Efficient Bark Recognition in the Wild

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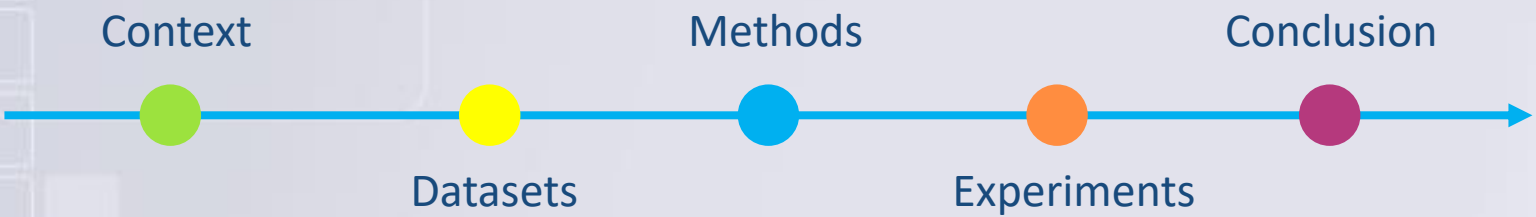
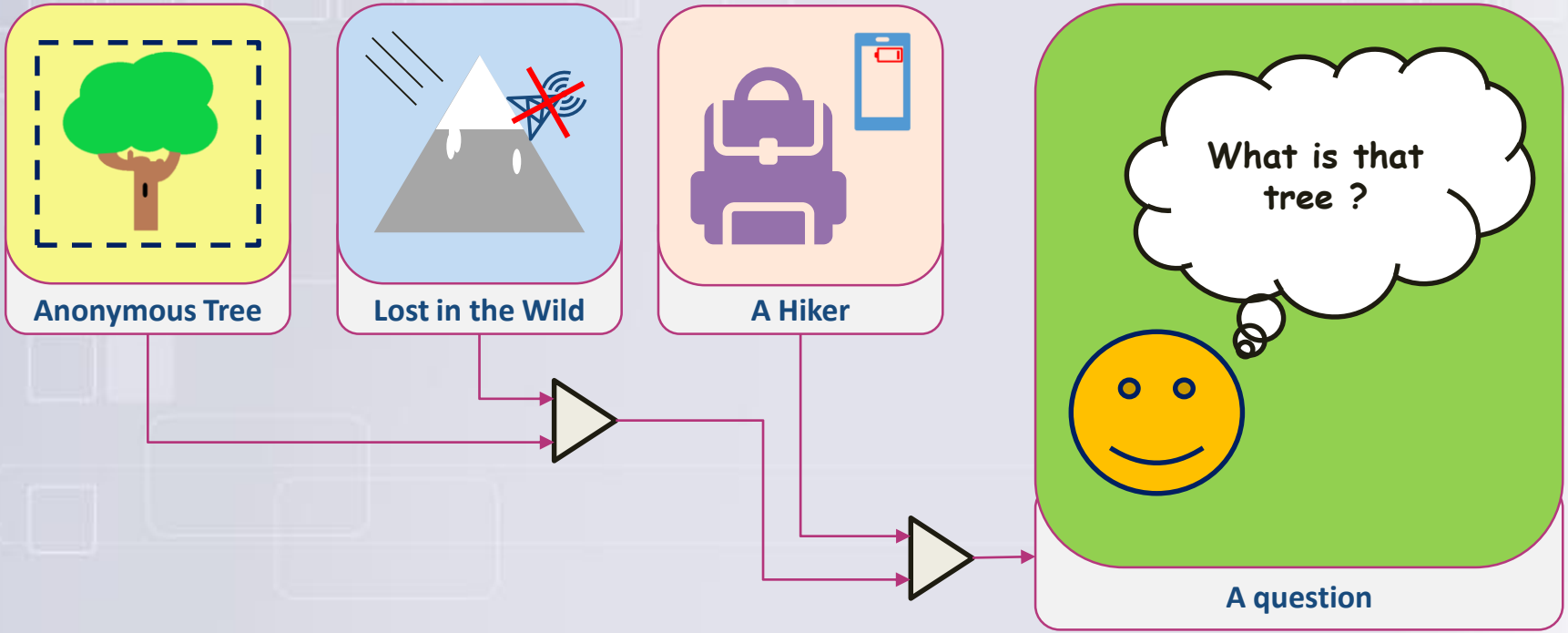
Summary



