Melanoma Detection by Classifying Skin Lesion Images

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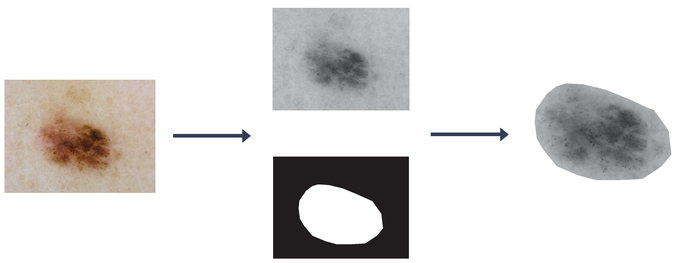
Overview

- **Traditional diagnosis** of skin cancer
  - Done in person by a physician
  - Rely on guidelines about the appearance of a mole
  - Expensive and inaccessible to some
  - To non-dermatologists, difficult to distinguish benign tumors and melonomas visually
- **Classification using machine learning algorithm**
  - Based on a jpeg image of the lesion
  - Enable diagnosis accessible to anyone with a smartphone
  - Supplement a doctor's diagnosis

Data

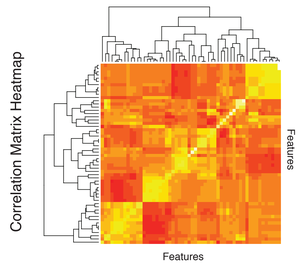
- **Resource**
  - *Skin Lesion Analysis toward Melanoma Detection: A Challenge at the International Symposium on Biomedical Imaging 2016* [1]
  - Hosted by the International Skin Imaging Collaboration
  - 3 Tasks
    - Lesion segmentation
    - Dermoscopic feature detection
    - **Disease classification** (our project goal)
      - Training data: 700 skin lesion images
        - Original dermoscopic images
        - Binary segmentation masks
        - Ground truth
      - Test data: other 200 skin lesion images
        - Original dermoscopic images
        - Binary segmentation masks
- **Preparation**
  - Quantify the images: transfer images to quantitative matrices whose elements represent the corresponding pixels in the images
  - Grayscale and mask out the background skin texture



Methods

- **Features extraction**

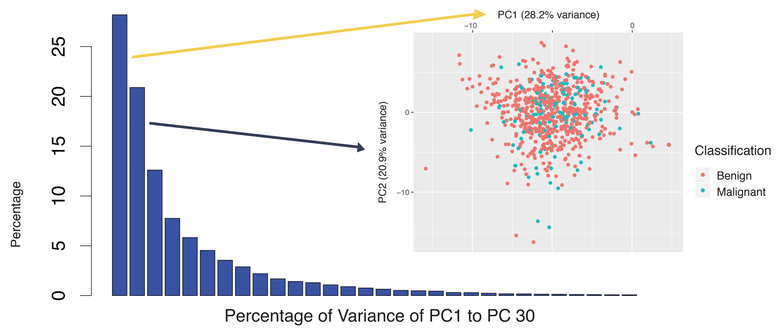
`calc_features`	First order features
`glcm`	Grey level co-occurence matrix features
`glrlm`	Grey level run length matrix features
`glscm`	Grey level size zone matrix features



- **Dimension reduction**
  - Total amount of features: 56
  - Use principle component analysis to reduce the dimensionality

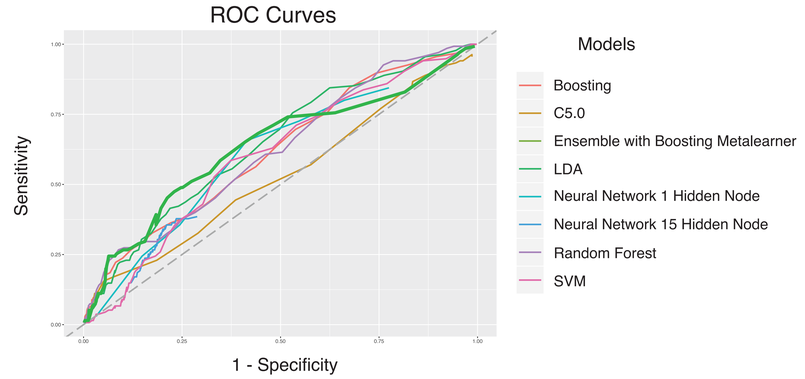
`prcomp`	Principle Component Analysis

  - Use the first 25 PCs to retain 95% variance.



- **Models**
  - Support vector machine (SVM)
  - Random forest
  - Neural network (nnet): Node 1 and Node 1
  - K-nearest neighbors (KNN)
  - C5.0
  - Linear discriminant analysis (LDA)
  - Generalized boosted regression (GBM)
- **Ensemble Model**
  - GBM Metalearner

Results



Models	Sensitivity	Specificity	Average accuracy
1	0.7368	0.4568	0.5968
2	0.1842	0.8148	0.4995
3	0.7632	0.5494	0.6563
4	0.5263	0.6420	0.5841

Conclusion

- Highest average accuracy = 0.6563
- Models and thresholds
- Predictions

Prediction \ Truth	Benign	Malignant
Benign	89	9
Malignant	73	29

Models	Thresholds
SVM	0.1
nnet (1 node)	0.6
nnet (15 nodes)	0.1
C5.0	0.05
Random forest	0.16
KNN	–
GBM Metalearner	0.22

What's Next

- **Problem:** Imbalanced training dataset (556 benigns and 134 melanomas)
- **Possible solution:** Balancing the training dataset
- **Trials:** Balancing lead to decrease in model accuracy

`SMOTE`	Synthetic Minority Oversampling TEchnique
`upSample`	Up-Sampling Imbalanced Data

- **Next step:** Looking into new data balancing methods that work better with the given training data

References

[1] Gutman, D., Codella, N., Celebi, E., Helba, B., Marchetti, M., Mishra, N. and Halpern, A. (2017). Skin Lesion Analysis toward Melanoma Detection: A Challenge at the International Symposium on Biomedical Imaging (ISBI) 2016, hosted by the International Skin Imaging Collaboration (ISIC). [online] Arxiv.org. Available at: https://arxiv.org/abs/1605.01397v1 [Accessed 10 Jul. 2017].

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