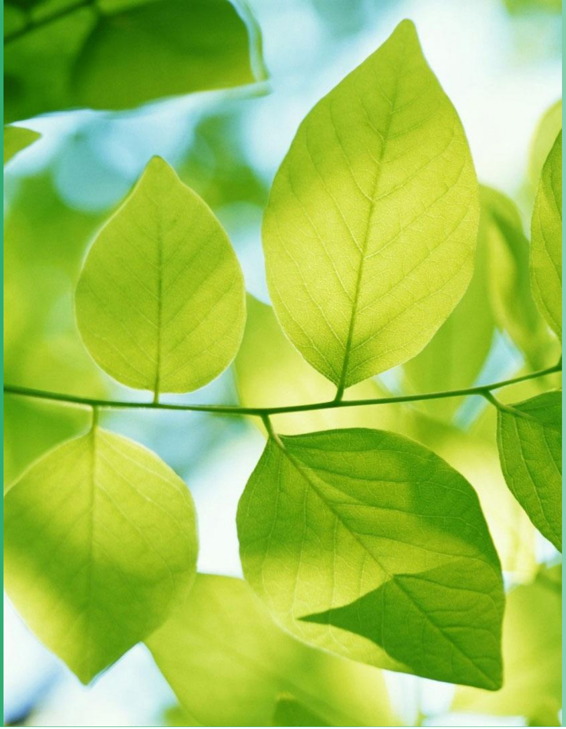
Leaves Classification

Project EduPark

Computer Vision



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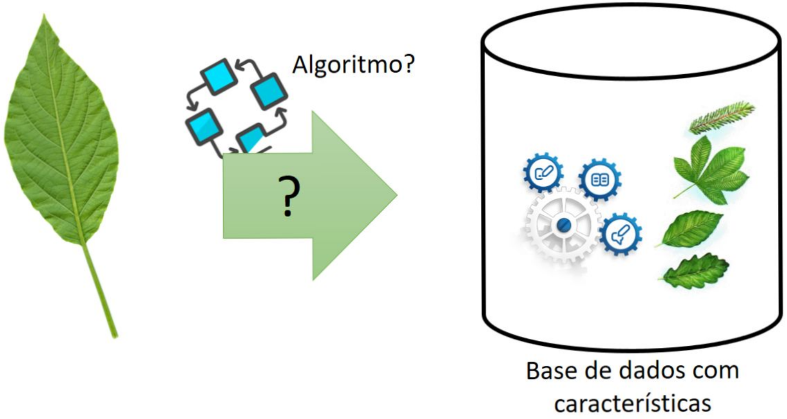
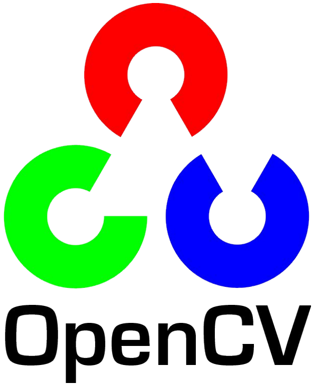
Main Goals

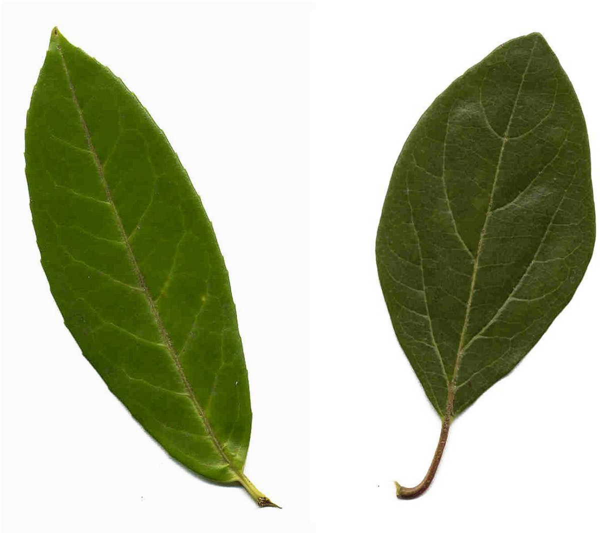
- Receiving a picture of a leaf predict its species name
- Test multiple features to compare performance and have a perception of what the best features to work with
- Train our own dataset with a classifier



