Skin Lesion Classification Using Hybrid deep Neural Networks

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Introduction

- Skin Cancer is one of the most common cancer types worldwide
- A powerful non-invasive method for skin lesion classification is analysis of dermoscopic images
- Visual classification by experts is challenging, subjective and time consuming
- In this work, we propose a fully automatic approach based on deep convolutional neural networks to classify skin lesion images

Aim

Classifying skin lesion images to 3 classes, namely malignant melanoma (MM), seborrheic keratosis (SK) and benign nevi (BN).

Example images, adapted from the International Skin Imaging Collaboration (ISIC) [1]

Method

- **General workflow is shown below**

- **Datasets**
  - Subset of ISIC archive for training and validation data
    - Training Data: 2037 images including training, validation and test images of ISIC 2016 competition as well as training set of ISIC 2017 competition
    - Validation Data: 150 validation images from ISIC 2017 competition

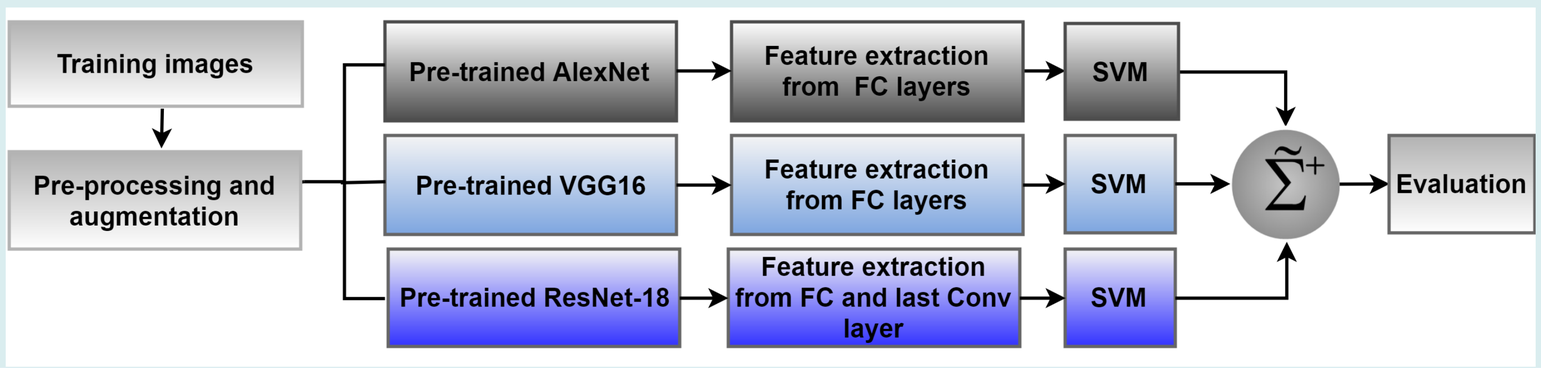
- **Preprocessing**
  - ImageNet mean subtraction
  - Resizing (224 x 224 and 227 x 227)
  - Data augmentation by rotating (0, 90, 180 and 270 degree) and horizontal flipping (increase of training data by a factor of eight)

- **Feature extraction from pre-trained deep models**
  - Exploring feature extraction from various depth and merging
  - Last two fully connected (FC) layers of AlexNet [2] and VGG16 [3]
  - FC layer and last convolutional (Conv) layer of ResNet-18 [4]

- **Multi-class non-linear support vector machine (SVM) as main classifier**

- **Fusion**
  - Taking average over SVMs results

- **Reporting results for two binary classification problems (defined in ISIC 2017)**
  - MM versus all & SK versus all

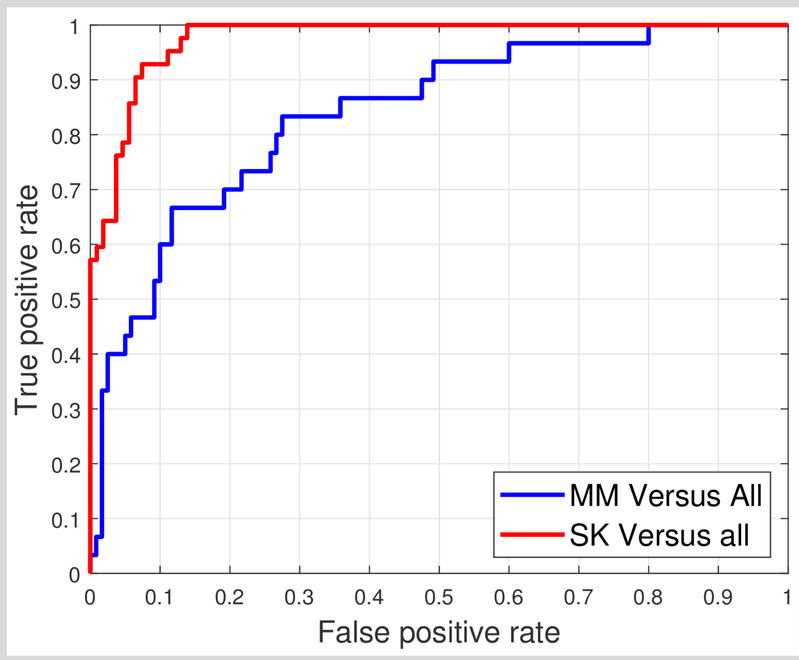


Results and Conclusion

- Validation results based on AUC

Network	Feature layer	MM AUC (%)	SK AUC (%)	Avg. AUC (%)
AlexNet	last FC	80.67	94.95	87.81
AlexNet	all FC	82.81	96.65	89.73
VGG16	last FC	82.61	90.94	86.78
VGG16	all FC	82.06	95.46	88.76
ResNet-18	FC	81.00	91.93	86.47
ResNet-18	FC+ last conv.	82.81	94.22	88.51
AlexNet + VGG16 fusion	All FC	83.56	97.05	90.30
AlexNet + ResNet-18 fusion	All FC	83.53	97.05	90.29
VGG16 + ResNet-18 fusion	All FC	83.69	95.97	89.83
Fusion of all networks	**All FC**	**83.83**	**97.55**	**90.69**

- Roc curves of best performing approach



- **Conclusion**

  A fully automatic method for dermoscopic skin lesion classification is proposed. It is based on feature extraction from various pre-trained deep models and delivers excellent classification performance for ISIC 2017 validation dataset.

References

[1] https://www.isic-archive.com/#!/topWithHeader/wideContentTop/main
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