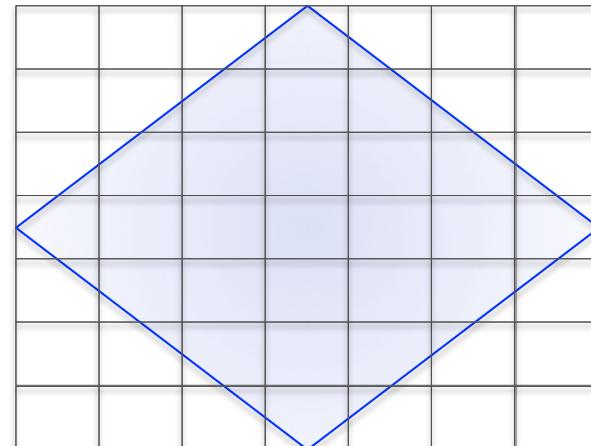
# Constrained Harris corner detection

*Inria PlantNet Run 1, 2 & 4*

Favoring local descriptions at the center



Multiscale Harris color  
corner detection



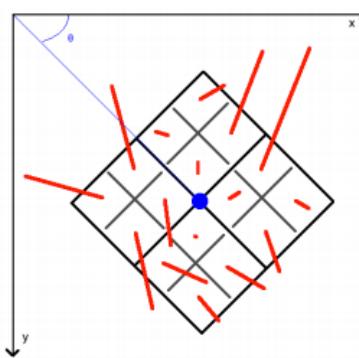
Rhomboid mask + 7x7 grid



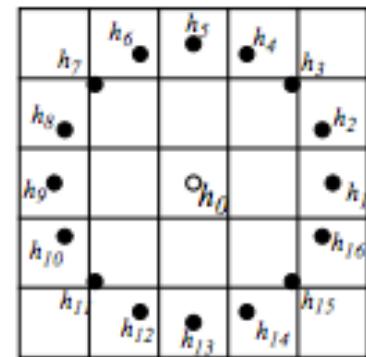
200 "best" points following  
the grid with a Gaussian  
like distribution

# Local features

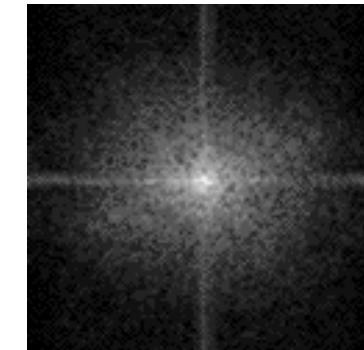
SURF



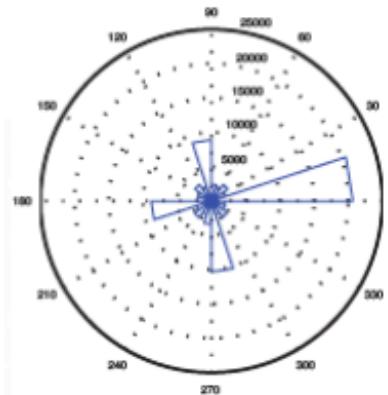
rotation invariant Local Binary Pattern (ri-LBP)