Context

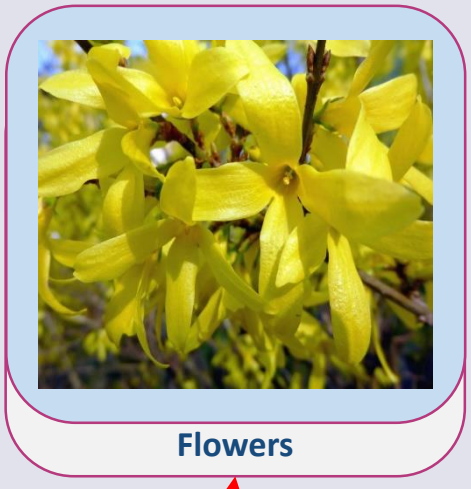
Once upon a time…



Bark: a robust tree organ

Leaves

Fruits



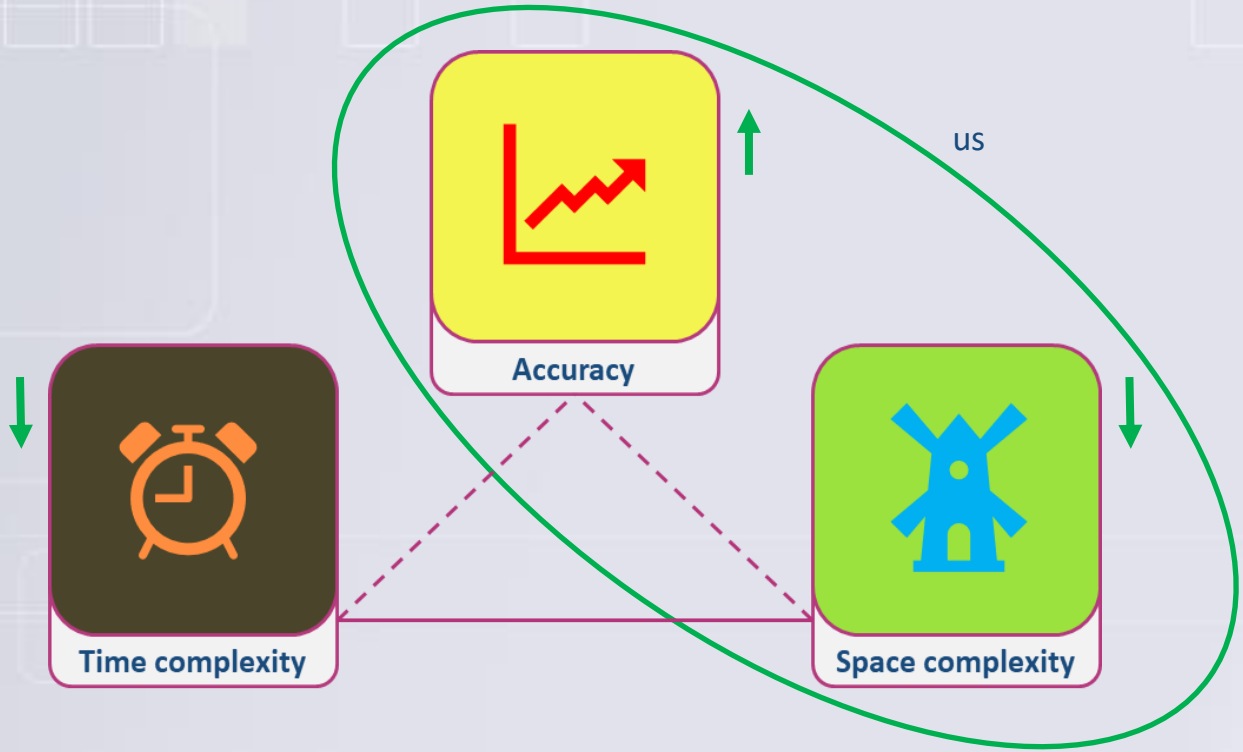
Flowers

Bark

yes yes yes no

Do they change according to the season ?

Efficient recognition, a trade-off



Datasets

Existing datasets

Dataset information	BarkTex	NewBarkTex	Trunk12	AFF
Classes	6	6	12	11
Total images	408	1632	393	1082
Images per classes	68	272	30-45	16-213
Image size	256x384	64x64	1000x1334	1000x(478-1812)
Illumination change	✓	✓	✗	✓
Scale change	✓	✓	✗	✓
Noise (shadows, lichen)	✗	✗	✗	✓
Train / Test splits	✗	50/50	✗	✗

[Lakmann, 1998]

[Porebski, 2014]

[Svab, 2014]

[Wendel, 2011]

- Tree barks
- Lack of representativity
- Segmented
- Size constraints

Contribution: Bark-101 dataset

Dataset information	BarkTex	NewBarkTex	Trunk12	AFF	Bark-101
Classes	6	6	12	11	101
Total images	408	1632	393	1082	2592
Images per classes	68	272	30-45	16-213	2-138
Image size	256x384	64x64	1000x1334	1000x(478-1812)	(69-800)x(112-804)
Illumination change	✓	✓	✗	✓	✓
Scale change	✓	✓	✗	✓	✓
Noise (shadows, lichen)	✗	✗	✗	✓	✓
Train / Test splits	✗	50/50	✗	✗	50/50