Technologies

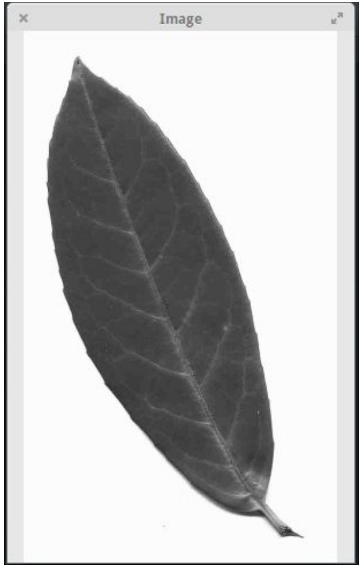


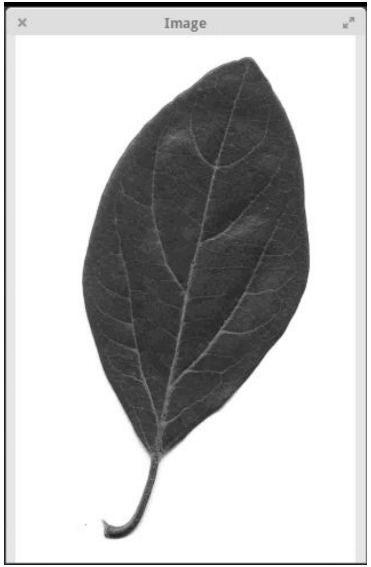
Segmentation and processing (I)



- Necessary procedure to **minimize noise**
- **Objective**: to obtain leaf contour
- **Example input**: two leaves

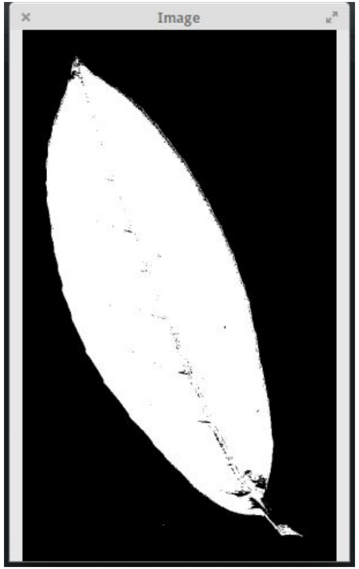
Segmentation and processing (II)

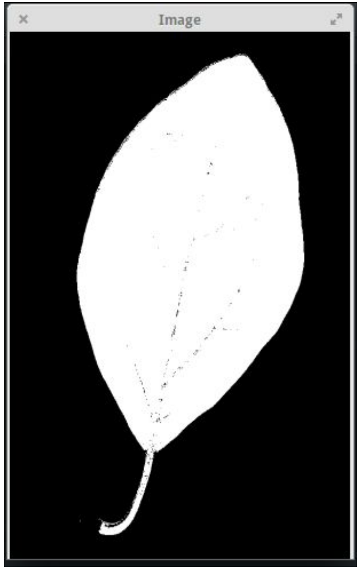




- Necessary procedure to **minimize noise**
- **Objective**: to obtain leaf contour
- **Example input**: two leaves
- Convert to **grayscale**

