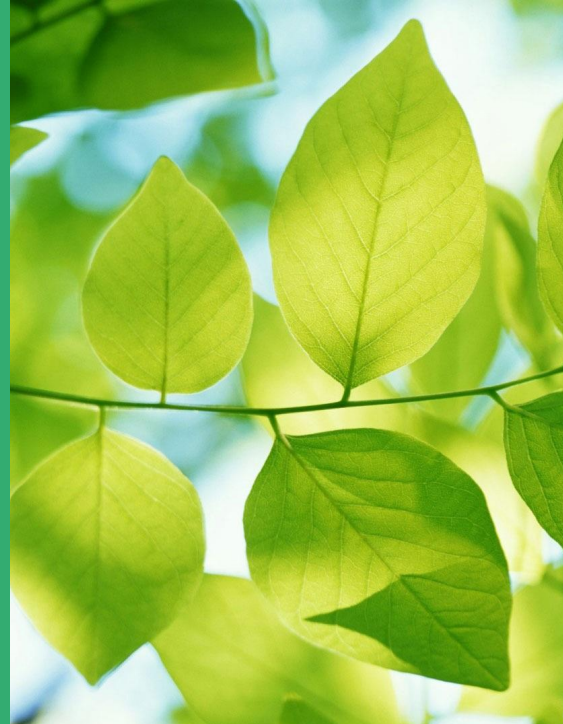


LEAVES CLASSIFICATION

PROJECT EDUPARK

COMPUTER VISION



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Teachers António Neves and Paulo Dias

Group 9

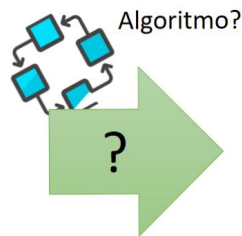
11 January 2017

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3. Segmentation and processing
4. Extracted Features
5. Classifier
6. Training Data
7. Testing Data
8. Results
9. Demo
10. Conclusions
11. Future work

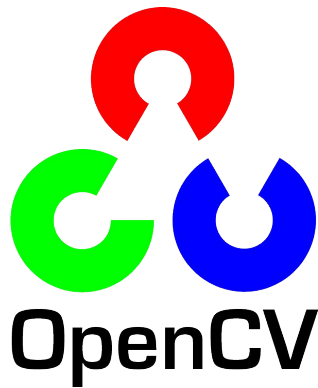
MAIN GOALS

- 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



Base de dados com características

TECHNOLOGIES

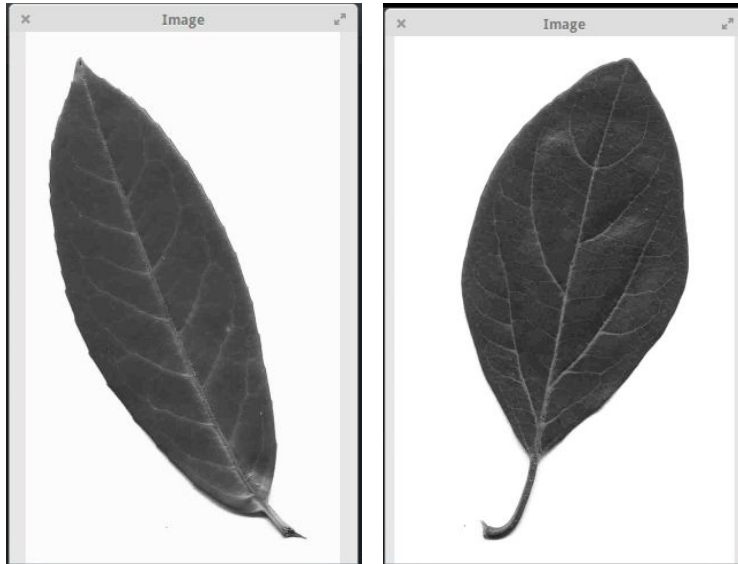


SEGMENTATION AND PROCESSING (I)