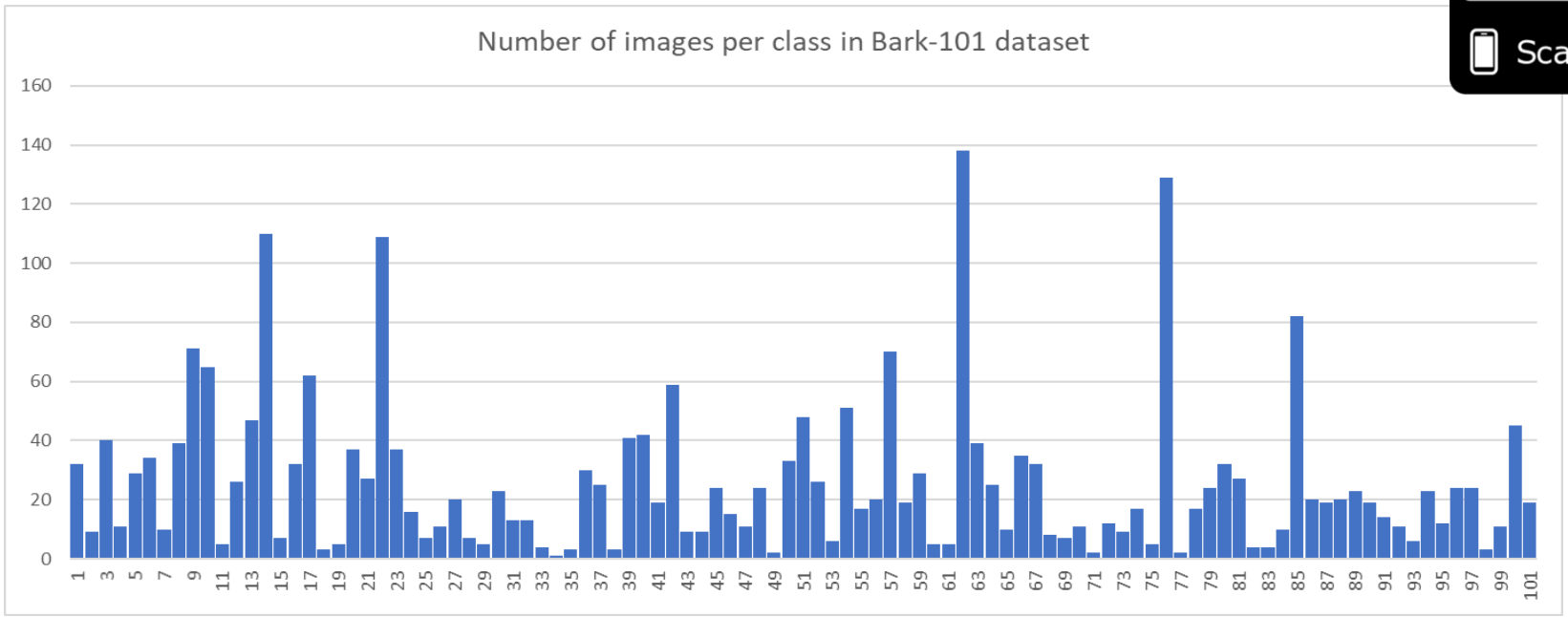
Ours

[PlantClef, 2017]
+ Segmentation

Scan me

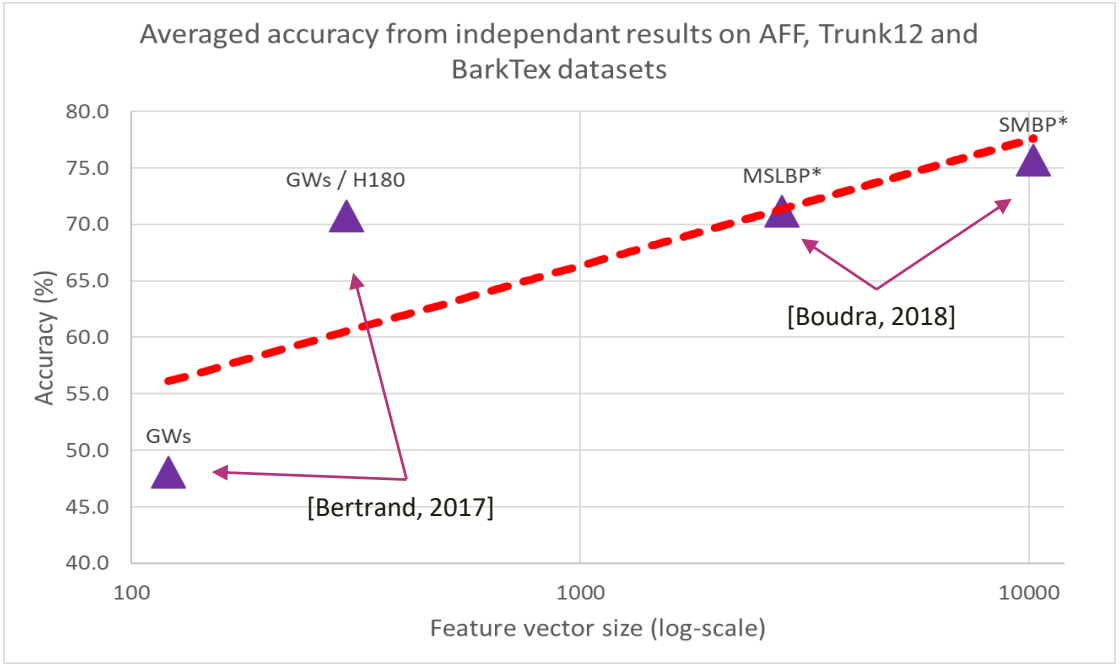
Contribution: Bark-101 dataset

Scan me



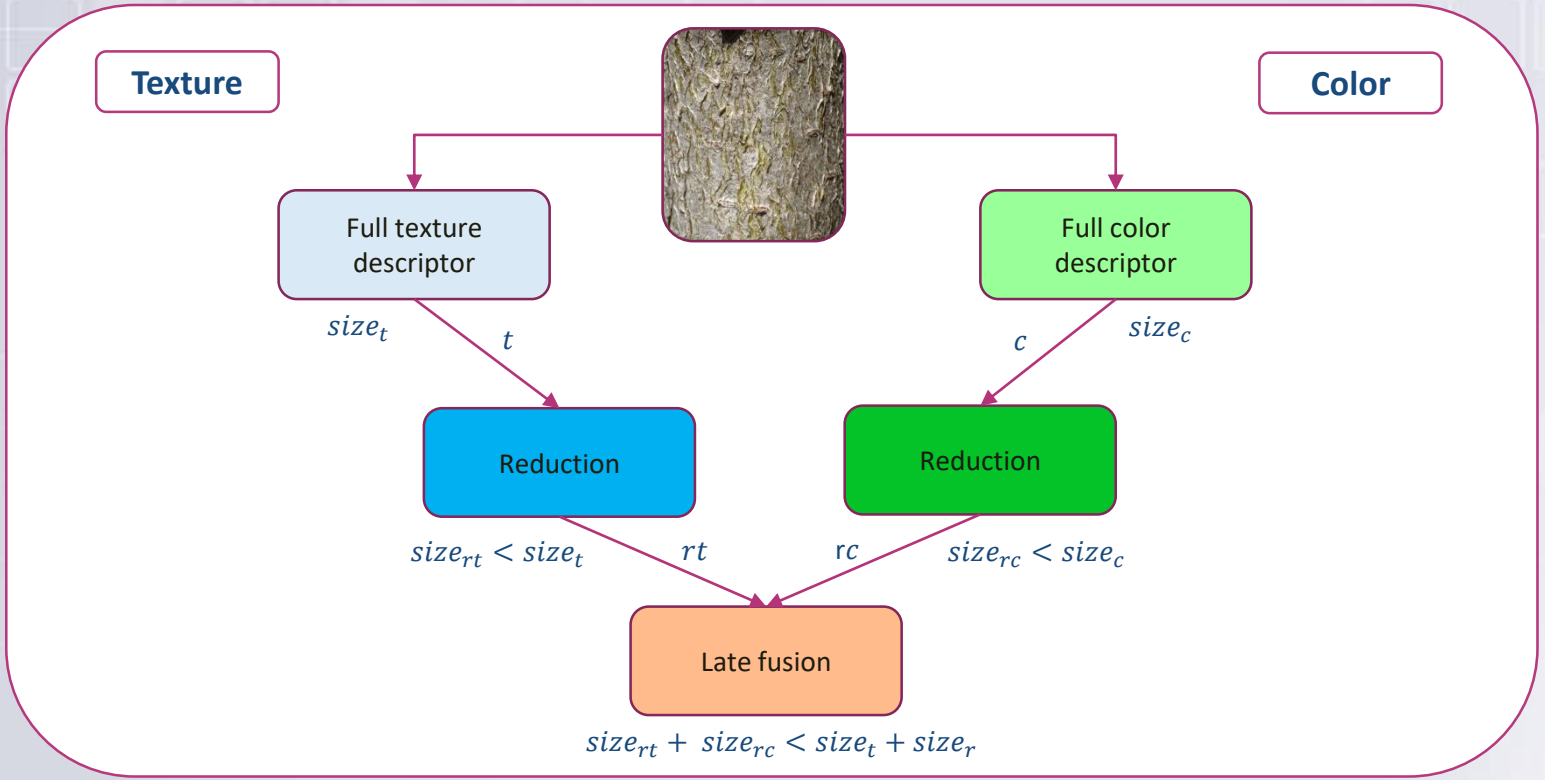
Methods

Existing methods: Limitations



Could we reduce the size without losing too much accuracy ?

An idea


Texture
Color
Full texture descriptor
Full color descriptor
$size_t$
t
c
$size_c$
Reduction
Reduction
$size_{rt} < size_t$
rt
rc
$size_{rc} < size_c$
Late fusion
$size_{rt} + size_{rc} < size_t + size_r$

Contribution: Late Statistics (1/3)

Texture

- $H_t = \{h_1, h_2, \dots, h_{N_h}\}$, full texture histogram
- H_t is made of N_h ordered sub-histograms with $size(h_i) \neq size(h_j)$
- $V_s[i] = \{s_1, s_2, \dots, s_{N_s}\}$, a vector of N_s statistics