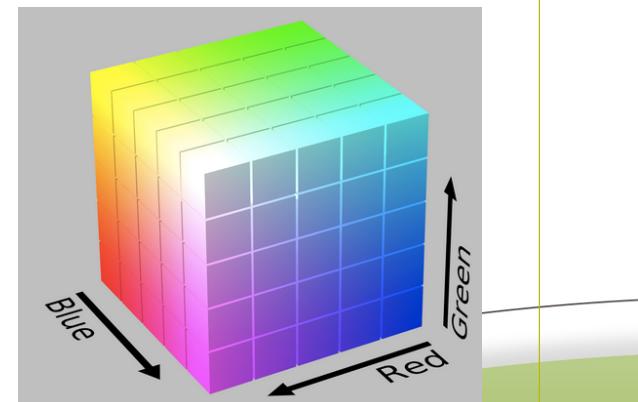
Fourier 2D



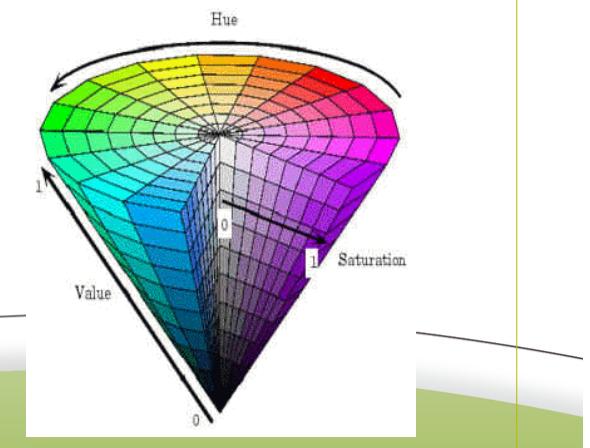
Edge Orientation Histogram



Weighted RGB  
(color+texture)

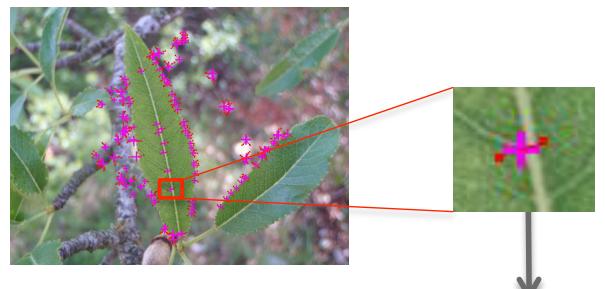


HSV histogram



# Large Scale Matching with RMMH

Random Maximum Margin Hashing [A. Joly, O. Buisson, CVPR 2011]



$(\mathbf{x}_1 \mathbf{x}_2 \mathbf{x}_3 \dots \mathbf{x}_n)$   
Ex: SURF

RMMH

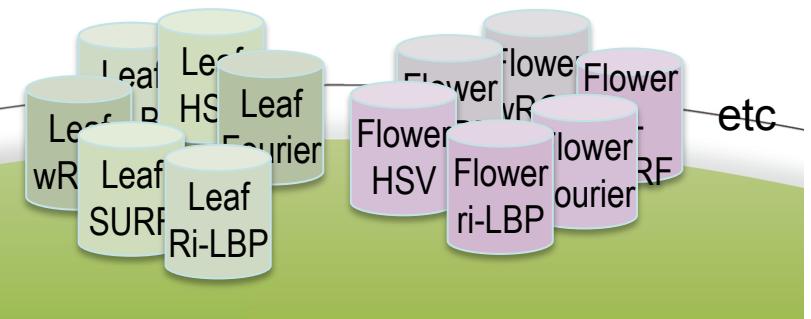
Hash code = 256 bits  
 $(1 \text{ 0 } 1 \text{ 1 } | 1 \text{ 0 } 1 \text{ 0 } 0 \text{ 1 } 0 \text{ 1 } 0 \text{ 0 })$   
Key                      Value

Local features are **embedded jointly** in compact hash codes

$$h(\mathbf{x}) = \text{sgn} \left( \sum_{i=1}^m \alpha_i^* \kappa(\mathbf{x}_i^*, \mathbf{x}) + b_m \right)$$



