Ensemble approach for differentiation of melanoma

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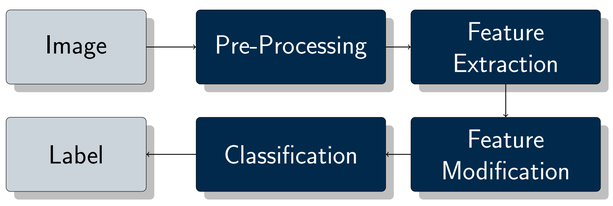
Introduction

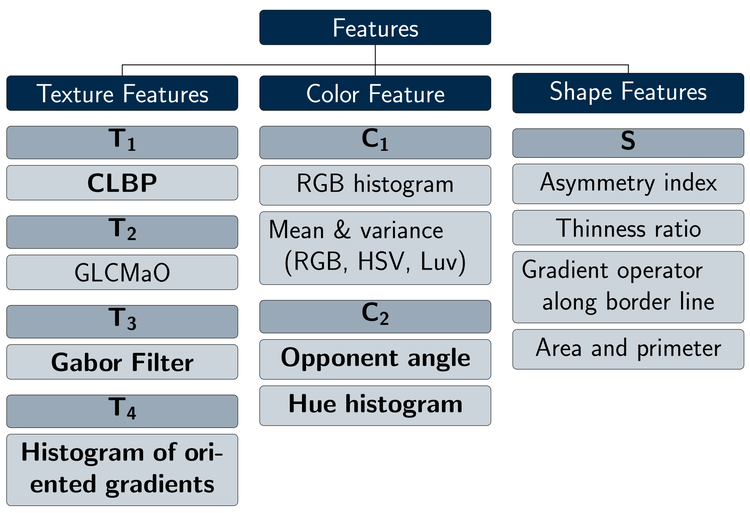
- **Melanoma**
  - The **deadliest** type of skin cancer
  - The **most treatable** kind of **cancer** conditioned to its **early stages**.
  - Diagnosis by visual inspection of **dermoscopy** images based on **ABCDE** rule
- **Challenges**
  - Time consuming
  - prone to errors due to similar characteristics of the lesions
- **Melanoma CAD system**
  - CAD systems are proposed to facilitate the specialists
  - CAD systems were proposed using different datasets
- **Review of state-of-the-art**
  - Lack of benchmark in the proposed CAD systems
  - Classification mostly based on single base learner
  - Features to mimic dermatologists assessments: **Shape** and **Colors**
- **Motivation**
  - Comparison of previously used **color** and **shape** features with well-known **texture** features
  - Ensemble learning methods instead of single base learner
  - Using a recently public benchmark **PH^2** dataset

Automated Classification Framework



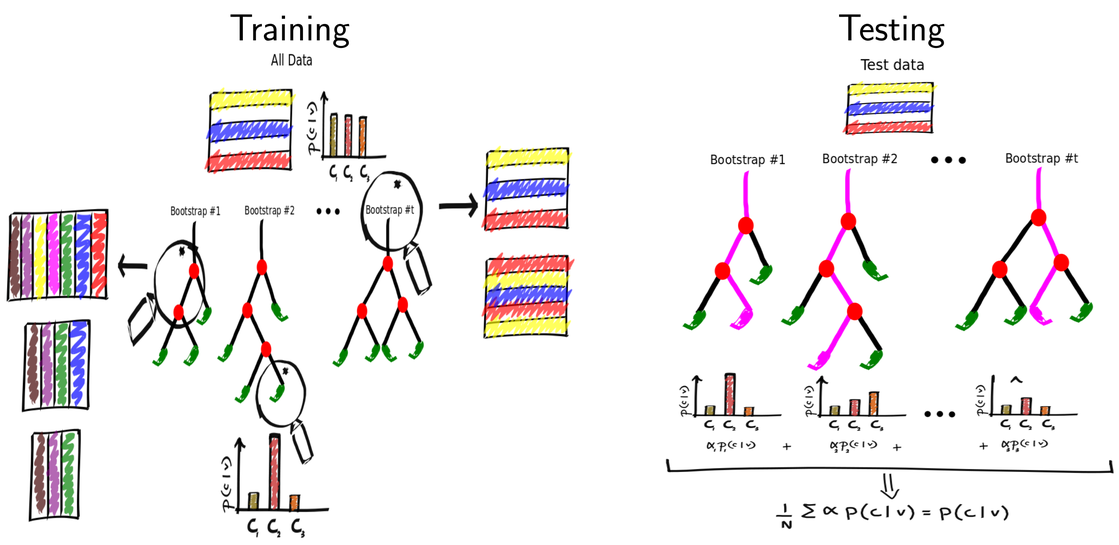
Feature Extraction

- Global feature extraction approach from the segmented lesions - **features** did not or rarely been used in this field