$LS(\ ) := late\_statistics(\ )$

$H_t := texture_{H_t}(image_{gray})$

Do for i in $(0, N_h - 1, 1)$
$V_s[i] := LS(H_t[i])$
end for

$size(V_s[i]) \leq size(H_t[i])$

$size(V_s[i]) = size(V_s[j])$

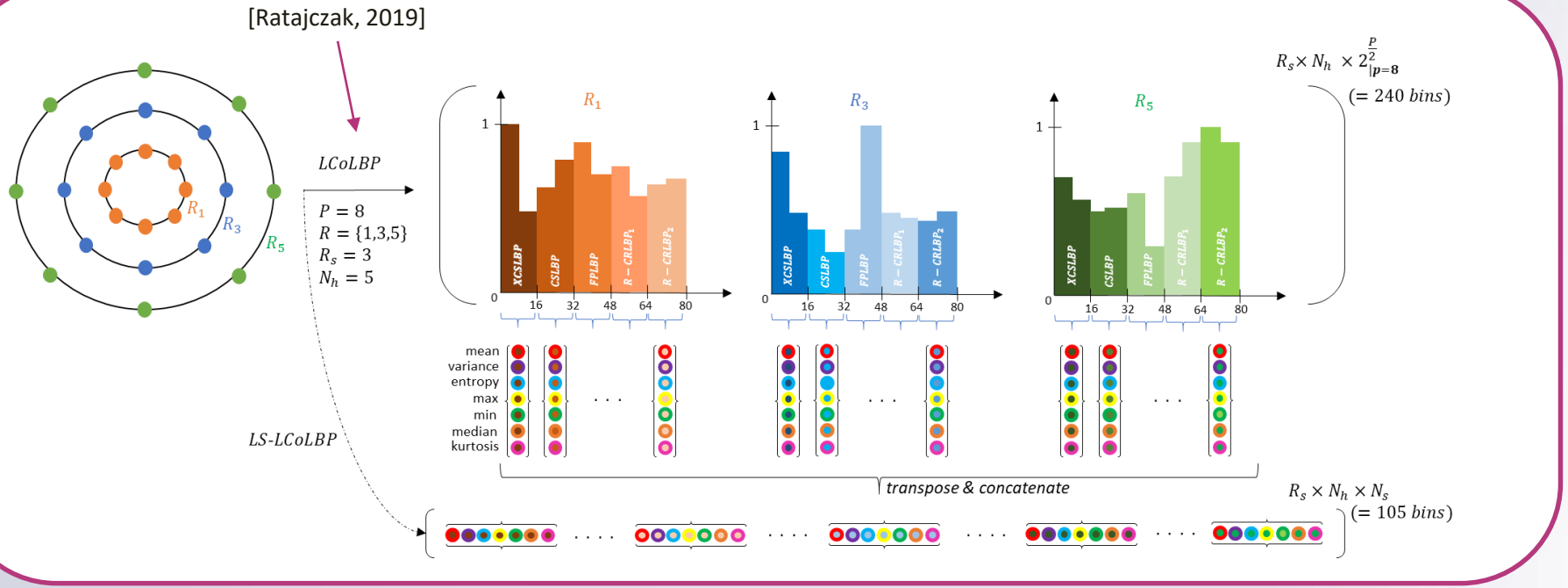
Ordered

Meaningful

Online & Offline

Contribution: Late Statistics (2/3)

Texture



Contribution: Late Statistics (3/3)

Texture

Ablation study - BarkTex

Late Statistics							Accuracy (%)	
mean	variance	entropy	minimum	maximum	median	kurtosis	*LS-LCOLBP*	*LS-CLBP*
✓	–	–	–	–	–	–	81.9	71.8
✓	✓	–	–	–	–	–	82.8	59.6
✓	✓	✓	–	–	–	–	78.4	64.7
✓	✓	✓	✓	–	–	–	82.8	63.2
✓	✓	✓	✓	✓	–	–	83.1	69.4
✓	✓	✓	✓	✓	✓	–	86.3	72.1
✓	✓	✓	✓	✓	✓	✓	89.5	62.8
✓	✓	–	✓	✓	✓	✓	88.2	60.1
✓	–	✓	✓	✓	✓	✓	89.5	62.5
✓	–	–	✓	✓	✓	✓	88.2	59.6
✓	–	–	✓	✓	✓	–	88.2	75.3

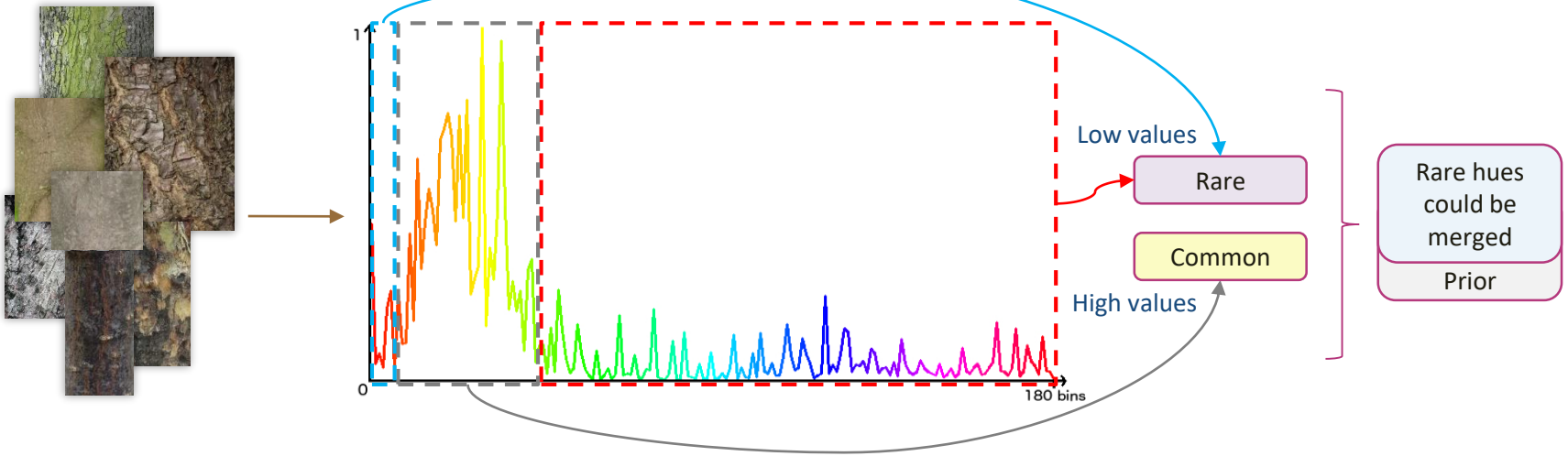
± 15%

≠ Filter → ≠ Late Statistics

Contribution: Color Reduction (1/3)