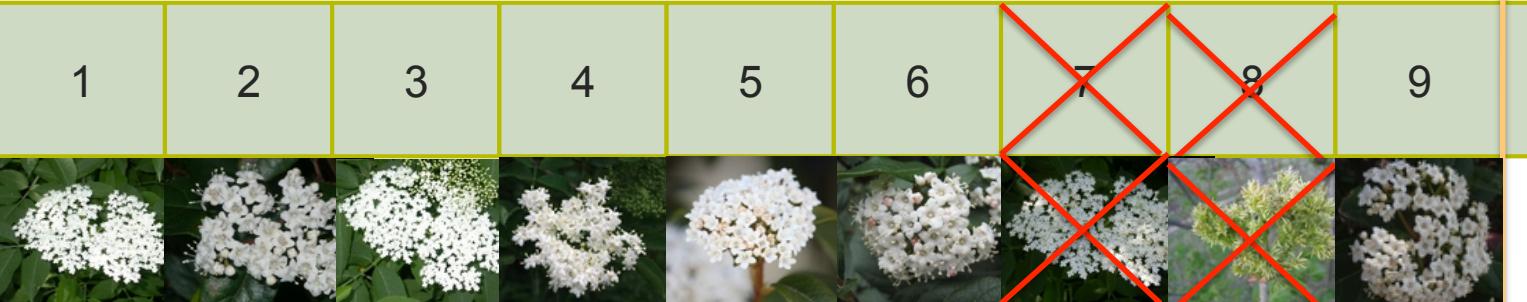
Each type of descriptor use a **independent index**  
6 types of descriptor x 5 plants views -> 30 visual indices



# Converting an image response list into a probability distribution

≈Adaptive Knn rule according to the plant (not only the most similar images)  
 -> favoring visual diversity within a same species

Query	1	2	3	4	5	6	7	8	9	...
Species	SN	VT	SN	SN	VT	VT	SN	FO	VT	Others (noisy)
Individual PlantID	SN1	VT1	SN1	SN2	VT2	VT3	SN1	FO1	VT4	Others (noisy)



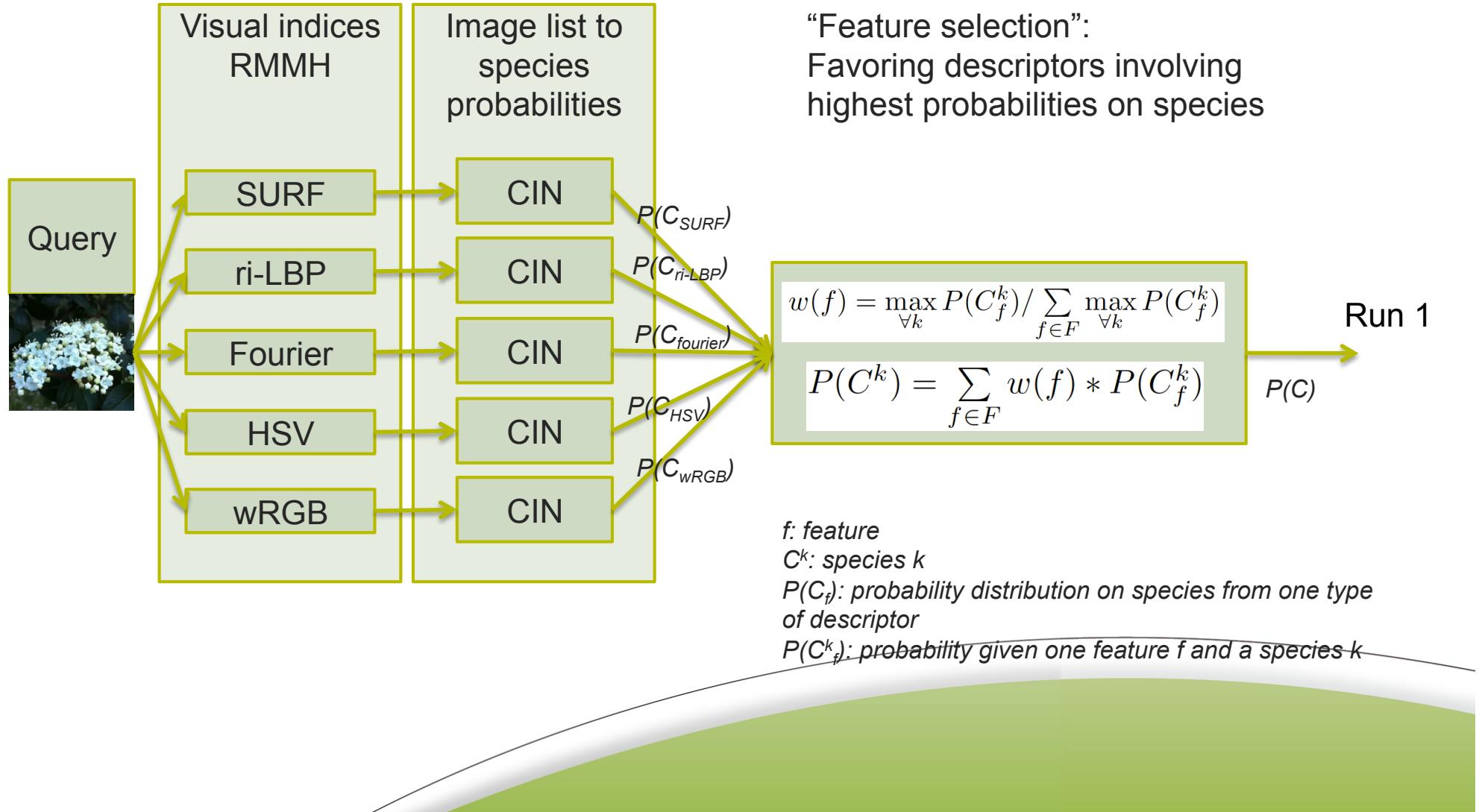
4 similar plant observations for VT > 2 similar plant observations for SN  
 $p(VT) > p(SN)$