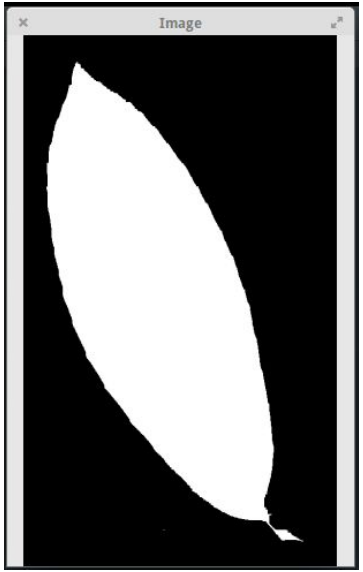
Segmentation and processing (III)

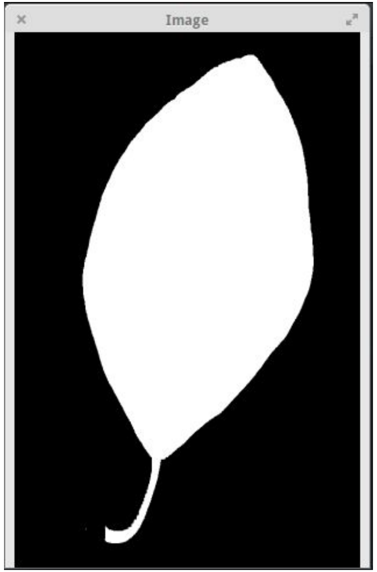




- Apply **threshold**
- **Inverted binary**
- **With** some noise…

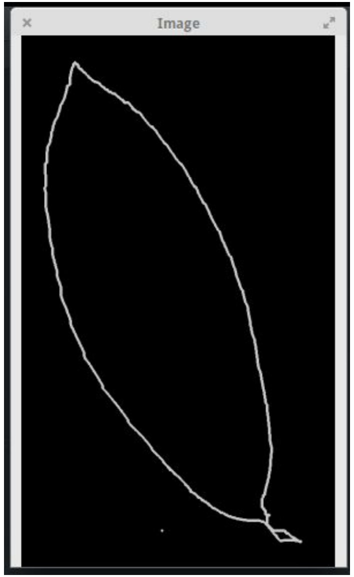
Segmentation and processing (VI)

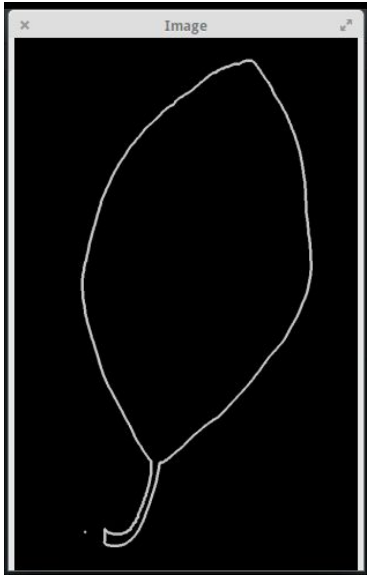




- Apply **morphological transformations**
- **Closing**
- Structuring element: **kernel**
- Allows to **remove noise**

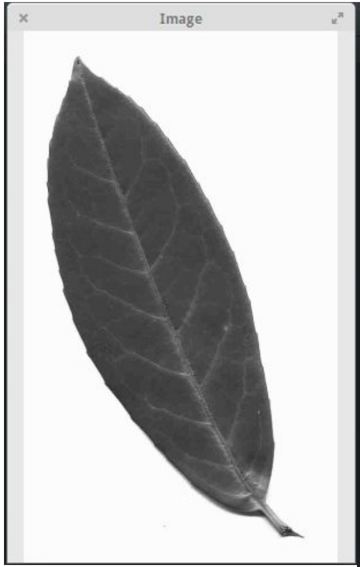
Segmentation and processing (V)