Ensemble Classifier

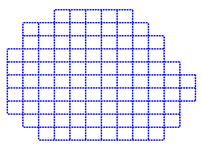
- **Random forest (RF) ensemble**



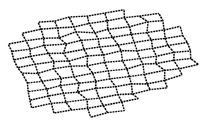
- **Weighted combination ensemble**

Experiment

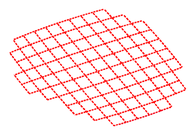
- **PH^2 Dataset**
  - First public dermoscopic dataset
  - Acquired at *Dermatology Service of Hospital Pedro Hispano, Matosinhos, Pourtugal*
  - 200 lesions, 40 melanoma, 80 benign and 80 dysplastic lesions
  - Our subset contains 39 melanoma , 78 benign and 76 dysplastic lesions. Seven lesions are removed due to artefacts such as hair occlusions.
- **Validation**
  - Oversampling in order to deal with unbalanced data
  - Oversampling in **data space** - generating synthetic melanoma images by deforming the original images
  - First approach: random deformation using Gaussian grid (RDGM) - $\mathbf{N(5,5)}$, $\mathbf{R = 80^\circ}$
  - Second approach: barrel deformation (BD) - barrel distortion , $\mathbf{R = 145^\circ}$



Original grid



RDGM deformation

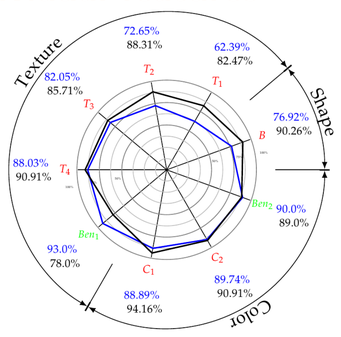


BD deformation

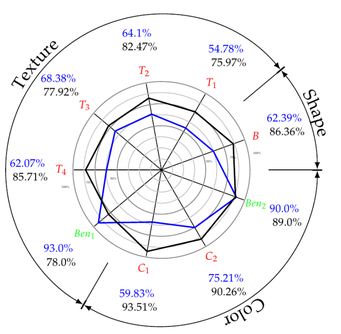
- One-vs-all classification

Results

- **Individual features**

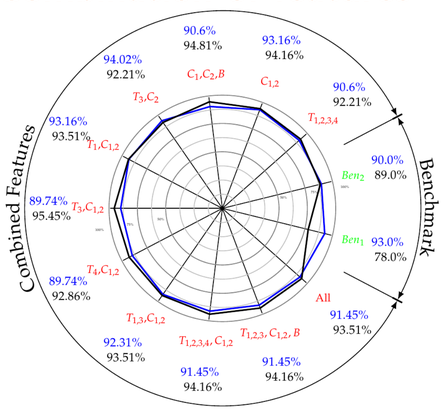


RF ensemble

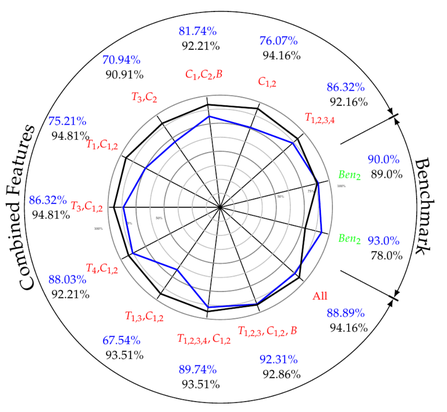


Weighted ensemble

- **Combination of features**



RF ensemble



Weighted combination ensemble

The features, sensitivity and specificity are presented in red, blue and black, respectively. The $\mathbf{Ben_1}$ and $\mathbf{Ben_2}$ represent the benchmark results, obtained by [**?**]. with color and texture features respectively.

Conclusion

- RF ensemble outperforms the single learners
- The obtained results by RF ensemble and combination of several features outperform the benchmark results without over-fitting
- Texture features such as Histogram of Oriented Gradients and Gabor filters and the new Opponent color angle prove to be effective for classification of melanoma lesions in comparison to previously color and shape features

References