Method used here:

- Require at least 2 distinct plants (2 IndividualPlantIDs)
- Keep only the 2 most similar images from distinct individual plants
- Based on the average of the number of matches

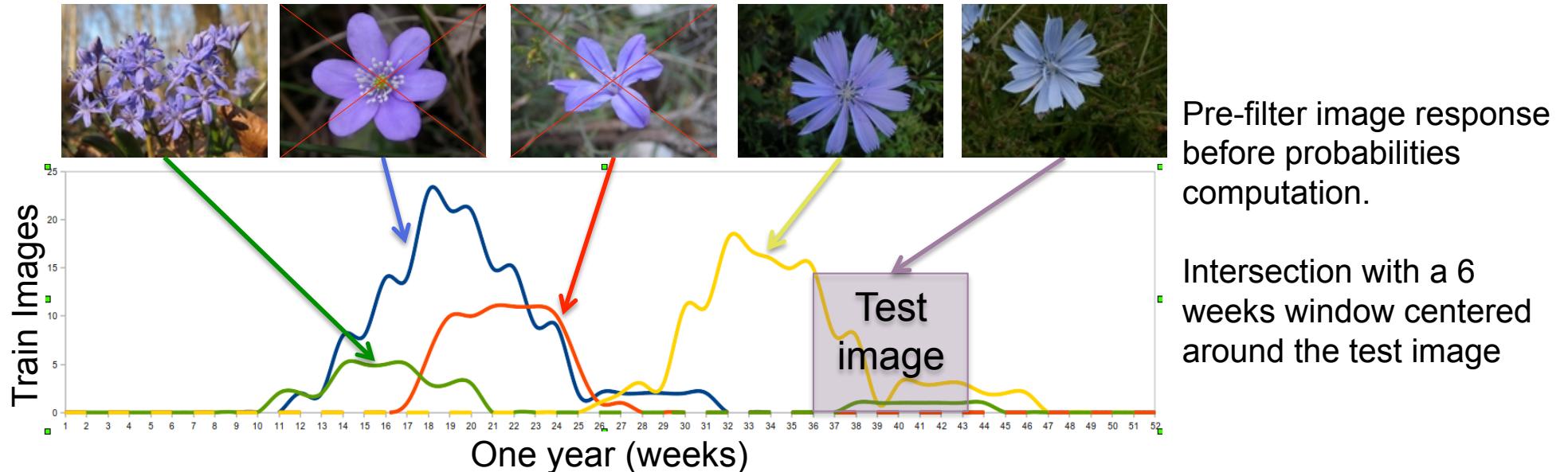
# Weighted combination for late fusion of descriptors