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

SEGMENTATION AND PROCESSING (II)



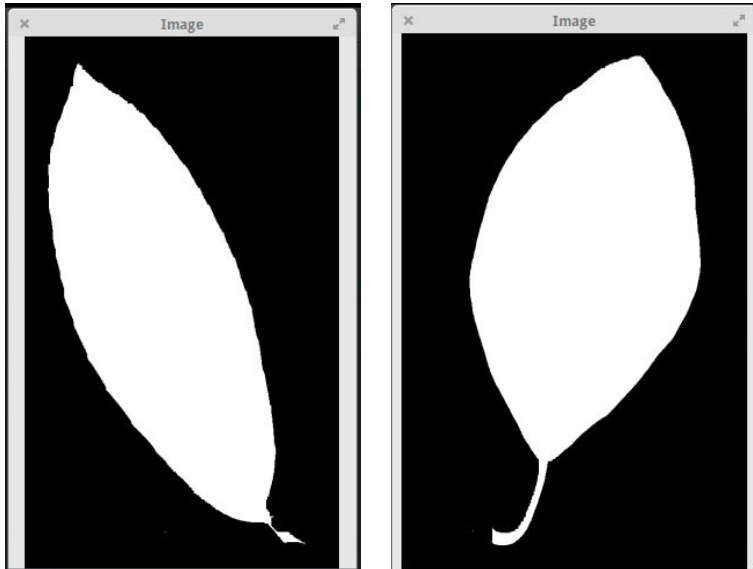
- Necessary procedure to **minimize noise**
- **Objective:** to obtain leaf contour
- **Example input:** two leaves
- Convert to **grayscale**

SEGMENTATION AND PROCESSING (III)



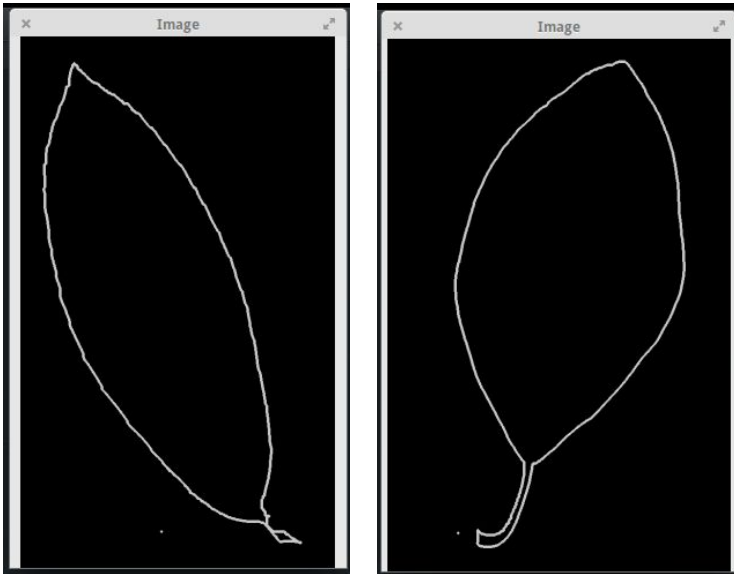
- Apply **threshold**
- **Inverted binary**
- **With** some noise...

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()`

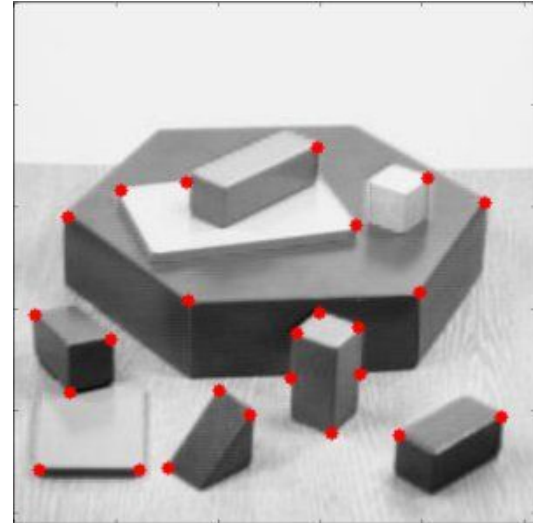
SEGMENTATION AND PROCESSING (VI)



