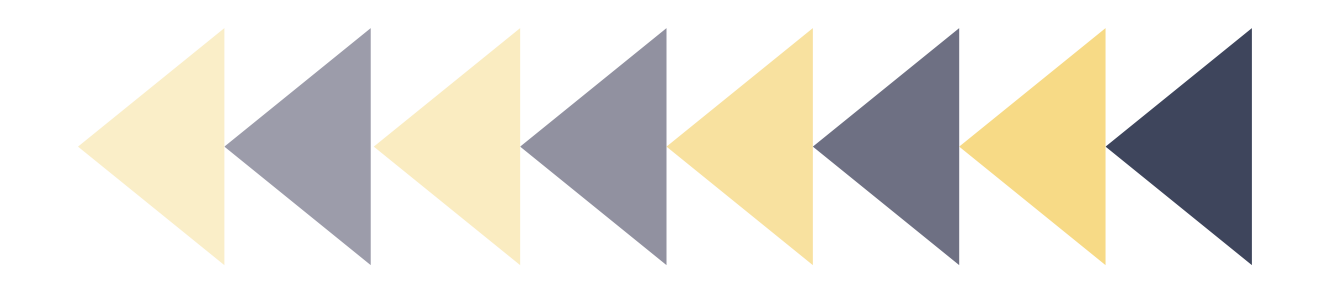


Melanoma Detection by Classifying Skin Lesion Images



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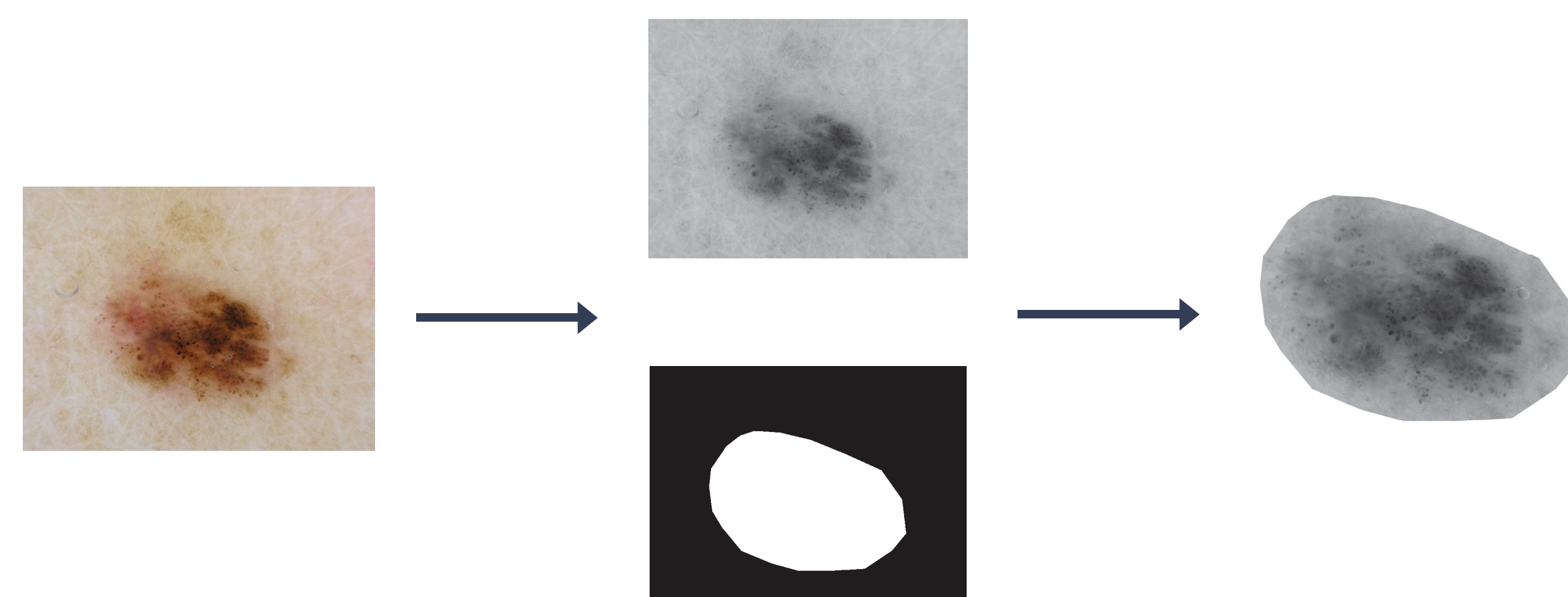
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Overview