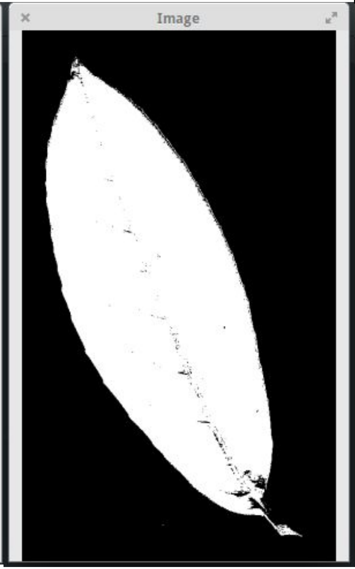


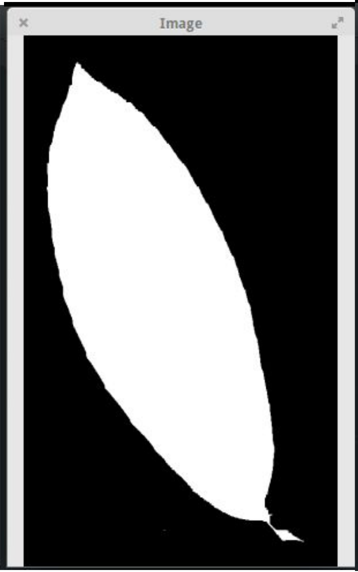


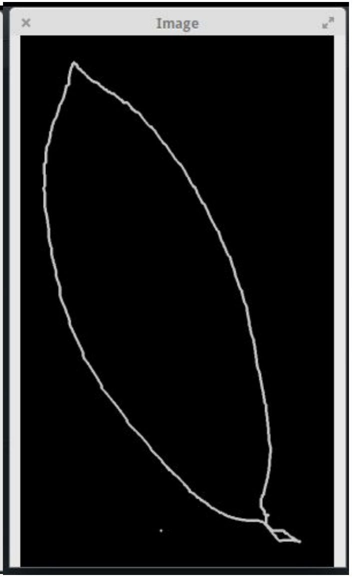
- Find and draw contours
- **findContours()**
- **drawContours()**

Segmentation and processing (VI)





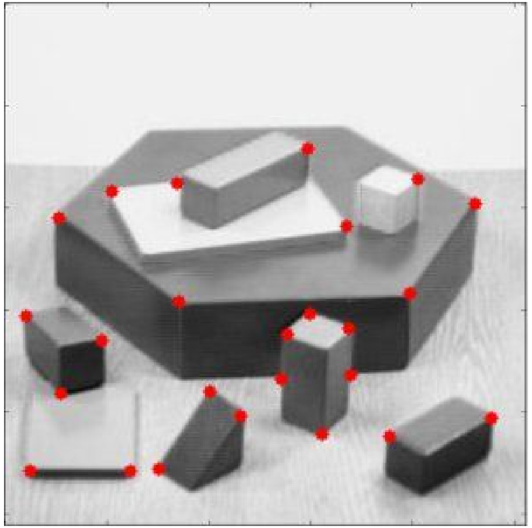




Extracted Feature

Number of Corners

- cv2.goodFeaturesToTrack()
- Used variation of the **Harris Corner Detection** algorithm
- Determines **strong corners** on an image.

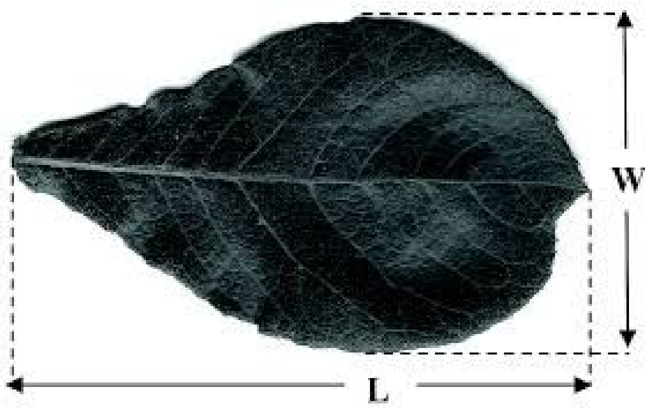


Extracted Feature

Ratio of length and Width

- Only width and height are **not useful**!