Color

Cumulated Hue Histogram – **visualization** on Bark-101



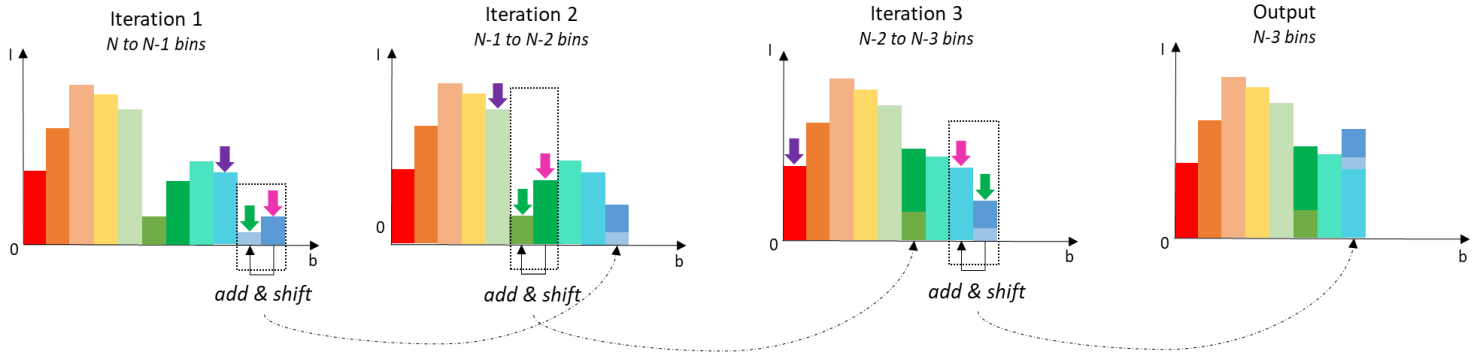
Contribution: Color Reduction (2/3)

Color

M is TBD for each dataset individually

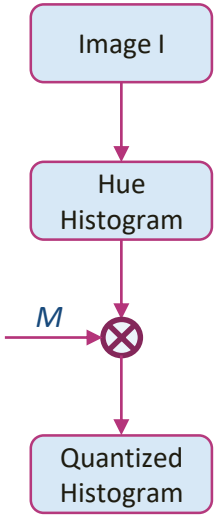
On cumulated histogram - **Train set**

$b_m, I(b_m) = \underset{b}{argmin}(I(b))$ $b_{m1}, I(b_{m1}) = \min(I(b_m - 1), I(b_m + 1))$ $b_{m2}, I(b_{m2}) = max(I(b_m - 1), I(b_m + 1))$



Let *M* be a correspondence matrix for add & shift operation
For each iteration i, $M(i) := (b_m, b_{m1})$

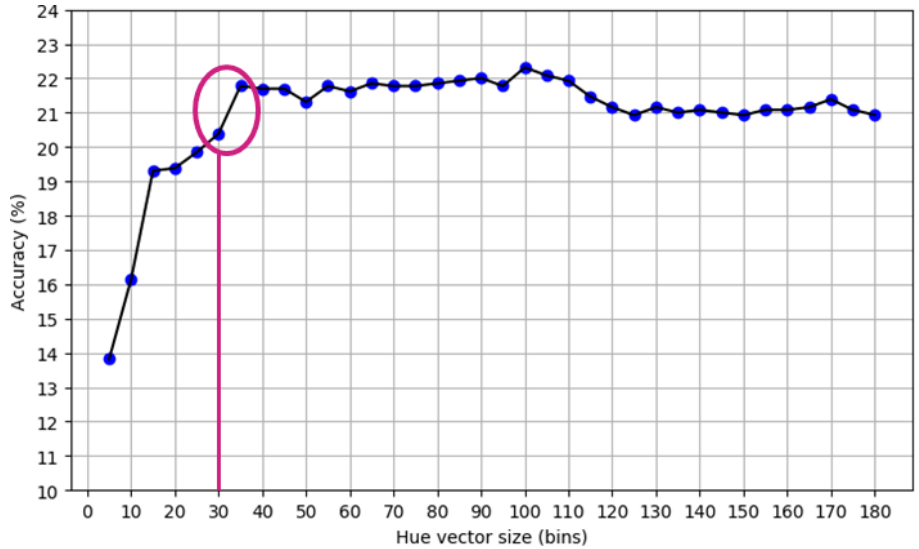
Test set



Contribution: Color Reduction (3/3)