- **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

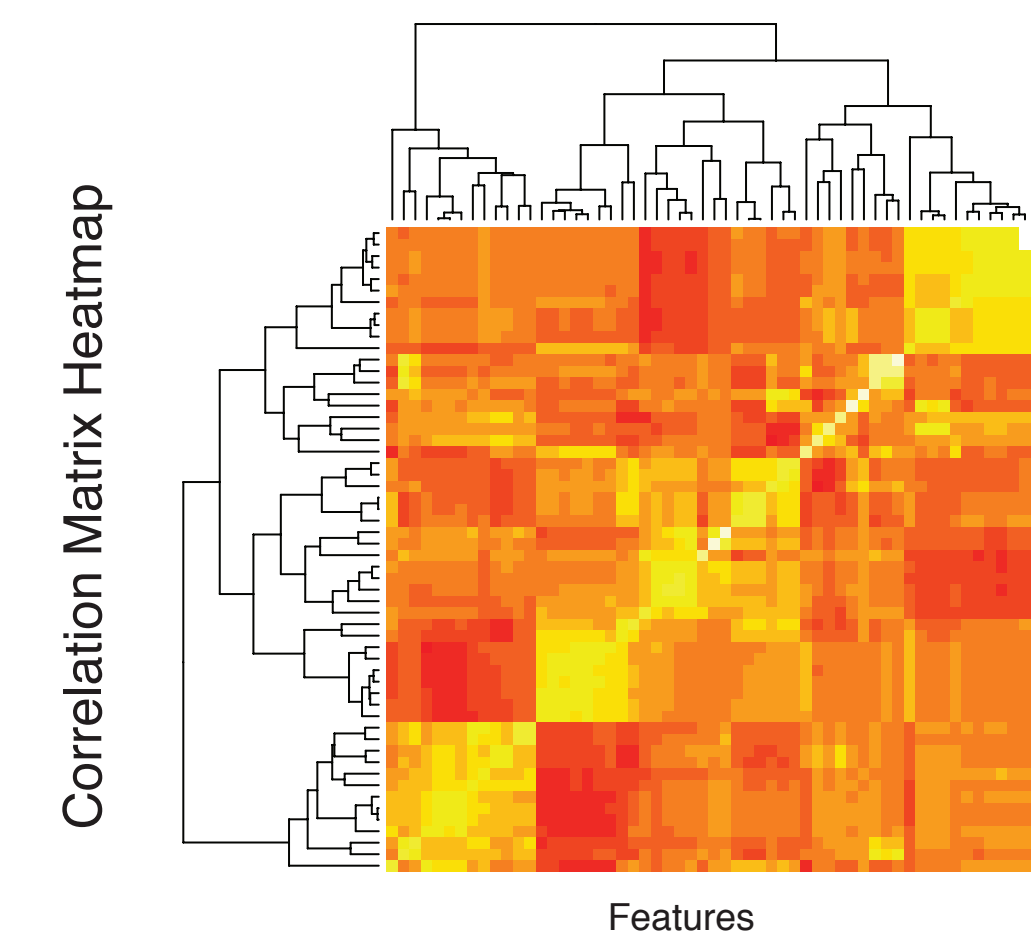
- **Resource**
 - *Skin Lesion Analysis toward Melanoma Detection: A Challenge at the International Symposium on Biomedical Imaging 2016* ^[1]
 - Hosted by the International Skin Imaging Collaboration
 - 3 Tasks
 - Lesion segmentation
 - Dermoscopic feature detection
 - **Disease classification** (our 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-occurrence matrix features
glrlm	Grey level run length matrix features
glscm	Grey level size zone matrix features