EXTRACTED FEATURE

NUMBER OF CORNERS

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

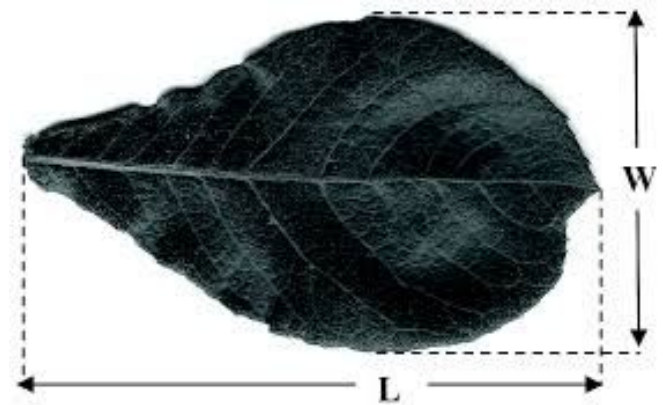


EXTRACTED FEATURE

RATIO OF LENGTH AND WIDTH

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

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



EXTRACTED FEATURE

RATIO OF PERIMETER AND AREA

- Only areas and perimeters are not useful!

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

rpa: razão entre perímetro e área



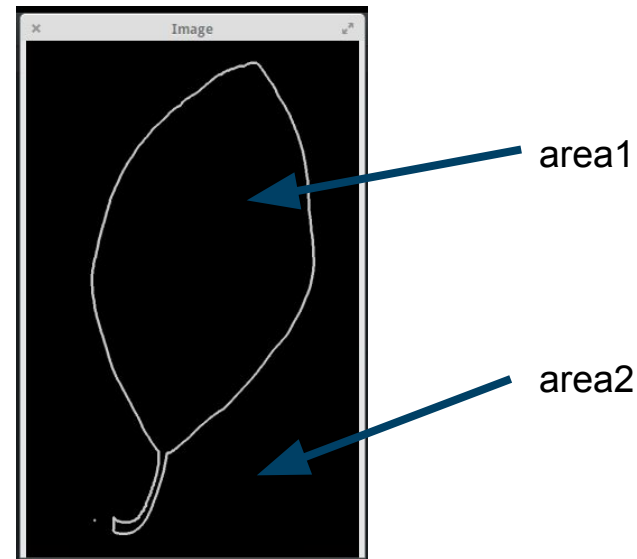
EXTRACTED FEATURE

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

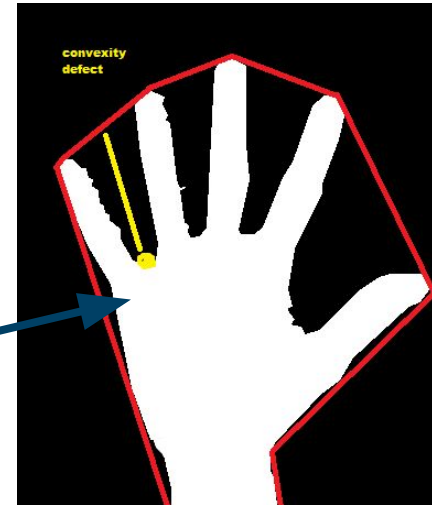


EXTRACTED FEATURE

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)`



```
ana@chicky: ~/Dropbox/Code
File Edit View Terminal Help
* 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
```