$$AspectRatio = \frac{Width}{Height}$$



Extracted Feature
Ratio of Perimeter and area

- Only areas and perimeters are not useful!

$$rpa = \frac{perimetro}{area}$$

rpa: razão entre perímetro e área

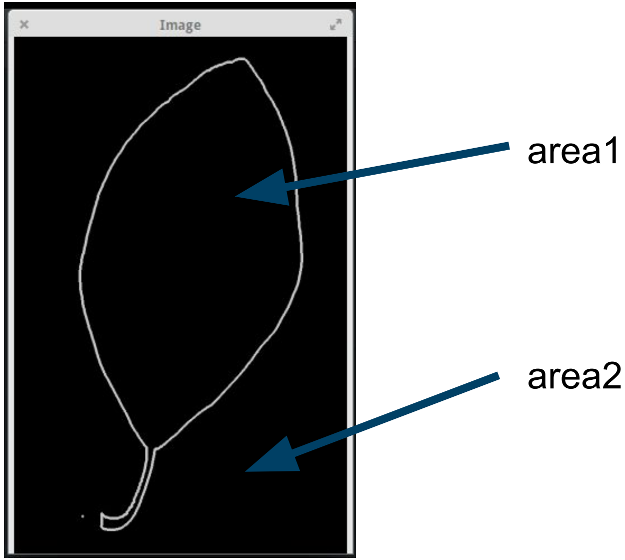
Extracted Feature

Ratio of area

- Ratio between **area of leaf** and the area of **outside the leaf's** contourn;

$$ra = \frac{area1}{area2}$$

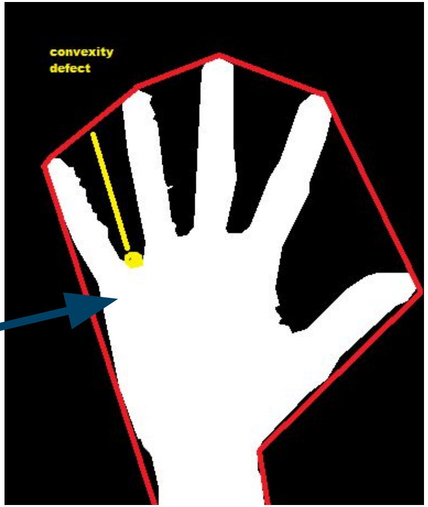
ra: razão entre áreas



Extracted Feature
Solidity

- Ratio between the **contour area** and the **convex area** formed by the union of the points forming a polygon

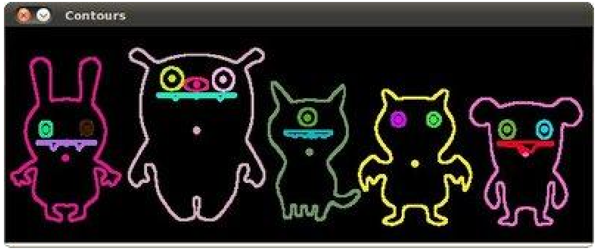
$$Solidity = \frac{ContourArea}{convexHullArea}$$