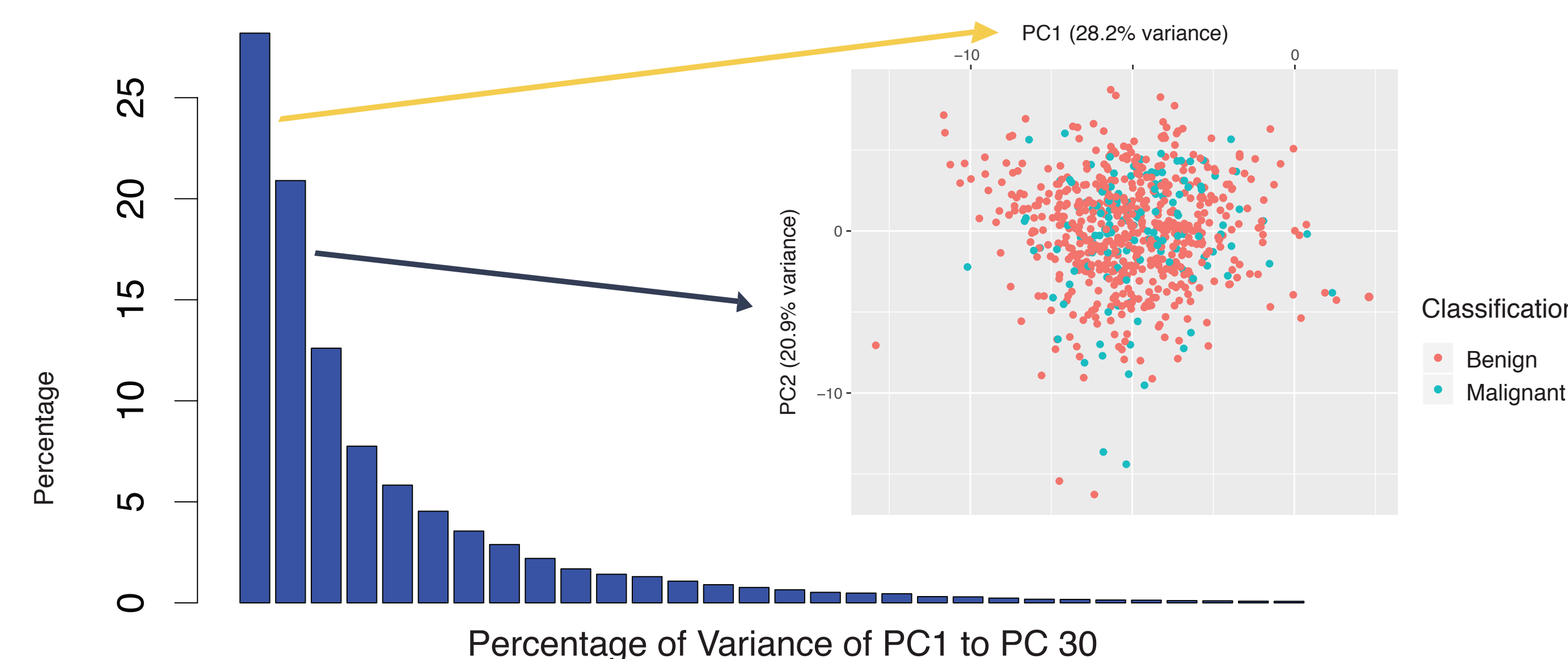


Dimension reduction

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

prcomp	Principle Component Analysis
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- Use the first 25 PCs to retain 95% variance.



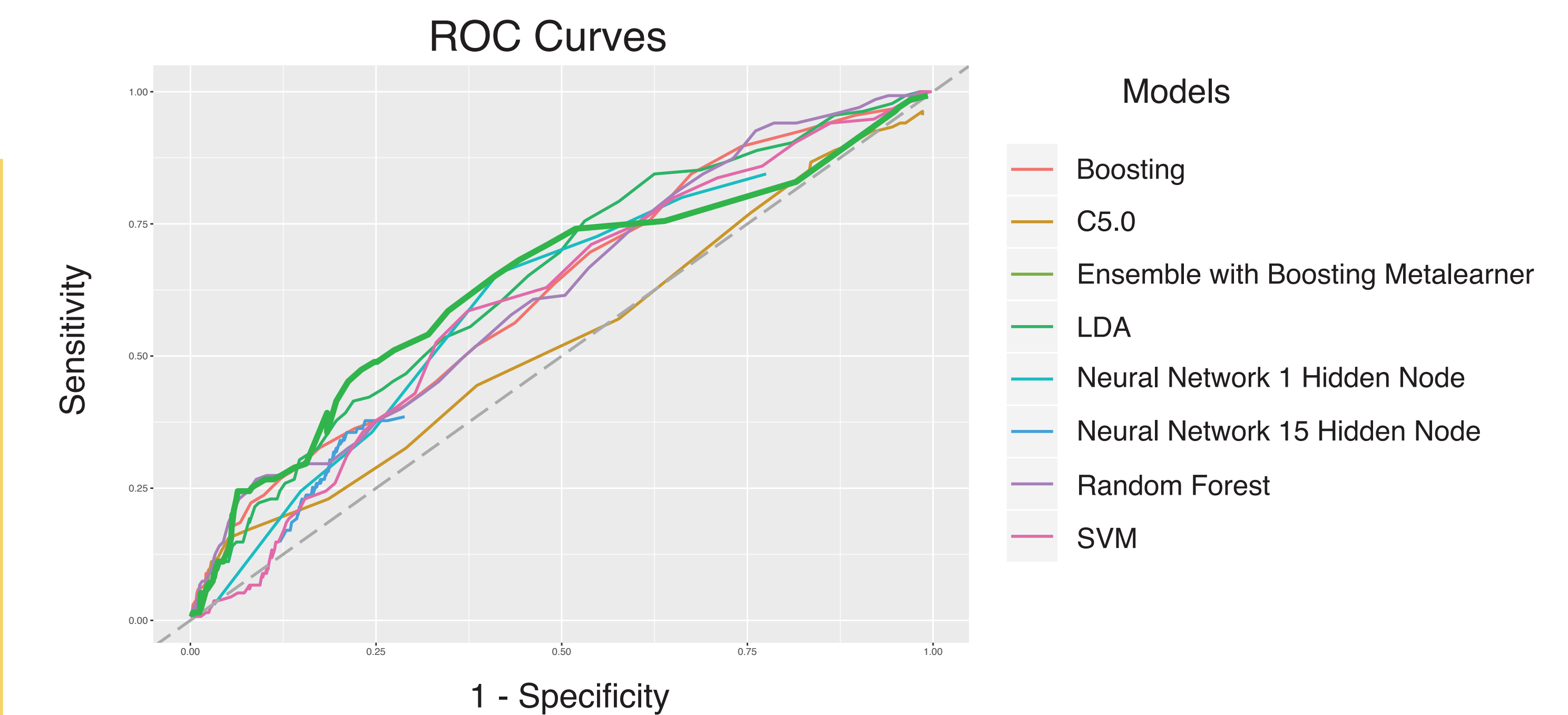
Models

- 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

Truth Prediction	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].