→ Inria PlantNet Run 1

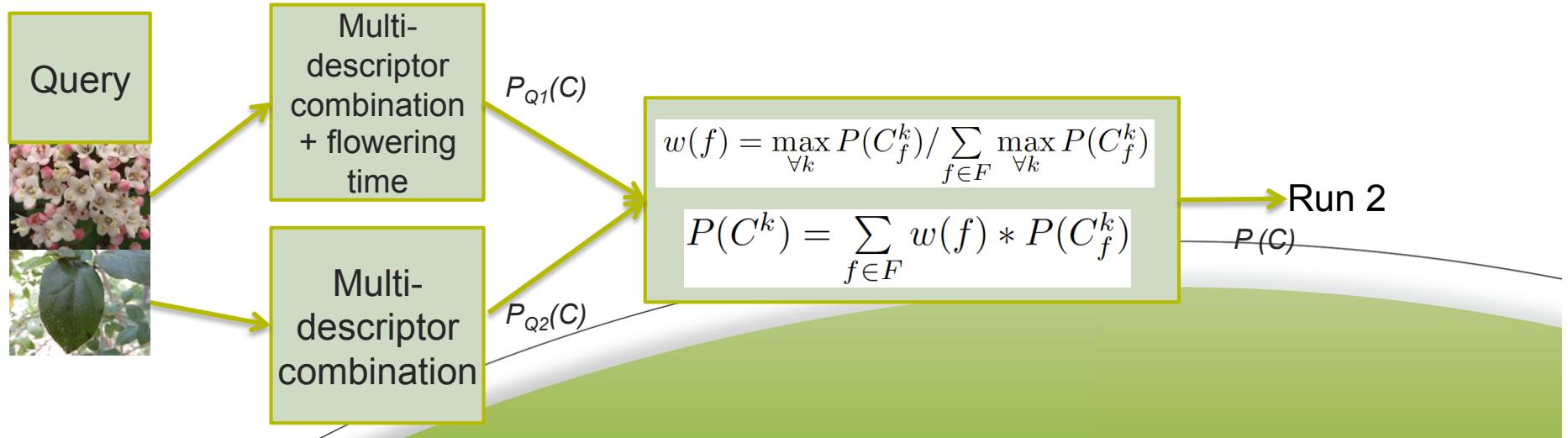


# Flowering time & multiple image queries

→ Inria PlantNet Run 2



+ test images from a same individual plant: weighted combination schema



# Reduced resources use with segmentation

→ *Inria PlantNet Run 3*

same as Inria PlantNet Run 1

Attempt segmentation: less background descriptions

-30% local descriptions by picture on average



Initial point selection (run1)