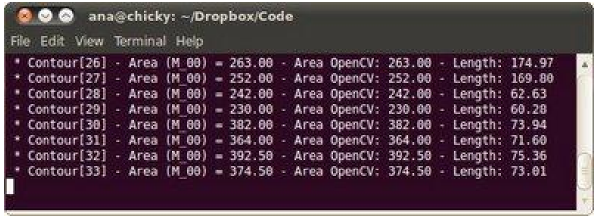


Extracted Feature

Moments

- Help us to calculate some **characteristics** of the image such as, **mass center** or **orientation** of the image.
- **cv2.moments(image)**





```
* Contour[26] - Area (M_00) = 263.00 - Area OpenCV: 263.00 - Length: 174.97
* Contour[27] - Area (M_00) = 252.00 - Area OpenCV: 252.00 - Length: 169.80
* Contour[28] - Area (M_00) = 242.00 - Area OpenCV: 242.00 - Length: 62.63
* Contour[29] - Area (M_00) = 230.00 - Area OpenCV: 230.00 - Length: 60.28
* Contour[30] - Area (M_00) = 382.00 - Area OpenCV: 382.00 - Length: 73.94
* Contour[31] - Area (M_00) = 364.00 - Area OpenCV: 364.00 - Length: 71.60
* Contour[32] - Area (M_00) = 392.50 - Area OpenCV: 392.50 - Length: 75.36
* Contour[33] - Area (M_00) = 374.50 - Area OpenCV: 374.50 - Length: 73.01
```

Extracted Feature

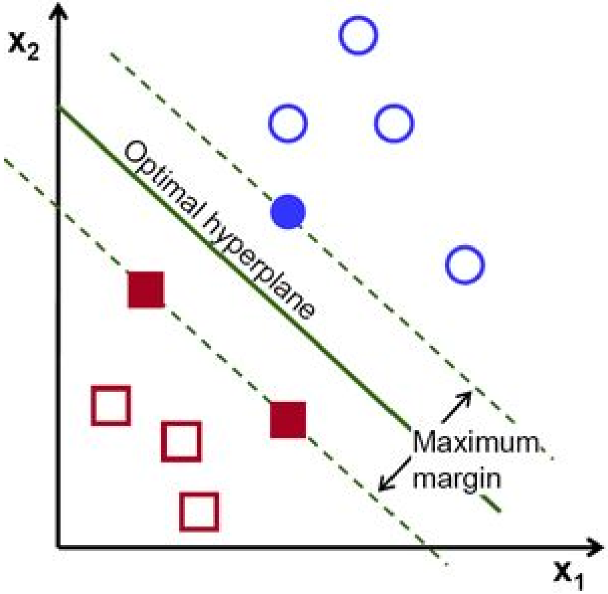
Summary

- Number of Corners
- Ratio of length and height
- Ratio of Perimeter and area
- Ratio of area
- Solidity
- Moments

Classifier

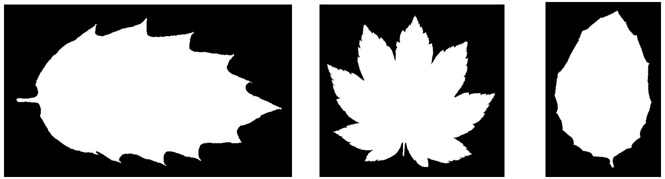
Support vector machine (SVM)

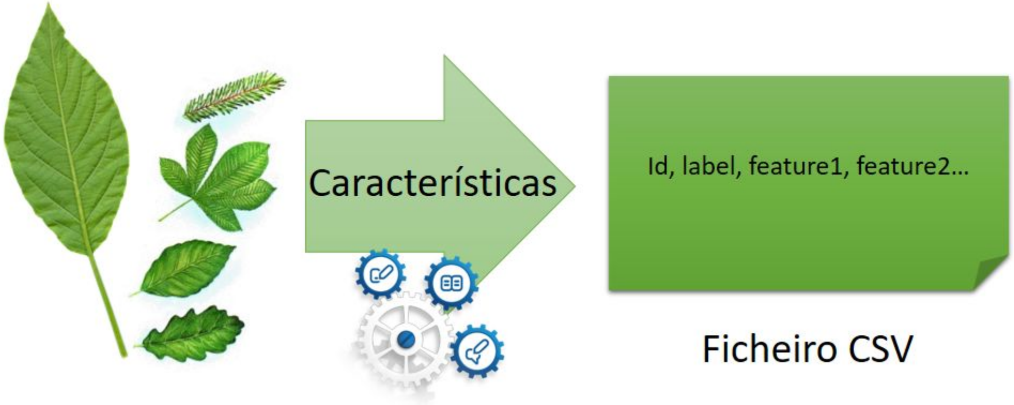
- Supervised learning models with associated learning algorithms that analyze data used for classification and regression analysis.