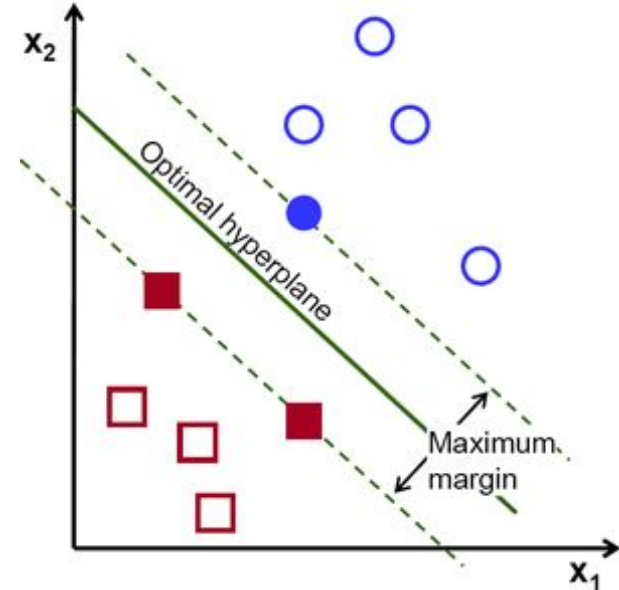

EXTRACTED FEATURE SUMMARY

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

CLASSIFIER

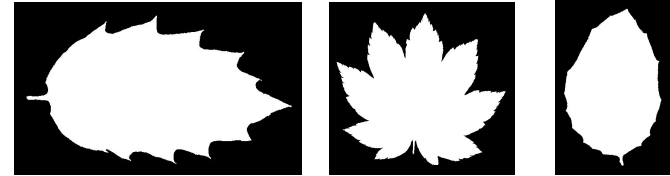
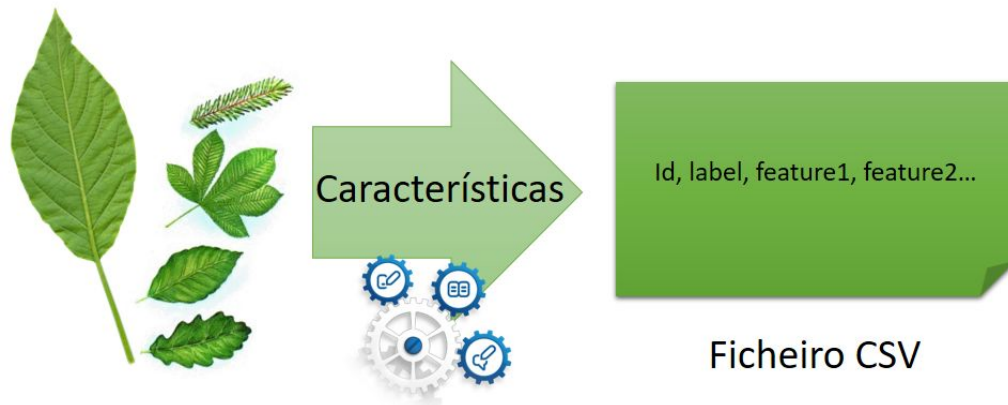
SUPPORT VECTOR MACHINE (SVM)

- 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



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 |
|---|----|------------------|----------------|--------------------|----------------------|----------------|----------------|----------------|-------------------|
| 2 | 1 | Acer_platanoides | 22 | 1.60103626943 | 0.403494207766 | 55.1340138108 | 0.523424099838 | 53324969550.7 | 6.64652797279e+12 |
| 3 | 2 | Acer_platanoides | 53 | 1.63001240182 | 0.411419491143 | 86.1167319742 | 0.447832445344 | 611007314359.0 | 3.1631336848e+14 |
| 4 | 3 | Acer_platanoides | 27 | 1.28092783505 | 0.409558004209 | 54.570756469 | 0.522850288505 | 47910792572.0 | 1.00351232489e+12 |
| 5 | 4 | Acer_platanoides | 29 | 1.61773255814 | 0.402451920492 | 54.8989299733 | 0.496183423517 | 45808535982.0 | 6.13111977024e+12 |
| 6 | 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 in
classification
- `python test_Leaves.py all`
All the characteristics are used in the **classification**