Segmentation mask for  
points filtering

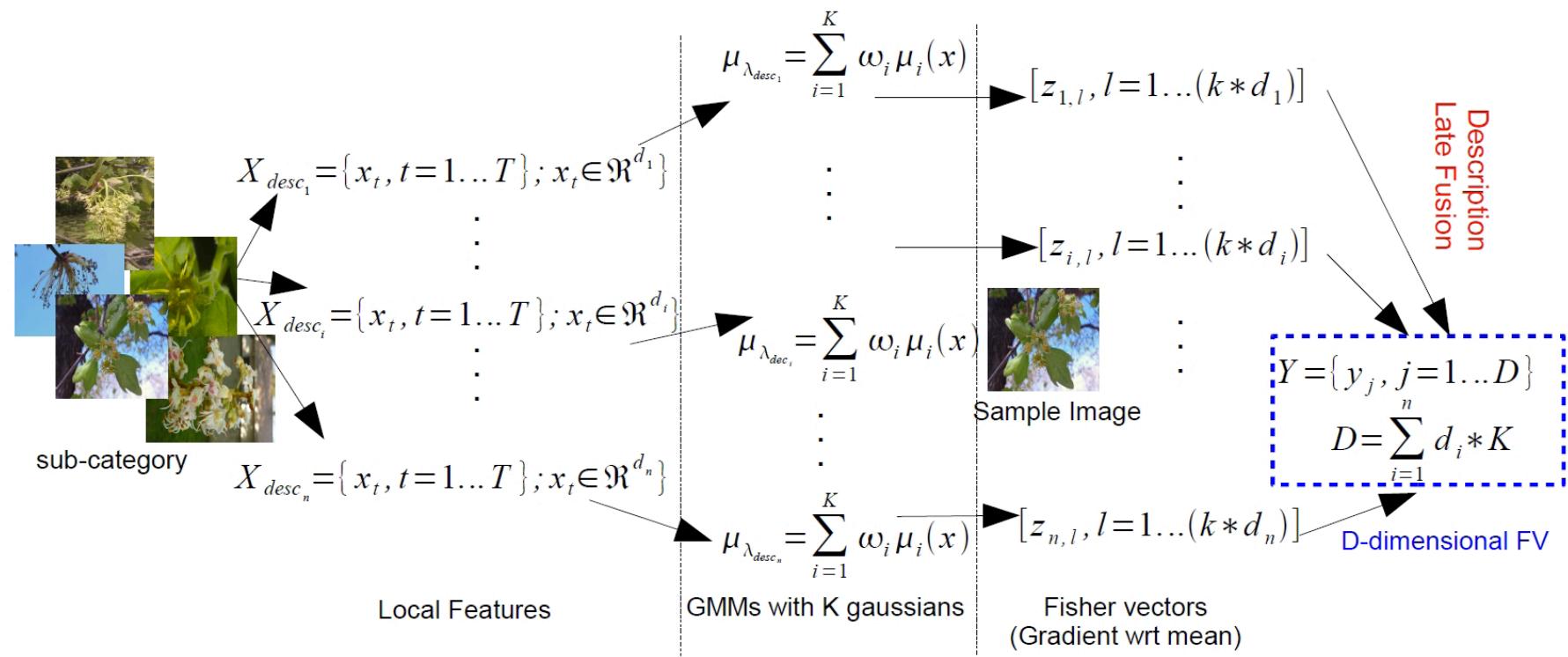


Filtered points

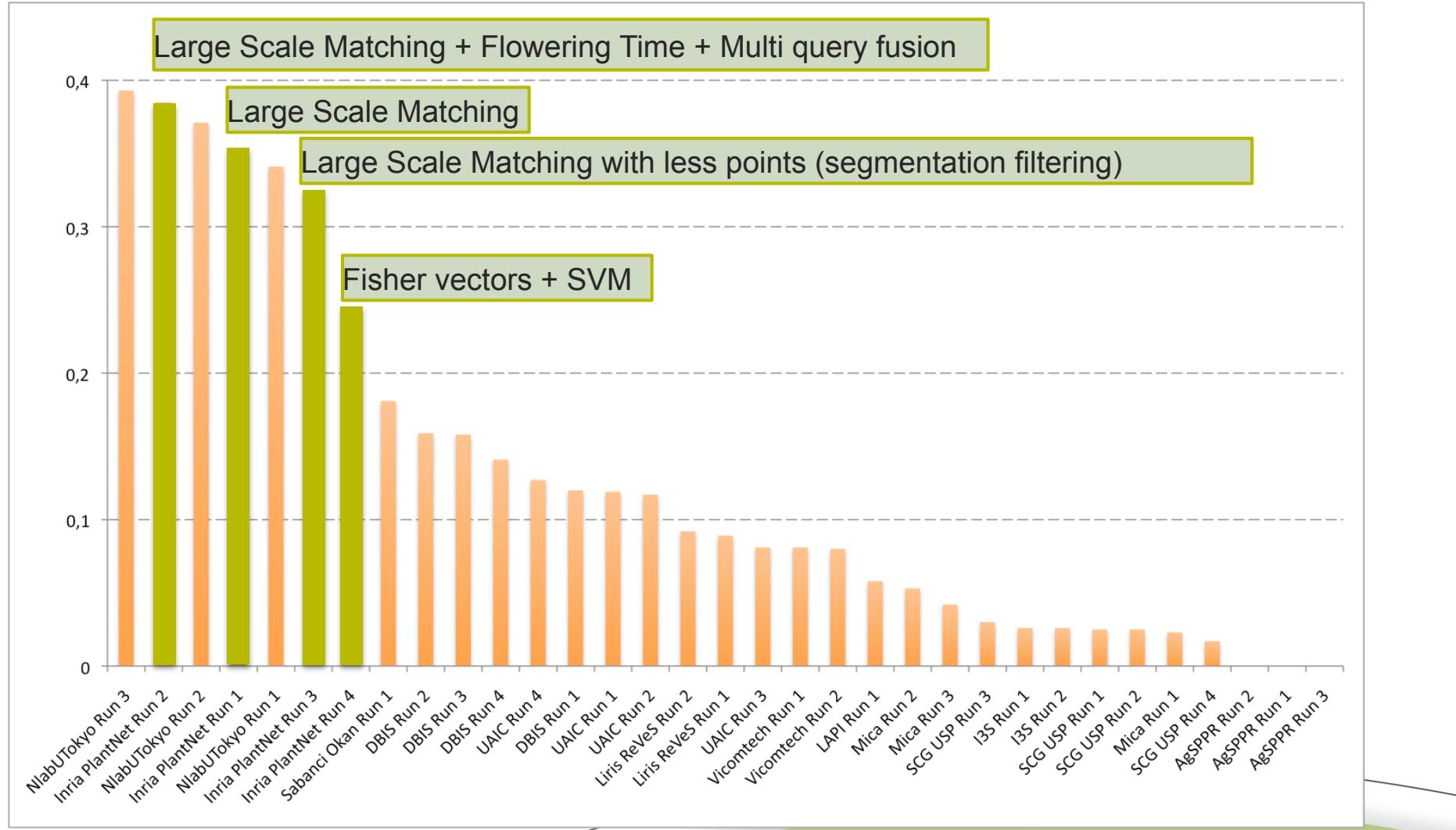
# Embedding schema with Fisher Vectors

→Inria PlantNet Run 4

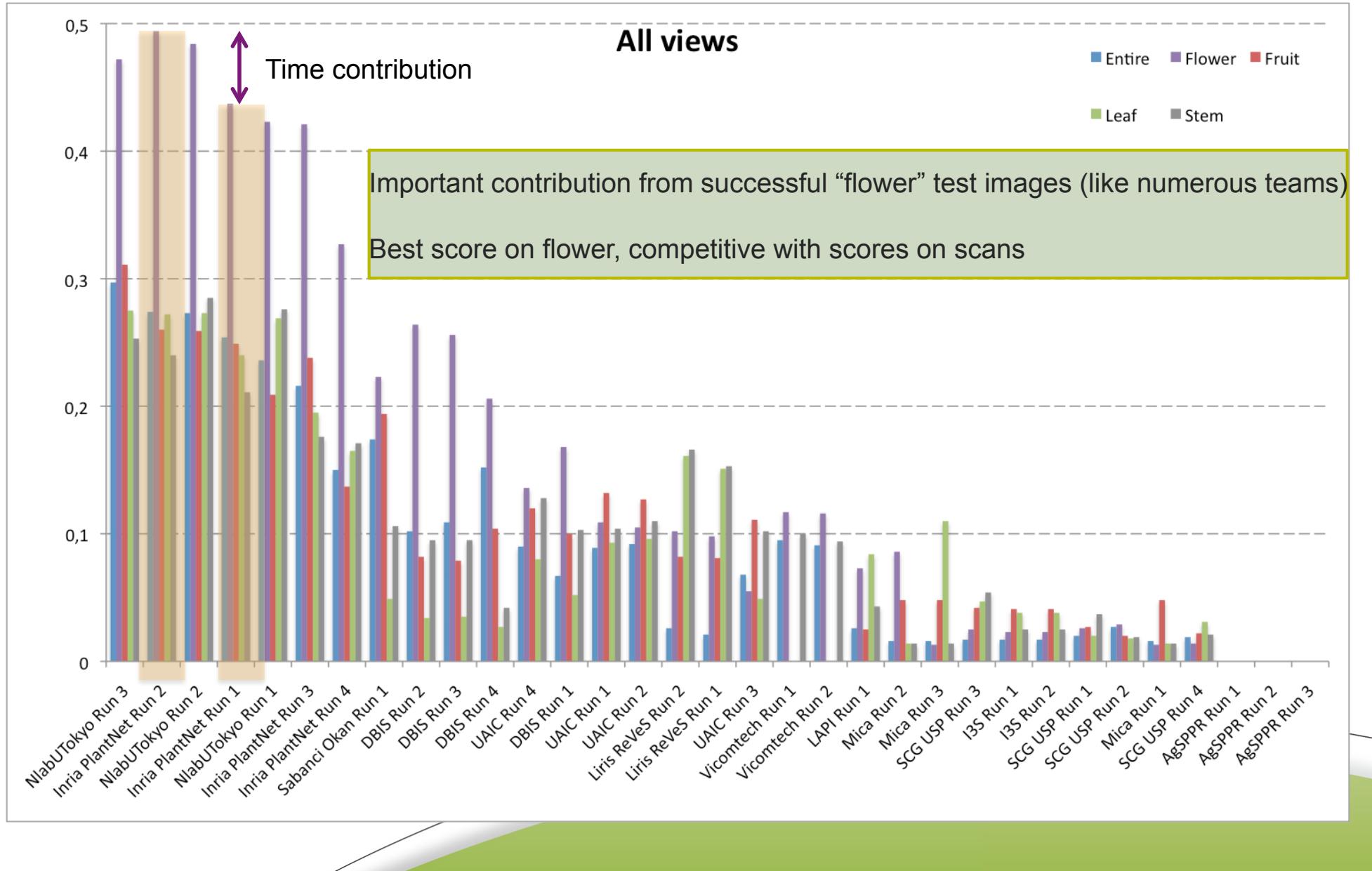
Fusion of descriptors embedded with Fisher Vectors + SVM classifiers



# Results NaturalBackground category

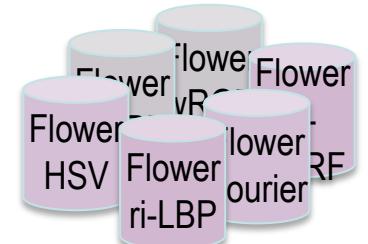


# Results details NaturalBackground



# Conclusions

- shape matching for scans
- combination of test images coming from a same plant
- feature extraction at the center for photos
- efficient visual search engine with RMMH
- independent indices for each type of visual description
- late fusion
- a profitable use of time for flower



# Future work

Better operators for fusion and combination mechanism

New descriptors

Better use of metadata (geolocation, optical parameters)

More investigations on Fisher Vectors ?

PI@ntNet mobile app: yet in production

Method used in “Inria PlantNet Run 2” = beta version (next update)

Try it now!

(IOS)



And contribute to the next year  
task with new images!