Training Data (I)

- **≈ 160** leaf images (binary images)
- **10** species
- Output: **CSV file** with the extracted features





Características

Id, label, feature1, feature2...

Ficheiro CSV

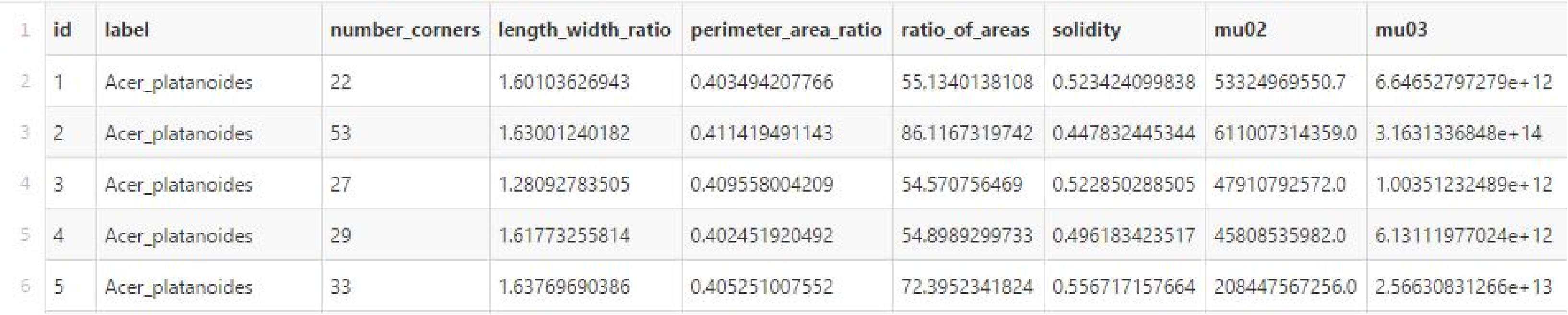
Training Data (II)

- `python training_Leaves.py` or `python training_Leaves.py nm`

  Extracts all the characteristics **except the moments**

- `python training_Leaves.py all`

  Extracts **all** the **features**



id	label	number_corners	length_width_ratio	perimeter_area_ratio	ratio_of_areas	solidity	mu02	mu03
1	Acer_platanoides	22	1.60103626943	0.403494207766	55.1340138108	0.523424099838	53324969550.7	6.64652797279e+12
2	Acer_platanoides	53	1.63001240182	0.411419491143	86.1167319742	0.447832445344	611007314359.0	3.1631336848e+14
3	Acer_platanoides	27	1.28092783505	0.409558004209	54.570756469	0.522850288505	47910792572.0	1.00351232489e+12
4	Acer_platanoides	29	1.61773255814	0.402451920492	54.8989299733	0.496183423517	458085535982.0	6.13111977024e+12
5	Acer_platanoides	33	1.63769690386	0.405251007552	72.3952341824	0.556717157664	208447567256.0	2.56630831266e+13

Testing Data (I)

- `python test_Leaves.py`

  All the features **except the moments** are used i

  classification

- `python test_Leaves.py all`

  All the characteristics are used in the **classification**

Testing Data (II)

- Test image in folder `Test_Leaves`
- Extract the characteristics of testing images
- Send those and training data's characteristics to the SVM
- Predict the plant's specie