Color

Number of iterations ? Bark-101



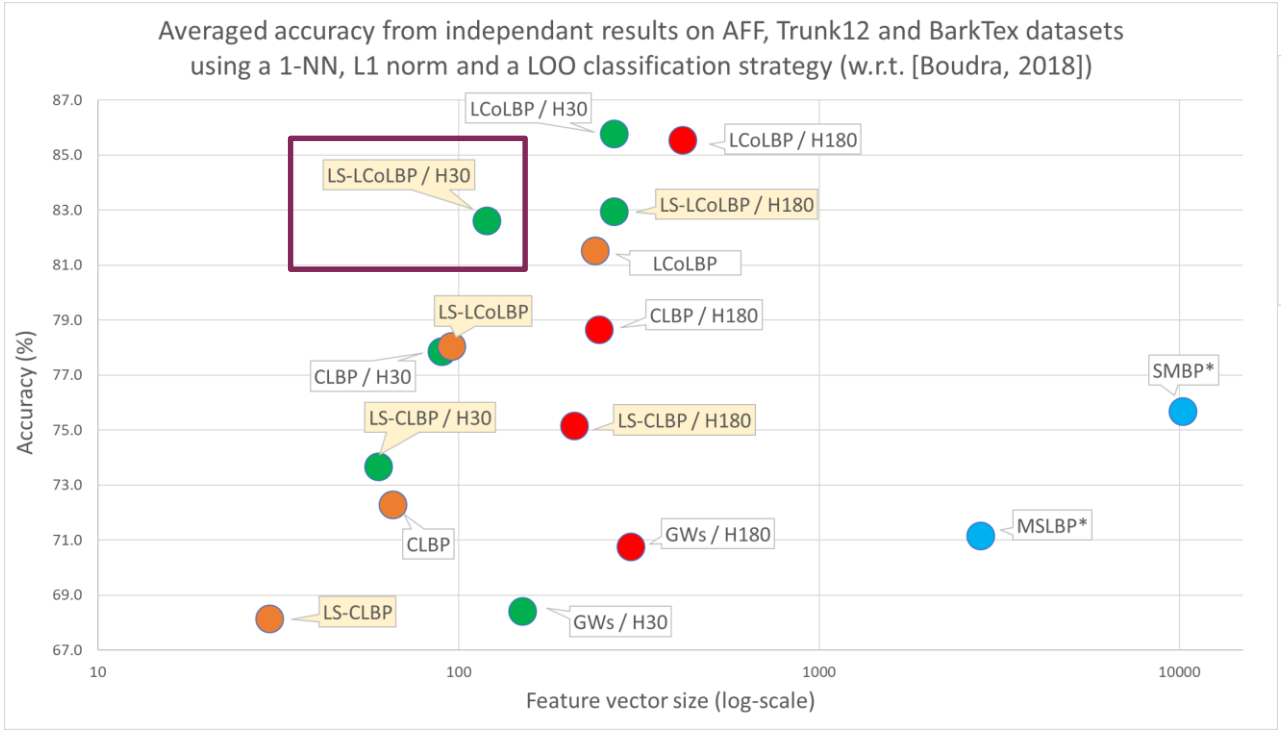
Representativity

N=150 → H30

N used for all bark datasets in our experiments

Experiments

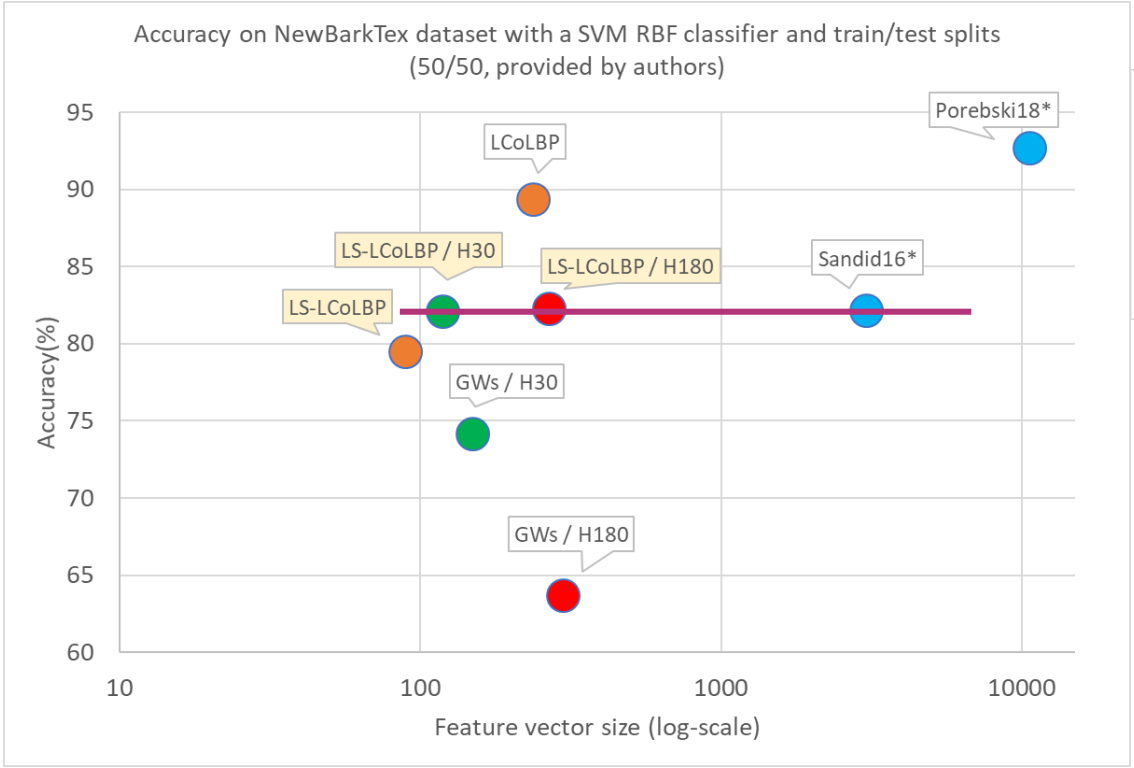
Experiments (1/3)