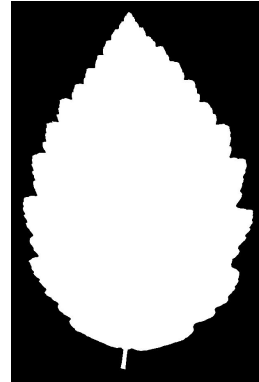


TESTING DATA (II)

- 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

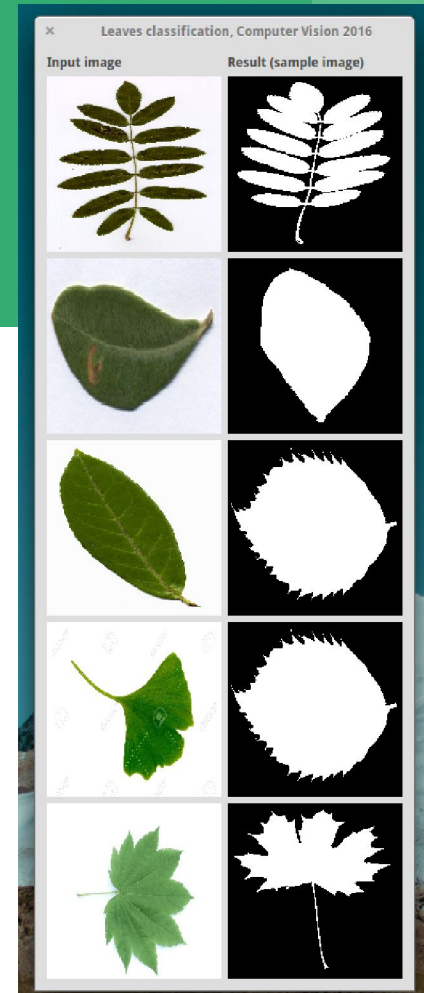


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RESULTS

- 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

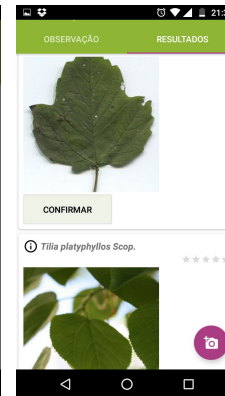
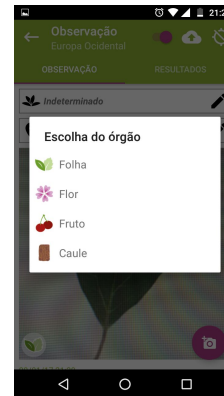
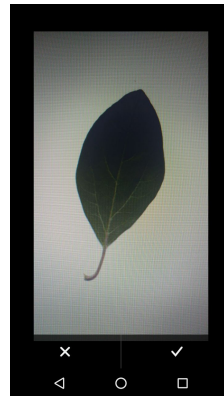
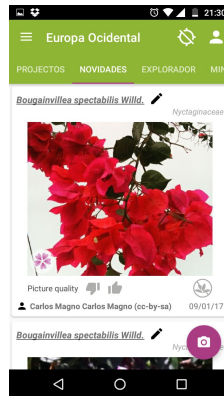
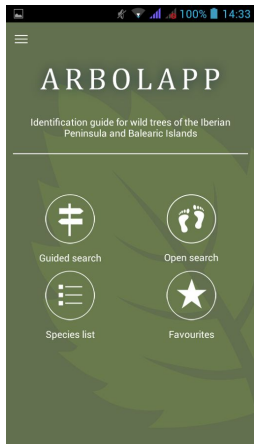
CONCLUSIONS

- 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



QUESTIONS?