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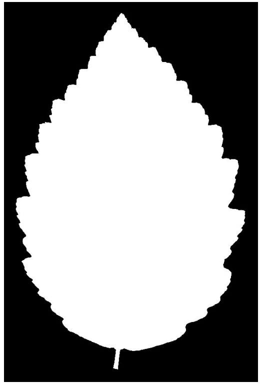
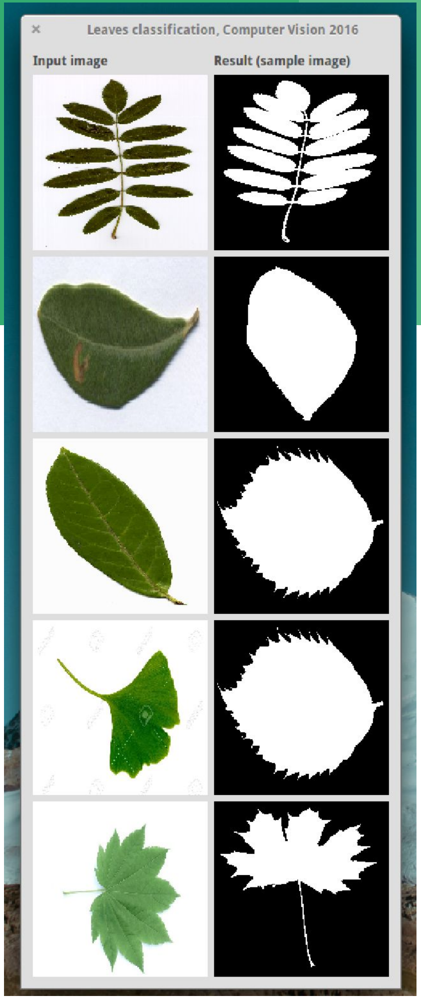


Results

- Interface with
  - input images (at left)
  - predicted specie image (at right)
- In terminal we have the name of the predicted specie and of the input image (e.g Ginkgo_biloba2.jpg)



Demo

Conclusions

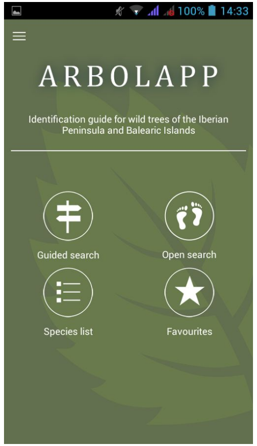
- Previsions are **not** always correct.
- SVM predict with **higher accuracy** testing the features **without moments.**
- Input images **used in training** are always predicted **correctly.**

Future Work

- Use **deep learning** and/or **neural networks** to increase accuracy.
- Increment/Improve the **vector of features.**
- **Increase** the training **data set**, maybe with colored images too.
- **Improve** the predictions for images in a more **realistic context**, maybe with leaf tracking first and then all the pré-processing

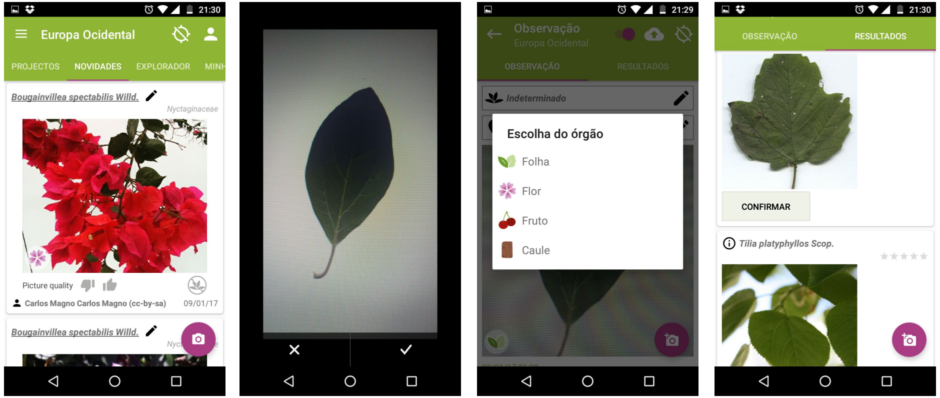
Mobile Application For Leaves Recognition

Pl@ntNet


ARBOLAPP

Identification guide for wild trees of the Iberian Peninsula and Balearic Islands

treezilla
the monster map of trees



Questions?