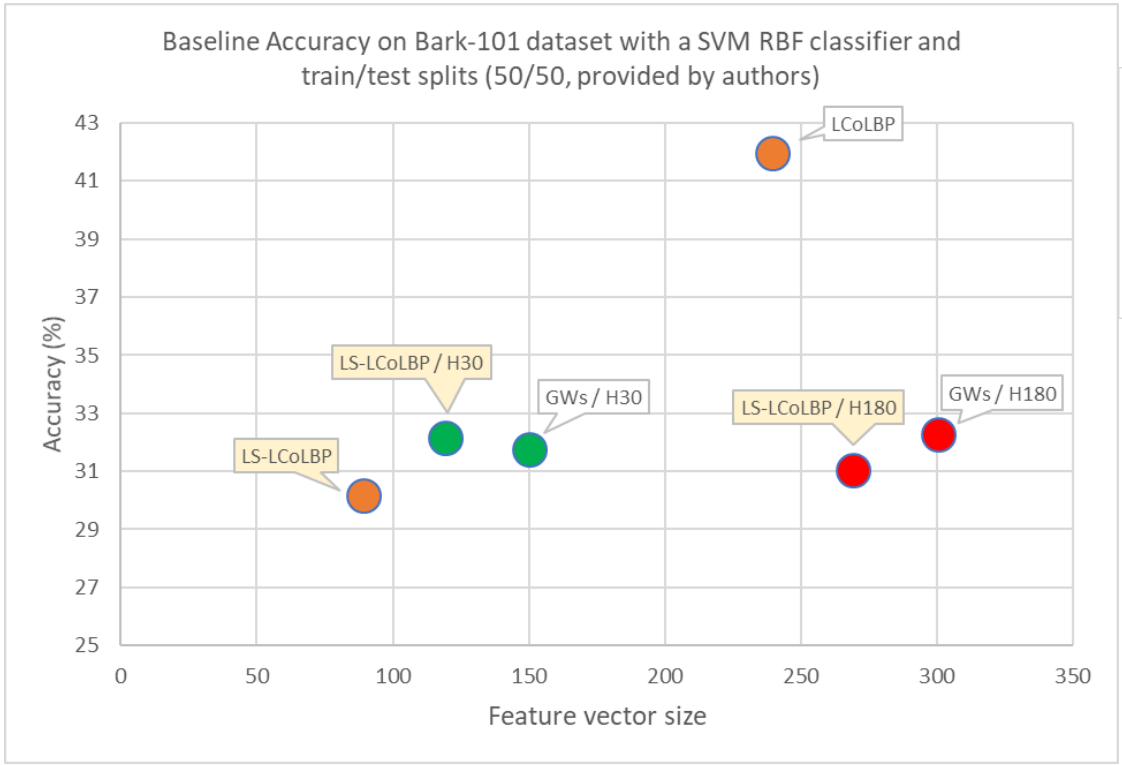
Less than 12 classes

- baseline
- texture
- texture + full color
- texture + reduced color
- late statistics

Experiments (2/3)



Experiments (3/3)



Conclusion

Conclusion

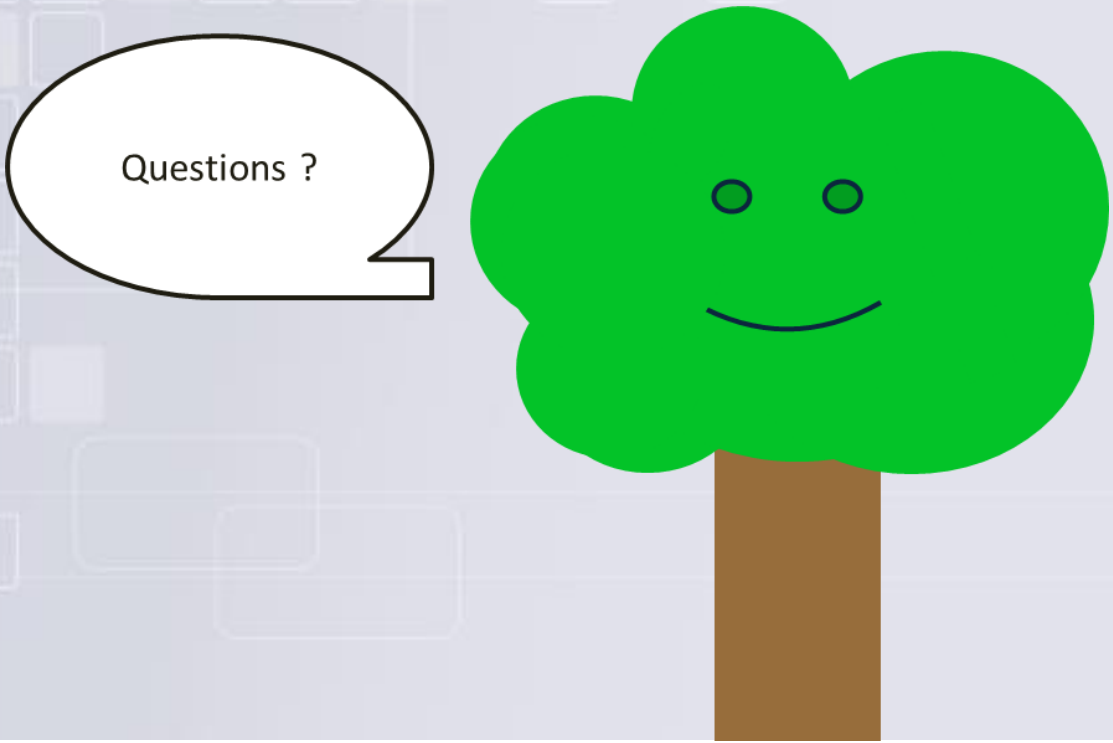
Achievements

- Released a new challenging dataset : Bark-101
- Proposed 2 efficient reduction methods for texture and color components
- Improved or achieved state-of-the-art accuracy on 4 datasets with up to two decades of gain in space
- Demonstrated the need for future prospects on bark recognition

Future works

- Extend proposed methods to multiple color spaces
- Evaluate algorithms on mobile devices

Thank you for your attention



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